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C. S. Pa.	RT. HON. CHARLES STUART PARKER, LL.D., D.C.L. Author of *Life of Sir Robert Peel;* etc.	**Peel, Sir Robert.**
C. T. H. W.	CHARLES THEODORE HAGBERG WRIGHT, LL.D. Librarian and Secretary of the London Library.	**Periodical.**
D. C. Pe.	MRS. C. S. PEEL, O.B.E. Departmental Editor, *Queen.* Editor of *Hearth and Home and Woman.* Managing Director of Beeton & Co., Ltd., 1903–6. Director of Women's Service, Ministry of Food, 1917–8. President, British Housewives Association. Editor of *The Daily Mail Cookery Book.* Author of *Social and Domestic Life of a Century; My Own Cookery Book;* etc.	**Pastry, Home Made.**
D. F. T.	DONALD FRANCIS TOVEY, M.A., MUS.DOC. Reid Professor of Music in Edinburgh University. Editorial Adviser for Music, 14th Edition, *Encyclopædia Britannica.* Author of Essays on *Musical Analysis,* comprising the *Classical Concerto; The Goldberg Variations* and analyses of many other classical works.	**Palestrina, Giovanni Pierluigi da.**
D. H.	DAVID HANNAY. Formerly British Vice-Consul at Barcelona. Author of *Short History of the Royal Navy, 1217–1688; Life of Don Emilio Castelar.*	**Pepys, Samuel** (*in part*).
D. Ke.	D. KEILIN, M.A., D.SC. University Lecturer in Parasitology, Cambridge; Fellow of Magdalene College.	**Parasitology.**
D. Mi.	D. MILRANY. Assistant European Editor of *Economic and Social History of the World War* and special correspondent for South-Eastern Europe for the Carnegie Endowment for International Peace.	**Peasant Movement.**
D. M. S.	DORIS MARY STENTON, B.A. Lecturer in History in the University of Reading. Hon. Secretary and Editor for the Pipe Rolls Society. Author of *The Earliest Lincolnshire Assize Rolls; The Reign of Henry II.;* etc.	**Pipe Rolls.**
D. M. S. W.	DAVID MEREDITH SEARES WATSON, M.SC., F.R.S. Jodrell Professor of Zoology and Comparative Anatomy, University College, London. Author of many papers on Vertebrate Palaeontology and connected subjects in *Proceedings of the Zoological Society*; *Journal of Anatomy;* etc.	**Palaeontology.**
D. R.-M.	DAVID RANDALL-MACIVER, M.A., D.SC., F.S.A. Curator of Egyptian Department, University of Pennsylvania. Formerly Worcester Reader in Egyptology, University of Oxford. Author of *Mediaeval Rhodesia;* etc.	**Picenes.**
E. C. E.	EDWIN CLARENCE ECKEL, B.S., C.E. Consulting Engineer and Geologist. Formerly of the United States Geological Survey.	**Physical Resources** (*in part*).
E. C. Q.	EDMUND CROSBY QUIGGIN, M.A. Formerly Fellow of, and Lecturer in Modern Languages and Monro Lecturer in Celtic, Gonville and Caius College, Cambridge.	**Patrick, St.** (*in part*).
E. C. S.	EDMUND CLIFTON STONER, PH.D. Reader in Physics at the University of Leeds. Author of *Magnetism and Atomic Structure.*	**Permeameter.**
Ed. M.	EDUARD MEYER, D.LITT. Professor of Ancient History in the University of Berlin. Author of *Geschichte des Alterthums;* etc.	**Pacorus; Parthia; Pērōz; Persia** (*in part*)**; Persis; Pharnabazus; Phraates; Phraortes.**
E. E. K.	E. E. KELLETT. Author of *Suggestions, Literary Essays; The Appreciation of Literature.*	**Paston Letters** (*in part*).
E. E. L.	E. E. LONG, C.B.E. Formerly Director of Eastern Propaganda. Foreign Office, as Officer-in-Charge, Eastern Section, News Department, 1918–21. *The Times* (London) Correspondent in Northern India. Formerly Editor of *The Indian Daily Telegraph; The Rangoon Times;* etc.	**Palembang.**
E. Gr.	ERNEST ARTHUR GARDNER, LITT.D., T.C.D. Hon. Fellow, Gonville and Caius College, Cambridge, and University College, London. Formerly Yates Professor of Archaeology, University College, London. Vice-Chancellor, University of London, 1924–6. Author of *The Art of Greece.*	**Parthenon** (*in part*).
E. Her.	ERNST HERZFELD. Professor of Oriental Archaeology in the University of Berlin.	**Persepolis** (*in part*).
E. Hu.	EDMUND HUSSERL. Professor of Philosophy, University of Freiberg.	**Phenomenology.**
E. im T.	SIR EVERARD IM THURN, K.C.M.G., K.B.E., C.B. Governor of Fiji and High Commissioner of the Western Pacific, 1904–10 (retired). Author of *Among the Indians of Guiana;* etc.	**Pacific Islands** (*in part*).
E. J. T.	EDWARD J. THOMAS, PH.D. Translator of *Vedic Hymns.* Author of *The Life of Buddha as Legend and History.*	**Pahlavi** (*in part*).
E. K.	ERNST KÜHNEL, PH.D. Keeper of Islamic Art in the Berlin Museum. Author of *Miniaturmalerei im Islam; Maurische Kunst; Islamische Kleinkunst; Stoffe aus ägyptischen Gräbern.*	**Persian Art, Painting and Calligraphy.**
E. L.	P. R. ELSA LEWKOWITSCH, PH.D., B.SC.HONS., A.R.C.S.	**Palm Oil** (*in part*).
E. L. K.	MAJOR EDWARD L. KELLY. Head of Department of Tactics, United States Military Academy.	**Physical Culture.**

E. M. H.	COLONEL EDWARD MANDELL HOUSE. Representative of the United States at the making of the Armistice, Versailles, 1918. Joint-editor with Charles C. Seymour, of *What Really Happened at Paris*.	**Paris, Conference of** (*in part*).
E. M. Ho.	EDWARD MORELL HOLMES. Emeritus Curator of the Museum of the Pharmaceutical Society, London.	**Pharmacopoeia.**
E. M. R.	MRS. E. M. REID, B.SC., F.L.S., F.G.S. Co-author of *The Pliocene Floras of the Dutch-Prussian Border.*	**Palaeobotany** (*in part*).
E. M. T.	SIR EDWARD MAUNDE THOMPSON, G.C.B., D.C.L., LL.D., LITT.D., F.B.A. Director and Principal Librarian of the British Museum, 1888–1909 Joint-editor of Publications of the Palaeographical Society Author of *An Introduction to Greek and Latin Palaeography; Shakespeare's Handwriting*	**Papyrus; Parchment.**
***E. N. da C. A.**	EDWARD NEVILLE DA COSTA ANDRADE, D.SC., PH D , F.INST.P. Quain Professor of Physics in the University of London. Author of *The Structure of the Atom, Airs; The Atom;* etc. Editor of the Physics section, 14th Edition, *Encyclopædia Britannica.*	**Perpetual Motion** (*in part*).
E. N. H.	E. NEWTON HARVEY. Professor of Physiology, Princeton University.	**Phosphorescence.**
E. R.	ELIHU ROOT, A.M., LL D., D.C L. Member, Permanent Court of Arbitration at The Hague Secretary of War in Cabinet of President McKinley, 1899–1904. Secretary of State in Cabinet of President Roosevelt, 1908–9. United States Senator for New York, 1909–15. Awarded Nobel Peace Prize, 1912.	**Permanent Court of International Justice.**
E. R. B.	EDWYN ROBERT BEVAN, O.B.E., M.A., HON.D LITT., HON.LL.D. Hon Fellow of New College, Oxford. Lecturer on Hellenistic History and Literature at King's College, London. Author of *Later Greek Religion;* etc.	**Perdiccas; Philip V.**
E. Ro.	EDWARD ROBERTSON, M A. Professor of Semitic Languages, University College, North Wales.	**Philadelphia.**
E. Sc.	EMIL SCHURER, D.PH. Formerly Professor of New Testament Exegesis in the Universities of Giessen, Kiel and Gottingen. Author of *Geschichte des judischen Volkes im Zeitalter Jesu Christi*	**Philo** (*in part*).
E. V. K.	E. V. KNOX. Humorist in Verse and Prose On the Staff of *Punch* Author of *Parodies Regained.*	**Parody.**
E. W. Bs.	ESTHER W. BATES. Professor of Dramatic Art, University of Boston, Mass.	**Pageant** (*in part*).
E. W. MacB.	ERNEST WILLIAM MACBRIDE, M A., D.SC., LL D., F.R.S. Professor of Zoology at the Imperial College of Science, London. Formerly Strathcona Professor of Zoology at McGill University, Montreal Author of *A Text Book of Zoology; Introduction to the Study of Heredity,* etc.	**Phoronis.**
E. W. T.	EDWIN WARD TILLOTSON, JR., B A., PH.D. Assistant Director, Mellon Institute of Industrial Research, University of Pittsburgh. Past-President, American Ceramic Society.	**Physical Resources** (*in part*).
F. Boo.	FRANKLIN BOOTH. Illustrator, Painter.	**Pen Drawing.**
F. D.	SIR FRANK WATSON DYSON, K B.E. Astronomer Royal of England. *See* the biographical article: DYSON, SIR FRANK WATSON.	**Parallax.**
F. E. M.	F. E. MATTHEWS, PH.D., F.I.C. Former Professor of Chemistry at the Royal India Engineering College, Coopers Hill. Consultant to Messrs. Johnson and Matthey, Research Chemists, Hatton Garden, London.	**Palladium.**
F. F. H.	F. F. HENSHAW, B.SC. Senior Engineer, Federal Power Commission. Author of numerous papers of the United States Geological Survey on water supply.	**Physical Resources** (*in part*).
F. F. R.	F. F. RUPERT, A.M., PH.D. Of the Mellon Institute of Industrial Research, University of Pittsburgh.	**Physical Resources** (*in part*).
F. G. P.	FREDERICK GYMER PARSONS, F.R.C.S , F.S.A. Professor of Anatomy, University of London. President, Anatomical Society of Great Britain and Ireland. Lecturer on Anatomy at St. Thomas's Hospital and the London School of Medicine for Women. Formerly Hunterian Professor at the Royal College of Surgeons.	**Pancreas; Pharynx.**
F. G. U.	F. G. UNDERHAY, M.A. Of the Inner Temple. Editor of the Official Reports of Patent Design and Trade Mark Cases. Editor of *Keely on Trade Marks.*	**Patents** (*in part*).
F. Hd.	F. LLOYD HOPWOOD, D.SC., A.R.C.SC., F.INST.P. Professor of Physics, St. Bartholomew's Hospital Medical College (University of London). Vice-President, Physical Society of London. Member, Grand Council, British Empire Cancer Campaign.	**Physics in Medicine.**
F. H. S.	F. H. SEARES, B S. Assistant Director of Mount Wilson Observatory of Carnegie Institution, Washington. Author of *Practical Astronomy for Engineers;* etc.	**Photography, Celestial** (*in part*).
F. J. Me.	F. J. MELVILLE. President of the Junior Philatelic Society and writer on stamp collecting for *The Daily Telegraph*, London.	**Philately.**
F. J. Mo.	F. J. MORTIMER, F.R.P.S. Editor of *The Amateur Photographer and Photography.* President of the Photographic Convention of the United Kingdom, 1913–4. Hon. Secretary of the London Salon of Photography. Fellow of the Royal Photographic Society. Publications: *Marine and Surf Photography; Photography of the Sea;* etc.	**Photographic Art.**

F. L. E.	F. L. ENGLEDOW, M.A. On the Staff of the Plant Breeding Institute, Cambridge, England.	**Plant Breeding.**
F. Ll. G.	F. LLEWELLYN GRIFFITH, M.A., PH.D., F.S.A., F.B.A. Professor of and Reader in Egyptology, Oxford University.	**Pharaoh.**
F. M. S.	F. M. STENTON. Professor of History, University of Reading. Editor of the History (Mediaeval) section, 14th Edition, *Encyclopædia Britannica.*	**Palestine** (*in part*); **Persia** (*in part*).
F. P. Do.	F. P. DORIZZI. Director of George Rowney and Co., Ltd., and Works Manager of Malden Pencil Works, London.	**Pencil.**
F. Sk.	F. SKEVINGTON, M.B.E. Principal of His Majesty's Treasury.	**Pensions: Civil Service, Municipal, etc.**
F. W. Mo.	FREDERICK WALKER MOTT, K.B.E., M.D., B.S., LL.D., F.R.S. Late Consulting Physician to Charing Cross Hospital, London, Pathologist to London County Asylums, and Lecturer on Morbid Psychology, Birmingham University. Author of *War Neuroses and Shell Shock;* etc.	**Paralysis.**
F. W. Pa.	FLOYD W. PARSONS, E.M. Editorial Director, Robbins Publishing Company, New York.	**Physical Resources** (*in part*).
F. Wt.	FRANCIS WATT, M.A. Barrister-at-Law, Middle Temple. Author of *Law's Lumber Room.*	**Paterson, William** (*in part*).
G. A. C.	REV. GEORGE ALBERT COOKE, D.D. Regius Professor of Hebrew, Oxford, and Canon of Christ Church. Formerly Oriel Professor of Interpretation of Holy Scripture, Oxford.	**Palmyra;** **Phoenicia.**
G. Bu.	GERALD BURRARD, D.S.O., F.R.G.S. Major Royal Artillery (retired). Gun Expert to *The Field* since 1919. Author of *Notes on Sporting Rifles; Big Game Hunting in the Himalayas and Tibet;* etc.	**Pig-Sticking.**
G. Cl.	GEORGE CHRYSTAL, M.A., LL.D. Late Professor of Mathematics and Dean of the Faculty of Arts, Edinburgh University.	**Perpetual Motion** (*in part*).
G. C. R.	GUY COLWIN ROBSON, M.A. Assistant Keeper in the Department of Zoology, British Museum.	**Periwinkle.**
G. C. W.	GEORGE CHARLES WILLIAMSON, LITT.D., F.R.S.L. Chevalier of the Legion of Honour. Author of *Portrait Miniatures; Life of Richard Cosway, R.A.; George J. Pinwell; George Engleheart;* etc. Editor of *Bryan's Dictionary of Painters and Engravers.*	**Pinwell, George John** (*in part*).
G. E.	REV. GEORGE EDMUNDSON, M.A., D.LITT., F.R.HIST.S., F.R.G.S. Formerly Fellow and Tutor of Brasenose College, Oxford. Sometime Foreign Member, Netherlands Association of Literature and Hon. Member, Dutch Historical Society.	**Pensionary.**
G. Ea.	GEORGE EASTMAN. Chairman of the Board, Eastman Kodak Company, Rochester, N. Y. Invented the kodak and developed roll films system of photography.	**Photography** (*in part*).
G. E. I.	G. E. IJAMS. Assistant Director of Veterans' Bureau, Washington.	**Pensions: The United States** (*in part*).
G. El.	(ROBERT) GEOFFREY ELLIS. Formerly Barrister-at-Law, Inner Temple. Joint-Editor of *English Reports.* Author of *Peerage Law and History.*	**Peerage.**
G. G. A.	MAJOR-GENERAL SIR GEORGE G. ASTON, K.C.B. Lecturer on Naval History, University College, London. Formerly Professor of Fortification at the Royal Naval College, Greenwich. Author of *Sea, Land and Air Strategy; Memories of a Marine; The Navy of To-day.* Editor of *The Study of War.*	**Palestine** (*in part*).
G. H. B.	REV. GEORGE HERBERT BOX, M.A., HON.D.D. Rector of Sutton, Beds. Davidson Professor of Old Testament Studies in the University of London.	**Passover** (*in part*); **Pentecost;** **Pharisees.**
G. H. W.	GEORGE H. WARBURTON. Editor of the Sixth Edition of *Oils, Fats and Waxes,* by E. Lewkowitsch and Chief Chemist of the Lewkowitsch Laboratories.	**Palm Oil** (*in part*).
G. L. E.	MISS G. L. ELLES, D.SC. Lecturer in Geology, Newnham College, Cambridge.	**Palaeozoic Era.**
G. McL. Wo.	GEORGE MCLANE WOOD. Editor, United States Geological Survey, Washington. Secretary, Chesapeake and Potomac Telephone Company. Author of *Texts* for U.S. Geological Survey and press notices.	**Panama** (*in part*); **Paraguay** (*in part*)
G. M. L.	G. M. LEES, M.C., D.F.C., PH.D., F.G.S.	**Persia** (*in part*).
G. M. McB.	G. M. MCBRIDE, B.A., PH.D. University of California at Los Angeles, California. Author of *Agrarian Indian Communities of Highland Bolivia.*	**Paraguay** (*in part*).
G. Mn.	GEORGE MORGAN, A.M., LL.D. Editorial Staff, *Philadelphia Record.* Author of *A Complete History of Philadelphia.*	**Philadelphia.**
G. W. Go.	GEORGE WASHINGTON GOETHALS, LL.D., D.S.M. Formerly Instructor in Civil and Military Engineering, United States Military Academy. Chief Engineer, Panama Canal, 1907–14. Civil Governor, Panama Canal Zone, 1914–6. State Engineer, New Jersey, 1917.	**Panama Canal** (*in part*).

G. W. Ki.	GEORGE WASHINGTON KIRCHWEY, LL.D. Head of the Department of Criminology, New York School of Social Work. Formerly Warden of Sing Sing Prison.	**Penology.**
G. W. R.	MAJOR GEORGE WILLIAM REDWAY. Author of *The War of Secession*, 1861–2; *Fredericksburg: A Study in War.*	**Petersburg Campaign.**
H. A. A.	H. A. ALLARD, B.S. Senior Physiologist, Tobacco and Plant Nutrition, Bureau of Plant Industry, United States Department of Agriculture, Washington.	**Photoperiodism** (*in part*).
H. Bi.	HENRI BIDOU. Member of the Staff of *Le Journal des Débats* (Paris). Chevalier of the Legion of Honour.	**Pétain, Philippe Henri, B.O.J.**
H. C.	HUGH CHISHOLM, M.A. Editor of the 11th and 12th Editions of the *Encyclopædia Britannica*	**Parliament** (*in part*).
H. D. O.	HILDA D. OAKELEY, M.A. Reader in Philosophy, King's College, University of London	**Personality.**
H. G. G.	HENRY GEORGE GREENISH, F.I.C., F.L.S. Professor of Pharmaceutics in University of London, and to the Pharmaceutical Society of Great Britain. Joint Editor of *The British Pharmacopaeia.*	**Pharmacy** (*in part*).
H. H. L. B.	HUGH HALE LEIGH BELLOT, M.A., D.C.L. Late Associé de l'Institut de Droit International, Honorary Secretary International Law Association, and Grotius Society. Formerly Acting Professor of Constitutional Law, University of London and Secretary, Breaches of the Laws of War Committee. Author of *Commerce in War, Permanent Court of International Justice.*	**Pacific Blockade** (*in part*).
H. I. B.	H. IDRIS BELL, D.LITT. Secretary, Egypt Exploration Society	**Palaeography** (*in part*).
H. Jn.	HENRY JACKSON, LITT.D., LL.D., O.M., F.B.A. Late Regius Professor of Greek in the University of Cambridge and Fellow of Trinity College. Author of *Texts to Illustrate the History of Greek Philosophy from Thales to Aristotle*	**Parmenides of Elea.**
H. Kr.	HARALD KREUTZBERG. German Ballet Dancer	**Pantomime.**
H. L. He.	HARRIET L. HENNESSY, L.R.C.S.I., L.R.C.P.I., M.D.	**Plague** (*in part*).
H. L. Sh.	H. L. SHANTZ, PH.D., D.SC. President, University of Arizona, Tucson, Arizona. Co-author of *Vegetation of the United States* and Author of numerous scientific articles on plant physiology and plant geography.	**Physical Resources** (*in part*).
H. O. B.	H. O. BUCKMAN, M.S., PH.D. Professor in Agronomy Department, New York State College of Agriculture, Cornell University. Joint Author of *The Nature and Properties of Soils*	**Physical Resources** (*in part*).
H. P. H.	H. P. HOLLIS, B.A., F.R.A.S. Assistant in the Royal Observatory, Greenwich, 1881–1920. Editor of *The Observatory Magazine*, 1893–1912	**Photography, Celestial** (*in part*).
H. R. A.	LIEUTENANT-COLONEL THE HON. HERBERT R. ATKINSON. Instructor at the Artillery College, Woolwich. Formerly Experimental Officer at the Small Arms School, Hythe, Kent.	**Pistol** (*in part*).
H. S. P.	MISS H. S. PEARSON. Senior Assistant, Department of Zoology, University College, London	**Pecora.**
H. To.	HENRY TONKS Slade Professor of Fine Art in the University of London since 1917.	**Pastel** (*in part*).
I. A. R.	IRMA A. RICHTER. Artist and Writer	**Palma, Jacopo; Paolo Veronese; Picasso, Pablo; Pisano, Vittore.**
I. G.	SIR ISRAEL GOLLANCZ, LITT.D., F.B.A. Fellow and Secretary of the British Academy. Professor of English Language and Literature in the University of London. *See* the biographical article GOLLANCZ, SIR ISRAEL.	**Pearl, The.**
I. K.	INGALLS KIMBALL. Co-director of Group Annuities, Metropolitan Life Insurance Company, New York.	**Pensions: The United States** (*in part*).
I. P. D.	IGNAZ PHILIPP DENGEL. Professor of Modern History in the University of Innsbruck. Director of the Austrian Institute of History in Rome	**Papacy** (*in part*).
J. A. J.	JAMES A. JOHNSTONE, D.SC. Professor of Oceanography, University of Liverpool. Author of *Conditions of Life at Sea, British Fisheries;* etc.	**Plankton.**
J. A. Mo.	JAMES A. MORE. Lecturer in Animal Husbandry, Department of Agriculture, University of Edinburgh.	**Pig** (*in part*).
J. A. R.	JAMES ALEXANDER ROBERTSON, PH.B., L.H.D. Professor of American History, John B. Stetson University, Deland, Fla. Managing Editor, *Hispanic-American History Review.* Co-editor of Blair and Robertson's *The Philippine Islands.*	**Philippine Islands.**
J. A. Ry.	JOHN ALFRED RYLE, M.D., F.R.C.P., F.R.S.M. Assistant Physician to Guy's Hospital. Consulting Physician to the Watford Hospital, and Blackheath and Charlton Cottage Hospital.	**Pain, Significance of.**
J. A. S.	JOHN ADDINGTON SYMONDS, LL.D. Author of *Renaissance in Italy; Studies of the Greek Poets;* etc. *See* the biographical article: SYMONDS, JOHN ADDINGTON	**Petrarch** (*in part*).

J. A. Th.	John Arthur Thomson, M.A., LL.D. Regius Professor of Natural History in the University of Aberdeen. Gifford Lecturer, St. Andrews, 1915. Terry Lecturer, Yale University, 1924. Author of *The Study of Animal Life; Outlines of Zoology; Heredity; Darwinism and Human Life; What Is Man?; Concerning Evolution.* Joint-Author (with Professor Patrick Geddes) of *Evolution; Sex; Biology.*	**Parasitism; Parthenogenesis.**
J. Bar.	Joseph Barcroft, C.B.E., M.A., B.Sc., M.D., F.R.S. Fellow and Lecturer, King's College, Cambridge. Professor of Physiology, Cambridge University. Fullerian Professor of Physiology, Royal Institution, 1923–6. Author of *The Respiratory Function of the Blood* and many other works. Editor of the Physiology section, 14th Edition, *Encyclopædia Britannica.*	**Physiology; Pigments of the Skin and Hair.**
J. B. Bi.	Joseph Bucklin Bishop. Late Secretary to the Panama Canal Commission. Author of *Our Political Drama; Issues of a New Epoch; The Panama Gateway.*	**Panama Canal** (*in part*).
J. B. M.	James Bolivar Manson. Assistant Keeper, National Gallery, London, since 1917. Author of *Rembrandt; Hours in the Tate Gallery;* etc. Translated *Cézanne*, by T. Klingsor.	**Painting** (*in part*).
J. D. E.	Junius David Edwards, B.S. Assistant Director of Research, Aluminum Company of America. Author of *Aluminum Bronze Powder and Aluminum Paint.*	**Physical Resources** (*in part*
J. D. J.	J. Dudley Johnston. Honorary Curator of Prints, The Royal Photographic Society of Great Britain. President, Royal Photographic Society, 1923.	**Photography** (*in part*).
J. D. M. S.	J. D. Main Smith, B.Sc., Ph.D., A.I.C. Formerly Research Assistant to the Professor of Chemistry, University of Birmingham. Late Assistant Examiner in Chemistry, University of London. Author of *Chemistry and Atomic Structure;* etc.	**Periodic Law, The.**
J. E. Sa.	John Edwin Sandys, M.A., Litt.D., LL.D., F.B.A. Late Public Orator in the University of Cambridge. Author of *History of Classical Scholarship;* etc.	**Pausanias** (*in part*).
J. F.	John Fiske. American Historical and Philosophical Writer. Sometime History Tutor at Harvard University. Author of *The American Revolution;* etc. *See* the biographical article: Fiske, John.	**Parkman, Francis**
J. F. C. F.	Colonel John Frederick Charles Fuller, C.B.E., D.S.O. Military Assistant to the Chief of the Imperial General Staff. Chief General Staff Officer, Tank Corps, 1917–8. Formerly Chief Instructor, Camberley. Author of *Tanks in the Great War; The Reformation of War; Sir John Moore's System of Training.*	**Patay, Battle of; Pavia** (*in part*); **Pharsalus, Battle of.**
J. F.-K.	James Fitzmaurice-Kelly, Litt.D., F.R.Hist.S. Late Gilmour Professor of Spanish Language and Literature, Liverpool University.	**Palacio Valdés, Armando; Pereda, José María de; Picaresque Novel, The** (*in part*).
J. Fo.	Hon. Sir John William Fortescue, K.C.V.O., Hon.LL.D., Litt.D. Librarian at Windsor Castle, 1905–26. Author of *Wellington; History of the 17th Lancers; History of the British Army, 1899–1920;* etc.	**Peninsular War.**
J. F. P.	Joseph Frank Payne, M.D., F.R.C.P. Late Harveian Librarian, Royal College of Physicians. Author of *Lectures on Anglo-Saxon Medicine;* etc.	**Plague** (*in part*).
J. F. Th.	John Fairfield Thompson, B.S., Ph.D. Manager, Operating Department, The International Nickel Company.	**Physical Resources** (*in part*
J. Ga.	John Garstang, M.A., D.Sc., B.Litt., F.S.A. John Rankin Professor of Archaeology, University of Liverpool. Director, British School of Archaeology in Jerusalem, 1919–26. Director, Department of Antiquities, Government of Palestine, 1920–6.	**Palestine** (*in part*).
J. G. Be.	J. Gould Bearn, M.Sc., A.I.C. Chemist, Messrs. Walter Carson & Sons, Battersea, London.	**Paint; Painter-Work in the Building Trade.**
J. G. G.	Jean Gabriel Goulinat. Chevalier de la Légion d' Honneur, Societaire et Membre due Comité du Salon de la 5th Nationale des Beaux Arts, Author of *La Technique des Peintres.*	**Paintings, Restoration and Preservation of** (*in part*)
J. G. M.	J. G. Mitchell, Ph.D., B.Sc. Assistant, Chemical Research Laboratory, Teddington, Middlesex, England.	**Perylene.**
J. H. B.	Joseph H. Bonneville, A.M. Department of Banking and Finance, New York University School of Commerce, Accounts and Finance. Author of *Elements of Business Finance.*	**Panic** (*in part*).
J. H. Mo.	J. H. Morgan, K.C. Professor of Constitutional Law, University of London. Reader in Constitutional Law to the Inns of Court. Brigadier-General, late Deputy Adjutant-General. Editor of the Law section, 14th Edition, *Encyclopædia Britannica.*	**Parliament** (*in part*); **Petition of Right** (*in part*).
J. H. Ry.	James H. Ryan, S.T.D., Th.D. Rector, Catholic University of America, Washington. Author of *An Introduction to Philosophy;* etc.	**Parochial Schools.**
J. Ja.	Joseph Jacobs, Litt.D. Formerly Professor of English Literature in the Jewish Theological Seminary, New York, and President of the Jewish Historical Society of England. Author of *Jews of Angevin England; Studies in Biblical Archaeology;* etc.	**Passover** (*in part*).
J. Jn.	J. Jackson, M.A., D.Sc. Chief Assistant, Greenwich Royal Observatory.	**Planetarium.**

J. Ki.	JOSEPH KITCHEN, F.S.S. London Manager of the Union Corporation, Limited.	**Physical Resources** (*in part*).
J. Lec.	JOHN LECKIE. Head of Sales Promotion Bureau, Joseph Dixon Crucible Company, Jersey City.	**Pencil Drawing.**
J. L. My.	JOHN LINTON MYRES, O.B.E., M.A., D.Sc., F.B.A. Wykeham Professor of Ancient History and Fellow and Librarian of New College, Oxford. General Secretary to the British Association.	**Paphos.**
J. L. W.	JESSIE L. WESTON, LITT.D. Author of *Arthurian Romances.*	**Perceval.**
J. M.-B.	J. MACMILLAN-BROWN, M.A., HON LL.D. Chancellor of the University of New Zealand Emeritus Professor, Canterbury College, Christchurch, New Zealand.	**Pacific Ocean Questions.**
J. M. Hi.	JAMES M. HILL, B.S. Consulting Geologist. Formerly of the United States Bureau of Mines	**Physical Resources** (*in part*).
J. M. La.	J. M. LANDIS, A.B., LL.B., S.J.D. Professor of Legislation, Harvard Law School. Author of *The Business of the Supreme Court of the United States.*	**Partnership** (*in part*), **Petition of Right** (*in part*).
J. M. M.	JOHN MALCOLM MITCHELL, O.B.E., M.C., M.A., F.S.A. Secretary, Carnegie United Kingdom Trust. Vice-President, Library Association Assistant Editor for Classics and Ancient History, 11th Edition, *Encyclopædia Britannica.* Author of the *Public Library System of Great Britain and Ireland.* Joint Editor, Grote's *History of Greece*	**Persia** (*in part*).
J. Mn.	JOHN MACPHERSON, M.A., M.D., M.R.C.S. Formerly Inspector-General of Hospitals, Bengal Author of *The Baths and Wells of Europe*, etc.	**Paranoia.**
J. Mof.	JAMES MOFFATT, M.A., D.D. Washburn Professor of Church History in Union Theological Seminary, New York, since 1927. Formerly Professor of Church History, U.F. College, Glasgow Author of *Theology of the Gospels, New Translation of the New Testament,* etc	**Pastoral Epistles, The;** **Philemon, Epistle to;** **Philippians, Epistle to the.**
J. Ms.	RT. REV. MONSIGNOR J. MOYES, D.D. Late Canon of Westminster Cathedral Editor of *The Dublin Review* and Domestic Prelate to H.H. Pope Benedict XV	**Pius XI.** (*in part*)
J. O. McC.	JOHN OPPIE MCCALL, A.B., D.D.S. Professor of Periodontia, New York University College of Dentistry. Author of *Text Book of Clinical Periodontia.*	**Pyorrhoea.**
J. P. B.	JAMES GEORGE JOSEPH PENDEREL-BRODHURST Consulting Editor, formerly Editor of *The Guardian*, London	**Pawnbroking.**
J. P. E.	JEAN PAUL HIPPOLYTE EMMANUEL ADHÉMAR ESMEIN Late Professor of Law in the University of Paris Membre de l'Institut. Author of *Cours élémentaire d'histoire du droit français*	**Parlement.**
J. P. Ma.	J. P. MAXFIELD. Formerly of the Victor Talking Machine Company, New York	**Phonograph.**
J. P. P.	J. P. POSTGATE, M.A., LITT.D., F.B.A. Late Professor of Latin in the University of Liverpool and Fellow of Trinity College, Cambridge Late Editor of the *Classical Quarterly* Editor-in-Chief of the *Corpus Poetarum Latinorum*, etc.	**Phaedrus** (*in part*).
J. R. D.	J. R. DOLPHIN, M.Sc., A.I.C., F.C.S. Research Chemist.	**Pearl, Cultivated.**
J. Rei.	J. REIGHARD, PH.B. Formerly Director of the Biological Survey of the Great Lakes for the United States Fish Commission. Author of numerous scientific papers on fresh water biology	**Pisciculture** (*in part*)
J. R. Mr.	JOHN R. MOHLER, A.M., D.Sc. Chief, United States Bureau of Animal Industry. Author of *Pathology and Therapeutics of Diseases of Domestic Animals*	**Physical Resources** (*in part*).
J. Ros.	JULIUS ROSENWALD. Chairman of the Board, Sears, Roebuck and Company, Chicago Trustee, Rockefeller Foundation, Art Institute of Chicago, University of Chicago, Hull House, etc	**Philanthropy.**
J. R. R.	JOHN ROBERTSON RIDDELL. Principal of the London School of Printing and Kindred Trades. Author of *The Training of the Printer*, etc.	**Photo-Engraving;** **Photogravure.**
J. R. T.	JOSEPH ROBSON TANNER, LITT.D. Fellow of St. John's College, Cambridge Lecturer in History at St John's College, 1883–1921 Author of *Pepys's Naval Minutes, Private Correspondence of Samuel Pepys, 1679–1703*, etc.	**Pepys, Samuel** (*in part*)
J. R. Th.	JAMES RICHARD THURSFIELD, M.A. Formerly Dean, Fellow, Lecturer and Tutor of Jesus College, Oxford. Author of *Peel*, etc.	**Parnell, Charles Stewart** (*in part*)
J. S. C.	J. S. COFFEY, B.S.A. Department of Husbandry, Ohio State University, Columbus, Ohio.	**Pig** (*in part*).
J. S. F.	SIR JOHN SMITH FLETT, K.B.E., D.Sc., LL.D., F.R.S. Director, Geological Survey of Great Britain and Museum of Practical Geology. Formerly Lecturer on Petrology in Edinburgh University.	**Peridotite;** **Perlite or Pearlstone;** **Phyllite;** **Pitchstone.**
J. V. B.	JAMES VERNON BARTLET, M.A., D.D. Professor Emeritus of Church History, Mansfield College, Oxford. Author of *The Apostolic Age.*	**Paul.**

J. W. Hu.	JOSEPH WELLINGTON HUNKIN, O.B.E., M.C., B.D. Archdeacon of Coventry. Late Fellow and Tutor of Gonville and Caius College, Cambridge. Chaplain to the King, 1926.	**Palestine** (*in part*).
J. Wn.	JOHN WALTON, M.A. Lecturer on Botany, University of Manchester.	**Palaeobotany** (*in part*)
J. W. T. W	J. W. T. WALSH. Senior Assistant, Electricity Department, National Physical Laboratory, Teddington, Middlesex.	**Photometry** (*in part*).
K. S.	KATHLEEN SCHLESINGER. Author of *The Instruments of the Orchestra;* etc.	**Pianoforte** (*in part*).
L. C. M.	SIR LEO CHIOZZA MONEY, F.R.STAT.S., F.R.G.S., F.Z.S. Author and Journalist. Member of the War Trade Advisory Committee, 1915–8. Parliamentary Secretary to the Ministry of Shipping, 1916–8. Chairman of the Tonnage Priority Committee, 1917–8. Editor of the Economics, Engineering and Industries section, 14th Edition, *Encyclopædia Britannica.*	**Pearl** (*in part*); **Peninsula and Oriental Steam Navigation Company.**
L. D.	LOUIS MARIE OLIVIER DUCHESNE, D-ÈS-L. French Scholar and Ecclesiastic. Late Professor at the Catholic Institute in Paris, Lecturer at the Ecole Pratique des Hautes Etudes, and Director of the French School of Archaeology at Rome. *See* the biographical article: DUCHESNE, L. M. O.	**Papacy** (*in part*).
L. H. Ba.	LIBERTY HYDE BAILEY, LL.D., LITT.D. Director and Dean of College of Agriculture, Cornell University, 1903–13. Ed. *Standard Cyclopedia of Horticulture.*	**Palm** (*in part*).
L. J. S.	LEONARD JAMES SPENCER, M.A., SC.D., F.G.S., F.C.S., F.R.S. Keeper of Department of Mineralogy, Natural History Museum, London. Formerly Scholar of Sidney Sussex College, Cambridge, and Harkness Scholar.	**Parisite.**
L. M. F.	LEONARD M. FANNING. Director of Publicity, American Petroleum Institute, New York.	**Petroleum;** **Physical Resources** (*in part*).
L. O. H.	LELAND OSSIAN HOWARD, PH.D., M.D., LL.D., SC.D. Principal Entomologist, Bureau of Entomology, United States Department of Agriculture since 1878. Author of *Mosquitoes, How They Live; The Insect Book;* etc.	**Peach Tree Borer.**
L. Ra.	LEWIS RADCLIFFE, A.B., M.S. Deputy Commissioner, United States Bureau of Fisheries.	**Physical Resources** (*in part*).
L. S. Ro.	LEO S. ROWE, PH.D., LL.D. Director-General, Pan-American Union, Washington. Author of *Report of the United States Commission to Revise the Laws of Porto Rico;* etc.	**Pan-American Union.**
L. St.	LEONARD STEIN. Political Secretary to World Zionist Executive. Staff-Captain, Palestine Military Administration and subsequently on Political Staff, E.E.F., in Jerusalem, and at G.H.Q., Cairo, 1918–20. Joint-Editor of *Awakening Palestine.*	**Palestine** (*in part*).
L. V.	LUIGI VILLARI. Italian Vice-Consul in New Orleans, 1906; Philadelphia, 1907; Acting-Consul at Boston, 1907–10. On the Secretariat of the League of Nations, 1920–3. Author of *Italian Life in Town and Country; The Awakening of Italy; Fascism;* etc.	**Pisa** (*in part*).
L. v. P.	LUDVIG VON PASTOR. Late Professor of History in the University of Innsbruck and Director of the Austrian Institute of Historical Studies in Rome.	**Papacy** (*in part*).
M. C.	MAX CARY, D.LITT. Reader in Ancient History in the University of London. Secretary of the Classical Association, 1911–4.	**Pericles;** **Phrygia.**
M. D.	MARCUS DODS. Scottish Divine and Biblical Scholar. Late Principal of New College, Edinburgh. Editor of Lange's *Life of Christ* and Author of *The Epistle to the Seven Churches;* etc.	**Pelagius** (*in part*).
M. E. J. C.	MISS M. E. J. CHANDLER. Late Yarrow Fellow of Girton College, Cambridge. Co-author (with E. M. Reid) of *Catalogue of the Cainozoic Plants*, Vol. I.	**Palaeobotany** (*in part*).
M. H. S.	MARION H. SPIELMANN, F.S.A. Formerly Editor of the *Magazine of Art.* Member of Fine Arts Committee of International Exhibitions of Brussels, Paris, Buenos Aires, Rome and the Franco-British Exhibition, London. Author of *History of "Punch"; British Portrait Paintings to the Opening of the 19th Century;* etc.	**Pastel** (*in part*).
M. M. Bh.	SIR MANCHERJEE MERWANJEE BHOWNAGGREE. Formerly Fellow of Bombay University. M.P. Bethnal Green, North-East, 1895–1906. Author of *History of the Constitution of the East India Company.*	**Patel, Framjee Nasarwanjee** (*in part*).
M. N. T.	MARCUS NIEBUHR TOD, M.A. Reader in Greek Epigraphy, University of Oxford. Joint-Author of *Catalogue of the Sparta Museum.*	**Pausanias.**
M. Po.	(CÉSAR) MARCEL POËTE. Director of the Institute of History, Geography and Civics, Paris. Director of Studies, History of Paris, Ecole Pratique des Hautes Etudes. Author of *L'Enfance de Paris;* etc.	**Paris** (*in part*).
M. Sa.	MONELL SAYRE. Executive Vice-President, The Church Pension Fund, New York. American Member, International Congress of Actuaries.	**Pensions: The United States** (*in part*).
M. S. L.	M. S. LOMBARDINI. Secretary, Pirelli, Ltd., London.	**Pirelli and Co.**
M. T. Bi.	MILLICENT TODD BINGHAM, M.A., PH.D. Member, Sociedad Geográfica de Lima. Author of *Peru, Land of Contrasts;* etc.	**Peru.**

N. E. C.	NORMAN E. CRUMP. Statistical Correspondent to the *Financial Times*, London. Member of the Council of the Royal Statistical Society. Joint-Author of Clare's *A. B. C. of the Foreign Exchanges.*	**Pegging the Exchange.**
N. G. G.	NICHOLAS G. GEDYE, O.B.E., B.Sc., M.I.C.E. Consulting Civil Engineer. Formerly Chief Engineer, Tyne Improvement Commission. Served B.E.F. Lt.-Colonel (late R.E.). Acting Director, Civil Engineer-in-Chief's Department, Admiralty. Chief Civil Engineer for Docks, Harbour and Inland Waterways, Ministry of Transport.	**Pier** (*in part*).
N. T. W.	NOEL TANCRED WHITEHEAD, M.B., B.S. Major, R.A.M.C. Late Government Bacteriologist, Wellcome Tropical Research Laboratory, Khartum.	**Paratyphoid Fever.**
O. J.	OTTO JESPERSEN, PH.D., LITT.D., LL.D., F.B.A. Professor of English in the University of Copenhagen, 1893–1925. Member of Academies of Copenhagen, Oslo, Lund, Helsingfors, Ghent, and Prague. Author of *Growth and Structure of the English Language; A Modern English Grammar; Language: Its Nature, Development and Origin; The Philosophy of Grammar;* etc.	**Philology.**
O. J. L.	SIR OLIVER LODGE, D.SC., LL.D., F.R.S. Principal of the University of Birmingham, 1900–19. Professor of Physics, University College, Liverpool, 1881–1900. President of the Physical Society of London, 1899–1900. President of the British Association, 1913–4. Albert Medallist of the Royal Society of Arts for pioneer work in wireless telegraphy, 1919. Author of *Ether and Reality; Evolution and Creation; Energy.*	**Physics.**
O. Wh.	CAPTAIN OWEN WHEELER, F.R.P.S. Author of *A Primer of Photography; Modern Telephotography; Colour Photography; Amateur Cinematography.*	**Photography** (*in part*).
P. A. T.	P. A. TIELE. Formerly Librarian, Utrecht University. Author of *Biographical and Historical Memoir on the Voyages of the Dutch Navigators;* etc.	**Plantin, Christophe.**
P. B.	PIERRE BERNUS. Foreign Editor of the *Journal des Débats.* Paris Correspondent of *Le Journal de Genève.* Chevalier of the Legion of Honour.	**Painlevé, Paul.**
P. E. B.	PHILIP E. BROWNING, A.B., PH.D. Associate Professor of Chemistry at Yale University. Author of *Introduction to the Rarer Elements.*	**Physical Resources** (*in part*).
P. Go.	PHILIP GOSSE, M.D., M.R.C.S., L.R.C.P. Assistant Superintendent, The Radium Institute, London. Author of *Notes on the Natural History of the Aconcagua Valleys; The Pirates' Who's Who; My Pirate Library.*	**Pirates and Piracy** (*in part*).
P. Gr.	PHILIP GRAVES. Assistant Foreign Editor of *The Times*, London. Author of *The Land of Three Faiths.*	**Palestine** (*in part*).
P. G.-S.	REV. P. GARDNER-SMITH, B.D. Fellow and Dean of Jesus College, Cambridge.	**Peter, St.; Peter, First Epistle of; Peter, Second Epistle of.**
P. Ma.	PAUL MARTIN. Director of Chemin de fer Métropolitain de Paris. Chevalier of the Legion of Honour.	**Paris Metropolitan.**
P. M. S.	BRIGADIER-GENERAL SIR PERCY SYKES, K.C.I.E., C.B., C.M.G. Consul-General for Khurasan, 1905–13. Consul-General, Chinese Turkistan, 1915. G.O.C., Southern Persia, 1916–8. Author of *History of Persia* with Ella Sykes; *Through Deserts and Oases of Central Asia; Ten Thousand Miles in Persia;* etc.	**Persia** (*in part*); **Persia, Campaigns in.**
P. V.	PASQUALE VILLARI. Italian Historian and Statesman. Author of *I primi due secoli della storia di Firenza; Saggi Critici; Scrittii Varii;* etc. *See* the biographical article: VILLARI, PASQUALE.	**Pisa** (*in part*).
P. Z. C.	MAJOR-GENERAL SIR PERCY Z. COX, G.C.M.G., K.C.S.I., K.C.I.E., F.R.G.S. Acting British Minister to Persia, 1918–20. High Commissioner in Mesopotamia, 1920–3. Secretary, Foreign Department, Government of India, 1914. Consul and Political Agent, Muscat, Arabia, 1899–1904.	**Persia** (*in part*); **Persian Gulf.**
R. A. S. M.	ROBERT ALEXANDER STEWART MACALISTER, M.A., LITT.D., LL.D., F.S.A. Professor of Celtic Archaeology, University College, Dublin. Director of Excavations for the Palestine Exploration Fund, 1900–9 and 1923–4. President of the Royal Irish Academy. President of the Royal Society of Antiquaries of Ireland, 1925–8. Author of *A Century of Excavation in Palestine;* etc.	**Palestine** (*in part*).
R. B. McK.	RONALD BRUNLEES MCKERROW, LITT.D. Trinity College, Cambridge.	**Parnassus Plays.**
R. C. A.	R. C. ARCHIBALD, M.A., PH.D., LL.D. Professor of Mathematics, Brown University, Providence, R. I. Fellow of American Academy of Arts and Sciences. Author of *Benjamin Peirce.*	**Peirce, Benjamin.**
R. C. J.	SIR RICHARD CLAVERHOUSE JEBB, O.M., LL.D., D.C.L. Public Orator, Cambridge University, 1869–75, and Professor of Greek, 1889–1905. Author of *Translations into Greek and Latin; Homer, an Introduction to the Iliad and Odyssey;* etc. *See* the biographical article: JEBB, SIR RICHARD CLAVERHOUSE.	**Pindar** (*in part*).
R. D. H.	R. DAWSON HALL. Engineering Editor, *Coal Age*, New York.	**Physical Resources** (*in part*).
R. E. B.	RICHARD EVELYN BYRD. Naval Officer and Aviator. Commander, Aviation Unit of Macmillan Polar Expedition, 1925. Made Flight over North Pole, 1926. Made Trans-Atlantic Flight with three Companions from New York to France, 1927. In command of South Polar Expedition, 1928–	**Peary, Robert Edwin.**

R. E. Si.	ROBERT E. SIMON. President of United Parents' Associations of Greater New York Schools. Chairman of Committee on Teachers' Salaries, New York.	**Parental Education.**
R. G.	RICHARD GARNETT, C.B., LL.D. Librarian and Author. Late Superintendent of the Reading Room, British Museum, London, and Keeper of the Printed Books. Co-editor with Edmund Gosse of *English Literature.* Author of *A Chaplet from the Greek Anthology; Emerson; Milton; Essays in Librarianship and Bibliophily;* etc.	**Panizzi, Sir Anthony** (*in part*); **Peacock, Thomas Love** (*in part*).
R. H. Ra.	ROBERT HERON RASTALL, SC.D., F.G.S., M.INST.M.M. University Lecturer in Economic Geology and Fellow of Christ's College, Cambridge. Member of Council of the Geological Society, 1915, and Mineralogical Society, 1918. Attached to War Office, 1915–9. Author of *The Geology of the Metalliferous Deposits.* Editor of the Geology section, 14th Edition, *Encyclopædia Britannica.*	**Pegmatite.**
R. I. P.	REGINALD INNES POCOCK, F.L.S., F.Z.S., F.R.A.I., F.R.S. Natural History Editor of *The Field* (London), and Temporary Assistant in the Zoological Department of the British Museum since 1923.	**Pedipalpi; Pentastomida.**
R. K. D.	SIR ROBERT KENNAWAY DOUGLAS. Late Keeper of Oriental Printed Books and MSS. at the British Museum, and Professor of Chinese, King's College, London. Author of *The Language and Literature of China;* etc.	**Parkes, Sir Harry Smith.**
R. L. T.	RALPH LILLEY TURNER, M.C., M.A. Professor of Sanskrit in the University of London. Sometime Fellow of Christ's College, Cambridge. Author of *Gujarati Phonology; The Position of Romani in Indo-Aryan;* Editor of *A Dictionary of the Nepali Language with Etymological Notes*	**Pali Language and Literature** (*in part*).
R. N. B.	ROBERT NISBET BAIN. Assistant Librarian, British Museum, 1883–1909. Author of *Scandinavia: The Political History of Denmark, Norway and Sweden, 1513–1900; The First Romanovs, 1613 to 1725; Slavonic Europe: The Political History of Poland and Russia from 1469 to 1796;* etc.	**Panin, Nikita Ivanovich; Peter I.; Peter III.; Petofi, Alexander** (*in part*); **Piper, Carl.**
R. P.	RENÉ POUPARDIN, D-ÈS-L. Secretary of the Ecole Nationale des Chartes. Honorary Librarian of the Bibliothèque Nationale, Paris.	**Philip the Bold** (*in part*); **Philip the Good** (*in part*).
R. R.	SIR RICHARD STUDDERT REDMAYNE, K.C.B., M.SC., M.INST.C.E., M.I.M.E., F.G.S. Past President, Institute of Mining and Metallurgy. Hon. Member, Surveyors' Institute. H.M. Chief Inspector of Mines, 1908–20. Author of *The British Coal Industry.*	**Peat.**
R. R. P.	RAYE R. PLATT, A.B. Head of Department of Hispanic American Research, American Geographical Society of New York.	**Patagonia.**
R. S. M.	R. S. MORRELL, M.A., PH.D., F.I.C. Research Chemist at Messrs. Mander Bros. Ltd., Wolverhampton. Formerly Fellow of Gonville and Caius College, Cambridge.	**Paints, Chemistry of** (*in part*).
R. Sto.	SIR RONALD STORRS, C.M.G., C.B.E. Governor and Commander-in-Chief, Cyprus, since 1926. Civil Governor of Jerusalem and Judaea, 1920–6. Formerly Military Governor of Jerusalem.	**Palestine** (*in part*).
R. T. L.	ROBERT THOMSON LEIPER. Professor of Helminthology, University of London. Director of the Division of Medical Zoology, London School of Hygiene and Tropical Medicine.	**Parasitic Diseases.**
R. Wa.	ROBERT WALLACE, F.R.S.E., F.L.S. Author of *Farm Live Stock of Great Britain; Indian Agriculture; The Agriculture and Rural Economy of Australia and New Zealand; Farming Industries of Cape Colony;* etc.	**Pig** (*in part*).
R. W. P.	RAYMOND WILLIAM POSTGATE. Editorial Staff, London, 14th Edition, *Encyclopædia Britannica.* Author of *The Bolshevik Theory; Revolution from 1789–1906; The Builders' History;* ed. *Pervigilium Veneris.*	**Peterloo; Place, Francis.**
R. W. S.-W.	ROBERT WILLIAM SETON-WATSON, LITT.D. Masaryk Professor of Central European History, University of London. Founder and Joint-Editor of *The New Europe,* 1916–20. Joint-Editor of *The Slavonic Review.* Author of *The Rise of Nationality in the Balkans; The New Slovakia;* etc.	**Peter I.**
R. Z.	RAPHAEL ZON, M.S., F.E. Professor of Forestry, University of Minnesota. Author of *Forest Resources of the World.*	**Physical Resources** (*in part*).
S. A. C.	STANLEY ARTHUR COOK, LITT.D. University Lecturer in Hebrew and Aramaic. Fellow and Lecturer in Hebrew and Syriac, Gonville and Caius College, Cambridge. Editor for the Palestine Exploration Fund. Co-editor of the *Cambridge Ancient History.* Author of *Religion of Ancient Palestine.*	**Palestine** (*in part*); **Philistines.**
S. A. H.	S. A. HURREN. Lecturer on Technology of Pianoforte Construction at Northern Polytechnic Institute, London.	**Pianoforte** (*in part*), **Pianoforte Manufacture.**
S. B. McC.	SAMUEL BLACK McCORMICK, M.A., D.D., LL.D. Chancellor Emeritus, University of Pittsburgh, Pennsylvania.	**Pittsburgh.**
S. d'A.	SILVIO D'AMICO. Italian Author and Journalist. Dramatic Critic of the *Idea Nazionale,* Rome.	**Pirandello, Luigi.**
S. E. S.	S. E. SHEPPARD. Assistant Director of Research, Eastman Kodak Company, Rochester, New York.	**Photochemistry.**

S. G. B.-B.	REV. S. GRAHAM BRADE-BIRKS, D.Sc., F.Z.S. Lecturer in Zoology and Geology, South-Eastern Agricultural College, Wye, Kent.	**Pauropoda.**
S. H. M.	SYDNEY HERBERT MELLONE, M.A., D.Sc. Lecturer, Manchester College, Oxford. Examiner in Philosophy, Universities of St. Andrews, 1899–1902; London, 1902–6; Edinburgh, 1907–10; in Psychology, Edinburgh, 1913–6. Lecturer in the University of Manchester, 1911–21. Author of *The New Testament and Modern Life; The Apocrypha, Its Story and Message;* etc.	**Pelagius** (*in part*).
S. K. L.	S. K. LOTHROP, A.B., PH.D. Anthropologist, Museum of the American Indian, Heye Foundation, New York. Author of *Tulum, an Archaeological Study of Eastern Yucatan; Pottery of Costa Rica and Nicaragua; Pottery Types and Their Sequence in El Salvador.*	**Pipil.**
S. R.	SIDNEY H. RAY, M.A., F.R.ANTHROP.S. Lecturer in Polynesian, Melanesian, Micronesian and Papuan Languages, Cambridge.	**Papuan Languages.**
T. A.	THOMAS ASHBY, D.LITT., F.B.A., F.S.A., HON.A.R.I.B.A. Formerly Director of the British School at Rome. Author of *Turner's Visions of Rome; The Roman Campagna in Classical Times, Roman Architecture.* Revised and completed for press a *Topographical Dictionary of Ancient Rome* (by the late J. B. Plattner). Author of numerous archaeological articles.	**Paestum; Pantelleria; Pavia** (*in part*)**; Perugia; Pisa** (*in part*).
T. B.	SIR THOMAS BARCLAY, LL.B., PH.D. Vice-President, International Law Association.	**Pacific Blockade** (*in part*).
T. E. G.	THEODOR E. GREGORY, D.Sc. Sir Ernest Cassel Professor of Banking in the University of London.	**Panic** (*in part*).
T. F. H.	TALBOT F. HAMLIN, B.A., B.ARCH. Instructor in the History of Architecture, Columbia University, New York. Chairman, City Plan Committee of the Merchants' Association, New York. Author of *The Enjoyment of Architecture; The American Spirit in Architecture.*	**Panel; Perpendicular Period; Persian Art Painting and Calligraphy** (*in part*).
T. G. B.	THOMAS GREGOR BRODIE, M.D., F.R.S. Late Professor of Physiology at St. Thomas' Hospital Medical School, University of London.	**Phagocytosis.**
Th. N.	THEODOR NÖLDEKE, PH.D. German Semitic Scholar. Professor of Oriental Languages at Strasbourg, 1872–1906. Author of *Geschichte des Korans. See* the biographical article: NOLDEKE, THEODOR.	**Pahlavi** (*in part*)**; Persepolis** (*in part*).
T. L. H.	SIR THOMAS LITTLE HEATH, K.C.B., K.C.V.O., SC.D., F.R.S. Assistant Secretary to the Treasury, 1907–13. Hon. Fellow of Trinity College, Cambridge. Author of *A History of Greek Mathematics.*	**Pappus of Alexandria.**
T. Sm.	T. SMITH, M.A. Principal Assistant, Physics Department, National Physical Laboratory, Teddington, Middlesex.	**Periscope.**
T. T. R.	THOMAS THORNTON READ, E.M., PH.D. Professor of Mining, Columbia University. Editor of *Mining and Metallurgy;* formerly Associate Editor of *Mining and Scientific Press.*	**Physical Resources** (*in part*).
T. W.	THOMAS WOODHOUSE. Head of Weaving and Textile Designing Department, Technical College, Dundee.	**Pile.**
T. W. R. D.	T. W. RHYS DAVIDS, LL.D., PH.D., F.B.A. Late Professor of Comparative Religion, University of Manchester. Formerly Professor of Pali and Buddhist Literature, University College, London and President of the Pali Text Society. Author of *Buddhism, Its History and Literature;* etc.	**Pali Language and Literature** (*in part*).
U. P. H.	ULYSSES PRENTISS HEDRICK, M.S., D.Sc. Director, New York Agricultural Experiment Station, Geneva, New York. Author of *Manual of American Grape Growing; Systematic Pomology;* etc.	**Peach** (*in part*)**; Pear** (*in part*).
V. C. C.-B.	V. C. CLINTON-BADDELEY. Editorial Staff, 14th Edition, *Encyclopædia Britannica.*	**Pitt, William.**
V. F. M.	V. F. MINORSKY. Professor of Persian Philology, Ecole Nationale des Langues Orientales Vivantes, Paris.	**Persian Literature.**
V. H. B.	VERNON HERBERT BLACKMAN, SC.D., F.R.S. Professor of Plant Physiology and Pathology, Imperial College of Science and Technology, London. Editor of the Botany section, 14th Edition, *Encyclopædia Britannica.*	**Palm** (*in part*)**; Pea.**
W. A. G.	WILLIAM A. GANOE, A.M. Major, United States Army. Executive, Historical Section, American War College, Washington. Author of *The English of Military Communications; The History of the United States Army.*	**Palo Alto.**
W. A. P.	W. ALISON PHILLIPS, M.A. Lecky Professor of Modern History, Dublin University. Contributor to the *Cambridge Modern History;* etc.	**Paris, Treaties of.**
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P TO PLANTING OF TREES

P This letter throughout its known history has represented the unvoiced labial stop. It corresponds to Semitic ⅂ (*pe*), Greek Γ, Γ, ⅂ (*pi*). The rounded form occurs in the early Greek inscriptions from the island of Thera. In the Italic alphabets the form varied strangely. The Chalcidic Greek had merely Γ and Γ. Etruscan had ⅂ and P. The Latin alphabet shows two forms Γ and P, one clearly taken from the Greek and the other probably from the Etruscan. The Umbrian alphabet had 1, a form resembling the ancient Semitic. Faliscan had the rounded form 7, Γ. Oscan lengthened the second small vertical stroke and developed the form Π.

The minuscule letter resembles the majuscule, the chief difference being that the loop is brought down to the level of the line of writing and the vertical stroke extended below the line. Thus a cursive form of the 6th century was p, the uncial form was p, the Carolingian p. In modern hand-writing and printing the vertical stroke is extended upwards again, the loop remaining small and on a level with the line, p.

In English and other modern languages the letter is used in combination with *h* in words of Greek origin to denote the unvoiced bilabial spirant, expressed in other words by the letter *f*, e.g., *philosophy, phonetics, graphic.* (B. F. C. A.)

PAARDEBERG, a ford on the Modder River, in the Orange Free State, 23 miles S.W. of Kimberley, was the scene of the surrender of Cronje's force to the British under Lord Roberts on Feb. 28, 1900. After the relief of Kimberley by French's cavalry, Cronje's command, which had been covering the siege, retreated from its position at Magersfontein towards Bloemfontein. The main body of the British infantry was despatched in direct pursuit, and French's cavalry, despite the exhaustion of their horses, moved south-east from Kimberley and successfully headed Cronje off at Paardeberg. An attempt was made on February 18 to rush his laager by a concentric attack from west, south and

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	B.C. 1,200	7
CRETAN	1,100-900	⅂
THERAEAN	700-600	⅂
ARCHAIC LATIN	700-500	P
ATTIC	600	⅂
CORINTHIAN	600	⅂
CHALCIDIAN	600	Γ
IONIC	403	⅂
ROMAN COLONIAL	PRE-CLASSICAL AND CLASSICAL TIMES	Γ Γ P
URBAN ROMAN		Γ P
FALISCAN		⅂
OSCAN		Π Π
UMBRIAN		1
CLASSICAL LATIN AND ONWARDS		P

THE DEVELOPMENT OF THE LETTER "P" FROM THE EARLIEST TIMES TO THE PRESENT DAY

east; hurriedly organized and insufficiently co-ordinated, it resolved itself into a succession of partial efforts which broke down

before the Boer fire, while an opportune raid by General Christian De Wet was a contributory cause of their failure. Cronje's fate was not averted but only postponed. Attempts to effect his relief by renewed attacks on the investing lines from without failed to break the ring which encircled him; after ten days' investment and bombardment, he surrendered on Feb. 28 with 4,000 men. (*See* also SOUTH AFRICAN WAR.)

PAARL, a town 36 m. by rail E.N.E. of Cape Town, situated about 400 ft. above sea level on the banks of the Berg river, along which it straggles for about 7 miles. To the west of the town are the Paarl mts.; to the east is the Drakenstein range. In and around the town are gardens, orange groves and vineyards. It is a busy agricultural and industrial centre. Fruit and tobacco cultivation is increasing. Wine, brandy, wagons and harness are made. There are several high schools, a training college and an industrial institute. In 1921 the population consisted of 6,395 "coloured" persons, 213 natives, 30 Asiatics, and 5,760 Europeans. By 1926 the latter had increased to 6,678. Paarl was founded in 1687.

PABJANICE, a town of Poland, in the province of Lodz, 30 m. N.W. of the town of Piotrkow, and 10 m. S.S.W. from Lodz railway station. Pop. (1921) 29,700. It lies amidst extensive forests round the head-waters of the Nér, which were the hunting-grounds of the Polish kings. It has woollen, cloth and paper mills, and manufactures agricultural implements.

PABNA or PUBNA, a town and district of British India, in the Rajshahi division of Bengal. The town is situated on the river Ichhamati. Pop. (1921), 19,343. The district of Pabna has an area of 1,678 sq.m. Pop. (1921), 1,389,494. It is bordered along its entire east face by the main stream of the Brahmaputra or Jamuna, and along its south-west face by the Ganges or Padma. Apart from the two great bordering rivers, it is intersected by countless water-channels, so that during the rainy season every village is accessible by boat and many by boat only. Almost the whole area is one green rice-field, the uniform level being broken only by clumps of bamboos and fruit-trees, which conceal the village sites. The Chalan Bil on the west is a marshy area once extending over 400 sq.m. It has been largely filled up by silt deposited by the rivers. The two staple crops are rice and jute.

PACA, a large, heavily-built, short-tailed rodent recognized by its spotted fur. This rodent (*Agouti paca*), together with one or two other tropical American species, represents a genus akin to the agoutis and included in the family *Dasyproctidae*. Pacas may be distinguished by their heavier and more compact build, the longitudinal rows of light spots on the fur, the five-toed hind-feet, and the peculiar structure of the skull. Their habits are similar to those of agoutis. In Brazil the flesh is eaten. Males differ from females in the rough outer surface of their cheek-bones. The paca-rana (*Dinomys branicki*), from the highlands of Peru, differs by its well-developed tail and the arrangement of the spots. (*See* RODENTIA.)

PACATUS DREPANIUS, LATINUS (or LATINIUS), one of the Latin panegyrists, flourished at the end of the 4th century A.D. He probably came from Aginnum (Agen), in the south of France. He was the contemporary and intimate friend of Ausonius, who describes him as the greatest Latin poet after Virgil. In A.D. 390 he was proconsul of Africa. He is the author of an extant speech (ed. E. Bährens in *Panegyrici latini*, 1874, No. 12) delivered in 389 in honour of Theodosius I.

PACCHIA, GIROLAMO DEL (1477–after 1535), Sienese painter, son of a Croatian cannon-founder, was born in Siena. In early life he visited Florence and Rome, returning to Siena in 1508. His fine altarpiece in the church of S. Christoforo reveals the influence of Raphael and Fra Bartolommeo. He was, however, an eclectic, and came more and more under the influence of Sodoma. In company with that master and with Beccafumi, he worked at the frescoes in the oratory of S. Bernardino. Other works are in the Oratory of S. Caterina in Fontebranda, in the Siena gallery, and in the National Gallery, London. Having joined the notorious company of the Bardotti, he is supposed to have fled upon the suppression of that turbulent club in 1535, and nothing further is known of him.

PACHECO, FRANCISCO (1564–1654), Spanish painter and art historian, was born at Sanlúcar de Barrameda, where he was baptized on Nov. 3, 1564. He went early to Seville, where he lived with his cousin, F. Pacheco, a canon whose house was a meeting place of the learned and artistic world of the town. Pacheco studied art under Luis Fernandez. It is not known whether he went abroad, but he greatly admired Italian art and formed a collection of Italian Renaissance drawings. Later he opened an academy which was largely attended. Of his pupils the most distinguished were Alf. Cano and Velazquez, who became his son-in-law. His early work is hard and cut out; after a visit in 1611 to Madrid and Toledo, where he met Greco, he became interested in the problem of chiaroscuro. Specimens of his work are to be seen at Seville in the gallery, the university and the cathedral. The church of St. Sebastian at Alcala de Guadaira, near Seville, contains one of his most important works. He was a successful portraitist and is said to have executed 150 portraits. Pacheco visited Madrid again in 1623 in the company of Velazquez and stayed there for two years. In his later life he devoted himself to writing. His treatise on the art of painting (*Arte de la pintura,* 1640) is of considerable value for the study of Spanish art.

PACHER, MICHAEL (*fl.* 1465–1498), German painter and wood carver. His chief work was the great altarpiece in the parish church of St. Wolfgang, in Upper Austria, commissioned by the abbot Benedict Eggh of Mondsee and executed between 1478–81. It is one of the greatest monuments of the late German Gothic period. The centrepiece is an elaborate wood carving representing Christ and Mary with St. Wolfgang and St. Benedict. The wings, two on each side, are painted with scenes from the life of Christ and of St. Wolfgang. While the carving is of the late Gothic style prevalent in Germany at the time, the paintings are influenced by the Italian Renaissance, which penetrated into the Tirol from Verona. The figures are plastic, the composition clear and monumental.

Other works by the master are: The altarpiece (wood carving) in the church of Gries, near Bozen (1471); the high altar for the church of St. Francis, in Salzburg, begun in 1484 and left uncompleted; and the altarpiece of the cathedral at Brixen, representing the fathers of the Church, panels of which are in the Munich and Augsburg galleries.

See O. Doering, *Michael Pacher* (München, 1913).

PACHMANN, VLADIMIR DE (1848–), pianist, was born on July 27, 1848, at Odessa, Russia, where his father was a professor at the university. His first musical instruction was on the violin at the age of six and it was not till he was ten that he began the serious study of the piano, under Dachs, at Vienna. He made his first appearance in Russia in 1869, but afterwards withdrew from the platform and continued his studies for a number of years; then, reappearing, he obtained at once universal recognition as one of the most remarkable executants of the day. As an interpreter of Chopin in particular he has always excelled, while his amusing platform mannerisms and eccentricities, taking the shape of audible comments on the music, comic gestures, and so on have added to his popularity.

PACHOMIUS, ST. (292–346), Egyptian monk, the founder of Christian cenobitical life, was born, probably in 292, at Esna in Upper Egypt, of heathen parents. He served as a conscript in one of Constantine's campaigns, and on his return became a Christian (314); he at once went to live an eremitical life near Dendera by the Nile, putting himself under the guidance of an aged hermit. After three or four years he was called (by an angel, says the legend) to establish a monastery of cenobites, or monks living in common. (*See* MONASTICISM, § 4.) Pachomius spent his life in organizing and directing the great order he had created, which at his death included nine monasteries with some three thousand monks and a nunnery. The order was called Tabennesiot, from Tabennisi, near Dendera, the site of the first monastery. Athanasius was his firm friend and visited his monastery *c.* 330 and later. The date of his death was probably in 346.

The best modern work on Pachomius is by P. Ladeuze, *Le Céno-*

bitisme pakhomien (1898). There have been differences of opinion in regard to the dates; those given above are Ladeuze's, now commonly accepted. The priority of the Greek *Life* of Pachomius over the Coptic may be said to be established; the historical character and value of this life are now fully recognized. A good analysis of all the literature is supplied in Herzog's *Realencyklopädie* (ed. 3). *See* also W. E. Crum, *Theological Texts from Coptic papyri* (1913).

PACHUCA, a city of Mexico and capital of the State of Hidalgo, 55 m. direct and 68 m. by rail north-north-east of the city of Mexico. Pop. (1921) 40,802. Pachuca's railway connections include the Mexican, the Hidalgo and the Mexican Oriental. The town stands in a valley of an inland range of the Sierra Madre Oriental, at an elevation over 8,000 ft. above the sea, and in the midst of several very rich mineral districts—Atatonilco el Chico, Capula, Potosí, Real del Monte, Santa Rosa and Tepenené. It is said that some of these silver mines were known to the Indians before the discovery of America. It was here that Bartolomé de Medina discovered the "patio" process of reducing silver ores with quicksilver in 1557, and his old *hacienda de beneficio* is still to be seen. Pachuca was founded in 1534, some time after the mines were discovered. The city has some fine modern edifices, among which are the palace of justice, a scientific and literary institute (now a university), a school of mines and metallurgy, founded in 1877, a meteorological observatory and a public library. Mining is the chief occupation. Electric power is derived from the Regla Falls, in the vicinity. The city's industrial establishments include smelting works and a large number of reduction works, including some of the most important metallurgical works in the republic.

PACHYDERMATA, a term often applied to thick-skinned animals, such as the rhinoceros, elephant and hippopotamus. The animals included by it have no close affinities.

PACIFIC, COMMAND OF THE. The development of the strategic situation in the Pacific ocean, as it now exists, may be said to have begun in 1894 when a victorious Japan eliminated the Chinese navy as a serious factor in the balance of sea-power. Three European sovereignties then proceeded to establish bases in the Far East, Russia at Port Arthur, Germany at Tsingtao, the naval fortress of Kiaochow on Shantung, and Great Britain at Weihaiwei. During this period, the most serious rivalry lay between Russia and Japan, each intent upon the control of Korea, and in 1904–05 the issue was resolved by a war in which Japan eliminated the Russian navy in the Far East as completely as the Chinese navy had been eliminated ten years before. Japan was left in undisputed mastery of Asiatic waters from Kamchatka in the north to the Philippine archipelago in the south.

In 1902 Great Britain concluded an alliance with Japan and so safeguarded her interests in the Far East. The British force on the China station was reduced, therefore, to a mere cruiser squadron. While Germany continued to fortify Tsingtao as a refuge for her small Asiatic fleet, it was clear that her forces, whether on land or sea, did not materially affect Japan's supremacy in armaments. At Manila in the Philippines the United States kept a few secondary ships of war, but took no steps to develop the naval resources of this fine harbour. Guam, an American island of the Marianas group, lying 1,500 m. to the east of the Philippines, ranked only as a fuel station, though its position invested it with unique strategic value.

This situation continued, substantially unchanged, from the year 1905 when the Treaty of Portsmouth was signed between Russia and Japan, and the outbreak of the World War in 1914. The Far Eastern seas, which had long been the arena of conflicting claims to supremacy, had now passed definitely and, as it seemed, permanently, under the control of a single Power. Subsequent events have tended to consolidate the strategic predominance of the Japanese empire. The conquest of Tsingtao early in the World War eliminated the only German stronghold in the Pacific. Domestic convulsions in Russia, by apparently reducing the naval forces of that State to impotence, have rendered still more remote the prospect of Vladivostok again becoming the headquarters of a formidable fleet.

In order to understand the new position, it is necessary to appreciate what the naval strategist means by "radius of fleet action." Modern fighting ships have a narrow radius of action, dimensioned by their relatively meagre fuel capacity. In time of war individual cruisers may roam the sea for weeks, even for months, at a stretch, replenishing their bunkers as opportunity offers. This, however, is not possible for an organised fleet, attended by the smaller craft which are essential as watch-dogs to the heavy ships. From experience gained in the World War it is estimated that a battle-fleet with its proper complement of ancillary units can remain at sea under war conditions not longer than four days. To be within reach of attack the objective must not be farther away than two days' travel at ordinary speed. To all intents, a battle-fleet within the war zone is restricted to a cruise of 96 hours.

These essential facts demonstrate the intimate relation between strategy and geography. In the vast expanse of the Pacific ocean, every problem of naval strategy involves the question of base facilities, and the broad consideration to be faced is that in consequence of recent international negotiations, the number of potential naval bases in the Pacific has been substantially increased, with the result that squadrons, if not whole fleets, may henceforth be able to operate in waters which formerly lay beyond their reach. It is true that a great many of these islands are mere atolls, affording little or no shelter for large vessels, and lacking even the most rudimentary naval resources. An important part was played in the South Atlantic operations of the British fleet during the World War by the remote coaling base at Abrolhos Rocks, off the Brazil coast.

Hence, the direct bearing of the Treaty of Versailles on the naval problems of the Pacific. Under that treaty, the former German islands north of the Equator passed into the custody of Japan, while those south of the Equator were transferred to the British empire. As an element in naval strategy, these islands possess an immense potential importance. Since 1919 Japan has exercised mandatory powers over several island groups situated far out in the Pacific. Strategically, her most important acquisitions are the Peleliu islands (500 m. east of the Philippines); the Carolines; the Marianas islands, excepting Guam, which is American territory; and the Marshall group, these latter being some 1,700 m. to the southwest of Hawaii. Light naval vessels, aircraft and submarines, judiciously distributed among the islands named, would represent a serious menace to a hostile force advancing towards Japan from the east.

It is thus essential to note that under the mandate of the League of Nations, the use of these islands for warlike purposes and their fortification are forbidden. Of equal significance have been the results of the Washington Conference (*q.v.*). The covenants there arrived at in 1922 not only reduced the battle-fleets of the leading naval Powers according to a definite schedule, but they deal also with naval bases and have in some degree nullified the effect of the territorial changes in the Pacific for which the Versailles Treaty was responsible. Under the Washington Treaty the British empire, the United States and Japan agreed to maintain the *status quo* as to fortifications and naval bases in a series of highly important strategic positions in the Pacific. The United States, for example, is pledged not to improve in any way the shore defences or naval works in the Philippines, Guam or the Aleutian islands; Japan accepts the like obligation in regard to the Bonin islands, Formosa and other insular possessions; while the British empire is debarred from adding to the naval resources of Hongkong.

The Hawaiian islands are also exempted, though they are more than 2,000 m. from the American mainland. Their position makes them invaluable as the pivoting centre of a fleet charged with the task of defending not only the western seaboard of the United States but the outlying territories of Alaska and Samoa.

The zone of agreement demarcated at the Washington Conference begins east of the meridian of 110° E. long. Singapore lies just outside this limit and is thus not subject to the pledges against fortification. First utilised as a naval harbour in 1882, Singapore has been for many years the southern base of the British China Squadron. Over the development of Singapore as the naval base of a battle-fleet, there has been serious controversy

in Great Britain, successive Governments, Conservative and Labour, taking different views. The new dockyard was begun in 1924–25, and was advocated on grounds mainly, if not entirely, defensive. The contention is that Singapore is regarded by Australia and New Zealand as the United States regards Hawaii. A naval station at Singapore would be an indirect but none the less effectual deterrent to plans, if they should ever be considered, for the invasion of Australia or New Zealand. The susceptibilities of these Dominions have been aroused somewhat by the nonrenewal of the Anglo-Japanese Alliance.

Since the Washington Conference, competition in battleships has been abated. But additional attention has been directed to cruisers, of which Japan has constructed a powerful contingent. The range of action of cruisers has become a factor on which experts lay great emphasis. By Great Britain, with her numerous coaling stations and her interest in confined waters like the Mediterranean, small cruisers are held to be most useful. But the United States, surveying an ocean like the Pacific, which extends from the Arctic to the Antarctic regions, and has a breadth as great as 10,000 m., and covers nearly one-half of the surface of the earth, is anxious for cruisers of the largest size; that is 10,000 tons. The Panama canal has enabled the United States to operate her fleet in two oceans, the Atlantic and the Pacific, and it is to the Pacific ocean in particular that she has devoted her naval developments. The fleets of the United States and Japan in the Pacific have become, therefore, the major determinants of the strategic situation. But, in the main, these imposing forces are dependent on shore communications, which shores are separated by thousands of miles. Even Hawaii and Singapore are outside of a fighting radius that would include Japan. No single Power or group of Powers, therefore, has achieved an absolute control of this vast area of sea. Up to the present, the Latin American Republics, bordering on the Pacific, for instance Chile and Peru, have not organized naval forces that seriously affect the situation. (*See* SINGAPORE; WASHINGTON CONFERENCE, etc.)

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PACIFIC BLOCKADE, a method of coercion short of war exercised by a great Power for the purpose of bringing pressure to bear on a weaker state. That it is an act of violence, and therefore in the nature of war, is undeniable. In this respect it is an act of war, and may be so regarded by a power strong enough to resist. On the other hand, the object and justification of a pacific blockade being to avoid war with the state against which the operation is carried on, rights of war cannot consistently be exercised against ships belonging to other states than those concerned. And yet if neutrals were not to be affected by it, the coercive effect of such a blockade might be completely lost. Recent practice has been to limit interference to the extent barely necessary to carry out the purpose of the blockading powers.

The earliest recorded instance of pacific blockade is the Anglo-Swedish blockade of Norwegian ports in 1814. This was succeeded by the intervention of France, England and Russia in Turkish affairs in 1827, and, in 1837, by Great Britain against New Granada.

The Declaration of Paris, 1856 (*q.v.*), however, required that "blockades in order to be binding must be effective; that is to say, maintained by a force sufficient really to prevent access to the coast of the enemy."

The blockade which first gave rise to serious theoretical discussion on the subject was that instituted by France in 1884 in Chinese waters. On Oct. 20, 1884, Admiral Courbet declared a blockade of all the ports and roadsteads between certain specified points of the island of Formosa. The British Government protested that Admiral Courbet had not enough ships to render the blockade effective, and that it was therefore a violation of the Declaration of Paris, 1856. Moreover, the French Government could only interfere with neutral vessels violating the blockade if there was a state of war. If a state of war existed, Britain as a neutral was bound to close her coaling stations to belligerents. The British Government held that in the circumstances France was waging war and not entitled to combine the rights of peace and warfare for her own benefit. Since then pacific blockades have only been exercised by the great Powers as a joint measure in their common interest, which has also been that of peace; and in this respect the term is taking a new significance in accordance with the ordinary sense of the word "pacific." The penalty for breach of pacific blockade by neutrals is detention or sequestration. In no event may ships be confiscated.

By the Hague Convention (II. 1907) respecting the employment of force for the recovery of contract debts, the contracting powers agree "not to have recourse to armed force for the recovery of contract debts claimed from the government of one country by the government of another country as being due to its nationals," unless "the debtor state refuses or neglects to reply to an offer of arbitration, or after accepting the offer prevents any *compromis* from being agreed on, or after the arbitration fails to submit to the award" (Art. 1). Though this does not affect pacific blockades in principle, it supersedes them in practice by a new procedure for some of the cases in which they have hitherto been employed. (T. B.; H. H. L. B.)

PACIFIC HIGHWAY, an American highway running along the western border of the United States from Vancouver, Canada, to the Mexican boundary line south of San Diego, Calif., about 1,675 m. long. It is paved or hard the entire distance. The sea or mountains are within view of the highway from end to end. It passes Mt. Rainier, Crater lake and the Mt. Lassen volcano.

PACIFIC ISLANDS (OCEANIA). The Pacific islands, also sometimes spoken of collectively as Oceania or even Oceanica, may from a geographical point of view, be described as including all the almost innumerable "oceanic" islands, as distinguished from the "coastal" archipelagoes adjoining the shores which more or less surround the Pacific Ocean, *i.e.*, those which obviously pertain physically to the coasts of Australia with its Territory of Papua, and those of New Zealand, and the shores of America on the east and again on the west of this great ocean.

No entirely satisfactory classification of these islands seems to have been suggested. The one most commonly put forward is to treat them as divisible, in accordance with the native races found in occupation at the time when Europeans first entered this area, into the three areas of Polynesia, Melanesia, and Micronesia; Polynesia (Gr. πολύς, many, and νῆσος, island) being the eastern part of the area embracing Hawaii, the Ellice, Phoenix, Union, Manihiki and Marquesas groups, the Cook, Society, Tubuai and Tuamotu groups and many other lesser islands; Melanesia (Gr. μέλος, black, and νῆσος, island), being the area in the western and south-central area embracing in some interpretations New Guinea and the Louisiade islands and, in addition, the Solomon, Santa Cruz, New Hebrides, New Caledonia and the Loyalty islands, the Fijian islands, and the intervening groups; Micronesia (Gr. μικρός, small, and νῆσος, island), the third and smallest of the divisions lying north and somewhat east of Melanesia, and embracing the Marianas, Palau (Pelew), Caroline, Marshall and Gilbert islands.

The Structural Arcs and Geology.—Several great zones of deep water may be traced in the Pacific Ocean. The first is east of the Ryukyu islands and the Philippines, and beyond it far out to sea rise the island chains which stretch in scattered order from south-east Hondo, Japan, to the Ogasawara Jima (formerly sometimes called Bonin islands) between lat. 28° and 26° 30′ N., the Volcano islands (lat. 25°–24° N.), the Marianas, Yap and the Palau (Pelew) islands.

Islands of the Asiatic Continental Edge.—The Ogasawara Jima include nummulitic limestone with ancient igneous rock and there are also newer (horizontal) limestones abutting against the above. The Volcano islands are said to continue the line of Fujiyama. In the southern Marianas' terraces of coral formation rise to the summits, but in the north the coral is restricted to the bases. Yap

is formed of basic volcanic material. The Palau islands have a volcanic foundation on which rests a fossiliferous limestone that is more or less crystalline. Malakal in this archipelago reaches a height of over 1,600 feet and syenitic pebbles occur even on this high ground. The island chains above discussed have been thought by Suess to mark the limit of the continental mass of Asia, in which case they may be said to mark the edge of the easternmost of a series of steps, the edges of which may be indicated by the Ryukyu, Corea and the Khingan Mts. Beyond the Ogasawara Jima-Palau zone to the east is one of the world's chief lines of sea-deeps, 4,000 fathoms being much exceeded over long distances.

Western Pacific Arcs. Introductory.—From the south-east of the Marianas another zone of deep water extends north-eastwards to the west-north-west end of the Hawaiian chain, beyond which again is another great deep. From the east-south-east end of the Hawaiian chain another zone of deeps extends south-south-westwards to the vicinity of East Cape, New Zealand with a south-eastward extension east of Chatham island (*q.v.*). The expanse of ocean extending south-westwards between the two deep zones, Marianas-Hawaii and New Zealand-Hawaii, is marked by islands set in arcs. These arcs are rather a series of overlapping sub-parallel lines than strictly continuous curves. Arcs of the western Pacific farther and farther away from Australia show less and less traces of continental land, and mountain folding and volcanic lines, usually with atolls, are all that remain. The western Pacific arcs have been thought to be in relation with those of both New Guinea and New Zealand.

Western Pacific Arcs. I. New Guinea, New Caledonia.—This arc may be traced through the Louisiade islands, a prolongation of south-east New Guinea, New Caledonia, with the Loyalty islands near by, and Norfolk island, perhaps to north-west New Zealand. New Caledonia has a band of Archaean and Palaeozoic rocks running almost the whole length of the island from north-west to south-east, while what are probably Eocene beds fringe the south-west coast. Much of the old rock is slate or schist with serpentine, granitic and basic volcanic intrusions. The slates are interbedded with limestones containing fossil brachiopods, referred to the Trias. There are evidences of submergence and a wide-lagoon barrier reef. There is a general geological resemblance between New Caledonia and New Zealand. The main mineral veins are of nickel (garnierite) in the eastern peridotite dikes. The Eocene rocks disappear in places beneath the older ones, thus demonstrating overfolding, the direction of which may have been south-westwards. There is thus no doubt that here is a remnant of a folded mountain chain. Some of the fossils found in New Caledonia are northern forms.

Western Pacific Arcs. II. New Britain Archipelago. New Hebrides.—This is traceable especially through New Ireland, the Solomons and Santa Cruz to the New Hebrides.

New Ireland possesses porphyries, diorite, some dark calcareous rock and some grey rather crystalline limestone reaching nearly 2,500 feet above the sea. The south of New Ireland is volcanic but, to the north, sedimentary rocks rest on an ancient mass which is scarped towards the south-west and probably represents the most easterly of the New Guinea folds. The other islands of the New Britain group, as well as the Admiralty islands, are volcanic, with recent coral. The features of New Ireland, including the grey limestone, are continued along the chain to the New Hebrides, and the limestone, containing *Rhynchonella* sp., is thought to be Mesozoic. Several active volcanoes occur at what appear to be breaks in the chain which may be considered a fragment of a cordillera. Former statements as to ancient rocks in the New Hebrides have not been confirmed.

Western Pacific Arcs. III. Caroline Islands, Marshall Islands, Fiji.—The general direction of the chain from the Marshall islands to Fiji north-north-west to south-south-east and the relation of the Fijis to the others may not be simple because of the interference of the Samoan line discussed below. The Fiji islands are mainly volcanic including many tuffs interstratified with tertiary limestone and resting on limestone older but still tertiary. In the south of Viti Levu is a high granitic plateau which is said to be a horst. Vanua Levu has hot springs. Fiji yields malachite, antimony, graphite, gold in small quantities, and specular iron sand. W. M. Davis has made a special study of the coral reefs of Fiji and thinks that they are formed by the method inferred by Darwin. He also notes that on the south-west side of Viti Levu and on the south side of Vanua Levu there are raised reefs and fringing reefs but no barrier reefs off shore; while on the north and north-west sides of the island there are off-shore barrier reefs but no raised reefs. The Ellice, Gilbert and Marshall islands north of Fiji are volcanic with coral atolls. The politically-famous Nauru island (Pleasant island) lies south-west of the Marshall group. The Carolines, west of the Marshalls, include several small chains not quite parallel to the main direction of the whole arc; it has been surmised that they are built upon a deeply foundered fold system.

Western Pacific Arcs. IV. New Zealand, Tonga.—The Ruahine chain of New Zealand is a scheme of fold mountains with a palaeozoic axis parallel to the east coast of North island, New Zealand. To the west of it lies a volcanic zone including the peaks of Ruapehu and Tongariro, Lake Taupo, Rotarua, and the bay of Plenty with the volcano of White island. The line is continued north along the Kermadec to the Tonga islands. The western side of the Tonga chain is highly volcanic; Hongu-tonga and Hongu-hapai appear to be fragments of a single crater, and Toqua Kao, Late, Metis, Amargua and Falcon islands are also purely volcanic; the rock is basic. Tonumeia and the Nomuka group (Mango, Nomuka-iki, etc.) have coral limestone over submarine volcanic deposits of tuffs, penetrated by basic volcanic dikes. The Vavau group, Tongatabu and Hapai do not show a volcanic substratum. Metis and Falcon islands are usually submerged.

Samoa, Tokelau Is., Phoenix Is.—The fourth arc just discussed is bounded by a long sea-deep which however has its continuity broken just where certain Polynesian island-chains cut it north of the Tonga islands. The chief of these is the Samoan group but the Tokelau (Union) islands and apparently the Phoenix islands may be mentioned here.

The Samoan chain shows vulcanicity, oldest in the east where the craters have disappeared, less old in the centre where they form peaks, and obviously very recent in the west.

The Eastern Polynesian Chains, orientated west-north-west to east-south-east have as a foundation a plateau submerged beneath 700–800 fathoms of water, on the east side of the zone of great depths. The island-chains diminish and disappear south-eastwards and here the ocean becomes 2,000 fathoms deep and more. The Austral and Cook islands are the most south-westerly chain. The Society islands (Tahiti) form the middle one and include some atolls but are mainly a basic volcanic group. Tahiti, itself ringed by strong cliffs with much evidence of submergence, has a discontinuous barrier reef off-shore. Here the submergence is older than in the Marquesas and the embayed valleys are filled with alluvium. Though all volcanic activity has now ceased, remains of plants and animals now living in the islands are found beneath some of the lava flows, so vulcanicity is recent. The north-easterly chain is that of the Tuamotu or Low Archipelago, in which Makatea (Metis) reaches a height of some 230 feet. Most of the islands are atolls which Agassiz thought were built on denuded summits of Tertiary limestone, cut at about sea-level. The Manahiki islands farther north-west may be related to the Tuamotu.

The Marquesas and Isolated Groups.—Beyond the Tuamotu group to the north-east lie the Marquesas showing basic volcanic material deeply dissected and recently so altered by submergence that only fragments of coral are found in the bay-head beaches. The New Zealand-Hawaii zone of great depths is cut between the Equator and lat. 10° N. by the low atolls of Christmas, Fanning, Samarang, Palmyra and Barber islands arranged more or less north-west to south-east. East of the eastern Polynesian chains lie Easter island and Sala-y-Gomez island south of the Tropic of Capricorn, and the Galapagos islands on the Equator. All are volcanic in origin and may possibly be compared rather with the oceanic islands of the Atlantic than with the island chains of the rest of the Pacific.

The Hawaiian chain is treated separately. (*See* HAWAII.)

General Physical Geography.—Volcanic islands, commonly called high islands, are widely distributed throughout the area of Oceania except in the extreme eastern parts, where "low islands," coralline atolls, are much more, indeed extraordinarily frequent. The high islands of the Marquesas and the Society (Tahitian) groups are types of extinct volcanic islands. In the long chain of the Solomon islands, in the New Hebrides, in the Tongan group there are still active volcanoes and Hawaii contains the celebrated active crater of Kilauea. In many other places at which only tradition tells of eruption it would hardly be safe to assume that activity might not again burst out. Submarine vents sometimes break out; the most remarkable instance of this is that of the so-called Falcon island (lat. 20° 19′ S., long. 175° 25′ W.), in the Tongan group. In the *Pacific Islands Pilot*, vol. ii., it is recorded that this was first seen as a breaking reef, from H.M.S. "Falcon," in 1865; from the position of this reef smoke was seen to issue, by H.M.S. "Sappho," in 1877; in October 1885 the reef was reported to have taken on the form of an island; four years later this island was actually surveyed by H.M.S. "Egeria," and found to be 1¼ miles long north and south, one mile wide, wedge-shaped, the highest part, 153 feet above sea-level, being at the south end. It was formed of loose volcanic ashes and cinders, which material was constantly slipping down, as the action of the sea undermined the coast. By 1885 two-thirds of the island had disappeared; and by April 1894 nothing was to be seen where Falcon island had been but a low streak of black rock, invisible at night. But in December of the same year renewed "volcanic action had formed a new crater, with the result that the island was then fifty feet high, three miles long and one and a half miles broad, the surface being still quite hot. In 1895 the island had again disappeared, its place occupied by a shoal about a hundred yards in extent breaking heavily. In April 1900, the shoal which had been the island was showing about nine feet above water at its northern end." In 1905, as the present writer can testify, the shoal was barely more than a waste, and in 1913 it was officially reported as "non est." In 1926 or 1927 the island, or rather the shoal again appeared, but is said to have disappeared again.

Coral Formations.—Coral reefs, like volcanoes, are dealt with under special articles, but here it must be noted that coral, in one or other of its several forms, is present, not everywhere but more abundantly than in any other ocean, in the Pacific island-area, more especially in the eastern portion of that area. The main type-forms in which it appears are as follows: *atolls, i.e.*, rings of coral surrounding a central lagoon; *barrier reefs, i.e.*, such as front a coast-line or encircle an island or group of islands, leaving a more or less deep channel between it and the shore; and *fringing-reefs, i.e.*, such as are extensions of the shore, generally for a short but sometimes for a more considerable distance, and not separated from the shore by any deep water channel.

As to the atolls it must be added that often one or more, or even many, of the highest parts of these may be more or less raised higher than the general sea-level of the ring, so that from a distance these higher parts, especially after vegetation has been attracted to them, may appear from a little distance as distinct islands, and in many cases have been so reported and named.

In other cases, again, what must originally have been atolls have been raised, sometimes more than once, and have thus become what have been called *elevated coral islands;* a good example of this is the island of Maré, of the Loyalty group, where there is evidence of three such elevations, so that three former reefs appear as distinct low cliffs, separated from the sea by low and level coast-tracts.

Flora.—In any general consideration of the flora of the islands it is necessary to distinguish between the rich vegetation of the fertile volcanic islands and the scanty vegetation of the low coral islands, especially of the atolls often only here and there raised slightly above sea-level. Of the plants not purposely brought in by human agency most must have been introduced by the wind or by ocean currents or by migratory birds, from one or other of the shores surrounding the ocean. The large but buoyant fruits of the coco-nut palm and of the "screw pine" (Pandanus), ocean-borne, found foothold on the coral rock barely raised over sea-level, and became the predominant vegetation of the low lands; doubtless the fact that both were found to offer an important food supply for vegetarian natives led to their being extensively planted by human beings in rather more inland parts, and even, as in some of the New Hebrides, far up on the hillsides. On the other hand, the wind-borne spores of mosses and ferns, the winged seeds of many shrubs and trees, and the bird-carried, comparatively large fruits of many other plants found favourable homes in the higher volcanic islands, especially on the most westward slopes, with the result that in time many slopes have acquired typical intertropical rain forests. It need hardly be said that there is no hard and fast line between the coastal and the mountain vegetation of the high islands which are more or less fringed by level coastal tracts; an instructive study of the merging of coastal and mountain vegetation is found in Lilian Gibbs' "Montane Flora of Fiji" (*Linn. Soc. Journ. Botany,* xxxix., 1909).

Marvellously beautiful as this original vegetation of the islands is, it must not be overlooked that the profusion of fruits, flowers and beautiful leaves now to be seen in the inhabited parts of the islands has not been brought about by natural means. The natives in their early migrations certainly carried with them not only food and other plants useful to them but also plants valued by them for ornament; that is to say they grew them round their houses and used the flowers and leaves—especially such as are scented—lavishly in dressing themselves for their ceremonies. Still more have Europeans since their arrival in the islands been responsible for the introduction of non-native plants, both useful and ornamental; a good illustration of this is to be found in the late J. H. Maidon's paper on the "Flora of Norfolk Island" (*Proc. Linn. Soc. of New South Wales,* Vol. xxviii., pp. 692–785 [1903]), in which is shown the extent to which the abundant natural vegetation of that island, as seen by Captain Cook, the earliest European visitor, and by other early visitors, has been almost smothered by the useful and ornamental plants introduced during the first half of the last century from Australia.

Fauna.—The indigenous land fauna is exceedingly poor in mammals, which are mainly represented by rats and bats. The pigs, so much treasured by the natives of the Solomon and New Hebrides islands, were supposed to have been introduced by Captain Cook, but it now seems more probable that they are descended from a Papuan form brought by the Melanesians in their southward migration into the Pacific. Cattle and horses when first introduced—certainly by the early navigators—seemed not to thrive under domestic conditions; but when, as has happened in some of the larger and more mountainous islands, they ran wild, they increased rapidly; and more recently, when suitable fodder plants were introduced for their benefit, they have thriven greatly even in a domestic state.

Birds are much more numerous than mammals, among the most important kinds being pigeons and doves, especially the fruit-eating pigeons, responsible as these doubtless have been for the distribution of the fruits from which many of the island plants have originated. Birds of specialized form occur in several of the island groups; Megapodes in the Solomon islands, the New Hebrides, Samoa and Tonga, as also in the Carolines and the Marianas. The remarkable Didunculus occurs in Samoa, and after the introduction of cats and rats, which preyed upon it, was compelled to change its habits from living on the ground to living in trees.

Insect life has been said to be fairly abundant but unequally distributed throughout the islands; as a matter of fact, except in the Solomon and Hawaiian islands, and more recently in the Fijian group, where the subject has been more particularly studied, little more than a general knowledge of the insect fauna is available.

The marine fauna of the area is much richer than that of the land. Fish are very abundant, especially in the lagoons of atolls, and form an important article of food for the natives, who are generally expert fishermen. The gorgeous colour of many of the species of fish is noticeable, as also the fact that the flesh of certain species of fish is poisonous at certain seasons of the year, but not at other times. Turtles are also abundant. Among

marine mammals the dugong occurs in the northern parts of the area; and whales traverse the waters of the area at certain seasons of the year. In considering the marine fauna the remarkable *palolo* or *balolo* should be mentioned. This annelid propagates its kind by rising to the surface of the sea and dividing itself; but this happens only in certain places, chiefly in the Fijian and Samoan groups, and on just two days in each year, the dates of which can be accurately predicted. As both the annelid and the fish which gather to prey on it are appreciated by the natives as a specially delicate article of food, the occasions of the appearance of the *balolo* are regarded as very important festivals.

For an account of the inhabitants and their social life *see* articles on POLYNESIA, MELANESIA and MICRONESIA, as well as the separate articles on a few larger island groups, *e.g.*, FIJI.

The subsequent sections of this article deal with the island groups in greater detail and in the order in which they have been already mentioned.

ISLANDS OF THE ASIATIC CONTINENTAL EDGE

The *Ogasawara Jima* (Bonin islands) are the subject of a special article.

The *Marianas* (*Mariannes* or *Ladrones*) are situated in about 12° to 21° N. and 145° E. and, with the exception of the island of Guam (the largest of the group) belonging to U.S.A. and the subject of a separate article, are administered under mandate by Japan. They fall into two groups—a northern of ten mainly volcanic islands, of which only four (Agrigan, Anatahan, Alamagan and Pagan) are inhabited, and a southern of five mainly coralline limestone islands (Rota, Guam, Aguijan, Tinian and Saypan), all inhabited save Aguijan. The total area (excluding Guam) is about 245 sq.m.; the Japanese population 1,493 and the natives, mostly descendants of the Tagal immigrants from the Philippines number 3,398. They were discovered by Magellan in 1521 and his crew called them *Islas de los Ladrones* (Islands of the Thieves). They received the name *Las Marianas* in 1668 in honour of Maria Anna of Austria, widow of Philip IV. of Spain. They were sold by Spain to Germany in 1899 and after the war of 1914–18 passed under Japanese mandate.

In the northern volcanic group an extreme elevation of about 2,700 ft. is reached and there are craters showing signs of activity. The southern islands are of slight elevation. The climate is damp and the heat not as intense as in the Philippines. Variations of temperature are not great. All the islands except Farallon de Medinilla and Uraccas or Maug (in the northern group) are more or less densely wooded and the vegetation is tropical and luxuriant, much resembling that of the Carolines and also of the Philippines, whence many species of plants have been introduced. On most of the islands there is a plentiful supply of water. The fauna likewise, is similar to that of the Carolines and certain species are indigenous to both regions. Swine and oxen run wild. The former were known to the early inhabitants while the latter, with most other domestic animals, were introduced by the Spaniards. Coco-nuts and areca palms, yams, sweet potatoes, manioc, coffee, cocoa, sugar, cotton, tobacco and mother-of-pearl are the chief products, and copra is the principal export.

The Island of Yap (lat. 9·35° N., long. 138·15° E) (pop., 8,439) is an important cable station and the subject of a special article.

The Palau (*Pelew*) *islands* are a group of twenty-six islands lying between 2° 35′ and 9° N. and 130° 4′ and 134° 40′ E. under Japanese mandate. The largest islands are Babeltop (Babelthuap, Baobeltaob, etc.), Uruktapi (Urukthopel), Korror, Angaur, Peleliu and Eilmalk (Irakong). The total area is 175 sq.m. and the population is 6,361 (5,754 natives). The islands lie within a coral barrier reef, and in the south the islands are of coral, but in the north of volcanic rock. They are well wooded and the climate is sub-tropical and the water-supply good. A few rats and bats represent the indigenous mammals; birds are numerous and the sea is rich in fish and molluscs. The islands were sighted in 1543 by Ruy Lopez de Villalobos who named them the Arrecifos. The origin of the name Islas Palaos is doubtful. The islands were bought by Germany from Spain in 1899 and administered from Yap. After the World War they passed under Japanese mandate. Further reference is made to Yap and the Palau islands in connection with the Caroline islands below.

THE WESTERN PACIFIC ARCS

First Arc.—The first arc comprises the Louisiade islands, New Caledonia, the Loyalty islands and Norfolk island.

The Louisiade Group form a chain extending south-eastward from the easternmost promontory of New Guinea (*q.v.*) and are included in the Australian territory of Papua (British New Guinea). The islands number over 80 and are interspersed with reefs. They are rich in tropical forest products and gold is obtained on the chief island Tagula or South-east island (area 380 sq m.) and on Misima or St. Aignan. The natives are Papuans. The islands were probably observed by Torres in 1606 but were named by de Bougainville in 1768 after Louis XV.

New Caledonia, a dependency of France, is situated between 20° 1′ and 22° 26′ S., and 164° and 167° 40′ E. Area 6,296 sq.m.; for the islands in the immediate vicinity add 73 sq.m.; while for the dependent islands such as the Loyalty islands, etc., add a further 917 sq.m. Pop. (1926) 51,368, of whom 26,915 were Melanesians and Polynesians, 3,610 introduced labourers from Java and Annam and 2,310 convicts. The total white population, was 17,015. The centres of population are Nouméa, pop. (1925) 27,016, the capital; Bourail, La Foa, Moindu, St. Louis and St. Vincent.

New Caledonia is about 220 miles long with an average breadth of 25–30 m., and lies north-west and south-east. An almost unbroken barrier reef skirts the west shore at about 5 m. distance, enclosing a navigable channel; on the east, which is more abrupt and precipitous, it is much interrupted. To the north the reefs continue, marking the former extension of the land, for about 160 m., ending with the Huon isles. The Isle of Pines, area 58 sq.m., pop. about 600, so called from its araucarias (its native name is Kunie), geologically a continuation of New Caledonia, lies 30 m. from its south-east extremity. It formerly abounded in sandalwood, and consists of a central plateau surrounded by a belt of cultivation. At the two extremities of New Caledonia, parallel longitudinal ranges of mountains enclose valleys; for the rest the island consists essentially of confused masses and ranges of mountains, rising to an extreme elevation of 5,387 ft., the plains being chiefly the deltas of rivers. The landscape is rich and beautiful, varied with grand rock scenery, the coast-line being broken by numerous small bays, into which flow streams rarely navigable even for short distances, but often skilfully used by the natives for irrigation; and sometimes flowing in subterranean channels. The large rivers in the wet season form impassable morasses, especially in the south-east, where the mountains rise in isolated masses from the plains.

The climate of New Caledonia is cooler and healthier than that of the New Hebrides; and its flora and fauna differs considerably, especially, as regards the flora, on the western side, where there is a marked intrusion of Australasian types as against the Polynesian types on the eastern side. The fauna is less different—though there is one very remarkable bird, occurring nowhere else, the wingless *Kagu* (*Rhinochetus jubatus*); deer, though undoubtedly an introduced species, are very abundant.

But perhaps the most remarkable natural feature of the island is the abundance and variety of its minerals; cobalt, nickel (without arsenic) iron and manganese abound, and many others, including gold, are known to exist in varying quantities.

The natives are Melanesians but of mixed blood, including some Polynesian elements.

The island was discovered by Capt. Cook in 1774. He touched at the haven of Balade (the original name of the island) as did d'Entrecasteaux in 1793. The natives were later exploited by traders in sandalwood. French missionaries arrived in 1843. After an incident with the natives in 1851 the island was annexed by France in 1853 although there were further difficulties with a British counter-claim. Nouméa was founded in 1854 when it was called Port de France. In 1860 New Caledonia became a colony distinct from the French possessions in the Pacific at large, and

in 1864 the first penal settlement was made on Nou island, off Nouméa.

New Caledonia is administered for the French Republic by a governor assisted by a privy council consisting of the heads of military, judicial and other services and of two notables of the colony appointed by the President of the Republic. There are also a general secretary and 5 administrators in charge of the arrondissements. There is also an elective general council. The capital Nouméa has a municipality and the other centres are administered by municipal commissions.

There are public and private elementary schools. In 1925 there were 55 public and private primary schools and 74 native schools. The College La Perouse at Nouméa gives some technical instruction in its general curriculum. There are extensive pasture and cultivated lands with some 500 sq.m. of forest. There is a native reserve, ruled in the main by native custom. Coffee, cotton, manioc, copra, maize, tobacco and bananas are among the agricultural products. Cattle and sheep are also important. There are blast furnaces for nickel smelting. A hydro-electric factory was set up in 1926. In 1925 20,715 tons of chrome; 4,400 tons of nickel and 10,000 tons of phosphates were exported. Coffee, cotton, copra and guano are also among the exports. Wine, coal, flour and rice are imported. A narrow gauge railway connects Nouméa to Paita and it is proposed to extend the line to Bourail. There are internal telegraph and telephone communications. The roads are on the whole poor.

New Caledonia has the central government for the Isle of Pines, the Wallis Archipelago, the Loyalty islands, the Huon islands and Futuna and Alofu.

The Loyalty group, a chain of small islands parallel to it, and at a distance of between 50 and 100 miles from the north-east coast of New Caledonia, is composed of three larger islands, Maré, Lifu (Lifou) and Uvéa, and of some islets and rocks, are coral islands of comparatively recent elevation, and nowhere rise more than 250 ft. above sea-level. Maré, the south-east island of the group, has a flat and barren top, between 200 and 300 ft. above the sea, with occasional slopes and terraces, indicative of several successive elevations; but there is an abundant growth of coco-nut palm on the sea-coast. Lifu, the central and largest island of the group (area 650 miles), its greatest length about 33 miles and greatest width about 28 miles, appears from the sea as a succession of plains. Uvéa, the north-westernmost of the three principal Loyalty islands, is a typical coral-atoll carrying on its rim many closely-connected islets and, on its eastern face, carrying the much larger island to which the name Uvéa (or Halgam) island properly belongs. The Loyalty islanders are Melanesians. The group was discovered at the beginning of the 19th century. Christianity was introduced into Maré by native teachers from Rarotonga and Samoa. From 1864 the French have considered the island a dependency of New Caledonia. Coco-nuts are cultivated, while copra and rubber are exported.

Norfolk island lies about 800 m. east of the nearest point of New South Wales, in 29° S., 167° 56′ E. Pop. (1925) 747. It stands on a submarine table-land extending about 18 m. to the north and 25 m. to the south and has itself an area of about 13 sq.m.

The islets of Nepean and Philip lie near it. Its high cliff-bound coast is difficult of access. With a general elevation of 400 ft. above the sea the island rises in the north-west to 1,050 ft. in the double summit of Mount Pitt. The soil, of decomposed basalt, is wonderfully fertile. Oranges, lemons, grapes, passion fruit, figs, pineapples, guavas and other fruits grow abundantly; while potatoes, onions, maize and arrowroot can be cultivated. The Norfolk island pine (*Araucaria excelsa*) is a magnificent tree. The flora is most closely associated with that of New Zealand, and the avifauna indicates the same connection rather than one with Australia. The climate is subtropical, the thermometer rarely sinking below 65°. The island was discovered in 1774 by Capt. Cook, and from 1788 to 1809 and again from 1825 to 1855 was used as a penal settlement in connection with that at New South Wales. In 1856 the descendants of the mutineers of the Bounty were transferred to Norfolk island from Pitcairn. The settlement remained under the authority of New South Wales till 1914, since when the administration has been in the hands of the Commonwealth Government. The imports (mostly from Australia) were valued (1924–25) at £17,190 and the exports at £3,960.

The Second Arc.—The second western Pacific arc comprises the New Britain Archipelago, the Solomon islands, Santa Cruz and the New Hebrides.

The New Britain Archipelago between about 145°–156° E., and the Equator and 8° S., is used here to include both New Ireland and the Admiralty islands which are in line with the Solomon islands and also New Britain which loops between New Ireland and New Guinea. The area of New Britain is 9,500 sq.m.; native population within explored areas (1925) 81,200. New Ireland has an area 3,000 sq.m.; native population (1925) including adjacent islands 38,800. The Admiralty islands have an area of 600 sq.m. All the islands are under Australian mandate. New Britain is crescent shaped and about 300 m. long with a mean breadth of 50 miles. The island is mountainous with several active volcanoes. The highest known peak is the Father (7,500 ft.)—an active volcano. New Ireland lies to the north and is also mountainous. It is separated from New Britain by St. George's channel. There are no active volcanoes. The islands have rich tropical vegetation, and New Britain is well watered by streams. The climate is tropical, considerably tempered by oceanic influences. The islands are not thoroughly explored yet and their coastlines were but imperfectly known until the middle of the 18th century. Jacob Lemaire and William C. Schouten sighted New Ireland in 1616, but it was long thought to be a part of the adjacent islands. In 1884 a German Protectorate was declared over the islands and they were known with many other islets as the Bismarck Archipelago. At the end of the World War they passed from Germany to be held by Australia under a mandate of the League of Nations. The chief town of New Britain and the seat of government is Rabaul; pop. (non-native) 1,350. It is also an anchorage for ships. The old capital was Kokopo, pop. (non-native) 369. Simpson Harbour in Blanche Bay is important. The chief town and seat of local administration in New Ireland is Kavieng (non-natives 356). It is in the extreme north-west of the island, on the north coast of the Nusa harbour. The only other town is Namatanai (non-natives 148).

Missionary societies are at work throughout the region.

New Britain is not much developed save in the Gazelle peninsula in the north. There are four plantations on the north coast and six on the south coast. There are a number of plantations in New Ireland around the coast near Kavieng. The chief industry of the group is coco-nut growing.

The Solomon islands are chiefly elongated islands stretching north-west to south-east, they include Buka (300 sq.m.), Bougainville (3,900 sq.m.), Choiseul (2,260 sq.m.), Malayta (2,400 sq.m.) and San Christoval, with New Georgia and Guadalcanar (2,500 sq.m.) as a subordinate line south-west of Isobel. The total land area is estimated at 17,000 sq.m., while the total population is in excess of 250,000 (1925), of which some 600 are Europeans. Bougainville (1925) had 46,600 native population and Buka (1925) 7,600 native population. There are very numerous outlying small groups. Ongtong Java (native name Leneneuwa) which has also been called 'Lord Howe islands,' is a coral atoll (measuring about 35 miles by 18) which carries a number of low sandy islets; it lies considerably northward of the main group, to which it can hardly be said to belong geographically.

The islands of the main chains are well watered though the streams seem to be small; and the coasts afford some good harbours. All the large and some of the smaller islands appear to be composed of ancient volcanic rock, with an incrustation of coral limestone showing here and there along the coast. The mountains generally fall steeply to the sea, and there is little level land. Deep valleys separate the gently rounded ridges of forest-clad mountains, lofty spurs descend from the interior, and, running down to the sea, terminate in bold rocky headlands, 800 to 1,000 feet in height. The small rocky island of Florida, midway between Guadalcanar and Malayta, is remarkable as being bi-sected by a narrow but navigable channel; it is also remarkable as having much

undulating grass-land interspersed with clumps of trees, between which patches of cultivation give evidence of the richness of the soil. The whole chain of the Solomon islands appears to be rising steadily. Some of the smaller islands are of recent calcareous formation. Barrier and fringing reefs, as well as atolls, occur in the group, but the channels between the islands are dangerous chiefly from the strong currents which set through them.

The climate is damp and debilitating, and the rainfall is unusually heavy. Fever and ague are prevalent on the uncleared parts of the coast; but the highlands, where most exposed to the south-east trade winds are healthier. The dry season, with north-west winds, lasts from December to May. Mangrove swamps are common on the coasts; but of recent years large tracts of these lands have been cleared, by Europeans, for coco-nut cultivation.

The Solomon islanders are of Melanesian (Papuan) stock, though in different parts of the group they vary considerably in their physical characteristics. The history of the Solomon islands is treated in a separate article. The administration is based on the former division of the islands between Germany and Great Britain (convention of 1899). The boundary ran through Bougainville Strait. Since the World War the ex-German territory is administered by mandate under Australia. The British section is administered by a resident commissioner, whose headquarters are at Tulagi, a small island off the south-west of Florida. A nominated advisory council assists in the government. The chief medium of exchange is Commonwealth bank notes. The various missions have charge of education. Coco-nuts, rubber, bananas, pine-apples and sweet potatoes are grown. Copra, trochus shell, ivory nuts and timber are exported mainly from the British Solomons. The value of the imports of the British Solomons 1925–26 was £266,943 and exports £418,818. Kieta on the east coast of Bougainville and Carola Hafen on the west side of Buka are important harbours. The plantations on these islands are, however, new.

The Santa Cruz Islands.—In the British Protectorate of the South Solomons, are a scattered group of small volcanic islands, irregularly disposed from north-west to south-east, between 8° 31′ and 11° 40′ S. and 168° E. to the south-east of San Cristoval, but separated by a deep channel from that island. The following islands are included in the group; the Duff and Matenna or Swallow islands, Analogo, Tinakula or Volcano island and others: from these a single chain curves south-east and then east consisting of Nitendi or Santa Cruz, the largest island, Tupua or Edgecombe, Vanicoro (the scene of the wreck of La Perouse's ships), Tucopia, Anuda (or Cherry) island, and Fataka (area 380 sq.m.; estimated population 5,000).

In Vanicoro there are volcanic mountains up to 3,030 ft. in height, and Tinakula is a still active volcano of 2,200 ft. Nitendi is of less elevation (1,215 ft. at the highest). Coral reefs are not extensive, except around Vanicoro. The islands are densely wooded, the flora and fauna being akin to those of the Solomon islands. The climate is hot and moist, and storms are frequent. The natives are of Melanesian (Papuan) stock, with an admixture of other blood, but the Duff group, Tucopia and Anuda, are inhabited by pure Polynesians. The islands were discovered by Alvaro Mendana in 1595, and in 1767 Philip Carteret visited them and called them the Queen Charlotte islands—their alternative name. A British protectorate was declared over them in 1898. There is some trade in copra.

The New Hebrides, with which may be classed the Banks and Torres islands, continue the chain south-eastward from the Santa Cruz, from which they are separated by a comparatively shallow channel, consist of about 40 mountainous islands besides numerous islets and rocks (*see* Map, Plate 176). Estimated area 5,700 sq.m. with a native population of about 60,000. The islands are under the joint administration of English and French officials. White population (1925) British 232, French 650.

Irregularly disposed at the northern end are the lesser islands composing the Banks group—Gaua, Vanua Lava, Mota, Valua, etc., and the Torres islands. South from these, the main islands are arranged somewhat in the form of the letter Y, the foot of which is at Aneiteum, the south-easternmost Hebridean island, north-west from which the main islands are Tanna, Eromanga, Efaté (known also as Vaté, Faté, and Sandwich island), the Shepherd Islands and Api or Epi. At this point the arms of the Y divide, the western formed by the large islands of Malekula (or Mallicolo) and Espiritu Santo (abbreviated to Santo; native name Marina), the eastern formed by Ambrym, Arag and Maiwo (Aurora), with Aoba (Opa, or Leper island) between the two arms. Espiritu Santo, the largest island, has an area of 875 sq.m.; at its north-east side is the great bay of St. Philip and St. James—locally called "Big Bay"—first seen by the Portuguese Quiros, in 1606, when he thought he had found the shore of a great southern continent, which he named Australia del Espiritu Santo.

Efaté, situated almost at the dividing point of the two arms of the Y, is one of the most important of the New Hebrides, having two excellent harbours, Vila and Havannah, within the first named of which is the seat of the Anglo-French administration. Britain is represented by a high commissioner who delegates his power to a resident commissioner. On the island of Mallicolo (Malekula) is Port Sandwich, the chief port of the New Hebrides after Vila.

With their rugged outline and rich vegetation, the New Hebrides islands as seen from the sea are very beautiful. Excepting the small Torres group, which are low-lying and perched on reefs, but without lagoons, all the islands are of volcanic, not coral formation, the larger ones lying on both sides of the line of volcanic activity. The coasts are almost free from reefs and the shores rise abruptly from deep waters. Old coral is sometimes found elevated to a considerable height. The islands are formed chiefly of basalt and recently erupted material; earthquakes and submarine eruption are not infrequent; and several of the islands have very active craters. All have considerable elevations, one of the loftiest being the isolated cone of Lopevi, near the junction of the arms of the Y; its height is 4,714 ft.; in Espiritu Santo a height of 6,169 feet has been recorded. The volcanic soil is very rich. Numerous clear streams water the islands, but some debouch upon flat ground towards the sea, and then form unhealthy marshes. Copper, iron and nickel are the most important minerals known in the group; and sulphur is of some commercial importance.

The climate is generally hot and damp, especially during the months from November to April. The natural vegetation is especially luxuriant and interesting. The coco-nut palm, elsewhere confined to the parts little above the sea-level, has here spread up on to the hill-sides. The sandalwood tree occurs; and it is noteworthy that when the sandalwood traders had exhausted the supply of their commodity in the Fijian islands (1804–1816), it was chiefly to the southern New Hebridean islands that this trade was diverted. The indigenous fauna is even less abundant than in the Solomon islands; as has been said, it is possible, even probable, that the pigs so treasured by the natives had spread into the New Hebrides from Papua before the first coming of Europeans, but otherwise the only mammals are bats and rats. European pigs and horned cattle have, however, run wild in certain parts. Birds, insects, and fish are abundant. The natives are Melanesians of mixed blood, though in places a few Polynesians have succeeded in establishing themselves.

The history of the New Hebrides is treated in a separate article. There are numerous missions at work among the natives. Presbyterian and Catholic missions have native schools. There are in addition one French government school and two Catholic mission schools for the white population. Large areas of the land have been cleared and well cultivated—chiefly by French and British; and there is a considerable export of copra, coffee, maize, cocoa, cotton and bananas, and even of European vegetables and fruits.

Imports include provisions and foodstuffs, clothing, furniture and metal work. There is a small saw-mill on Efaté. The imports for 1925 were, British, 6,107,509 francs; French, 15,896,723 francs; and the total exports amounted to 31,115,143 francs, of which three-quarters was French. The trade is mostly with Australia, New Caledonia and France.

So far as concerns the movement of peoples in this region the continuation of the line from north-west to south-east repre-

sented by the Solomon and the New Hebridean islands, along which the Melanesians doubtless passed down into the Pacific is to be found in the Fijian group where the Melanesians confronted the Polynesians of the Tongan (Friendly) islands. It has been found advisable, however, in this article, to treat the island chains in the order of their supposed structural relations.

The Third Arc.—The third western Pacific arc comprises the Caroline islands, the Marshall islands, the Gilbert islands with Nauru and Ocean islands, the Ellice islands, Rotumah and the Fijian archipelago.

The Caroline islands are a widely scattered archipelago under Japanese mandate, included in Micronesia, and lying between 5° and 10° N. and 135° and 165° E. Geographically they fall into a series of sub-parallel lines while administratively the islands are divided into two groups—the Eastern Carolines, with Truk and Ponape as centres, and the Western Carolines, together with the Palau (Pelew) islands and Yap island which belong to the continental border (*v.sup.*). The total land area is about 380 sq.m. and of this 307 sq.m. is covered by the four main islands, Ponape, Kusaie, Truk (or Hogolu), and Yap. The total population of the Carolines is estimated at 36,000. Truk has 598 Japanese, 5 foreigners, and 14,788 natives; Ponape, 425 Japanese, 6 foreigners and 6,638 natives; Palau (Pelew), 592 Japanese, 15 foreigners, 5,754 natives; Yap, 97 Japanese, 4 foreigners, 8,338 natives. The islands were made known to Europeans by the Portuguese Diego da Rocha in 1527 and were called by him the Sequeira islands. In 1686 Admiral Francesco Lazeano renamed them the Carolines in honour of Charles II. of Spain. Spain definitely claimed the group in 1875 but this was contested by Germany. After arbitration the islands passed to Spain with free trading rights for Germany. In 1899 Germany finally bought the islands from Spain and held them until after the World War when they passed under Japanese mandate.

The main islands are of considerable elevation. The highest point of Ponape reaching some 3,000 ft. The remaining islands of the group are generally low coral islets. The climate is equable and moist, but the islands are subject to severe storms. The vegetation is tropical and luxuriant, much resembling that of the neighbouring island groups particularly the Marianas. The fauna is likewise similar to that of the Marianas group. The natives are careful agriculturists and clever navigators. Copra is the chief export.

The *Marshall* group consists of a number of atolls ranged in two almost parallel lines which run from north-west to south-east between 4° and 15° N. and 161° and 174° E. The north-east line, with fifteen islands, is called Radak, and the other, numbering eighteen, Ralik. The islands are under Japanese mandate. Area (estimated) 160 sq.m. with a population of 198 Japanese, 13 foreigners and 9,589 natives. The most populous island is Majeru. The islands were probably visited by de Saavedra in 1529, Capt. Wallis touched the group in 1767, and in 1788 Captains Marshall and Gilbert explored it. They were annexed by Germany in 1885–1886 and passed under Japanese mandate after the World War. The atolls rise but little above high water mark. The highest elevation occurs on the island of Likiep but is only 33 feet. The lagoon is scarcely more than 150 feet deep and is accessible through numerous breaks in the reef. The reef scarcely exceeds 600 ft. in width. The surface of the atolls is covered with sand except in a few places where by admixture of decayed vegetation it has been turned into soil. The climate is moist and hot, the mean temperature being 80·5°. Easterly winds prevail throughout the year. There is little change of seasons the highest temperature being in January and the lowest in July. Vegetation, on the whole, is very poor. There are many coco-nut palms, bread-fruit trees (*Artocarpus incisa*), various kinds of bananas, yams and taro, and pandanus, of which the natives eat the seeds. From the bark of another plant they manufacture mats. There are few animals. Cattle do not thrive and even poultry are scarce. Pigs, cats, dogs and rats have been imported. There are a few pigeons and aquatic birds, butterflies and beetles. Crustacea and fish abound on the reefs.

The chief island and administrative centre is Jaluit. Protestant (American) and Roman Catholic missions maintain coloured teachers on many of the islands. The chief products for export are copra, tortoise-shell, mother-of-pearl, sharks' fins and trepang. The plantations of coco-palm amount to 1,275 hectares.

The Gilbert islands, or as these are sometimes called, the Kingsmill islands, a chain of coral atolls, carrying some 16 small and low islands, begin slightly north of the Equator and only a little west of the 180 meridian line. Area 166 sq.m. Pop. (1926) 23,250 of which 264 were Europeans (1921). The soil, mostly of coral sand, seems originally to have produced little other vegetation than coconut palms, "screw-pines" (Pandanus), and perhaps a few bread-fruit trees; but, by digging pits to catch the rain water, a giant form of tannia has been introduced by the natives. These few plants—together with the very rich produce of the sea—must have sufficed to support a very dense population of Polynesians. The islands were discovered by John Byron in 1765, Capts. Gilbert and Marshall visited them in 1788. The dense native population of these islands led to the introduction of many of their number to Hawaii as labourers in 1878–1884, but the experiment was unsatisfactory. The islands were claimed as Protectorates by Britain in 1892 and annexed as part of the Gilbert and Ellice Islands Colony in 1915. British and American missions are at work.

Some 200 m. west of the Gilbert islands and a little south of the Equator, are the two remarkable islands of Ocean island (native name Banaba), six miles in circumference (pop. [1926] 2,062 [126 European, 471 Chinese besides Pacific islanders]); and *Nauru* (Pleasant island), area 5,936 acres (pop. [1926] 2,217 [117 Europeans and 822 Chinese besides Pacific islanders]), both notable for their rich phosphate deposits. Unlike the Gilbert islands proper, these islands have been elevated, probably by volcanic action, much above sea-level—the highest part in each being about 260 feet. Even this elevation has allowed a rather more varied natural vegetation than in the Gilbert islands; the natural conditions have however been much altered.

The phosphate deposits were discovered in 1900, and were developed by the Pacific Phosphate Co., until 1919 when the interests of the company were bought by the British, Australian and New Zealand governments.

Ocean Island was annexed by Britain in 1901 and is the headquarters of the Gilbert and Ellice islands Colony. Nauru was annexed by Germany in 1888, but passed by mandate of the League of Nations to Britain after the World War. Great Britain, Australia and New Zealand agreed (1919) that Australia should appoint the first administrator for a term of five years. There is compulsory education for Europeans and natives to the age of 16, after that age technical training is given.

Ocean island and Nauru have important wireless stations.

The Ellice (Lagoon) islands, area 14 sq.m. Pop. (1925) 3,530, like the Gilbert islands, all coral atolls, nowhere raised more than a few feet above the sea-level, and where so raised densely clad with coco-nut palms, comprise a large number of low coralline islets clustered on some nine atolls, spread over a distance of about 400 m. in the direction from north-west to south-east. The chief groups, all yielding coco-nuts, pandanus-fruit and taro, are Funafuti (Ellice island), Mukulailai, Murakita, Nukufetau, and Nanomana. Like the Gilbert islanders, the natives are Polynesians exhibiting traces of Samoan origin. Nearly all the natives are nominally Christians. These islands together with the Gilbert islands were proclaimed Protectorates in 1892 and annexed within the Gilbert and Ellice islands Colony in 1915. This Colony is administered by the high commissioner through a resident commissioner whose headquarters are at Ocean island.

Rotuma, area, 14 sq.m. and population about 2,200, the principal of a cluster of small islands lying some 220 m. north-north-west of the northernmost Fijian reef, is of volcanic formation, though activity has so long been extinct as not to be recorded even in tradition; there is much coral-growth about the main island—as indeed about the adjacent islands. The island was discovered by Capt. Edwards of the "Pandora" in 1791. The island is high and rugged, clothed on the higher parts with luxuriant vegetation and on the coast with many coco-nut palms. There are

no visible streams, though the rainfall is considerable: the water apparently sinks through the loose soil and boulders which cover the whole island, and runs underground to the sea. The natives differ in language and in many other aspects from the Fijians. Always a vigorous and enterprising people, with a special reputation for peacefulness and hospitality to the occasional visitors who reached their shores, they have, since being taken at their own request under British protection (1881), become perhaps one of the most satisfactorily civilized peoples of their kind.

The natives are mostly either Wesleyans or Roman Catholics. A European commissioner resides, who, together with the native chiefs and two native magistrates, forms a regulation board which draws up the local laws subject to the approval of the legislative council of Fiji. The chief product is copra.

The Fijian Archipelago (*see* Map, Plate 51) in many respects the most important in the Pacific, lies east-north-east and at a distance of about 730 miles from New Caledonia, between 15° and 20° S., and on and about the meridian of 180°. It consists of about 250 islands, of which some 80 are inhabited, with a total land area of about 7,050 sq m. (thus roughly equalling that of Wales). The islands are ranged more or less in the form of a horse-shoe, open to the south, and more or less enclosing the Koro Sea. The largest island is Viti Levu, which with the long and narrow island of Kandavu, forms the western leg of the horse-shoe; it is 95 m. in length (east to west) and 67 in extreme breadth, with an area of 4,053 sq.m. Forty miles north-east, at the central point of the horse-shoe, lies Vanua Levu, measuring 117 m. by 30, with an area of 2,130 sq m. Close off the south-east extremity of Vanua Levu is Taveuni, 26 m. in length by 10 in breadth; and from the eastern side of Taveuni a chain of comparatively small islands, known as the Lau or Eastern Group, runs down nearly to 20° S., thus forming the eastern leg of the horse-shoe. Three other islands, all within the Koro Sea, must be mentioned: Ovalau, Koro and Ngau (Gau).

The Fijian islands are mostly extinct volcanic elevations (some up to about 4,000 ft.) which with very few exceptions are surrounded by fringing reefs; but, especially on the eastern side of the group, there are many coral atolls with or without openings into central lagoons.

The surface of the high islands is very rugged, the vegetation is luxuriant, and the general appearance very beautiful. There is not much level country, except for certain rich tracts along the coasts of the two large islands (Viti Levu and Vanua Levu), especially near the mouths of the rivers, and these larger islands have a considerable extent of dry and open undulating country on their lee sides. Streams and rivers are abundant, the latter very large in proportion to the size of the islands, affording a water way to the rich districts along their banks. These and the extensive mud flats and deltas at their mouths are often flooded, their fertility is thus increased, though at a heavy cost to the cultivator. The Rewa river, debouching through a wide delta at the south-east of Viti Levu, is navigable for small vessels for 40 m.; also in this island there are the Navua and Singatoka rivers (flowing south), and the Nandi (west), and the Ba (north-west). The chief stream of Vanua Levu is the Dreketi, flowing west, breaking through the mountains in a fine valley; for this island practically consists of one long range, whereas in Viti Levu the main valleys and separating ranges radiate for the most part from a common centre. Viti Levu is the most important island not only from its size, but from its fertility, variety of surface, and population, which is over one-third of that of the whole group. At Suva, the capital of the Colony of Fiji, there is a very good harbour. Vanua Levu is less fertile; it has good anchorages along its entire southern coast. Of the other high islands, Taveuni, remarkable for a lake (presumably a crater-lake) at the top of its lofty central ridge, is fertile, but exceptionally devoid of harbours; whereas the well-timbered island of Kandavu has an excellent one, Ngaloa, on its southern side. On the island of Ovalau, an island which contains in a small area a remarkable series of gorge-like valleys between commanding hills, is the town of Levuka, the capital until 1882. The chief islands scattered about the western side of the Koro Sea (Koro, Ngau, Moala and Totoya), are all productive, elevated and picturesque, and afford good anchorage.

The islands of the chain limiting the Koro Sea on the east are smaller and more numerous. At the north of the chain are the Exploring isles, a somewhat scattered group surrounded by a barrier reef, 77 m. in circuit; on the western side of which is Vanua Mbalavu (14 m. long and from ½ to 2½ m. broad) with several peaks, the highest of which rises to 930 ft.; it is a centre of native trade. Farther south in the chain, and somewhat to the east, is Mango (3 m. in diameter, and almost surrounded by a reef half a mile broad), remarkable for a subterranean outlet of the waters from the fertile valley in its midst. Farther south again is Lakemba, a rounded, volcanic island, from 4 to 5½ m. in diameter, its highest point rising to 720 ft., and surrounded by a fringe of coral extending from 2 to 10 cables from the shore. It also is an important centre of native trade. Farther south is a welter of small volcanic coral-reef surrounded islands, ending at Vatoa (lat 19° 49′ S., long. 175° 13′ W.), the only Fijian island visited by Capt. Cook—and by him named Turtle island.

The Fiji islands lie beyond the limits of the perpetual south-east trade wind, while not within the range of the north-west monsoons. From April to November the winds are steady between south-east and east-north-east, and the climate is cool and dry, after which the weather becomes uncertain and the winds often northerly, this being the wet, warm season. From November to March heavy gales are frequent, and hurricanes sometimes occur between these months—though, curiously enough, very rarely in February. The rainfall is much greater on the windward than on the lee sides of the islands (about 110 in. in Suva); the mean temperature is much the same, viz., about 80° F.; in the hills the temperature sometimes falls below 50°. The climate, especially from November to April, is somewhat enervating to the Europeans, but not unhealthy. Malaria is hardly known; but severe epidemics of dengue fever and of influenza sometimes occur. Dysentery, which is common, and the most serious disease in these islands, is said to have been unknown before the incoming of Europeans.

The flora is mostly of a tropical Indo-Malayan character—thick jungle with great trees swathed with creepers and epiphytes, but, especially on the western side, there is some intermixture of Australian and New Zealand types. On the lee side of the larger islands, however, the tree growth is often replaced by grassy plains, suitable for grazing, with trees (chiefly Pandanus) few and scattered in more open parts but more thickly clustered in the stream gullies. On the coastlands of the larger high island the coco-nut palm is ubiquitous in the drier parts, but is replaced in the damper parts by the mangrove. Many of these mangrove swamps have, however, been laboriously reclaimed, and now carry flourishing crops of sugar cane. At an elevation of about 2,000 ft. the vegetation changes to a more montane type, and at still higher elevation takes on the appearance of inter-tropical rain forest in the more densely tree-covered areas, while the drier and more open mountain-slopes are clothed in a dense growth of tall reeds. Many of the indigenous trees are of value, *e.g.*, the vesi (*Afzelia bijuga*) and the ndilo (*Calophyllum Inophyllum*) for their timber, the last named also for the oil obtained from its seeds which is much used in the islands, as in India, in the treatment of rheumatism; the dakua (*Dammara Vitiensis*), a pine-tree allied to the New Zealand Kauri, provides a valuable resin resembling the Kaurigum. The yasi or sandalwood (*Santalu, yasi*, Seemann) formerly abundant on the north-west side of Vanua Levu was all but exterminated as a consequence of the too-busy trade carried on in this very valuable commodity between 1804 and 1816; in recent years this tree has been strictly protected by law, but though discovered in other parts of the Fiji neither in these nor in the original locality has it since again become abundant. It was mainly this mad rush for sandalwood which led to the earliest settlement of white men in the Fiji islands.

The fauna is very little different from that of the other comparable south sea islands. Indigenous mammals except bats, and possibly rats, though even these are probably no longer represented by an indigenous species, are non-existent; birds, especially pigeons, doves and parrots, are, or were, fairly numerous; fish of many kinds are plentiful, and, together with vegetables, form the

chief food of the natives; insects are not conspicuously abundant. It has already been told that the remarkable phenomenon of the periodical rise of the annelid known as *balolo* is mainly observable in Fiji.

The natives are undoubtedly of Melanesian stock, but more specialized than the other folk of the same original stock who entered the Pacific by way of the Solomon islands and the New Hebrides; moreover there has been—though probably only in comparatively recent times—some intermixture of Polynesians from the Tonga or Friendly islands, especially in the Eastern or Lau group, and to a less extent in certain districts of both Viti Levu and Vanua Levu. The sea channel, some 200 miles wide, which separates the Fijian from the Tongan group served as a barrier between Melanesia and Polynesia where the two most nearly approached each other. The population in 1921 was 157,266, estimate (1926) 171,644, and the indigenous people (*see* MELANESIA) now form slightly more than half the total, the principal other element being Indian coolies. Among the immigrant elements, who are largely labourers, it is natural that there should be an excess of men, but this excess occurs also among the native folk; it is held by many students that such an excess in an indigenous people is usually a sign of the decline of the race concerned. The transition from traditional to Europeanized life is a most complex one involving myriad crises of adjustment, many unforeseen and almost unforeseeable, and there is besides a heavy toll to be paid by way of deaths from infectious diseases which may not do great harm in Europe but mow down peoples which have not acquired immunity. It is said that the intermingling of indigenous and Indian elements is slight.

For an account of the history of Fiji *see* separate article.

The archipelago is governed under the secretary of State for the British colonies by a governor who is helped by an executive of six members. There is also a legislative council of twelve nominated members (including one Indian), seven members elected by persons of European descent, and two nominated Fijians. There are seventeen provinces under native chiefs advised in some cases by European commissioners. The Wesleyan Methodist Church claims a very large number of members among the native population but there are some Roman Catholics. The Indian element is Mohammedan or Hindu. There are numerous mission schools and government schools. The chief activity is agricultural and the crops grown for export are chiefly copra, sugar and bananas but rice, maize, rubber, tobacco, beans, etc., are also grown, and shells are an object of export trade. There are several sugar mills, copradying establishments and sawmills. Fiji imports manufactured goods, flour, fuel, manures, timber and some of the meat it needs though cattle are kept in fair numbers.

Maritime communications are naturally of special importance in an archipelago but there is a small gauge railway, 120 m. long, from Tavua to Singatoka and motor roads and bridle paths are in use. There is telegraphic and telephonic communication and now also stations for wireless telegraphy. Cables go to Canada, Australia and New Zealand, and steamship communications are chiefly with Vancouver, Sydney and Auckland. The 1925 trade figures were imports, £1,271,135, exports, £2,156,257. The tonnage entered and cleared in 1924 was 799,214, a very large proportion being British. Money weights and measures are all as in the United Kingdom.

The Fourth Arc.—The fourth western Pacific arc comprises the Kermadec islands and the Tonga group.

The Kermadec islands lie about 30° S., and 178° W., and about 600 m. north-north-east of New Zealand. The total area is about 15 sq.m. The largest island of the group is Raoul or Sunday island, 20 m. in circumference and 1,600 ft. high and thickly wooded. Macaulay island is 3 m. in circuit. The flora and fauna are related to those of New Zealand. The islands were named from D'Entrecasteaux's Captain, Huon Kermadec, in 1791. They were annexed by New Zealand in 1887, and are now uninhabited.

The Tongan Archipelago, or as Captain Cook named them "the Friendly islands," consists of at least 100 islands and islets, between parallels 15° and 23½° S., and meridian 173° and 177° W. These islands, lying south-east from the Fijian group, resemble irregularly scattered links of a broken chain, the main axis of which extends for some 175 m. This chain is divisible into three main groups, the Vavau islands the northernmost, the Haapai islands, and the Tongatabu group—with which may be included Eua—the southernmost. The total area of the group is about 385 sq.m. Pop. (1921) 23,759 Tongans, 370 Pacific islanders, 571 Europeans and 235 half-castes.

It was the island of Tongatabu, discovered by Tasman in 1643 and by him named Amsterdam island, which at the beginning of the 19th century became the starting-off point from which the sandalwood traders reached the then still hardly known Fijian islands, a fact to which it is due that the name Tonga (the first syllables of Tongatabu) has passed into use for the whole archipelago—for which the natives themselves seem to have had no one name. (For history of Tonga, *see* separate article.)

Even the main islands of the groups, Tongatabu and Vavau, are small, the former measuring about 25 m. by 10 and nowhere rising to a height of more than 60 ft., and Vavau measuring some 9 m. in length and 6½ in breadth. Vavau, however, has cliffs rising to 600 ft. on its northern sides.

Coral, present throughout the group, is more especially so in some of the smaller islands of the chain, *e.g.,* in the Haapai group; but even here volcanic formation is still very evident, and in some cases still active; Tofua, rising to 2,846 ft., Late, 1,800 ft., and Kao, 3,020 ft. are still active cones.

Most of the Tonga islands, however, are level, averaging 40 ft. high and rising to 600 ft.; their sides are generally steep. The surface is covered with a rich mould unusual in coral islands, mixed towards the sea with sand, and having a substratum of red or blue clay. The soil is thus very productive, although water is scarce and bad. Barrier reefs are rare; fringing reefs are numerous, except on the east side, which is nearly free, and there are many small isolated reefs and volcanic banks among the islands. If the reefs impede navigation, they form some good harbours; the best of these harbours is that of Vavau, the only defect of which is that the entrance is somewhat narrow and tortuous. Fairly good harbourage is also to be found off the north of Tongatabu.

The climate is dry and cool compared with that of Samoa and Fiji. There are frequent alterations of temperature, which averages 75° to 77°, though considerably higher in the wet season. Cool south-east trade winds blow, sometimes with great violence, from April to December. During the rest of the year the winds are from north-west and north, with occasional hurricanes. The average rainfall for the year is about 80 inches. The vegetation is somewhat similar to that of Fiji, but less luxuriant; it was the absence in the Tonga islands of timber trees large enough for the necessary boat-building that led to expeditions by the Polynesian Tongan folk to the distant and almost unknown islands where dwelt the fierce Melanesians of "Viti." Ferns, mosses, orchids, aroids and other plants of moist tropical forests are naturally, also much less abundant in the Tongan than in the Fijian islands. As a consequence of these conditions, the landscape in the Tongan islands is less beautiful than that seen either in the Fijian group to the west or in the Samoan group in the east.

The only indigenous land mammals are a small rat and a large fruit-eating bat, which last named occurs in extraordinary numbers. Birds of prey are very few, but other genera of avifauna are fairly numerous. There are snakes and a few lizards but no frogs or toads. The marine fauna is, as usual in the islands, much more abundantly represented.

Northward and eastward from Vavau are the two very isolated volcanic islands of Niuatombutombu (or Keppel island) and Tafahi (or Boscawen island) which, politically at least, are reckoned as part of the Friendly group. Both, despite their inaccessibility, are inhabited by natives and now by a few Europeans, and from both trade is done in copra derived from the very numerous coco-nut palms.

The islands became a British protectorate under native rule in 1900, and in 1905 the financial administration came under British control. The native sovereign is assisted by a legislative assembly which meets annually. It has 21 members, seven nobles, seven representatives of the people (elected) and the seven minis-

ters of the Crown. The elections are held every three years. The capital of the group is Nukualofa. The natives are Christians and the Wesleyan Free Church of Tonga, the Free Church, and the Roman Catholics claim the majority of the inhabitants. The natives have free education and medical attendance. There were 105 public primary schools in 1924. There is also a Tonga College (161 students in 1924).

Copra is the chief export (13,758 tons in 1925). Imports include flour, timber, sugar, meats, drapery, hardware, foods, etc., while a certain amount of live-stock figures among the exports. Most of the trade is with Britain, Australia, America and New Zealand. There is a wireless station at Nukualofa and a substation at Vavau.

THE ISLAND GROUPS CUTTING THE HAWAII–NEW ZEALAND DEEP

These islands fall into four groups, the Samoan archipelago, the Wallis archipelago and the Tokelau and Phoenix groups.

The Samoan Archipelago, an insular series of much importance, is a chain of many island-groups, the five principal of which, are from west to east, Savaii (area 660 sq.m.); Upolu (area about 575 sq.m.), under New Zealand mandate; and Tutuila (40·2 sq.m.) Manua and Rose I. the property of the United States of America, all lying between lats. 13° 30′–14° 35′ S. and longs. 168° 00′ and 173° W. Pop. New Zealand mandated Samoa (1925) 36,308 natives, 2,498 European and half-castes, Chinese 888, others 535. Total 40,229. American Samoa total area 60 sq.m. Pop. (1926) 8,763. All the main islands except Rose island, which is a coral atoll carrying two islets (uninhabited), are high volcanic islands surrounded by many coral reefs. Volcanic activity though generally quiescent is still liable to outbursts, as for instance in Savaii in 1905 when the lava flowing from a cone in the centre of the island devastated much of the previously fertile soil.

The group is well-watered and the igneous soil generally very fertile, with the result that the vegetation is luxuriant, and the scenery in the valleys running down from the mountains to the sea is very beautiful.

There are fairly good reef-protected harbours at Saluafata and at Apia (both on the N. side of Upolu Island), though it was at Apia, in the hurricane season of March 1889, that a famous tidal-wave destroyed most of the shipping which happened to be lying within the harbour. But the one really good harbour in the group is that at Pango Pango, on the south side of Tutuila—which island, with all others to the east of it, is United States owned.

Climate, Flora and Fauna.—The climate, though moist and sometimes oppressively hot, is pleasant on the whole. The fine season lasts from April to September, the wet from October to March. The temperature is equable—at Apia the mean annual temperature is 78° F, the warmest month being December (80°) and the coldest July (75°–76°). The prevalent winds are south-east trades, but west winds supervene from January to March

The Samoan forests are remarkable for the size and variety of their trees—hardwood trees, useful for boat-building, being especially characteristic of Savaii. The luxuriance and beauty of ferns, creepers and epiphytes is very notable.

Of the very limited land fauna of Samoa, consisting mainly of a rat, a few snakes, and a few birds, the most interesting member of which is a ground pigeon (*Didunculus strigirostris*), which forms a link between the extinct Dodo and the extant African Treroninae. The marine fauna is as abundant and varied as elsewhere in the tropical South Seas.

The Samoans are Polynesians of the purest breed; they indeed dispute with the Hawaiians a claim to be the original Polynesian stock.

The history of Samoa is dealt with in a separate article.

The ex-German Territory of Western Samoa is now (1929) administered by New Zealand under a mandate of the League of Nations, while Eastern Samoa (Tutuila, Manua, etc.) is in the possession of the United States. Administration etc. in this territory is discussed elsewhere.

In Western Samoa there is a legislative council of not less than six official members. Unofficial members must not exceed in number the official members. Three unofficial members are elected members. The administrator is entitled to preside over every meeting of the council. There is a native council which advises the administrator in native affairs. There are four Government schools and also schools conducted by various missions. There are over 11,000 scholars. The inhabitants of the islands profess Christianity (Protestants, Catholics and Mormons). Coco-nut, cacao and bananas are the principal products and copra is the chief article of export. The cultivation of cotton and rubber-tapping has been recommenced (1918–28). In 1925–26 the revenue was £150,038, and the expenditure £145,688. The revenue is augmented by an annual subsidy from New Zealand.

There are high-power wireless stations at Apia (belonging to New Zealand) and on the island of Tutuila (belonging to U.S.A.).

The Wallis Archipelago (Uvea or Uea) is a group situated about 13° S. 176° W. with a land area of 40 sq.m. pop. about 4,500 belonging to France. The principal islands are Uvea, of volcanic formation and surrounded with coral, and Nukuatea. The inhabitants are Polynesians. The islands were discovered by Samuel Wallis in 1767 and came under French missionary influence in 1837 and were subsequently annexed coming under New Caledonia for administrative purposes in 1888. There is a French resident. The trade of the islands is mainly with Samoa, whence cottons and iron goods are imported, and to which copra and roots are exported.

The Horne islands (Futuna and Alofi), south of the Wallis group with about 1,500 inhabitants were discovered by J. Lemaire and W. C. Schouten in 1616 and placed under the French protectorate in 1888. They are administered from New Caledonia.

The Tokelau (*Union Group*), east from the southernmost of the Ellice group, and about 350 m. north-east of Samoa, consists of three atolls, Atafu, Nukunau, and Fakaafo, each of which carries many islets. Little but copra is produced from these.

The area of the group is 7 sq.m. and population (1921) 989. The natives are all Christians and akin in type to the Samoans. These islands were formerly administered as part of the Gilbert and Ellice Is. Colony but were transferred (1926) to the jurisdiction of New Zealand, and are administered by the administrator of Western Samoa.

The Phoenix islands are a group between 2° 30′ and 4° 30′ S. and 171° and 174° 30′ W. They comprise eight small coral islands. Total area of the group 16 sq.m. Pop. 59. With the exception of Sydney and Hull islands they have little vegetation. A considerable amount of guano has been obtained from these islets, but this has now been exhausted. The islands were annexed by Great Britain in 1889–1892.

THE EASTERN POLYNESIAN CHAINS

The first chain. The first eastern Polynesian chain may be taken to include the island of Niue (Savage I) the Cook (Hervey) Is. and Austral (Tubuai) Is.

Niue (*Savage island*) 40 m. in circumference; pop. (1926) 3,795, eastward from the Friendly group, and nearer to that than to any of the other groups, is a dependency of New Zealand since 1900. The whole island (in 19° 10′ S., 169° 47′ W.) is an old coral reef upheaved 200 ft., honey-combed with caves and seamed with fissures, through which the abundant rainfall drains into caverns having communication with the sea. The natives (all Christians) are of mixed Polynesian and Melanesian race, are certainly less cultured than the Tongans or the Samoans, are industrious and friendly, and certainly do not seem to deserve to be regarded as especially "savage."

Niue is administered under the Cook islands and there is a New Zealand resident commissioner stationed on the island. A little copra and fungus is exported.

The Cook (*or Hervey*) *islands* lie between 155° and 160° E. and about 20° S. The group comprises partly volcanic, partly coralline islands the most important of which is Rarotonga, 20 m. in circumference (pop. [1926] 3,906). This island has several cones 300 to 400 ft. high above which towers the Rarotonga vol-

cano (2,920 ft.). The land is fertile and well watered. The other important islands are Mangaia (Mangia) (pop. [1926] 1,249) and Aitutaki, 21 m. in circumference (pop. [1926] 1,431). These islands have luxuriant coco-nut palm groves. The island of Atiu has 933 inhabitants, Mitiero 238, and Mauki (Parry Island) 511. The total land area is about 111 sq.m. The climate is tempered by oceanic influences, but the reefs make the islands difficult of access. The natives are Polynesians possessing legends of their emigration from Samoa. The group was discovered by Captain Cook in 1777. Missionary work has been in progress since 1823, the population being almost entirely Protestant. Since 1890 laws for the islands have been drawn up by a general legislature and administered by an executive council of which *Arikis,* or native chiefs, are members. At Rarotonga there is a New Zealand resident commissioner who has a veto over all laws. In 1915 New Zealand included a minister of the Cook islands, charged with their administration as a member of its own executive council. The new act provided also for the constitution of island councils, courts of justice, and the establishment of public schools.

The chief products of the Cook islands are bananas, oranges, tomatoes, coco-nuts, copra, shells and hats. A wireless station is established at Rarotonga, with other stations at Atiu, Niue, Aitutaki, and Mangaia.

The *Tubuai or Austral is.*, belonging to France are situated between 21° 49′ and 27° 41′ S., and 144° 22′ and 154° 51′ W. The total land area is about 110 sq.m. and about 2,955 inhabitants. They are a scattered group of five principal islands surrounded by fringing coral-reefs, the islet-bearing coral atoll known as Hull or Maria island, and, of more importance, four islands forming a curved broken chain from N.W. to S.E., namely Rimitara, Rurutu, Tubai (area 40 sq.m.), Vavitao, and, at a distance of 380 m. from Tubuai, Rapa or Oparo islands. Tubuai, Vavitao, and Rapa are volcanic and reach considerable elevations (2,077 ft. in Rapa). The islands are well watered and fertile. The natives are Polynesians and were once much more numerous than they now are. Captain Cook visited Rurutu in 1769 and Tubuai in 1777. Rapa was discovered by Vancouver in 1791 and Vavitao at different times. The French protection and subsequent annexation was carried out spasmodically between the middle of the 19th century and 1889. The islands are politically dependent on Tahiti.

The second chain includes the Society islands. The Society archipelago, now commonly called Tahiti, is another group of high volcanic islands—with a few coral atolls—lying between 16° and 18° S., 148° and 155° W. with a total area of 657 sq.m. belonging to France. The "Society islands" is a double group, separated by a clear channel of 60 m. in breadth; the north-west or Leeward group including the islands of Huaheine, Raiatea and others, and the south-east or Windward group containing the famous island of Tahiti (600 sq.m.). Pop. (1924) 7,145—on which is Papeete (pop. [1924] 4,601, of whom 2,126 are French) the capital of the French possessions in those parts—and a few small islands.

The island of Moorea (50 sq.m.), pop. (1924) 1,927, is important.

The island of Tahiti itself, in shape not unlike the figure 8, has a length of 33 m., a coast-line of 120 m., and an area of 402 sq.m. It is divided into two portions by a short isthmus (Taravo) about a mile in width, and nowhere more than 50 ft above sea-level. The southern, the peninsula of Taiarapu, or Tahiti-iti (Little Tahiti), measures 11 m. in length by 6 m. in breadth, while the northern, the circular main island of Porionuu, or Tahiti-uni (Great Tahiti), has a length of 22 m. and a breadth of 20. The whole island is mountainous. A little to the north-west of Great Tahiti the double peak of Orohena rises to 7,321 ft. and the neighbouring Aorai is but little lower. Little Tahiti has no such elevation, but its tower-like peaks are very striking. The flat lands of the Tahitian coast, several miles wide—with its chain of villages, its fertile gardens, and its belt of palms, here and there intersected by streams from the mountains form a striking foreground to the grand mountain ranges. A good road now runs round the island, leading to Point Venus, the site in 1769 of Capt. Cook's observation of the transit of Venus.

Climate.—The seasons are not well defined. Damp is excessive, and the heat generally great, but the climate, on the whole, is not unhealthy.

The indigenous mammalian fauna is as scanty as in the other South Sea islands; of domestic animals, pigs of a small breed which died out on the introduction of stronger European strains—and, though this is more doubtful, dogs are said to have been plentiful when Capt. Wallis, as he supposed, "discovered" the island in 1767. Land birds are few in number and species as compared with those of the western Pacific islands. The lagoons swarm with fish of many species. Insects are poor in species though some of them are indigenous. Crustaceans and molluscs, on the other hand, are well represented; worms, echinoderms, and corals comparatively poorly. The most interesting feature of Tahitian conchology is the number of peculiar species of the genus *Partula,* almost every valley having a distinct form.

The Tahitian flora though luxuriant and beautiful is not very rich, especially in the smaller plants which form the undergrowth in similar islands. Especially remarkable are many indigenous species of banana, one form of which (peculiar in that its fruit-bunches are not pendent but grow upright) is abundant in the mountains, and formerly much used by the natives as food.

Part of the archipelago was discovered by Pedro F. Quiros in 1607. In 1767 Wallis named it King George's island. In 1768 de Bougainville visited Tahiti, claimed it as French, and named it La Nouvelle Cythère. In 1769 Cook named the Leeward group the Society islands in honour of the Royal Society, at whose instigation his expedition had been sent. Tahiti and the adjacent islands he called Georgian, but the first name was subsequently adopted for the whole group.

In 1903 it was decided that separate islands or groups should no longer be regarded as distinct establishments, but that all should be united into one colony. Thus the Society islands are joined for administrative purposes with the other French possessions in the eastern Pacific, the whole being administered by a governor with an administrative council consisting of certain officials, the *maire* of Papeete and the presidents of the chambers of commerce and agriculture. At Papeete there are a higher primary school, and a normal school and there were (1925) 63 primary schools. The chief industries on Tahiti are the preparation of copra, sugar and rum. Imports (1925) 43,966,400 francs, exports 50,550,511 francs. The imports include wheat, and metalwork, and the exports copra, mother-of-pearl, vanilla, coco-nuts and particularly phosphates (81,062 tons in 1925).

The third eastern Polynesian chain may be taken to include the Manihiki islands, the Tuamotu or Low Archipelago and Pitcairn island.

The Manihiki Archipelago is situated between 4° and 11° and 150° and 162° W. Manihiki (Humphrey island) itself an islet with a land area of about two square miles, pop. (1926) 416, encircling a lagoon of about 6 miles in diameter. Its shallow soil, nowhere raised much above sea-level, supports many tall coconut palms which serve to make the islet visible from a distance generally of about 12 m. The native population feed chiefly on coco-nuts and fish, and now have little for export except copra—though formerly pearl-shell, now practically exhausted, was dredged from the lagoon.

Almost directly east from Manihiki is a group of low coral islands of which the Caroline atoll, carrying many islets on a rim of coral surrounding a lagoon (some 7½ by 1½ miles) is a type; the other members of the group being Vostock and Flint islands. The natives of the group are Polynesians and nominally Christian. The islands were mostly discovered in the 19th century and were annexed by Great Britain mainly in 1888–1889. They are now administered by New Zealand.

The *Tuamotu* (*Paumotu*) *or Low Archipelago,* the northern extremity of which is situated between the Society and the Marquesas islands, consists of a great number of low coral islands, or rather atolls, of very similar character and appearance, trending in irregular lines from north-west to south-east, the major axis of the group extending over 1,300 miles. The total land area of the group is only 330 sq.m. Pop. (1924) 3,715. The largest

atoll, Rahiroa or Rangiroa, with a lagoon 45 m. long by 15 wide, carries 20 islets on its narrow rim; Fakarava, the next in size, carries 15 islets, and its oblong lagoon affords the best anchorage in the group. Hao (Harpe or Bow) atoll, 30 m. long with a width varying from 5 to 9 m., has some fifty islets around its lagoon —which is dangerously studded with coral heads. Anaa, or "Chain island" as Capt. Cook named it, 19 m. long with an average width of 6 miles, is remarkable in that it has, or recently had, a continuous growth of coco-nut palms along its entire rim, whereas when Capt. Cook visited it in 1769 the line of palms was so interrupted as to seem to grow from a number of regularly placed distinct islets—hence the name "Chain island"—this effect doubtless being due to the breaking of the line of trees by the great winds occasional in these parts.

The almost innumerable Tuamotu islands differ in character very little—except in size; with two exceptions, Tikei and Makatea, all are low coral atolls with but little natural vegetation except coco-nut palms and, occasionally a scanty undergrowth, chiefly screw-pines (Pandanus). The climate is healthy—with a lower mean temperature than Tahiti. The easterly trade wind prevails. Rain and fogs occur even during the dry season. The stormy season lasts from November to March, when devastating hurricanes are not uncommon, and a south-west swell renders the westerly shores dangerous. Animal life is scarce, a few rats are the only mammals; land birds are chiefly parakeets, thrushes and doves; insects are few. But marine life abounds in the lagoons and the surrounding seas; pearls and pearl-shell, abundant in many of the lagoons, provide the natives with their chief object of industry and trade. The natives are not numerous but are a fine strong race of Polynesians.

The first discovery of part of the archipelago was made by Pedro Fernandez Quiros in 1606. Many navigators subsequently discovered or re-discovered various parts of the group. The best harbour is Fakarava, the seat also of the French resident. Another harbour is Mangareva. The group passed under the protection of France in 1844, and was annexed in 1881 forming part of the dependency of Tahiti, and now administered jointly with other French possessions in the Eastern Pacific.

Pitcairn island (lat. 45° 4′ S., and long. 130° 19′ W.) is about 100 m. south from the nearest of the Tuamotu group, differs from most of the islands in this region in that it is without coral reefs but rises abruptly with steep and rugged basaltic cliffs. The highest point of the island is 2,000 ft., and its area is 2 sq m. Pop. (1914) 140. The soil in the islands is volcanic and fertile; but owing to the felling of the natural timber the liability to drought increases, as there are no streams. The climate is variable and rainy. It was discovered, uninhabited, by Carteret in 1767. Pitcairn was the name of the midshipman who first observed it. The present population are the descendants of the mutineers of the "Bounty" who occupied the island, which they found uninhabited in 1790, bringing with them from Tahiti six Polynesian men and twelve women; but it must be recorded that the finding by these new-comers of stone implements, rock-carvings, and other traces of humanity makes it certain that there had been previous inhabitants, or at least visitors, at some former time.

In religion the islanders are "Seventh Day Adventists." The island is a British colony and is administered by a council of seven members with a president (also chief magistrate), and a vice president (also Government secretary), subject to the control of the high commissioner for the Western Pacific since 1898. The island grows coffee, and has poultry and goats. The products include beans, sugar-cane, yams, taro, melons, sweet potatoes, oranges, pine-apples, bananas, arrowroot and other fruits and vegetables.

THE OUTLYING GROUPS

Within this section fall the Marquesas islands, Palmyra, Washington, Fanning and Christmas islands, the Hawaii islands, Easter island, Sala-y-Gomez, etc.

The *Marquesas Archipelago,* east from Caroline atoll, consists of two somewhat distinct groups of high volcanic islands, peculiar in the comparative rarity of coral fringes to their coasts. Total area 480 sq.m. Pop. (1924) 2,300. The north-western group has seven islands, the four largest being Ua Pou or Adam island, Ua Huka or Washington, Nukuhiva (70 m. in circumference, and the most important of the whole archipelago) and Eiao. The south-eastern group consists of the islands of Fatu Hiva or Magdalena, Motane or San Pedro, Tahuata or Santa Christina, and Hiva Oa or Dominica, the last with a coast-line of more than 60 m.

Along the centre of each of the main islands is a ridge of mountains, rising to between 3,000 and 4,000 ft., from which rugged spurs forming deep valleys stretch toward the sea. There are no active volcanoes. Vegetation is luxuriant in the valleys, which are well watered by streams. The flora is abundant, many of the species identical with those of the Society islands, but more indigenous land mammalian fauna is remarkably poor. Land birds are of comparatively few species. On the other hand, marine forms of animal life are as abundant as around other sub-tropical Polynesian groups. The climate is hot and damp but not unhealthy; the temperature during the six months' rainy season, which begins at the end of November, varies between 84° and 91°, and during the rest of the year between 77° and 86°. It is tempered by moderate easterly trade winds, and in the larger islands by the alternation of land and sea breezes. The natives, purely Polynesians, are reputed to be physically the finest of the South Sea islanders, and at the incoming of Europeans were numerous, warlike and active, but have since very greatly diminished in number and energy.

The islands were discovered in 1595 by Mendana who only knew the south-eastern group. The remaining islands were discovered from time to time subsequently. In 1842, after French Roman Catholic missionaries had prepared the way, the islands were annexed by France. The islands were almost abandoned between 1860–1870. They are now administered together with the other French possessions in the Eastern Pacific from Tahiti. The natives have outwardly adopted Christianity. Large numbers of swine and fowls are reared.

The Line islands (or America islands) north of the Equator, sometimes called Palmyra, Washington and Fanning, and Christmas islands, are low atolls which would hardly be distinguishable from a distance but for their tall coco-nut palms. Palmyra (1½ sq.m.), uninhabited but occasionally visited for the gathering of the coco-nut crop, the smallest, is remarkable in that it has three distinct lagoons. Washington (3½ by 1¼ miles), pop. 60, and Fanning (9½ by 4 miles), pop. (1926) 447, are of much greater importance, both having for many years been more or less successfully cultivated by Europeans employing labour imported from the Gilbert islands. Fanning, since 1902, has been a Pacific Cable Board station, with a large staff of employees. Christmas island (40 m. long, with an average width of 35 m.), pop. (1922) Europeans 4, Tahitians 28, the largest atoll in the Pacific, has been the scene of several attempts at coco-nut cultivation. It was discovered by Captain Cook in 1777 and annexed by Britain in 1888 and included in the Gilbert and Ellice Islands Colony in 1919. It was leased to the Central Coco-nut Plantations Ltd., for 87 years in 1914. South of the Equator the northernmost of the Line islands is Jarvis island (area 1½ sq.m., pop. 30), a small treeless and almost grassless islet, which has obviously been elevated some 10 or 12 ft. above sea-level; it has, or had, considerable deposits of guano. South-east from Jarvis island, a chain of more or less similar islets, the principal of which are Malden (35 sq.m.), Starbuck (1 sq.m.), extends—but at considerable distances from each other Caroline, Vostok and Flint atolls. All these islands belong to Britain, Fanning, Washington and Christmas islands being a part of the Gilbert and Ellice Islands Colony. Adjacent to Pitcairn island there are small uninhabited islands, namely Oeno and Ducie atolls, and Henderson, or Elizabeth island, which last named is remarkable as being an eighty feet high flat-topped island which appears to have been raised by some subterranean convulsion.

The Hawaiian group (Sandwich islands) are treated in a separate article. The remaining outlying Pacific islands, *e.g.,* Easter island, Sala-y-Gomez and the Galapagos islands are also treated elsewhere.

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PACIFICO, DON or **DAVID PACIFICO** (1784–1854). A Portuguese Jew born a British subject in Gibraltar who brought an action against the Hellenic Government claiming £26,000 compensation for his house in Athens burnt down in 1847 in an anti-Semitic riot. Pacifico finally received compensation.

PACIFIC OCEAN, the largest division of the hydrosphere, lying between Asia and Australia and North and South America. It is nearly landlocked to the north, communicating with the Arctic ocean only by Bering strait, which is 65 km. wide and of small depth. The southern boundary was sometimes regarded as the parallel of 66½° S., but this limit is artificial, and it is now considered that the Pacific extends to the borders of the Antarctic continent, exactly as the Atlantic and Indian oceans do. As east and west boundaries in the higher southern latitudes one may take the meridians passing through South cape in Tasmania and Cape Horn. The north to south distance from Bering strait to Antarctica, near Cape Adare, is 15,500 km. or 8,350 nautical miles, and the Pacific attains its greatest breadth between Panama and Mindanao (Philippine Isl.), when it measures 17,200 km. or 9,300 nautical miles. The distance between Yokohama (Japan) and San Francisco is about half as great again as that from New York to Southampton; similarly the distance between Sydney and Cape Horn is greater than that from Buenos Aires to Cape Town by fully a half. The coasts of the Pacific are of varied contour. The American coasts are for the most part mountainous and unbroken, the chief indentation being the Gulf of California; but the general type is departed from in the extreme north and south, the southern coast of South America consisting of bays and fjords with scattered islands, while the coast of Alaska is similarly broken in the south and becomes low and swampy towards the north. The coast of Australia is high and unbroken; there are no inlets of considerable size, although the small openings include some of the finest harbours in the world, as Moreton bay and Port Jackson. The Asiatic coasts are for the most part low and irregular and a number of seas are more or less completely enclosed and cut off from communication with the open ocean. Bering sea is bounded by the Alaskan peninsula and the chain of the Aleutian islands; the Sea of Okhotsk is enclosed by the peninsula of Kamchatka and the Kurile islands; the Sea of Japan is shut off by Sakhalin island, the Japanese islands and the peninsula of Korea; the Yellow sea is an opening between the coast of China and Korea; the China sea lies between the Asiatic continent and the island of Formosa; the Philippine group, Palawan and Borneo. Amongst the islands of Malay archipelago are a number of enclosed areas —the Sulu, Celebes, Java, Banda and Arafura seas.

The question as to where within the Malay archipelago the limit between the Indian and Pacific oceans is to be drawn, is as difficult to answer as the question of the natural boundary between Further India and Australia. Wallace placed the latter in the Macassar strait, so that Borneo would belong to the Indian province, and Celebes to the Australian. So far as we know to-day we must argue, from oceanographic considerations, *e.g.*, the configuration of the sea floor, the properties of the water, etc., that the deep basins of the Sulu sea, Celebes sea, Flores sea, Savu sea and Banda sea, belong to the Pacific, while the shallow Java sea and the South China sea are part of the Indian ocean.

The Pacific was first scientifically explored by the great English Deep-Sea Expedition of H.M.S. "Challenger" (1872–76) and then by the German expedition of S.M.S. "Gazelle" (1874–76), by the two United States ships "Tuscarora" (1874–76, 1878–79) and "Albatross" (1888, 1890–92, 1899–1900, 1904–05), by the Russian warship "Vitiaz" (1887), by S.M.S. "Planet" (1906–14) and others. For many important soundings in the south-west Pacific we are indebted to H.M S. "Penguin" and many British cable ships; in high southern latitudes the "Discovery" (1901–04) carried out many observations. Lately many oceanographical enterprises have been prosecuted by the Japanese navy, as well as from the U.S. oceanographical station at San Diego (California).

Extent.—The area and volume of the Pacific ocean and its seas, with the mean depths calculated therefrom, are given in the article *Ocean*. The Pacific ocean has double the area of the Atlantic—the next largest division of the hydrosphere—and has more than double its volume of water. Its area is as much as the area of Africa, greater than the whole land surface of the globe, Antarctica included. The total land area draining to the Pacific is estimated by Murray at 19,400,000 sq.km., or little more than one-fourth of the area draining to the Atlantic. The American rivers draining to the Pacific, except the Yukon, Columbia and Colorado, are unimportant. The chief Asiatic rivers are the Amur, the Hwang-ho and the Yangtsze-kiang, none of which enters the open Pacific directly. Hence the proportion of purely oceanic area to the total area is greater in the Pacific than in the Atlantic.

Relief of Bed.—The bed of the Pacific is not naturally divided into physical regions, but for descriptive purposes the parts of the area lying east and west of 150° W. are conveniently dealt with separately. The eastern region is characterized by great uniformity of depth; the 4,000 metres line keeps close to the American coast except off the Isthmus of Panama, whence an ill-defined ridge of less than 4,000 metres runs, including the Galapagos islands, south-westwards, and again off the coast of South America in about 40° S., where a similar bank runs west and unites with the former. The bank then continues south to the Antarctic ocean, in about 110° W. Practically the whole of the north-east Pacific is therefore more than 4,000 metres deep, and the south-east has two roughly triangular spaces, including the greater part of the area, with depths of more than 4,000 metres. Notwithstanding this great average depth, the "deeps" or "trenches," deeper than 5,000 metres, which are so characteristic of the western Pacific, are small in number and extent in the eastern half along the west coasts of North and South America. Four small deeps are recognized along a line close to the coast of South America, and parallel to it, in the depression enclosed by the two banks mentioned; *i.e.*, along the coast of Chile and Peru between 35° and 10° S. The first deep (5,667 metres) lies with its centre off Valparaiso; the second and deepest (7,635 metres) has its centre off Taltal, and is called the Atacama trench; the third (6,867 metres) lies in the angle of the coast between Iquique and Mollendo; the fourth (5,868 metres) in front of Callao. All four deeps have their greatest depth between 100 and 400 km. from the coast.

The largest gulf on the north-west coast, off Puget sound and British Columbia, even at a great distance from land, reaches only the relatively small depth of less than 3,000 metres. East of 150° W. the Pacific has few islands; the oceanic islands are

volcanic, and coral formations are, of course, scanty. The most important group is the Galapagos islands. On the other hand in the western Pacific we have numberless great and small islands and island groups. They are sometimes set out in regular chains, at other times spread out irregularly over great areas. To the first type, in the north, belong the Aleutians, the Kuriles, the Japanese islands, the Riu-Kiu islands, the Philippines, and parallel to them the Pelew islands, the Yap group, the Bonin and Marianne group; in the Southern Hemisphere, the Solomon islands, the New Hebrides, New Caledonia and New Zealand. New Zealand morphologically is related northward to the Kermadec and Tonga islands, and southward through the Auckland islands to Macquarie island (550° S.). On the outside of nearly all these island chains are observed very deep, and sometimes fairly wide, trenches, in which depths of over 8,000, even over 10,000 metres, have been registered. This is the most important characteristic of the configuration of the Pacific floor; no other ocean has anything like it. The greatest deeps are the Aleutian trench (7,382 metres), the Kurile-Japanese trench (8,514 metres), the Philippine trench, eastward of north Mindanao in lat. 9° 42′ N. and long. 126° 51′ E., only 75 km. from the coast where in 1927 the German cruiser "Emden" measured the greatest of all sea depths, viz., 10,800 metres. In the same latitudes three other trenches are known, east of the Palau islands, east of Yap and south-east of Guam and the Marianne islands, where the United States telegraph ship "Nero" found a depth of 9,685 metres.

In the Southern Hemisphere between New Guinea and the Solomon islands is the Bougainville trench (9,140 metres). The New Caledonian trench has a depth of 7,570 metres. Finally, H.M.S. "Penguin" explored the Kermadec-Tonga trench which lies outside; *i.e.*, eastward of these groups between 36° S. and 16° S. and includes depths attaining 9,412 metres. The area of these long, deep regions is always small; these deeps lie parallel to the coasts of the present continents or to the coasts of earlier continents. In earlier geological epochs, for example, a continent may have extended eastward from New Guinea to the Tonga islands and New Zealand, and perhaps north to the Mariannes. It is certain that in these trenches, which lie in front of the fold mountains of eastern Asia, is to be sought a centre of great tectonic disturbances; just as the west coast of South America is afflicted by terrible earthquakes, whose epicentre lies in the trenches off Chile and Peru. The immense stretches of the west Pacific contain, besides these regular island groups and deeps, many irregularly strewn islands; *e.g.*, the Hawaii islands, the Carolines, the Gilbert islands, the Samoa archipelago, the Taumotu archipelago, etc. Most have volcanic cores; in low latitudes these islands are surrounded with coral reefs, or it may be that the reefs alone appear as atolls. In the great areas between these groups the sea floor sinks to depths exceeding 4,000 metres, sometimes even exceeding 6,000 metres. Thus the Pacific has an average depth of 4,028 metres; this average is greater than in any other ocean, the figure for the Atlantic being 3,332 metres. The following table showing the area of the floor at various depths for the Pacific is the work of Kossinna (1921):—

Metres	Areas	
	Sq. kilometres	%
0–200	10,207,600	5·7
200–1,000	5,627,100	3·1
1,000–2,000	7,018,400	3·9
2,000–3,000	9,384,000	5·2
3,000–4,000	33,248,100	18·5
4,000–5,000	63,074,200	35·2
5,000–6,000	47,727,700	26·6
6,000–7,000	2,957,800	1·6
7,000–8,000	302,000	
8,000–9,000	114,200	0·2
9,000+	17,900	
Total	179,679,000	100

Deposits.—The deeper parts of the bed of the Pacific are covered by deposits of red clay (*see* OCEAN), which occupies an area estimated at no less than 105,672,000 sq.km., or three-fifths of the whole. Over a large part of the central Pacific, far removed from any possible land influences or deposits of ooze, the red clay region is characterized by the occurrence of manganese, which gives the clay a chocolate colour, and manganese nodules are found in vast numbers, along with sharks' teeth and the ear-bones and other bones of whales. Radiolarian ooze is found in the central Pacific in a region between 15° N. to 10° S. and 140° E. to 150° W., occurring in seven distinct localities and covering an area of about 3,000,000 sq.km.; further, a wider strip of radiolarian ooze was discovered by the "Challenger" and the "Albatross," between 7° and 12° N. lat., stretching from 140° W. long. to the neighbourhood of the west coast of Central America, bringing the total area of the radiolarian ooze in the Pacific to about 10,000,000 sq. kilometres. Between these two areas, almost on the Equator, a strip of globigerina ooze was found corresponding to the zone of globigerina in the equatorial region of the Atlantic. Globigerina ooze covers considerable areas in the intermediate depths of the west and south Pacific—west of New Zealand, and along the parallel of 40° S., between 80°–98° W. and 150°–118° W.—but this deposit is not known in the north-eastern part of the basin. The total area covered by it is estimated at 30,000,000 sq.km.—about two-thirds of that in the Atlantic. Pteropod ooze occurs only in the neighbourhood of Fiji and other islands of the western Pacific, passing up into fine coral sands and mud. Diatom ooze has been found in a broad band between 57° and 67° S. lat., and thus in the Antarctic part of the Pacific, corresponding with its occurrence in the same latitudes in the Atlantic and Indian oceans.

Meteorology.—Partly on account of its great extent, and partly because there is no wide opening to the Arctic regions, the normal wind circulation is on the whole less modified in the north Pacific than in the Atlantic, except in the west, where the south-west monsoon of southern Asia controls the prevailing winds, its influence extending eastwards to 145° E., near the Ladrones, and southwards to the Equator. In the south Pacific, during the winter months of the Northern Hemisphere, the north-west monsoon of Australia affects a belt running east of New Guinea to the Solomon islands. In the east the north-east trade-belt extends between 5° and 25° N., the south-east trade crosses the Equator, and its mean southern limit is 25° S. The trade-winds are generally weaker and less persistent in the Pacific than in the Atlantic, and the intervening belt of equatorial calms is broader. Except in the east of the Pacific, the south-east trade is only fully developed during the southern winter; at other seasons the regular trade-belt is cut across from north-west to south-east by a band 20°–30° wide, in which the trades alternate with winds from north-east and north, and with calms, the calms prevailing chiefly at the boundary of the monsoon region (5° N.–15° S., 160°–185° E.). This area, in which the south-east trade is interrupted, includes the Fiji, Navigator and Society groups, and the Paumotus. In the Marquesas group the trade-wind is fairly constant.

The great warming and abundant rainfall of the island regions of the western south Pacific, and the low temperature of the surface water in the east, cause a displacement of the southern tropical maximum of pressure to the east; hence we have a permanent "south Pacific anti-cyclone" close to the coast of South America. The characteristic feature of the south-western Pacific is therefore the relatively low pressure and the existence of a true monsoon region in the middle of the trade-wind belt. It is to be noted that the climate of the islands of the Pacific becomes more and more healthy the farther they are from the monsoon region. The island regions of the Pacific are everywhere characterized by uniform high air-temperatures; the mean annual range varies from 1° to 9° F, and the diurnal range from 9° to 16°. In the monsoon region relative humidity is high, viz., 80 to 90%. The rainfall is abundant; in the western island groups there is no well-marked rainy season, but over the whole region the greater part of the rainfall takes place during the southern summer, even as far north as Hawaii.

The whole north Pacific from the tropic to the Bering sea has on its Asiatic side a monsoonal reversal of its prevailing winds.

winter and summer. In winter exceedingly dry and cold north-westerly winds, dependent on an air pressure maximum over Siberia and an air pressure minimum near the Aleutians, blow over the whole area; in summer, with low pressure over the Asiatic continent, warm and rainy south and south-easterly winds (in connection with the south-west monsoon of the China sea) prevail over the whole area of the Yellow sea, Japan sea, Okhotsk sea and Bering sea. On the American side of the Pacific this complete change of wind direction is absent, and throughout the year moist, warm winds from the ocean; *i.e.*, south-westerlies, prevail from Sitka to Vancouver, except for irregular changes in consequence of the passing of atmospheric depressions. These circumstances explain the great differences shown in the following table between the average air temperatures on the Australo-Asiatic side of the Pacific and on the American:—

Air Temperature (° F) and Rainfall (mm.) in the Pacific

Place	Lat.	Feb.	May	Aug.	Nov.	Year	Amplitude	Rain
Ajan, Sea of Okhotsk	56° N.	0·0	35·4	55·0	14·4	27·0	57·2	1,118
Sitka, U.S.A.	56° N.	32·5	44·1	54·9	36·7	42·5	22·4	2,070
Yokohama, Japan .	36° N.	40·8	63·3	78·1	51·3	57·7	38·2	1,476
San Francisco, U.S.A. .	36° N.	52·5	54·1	58·6	56·1	55·2	10·8	594
Sydney, Australia . .	34° S.	70·5	58·5	54·5	66·4	62·8	19·1	1,265
Valparaiso, Chile . .	34° S.	63·1	55·6	52·5	59·0	57·7	10·6	355

Temperature.—The distribution of temperature in the waters of the Pacific ocean has been fully investigated, so far as is possible with the existing observations, by G. Schott. At the surface an extensive area of maximum temperature (over 82° F) occurs over 10° on each side of the Equator to the west of the ocean. On the eastern side temperature falls to 72° F on the Equator and is slightly higher to north and south. In the north Pacific, beyond lat. 40°, the surface is generally warmer on the east than on the west, but this condition is, on the whole, reversed in corresponding southern latitudes. In the intermediate levels, down to depths not exceeding 1,000 metres, a remarkable distribution appears. A narrow strip of cold water runs between the Equator and 10° N., widest to the east and narrowing westward, and separates two areas of maximum which have their greatest intensity in the western part of the ocean and have their central portions in higher latitudes as depth increases, apparently tending constantly to a position in about latitude 20° to 30° N. and S. A comparison of this distribution with that of atmospheric pressure is of great interest. High temperature in the depth may be taken to mean descending water, just as high atmospheric pressure means descending air; low temperature in the depth may be taken to mean ascending water, as low pressure means ascending air, and hence it would seem that the slow vertical movement of water in the Pacific reproduces to some extent the phenomena of the "doldrums" and "horse latitudes." The isothermal lines, in fact, suggest that in the vast area of the Pacific something corresponding to a "planetary circulation" is established. In the greater depths of more than 2,000 metres, temperature is extraordinarily uniform, 80% of the existing observations falling within the limits of 34·8 and 35·5. In the enclosed seas of the western Pacific, temperature usually falls till a depth corresponding to that of the summit of the barriers which isolate them from the open ocean is reached, and below that point temperature is uniform to the bottom. In the Sulu sea, for example, a temperature of 50·4° F is reached at 700 metres, and this remains constant to the bottom in 4,660 metres.

Salinity.—The surface waters of the whole Pacific have less salt than those in the corresponding regions of the Atlantic. For example, the salt content west of San Francisco is 33·2‰, but west of Lisbon over 36‰; in the north-east trade region of the Pacific it measures only about 35‰, whereas, in the region of the Atlantic north-east trades, it is over 36‰ or 37‰. The reason for this is not yet known with certainty; probably evaporation is less than in the Pacific because of the smaller velocity of the wind, and the rainfall is greater than in the Atlantic. The geographical disposition of the varying salt content is essentially the same in the Pacific as in the Atlantic and Indian oceans. In each hemisphere, in the region of the north-east and south-east trade-winds, appears a broad zone with relatively the highest salt content. In northern latitudes its centre lies in the middle of the ocean; in southern latitudes it is in the eastern or South American half. Between these, mostly from 5°–10° N. lat., is a small strip of water poor in salt, stretching from the Philippines to the coast of Central America; here the salt content amounts to less than 34‰ in the west, less than 33‰ in the east, where, in the Gulf of Panama, 31‰ or even 30‰ have been observed. North and south also from the two first-named tropical maxima the salt content diminishes, particularly in the north Pacific. In the ocean off the Japanese islands, in spite of a warm current resembling the Gulf Stream, the salt content is only 34·5‰ or 34‰, almost 2‰ less than in the Atlantic. The Okhotsk and Bering seas, which perhaps can be compared with Baffin bay and the Norway sea, have 32–31‰, a salt content 2–3‰ less than the Atlantic regions named.

The distribution of saltness in the depths of the Pacific ocean is not yet sufficiently known, but it seems to correspond in the main with that ascertained for the Atlantic (*q.v.*).

Circulation.—The surface currents of the Pacific have not been studied in the same detail as those of the Atlantic, and their seasonal variations are little known except in the monsoon regions. Speaking generally, however, it may be said that they are for the most part under the direct control of the prevailing winds. The North Equatorial current is due to the action of the north-east trades. It splits into two parts east of the Philippines, one division flowing northwards as the Kuro Siwo or Black Stream, the analogue of the Gulf Stream, to feed a drift circulation which follows the winds of the north Pacific, and finally forms the Californian current flowing south-eastwards along the American coast. Part of this rejoins the North Equatorial current, and part probably forms the variable Mexican current, which follows the coasts of Mexico and California close to the land. The Equatorial Counter-current flowing eastwards is largely assisted during the latter half of the year by the south-west monsoon, and from July to October the south-west winds prevailing east of 150° E. further strengthen the current, but later in the year the easterly winds weaken or even destroy it. Between the Kuro Siwo and the Asiatic coast; *i.e.*, east of the Kuriles and Kamchatka, a band of cold water with a slight movement to the southward, known as the Oya Siwo, forms an analogue of the "cold wall" of the Atlantic. In the Japan sea, too, on the Siberian coast, as well as in the Yellow sea on the Chinese coast, there flows southward, during the greater part of the year, cold water poor in salt. This current is easily recognized from its green colour in the Straits of Formosa as far as Hong Kong. In the Southern Hemisphere the South Equatorial current is produced by the south-east trades, and is much more vigorous than its northern counterpart. On reaching the western Pacific, part of this current passes southwards, east of New Zealand, and again east of Australia, as the east Australian current parts northwards to join the Equatorial Counter-current. In the higher latitudes of the south Pacific the surface movement forms part of the west wind-drift of the Roaring Forties.

The cold water of this stream, with contributions from the depths, on the coasts of Chile and Peru, gives rise to the scantiness of the rain in this region as far northward as Callao and Payta, an effect analogous to that of the Benguela current along the coast of South-west Africa. Sometimes it appears that this Peruvian current in the northern part is hemmed in by the warmer water of the "El niño" current, which spreads southward from the coast of Colombia and Ecuador. This has disastrous consequences for the animal world: the guano-birds and the fish die. It also has fatal effects on the coast regions, for the rain associated with the warm current entails great economic injury on

this erstwhile desert-like region. Such a catastrophe occurred last in Peru between January and March 1925.

See *Reports* of expeditions of the U.S.S. "Albatross" and "Thetis" (1888–92); A. Agassiz, *Expedition to the Tropical Pacific* (1899–1900, 1904–05); H.M.S. "Challenger" (1873–76); "Egeria" (1888–89 and 1899); "Elisabeth" (1877); "Gazelle" (1875–76); "Planet" (1906); "Penguin" (1891–1903); "Tuscarora" (1873–74); "Vettor Pisani" (1884); "Vitiaz" (1887–88); also observations of surveying and cable ships, and special papers in the *Annalen der Hydrographie;* for distribution of temperature and for currents *see* H. Thorade, p. 17 (1909); G. Schott, p. 2 (1910); B. Schulz, p. 177 (1911); F. Zorck, p. 166 (1928); for salinity *see* G. Schott, p. 148 (1928) and in the Archiv der Seewarte (G. Schott, 1891; C. Puls, 1895).

PACIFIC OCEAN QUESTIONS. The huge expanse of the Pacific, covering half the globe, has obstructed human migration and intercourse till recent times. There was only one way of reaching America from Asia, and that was over Behring's Straits, a shallow connection between the Arctic and the Pacific, 36 m. broad. It was doubtless across this gap that the New World was peopled. The Kuro Siwo or tropical current which runs north along the East Coast of Japan and when it reaches its northern limit bends south-east along the American Coast may have carried craft on to a shore far from home, and thus Japanese or Chinese junks may have been borne on to the islands on the north-west coast of America or even on to the continent itself. There is a zone of westerly winds that might assist seacraft from Asia to America, but the equatorial zone of calms and variable winds makes migration or even drift across the broadest part of the ocean improbable. The southern zone of westerlies, commonly called "the roaring forties" lying between 40 and 60 degrees south is the only one that could give easy passage from west to east such as a migration or trade route demands; but the landless character of the Pacific there makes it improbable, especially as an unmaritime people occupied Australia, and New Zealand was uninhabited till the daring sailors of Polynesia reached it. After that time Maori canoes seem to have come as far east as the South American coast as evidenced by the likeness of the Araucanian stone axe to the Polynesian, and especially the identity of the name for it in both regions (*toki*), the identity of a polished war-club with cutting edges and wristcord found early last century in a grave in Ecuador with the Maori *mere*, the use of the earth-oven and of an intoxicating drink made by chewing the root of a plant in ancient Chile, and especially the identity of the Araucanian name of this last (*cawau*) with that of the similarly brewed Polynesian drink (*kawa*).

Problem of Polynesia.—By far the most difficult of Pacific questions is that of the peopling of the far-spread groups of the centre and east of the Ocean. The voyagers of the 18th century observed the identity of the people who occupied the widely-divided islands of this vast region in customs, language and physique, and called them the Polynesians, or people of the many islands. And when they went away west through Melanesia, Papuasia and Indonesia and found that most of the languages they encountered had a proportion of their vocabulary manifestly related to, if not identical with, Polynesian words, and the numerals the same all through, they assumed that the language was one and the same, and called it Malayo-Polynesian. The further conclusion that it indicated the same race was too manifestly in conflict with the pronounced racial differences to be long held. That there is a negroid element in the physique of many Polynesians is undenied, but how it came into the Pacific is one of its difficult questions; for the universal custom in Polynesia of massaging the nose of the baby as soon as it is born, into the flat, negroid form, is meant to add to the beauty of the face, and that idea of beauty could not have arisen if there was an aboriginal negroid race in the islands, which the newcomers subdued. The ethnologist must rely on other features of the physique; and there are plenty to distinguish this people from those to the west of them.

The Age of Steam.—It was the age of steam that brought the Pacific ocean into world history and made Pacific questions urgent. The era that was to bring the two great cultured racial sections of mankind into closer contact and to make the great ocean fulfill its destiny as the arena of history began when the pursuit of gold drew crowds to California and Australia; but not in earnest till railways across North America commenced to direct the trail of the immigrants to the western lands and the cheapness and capacity of steamer traffic peopled the east of Australia and New Zealand and drew to it Oriental traders and labourers. Not till near the end of the 19th century did the white man realise the great part the Pacific was to play in the history of mankind.

China and Japan.—The Suez canal came earlier; but that would have been cut had there been no great ocean beyond Asia; its aim was to bring Oriental possessions nearer to their managers and the Oriental market nearer to the manufacturing nations of Europe. The greatest of all Oriental markets, China, was the last to come within the range of Western commerce, though the Arabs had been trading with Canton for many centuries. Like all lands enriched by the overflow of rivers, northern and eastern China were early populated and were organised first socially and then politically soon after the old stone age gave way to the neolithic. But the spill of peoples from the steppes of central Asia continued to be recurrent. The northern plains and plateaux of China were ever overcrowded, and drought or flood from "China's sorrow," the Hwang Ho, followed by famine, caused the people to overflow southwards into a zone that was warmer and seldom or never troubled with droughts. Thus this rich section of the earth came to hold one-fourth of the human race, so wedded to the soil and to the graves of their ancestry that it became the most stable of peoples, ready for the strong and vigorous ruler to civilise and unify; and when civil war ceased it had long periods of peace that made it easy for so prolific a race to fill its borders to overflowing, ripe for the discipline of famine and plague.

Further north the closer proximity of the Japanese islands to the continental coast stimulated migration throughout at least the neolithic and bronze ages. It was doubtless the central Asiatic push that drove the Mongoloids over the straits of Tsushima in the bronze age. But they found the archipelago already filled with a vigorous Caucasoid people whom they called the "hairy Ainu" because of their having much face-hair. Though aided and led by a seafaring people who came overseas from the south, it took them till the 12th century to drive the aborigines north of Tokio. That another race different from all three had found its way into the archipelago is evident in the tall people over the mountains of the central island.

The East and West developed their civilisations in isolation from each other. Japan closed its doors against alien civilisations and foreign commerce just when with its maritime bent it might have gone freely all over the great ocean and planted its colonies in Indonesia, Australia and New Zealand and on the western shores of America without any hindrance. At its awakening in the latter part of the 19th century and its welcome to Occidental trade and culture the Occident had placed its mark upon these lands and begun to pour in its immigrants. Now that the East is eager to find issues for the overflow of its prolific population, the white man has fenced in by head tax and prohibitions these open lands to the west and south against the Oriental who has to find the main arena for his immigration on the continent of Asia. The islands of the ocean where it is not merely welcomed but sought after affords but little scope for a country like China which, according to a recent rough Shanghai estimate, added nearly 50,000,000 to its population between 1923 and 1926, in spite of civil war, and like Japan which added 700,000 to its 65,000,000 in 1927, in spite of its decreasing birth-rate and increasing death-rate.

Industrialization of the East.—Manchuria is, now that it has a network of railways, giving issue to the overflow of China, nearly a million trooped into it in 1927, chiefly from northern China which was harassed with civil war and famine and especially from Shantung. Japan, after the defeat of Russia, thought it had secured an arena for its overflow in taking over the Southern Manchurian railway, but failed to turn the current of emigration thither; in 1909, for example, 600,000 Japanese entered, but by the end of the year, 575,000 had gone back to their own land But Manchuria is essential to the life of Japan as a producer of its food, of raw material for its manufactures and of profit from

its railways; little wonder that Japan is ever expanding the railway system and making the future of this great market secure. For the island nation is rapidly industrializing itself as the only solution of its problem of over-population. Whether this is to be the solution of China's still more clamant problem after Manchuria and Mongolia and eastern Siberia have received their full complement of farmers and coolies is a Pacific question that will have to be answered before the end of this century. The process has already begun in the cities on the deltas of the rivers; the labour is cheap enough and, in its own way, virile enough; but its financial success depends on the honesty and thoroughness of the business methods; and hitherto few or no Chinese companies have paid dividend and the railways managed by the Chinese are failures. This is due to the eleventh commandment of "squeeze," a tradition born of the payment of Government officials by what they could extract from the tax-payers. It is still a question whether Oriental mass-production managed by Orientals can attain the standard and honesty of the former individual craftsmanship; and on that depends the stability of the markets the products may find.

Whether China can follow the lead of Japan and westernize its ancient civilization is the question of Pacific questions, when we consider the mass and fecundity of its population and the potentialities of its resources. As yet its republican form of Government has proved itself a failure. How long it will take to make it a reality instead of a pretence depends upon the answer to a variety of questions; chief of which is this: Can a nation so huge and unorganized overcome the handicap of its script as Japan has done and make education universal and compulsory? A Chinese scholar, James Yen, of Pekin, has reduced the 10,000 ideographs essential for education to 1,000, and, within a year or two, has had a million of his countrymen taught them through volunteer teachers. Japan has raised the standard of living of her population at least 50% in spite of the doubling of its numbers during the last half-century; this she has done by her vigorous industrialization; but she is the most organizable of Oriental nations, because of her insular character, the absence of disturbing racial differences, and the atmosphere of social discipline that was left when the revolution abolished the privileges of her highly-educated aristocracy; but most of all because she set herself at once to the task of establishing a system of universal education.

Russia.—One of the most interesting of Pacific questions is how far Bolshevik Russia will succeed in the Orient. In China its propaganda is probably doomed to failure because of the almost universal peasant-proprietorship; but if it has fallen heir to the Oriental ambitions of Tsarist Russia, there is bound to be a triangular conflict in Manchuria; it cannot abandon the shorter route to the Pacific by the Chinese Eastern railway through north Manchuria. Japan cannot abandon its claims on Manchuria as the best source of its food and raw material for manufactures and its best market; nor can China cease to proclaim this great province outside the Great Wall her own now that it is filling up with Chinese.

The Future.—Advance towards the conciliation between East and West will not be possible till this is settled. And the mutual influence of their culture and civilization will be of little avail unless there is peace and mutual respect between them. Occidentals must give up their arrogant assumption of superiority and cease thinking of Oriental social customs and religious attitudes as futilities to be thrust aside for what they introduce, whilst Orientals must learn to recognize what the "foreign devils" have done for their commerce and the development of their countries. The Pacific ocean is the arena in which must be worked out the problems of the unification of mankind; for here have been brought face to face the racial types that have shown the greatest capacity for advance in civilization.

The process of human hybridization has grown slower as nations have become stable and will grow slower still as national consciousness becomes more definite in its aims. And in the Pacific ocean, the new stage set for the next drama of human evolution, the action may drag through acts that each may take 10,000 or even 100,000 years to reach its *dénouement,* so contrasted are the peoples and cultures, so broad the sea that divides them, so slow the processes that have to depend only on commercial intercourse.

The most hopeful omen is the rapidity with which Japan has absorbed Occidental culture and yet come out of the process strong in her personality and national character. It was her national environment that made this abnormal rapidity sure without a devastating revolution. An island or extensive archipelago lying not far off a populous continent in the temperate zone, the zone of enterprise and initiative, and across the latitudes so as to secure a constant flow of variations for selection to work on, once it attains a unity, is bound to make swift and easy progress and to a play a dominant part in the ocean around it, if not in the world as a whole. Japan is the counterpart in the Pacific of Britain in the Atlantic. There are two other insular unities in the ocean that have a similar environment, New Zealand in the south and Vancouver in the north; whether they will have a large part to play is an interesting question; one is too far from its still sparsely populated island-continent and the other too much in the shadow of Canada to enter soon into the dominance that is the natural heritage of such an environment; but both will have that combination of a sailor-breed and a mountain-breed which makes a people bold in enterprise and passionately devoted to freedom; they will be the maritime shields of their neighbours. The very isolation of New Zealand will make her capable of controlling her own destiny and transmitting pure her Anglo-Saxon culture and tradition, whilst her proximity to the islands of the South Seas will make her dominant in their development and prosperity. How Australia is to fill her empty spaces and preserve her white tradition so far from Europe and so near to the East is one of the most clamant Pacific questions and next to it stands in importance how she is to develop her vast droughty, if not desert, areas. As for British Columbia and Canada, as a whole they lie in the shadow of the great republic and for generations will be more or less dependent on her for capital and development.

It is significant that three of the most developable countries that abut on the ocean are English-speaking, and that the peoples of Anglo-Saxon descent have been amongst the most enterprising in pushing their way both by land and sea but especially by sea; they have been the most successful of pioneers in colonization and commerce. It looks as if English were ultimately to be the dominant language in the Pacific ocean; and a sign of this is that pidgin-English is the favourite medium of communication between Chinese of different dialects besides being the favourite linguistic intermediary in the islands of the ocean even when owned and managed by peoples that speak another European language. The Polynesian dialect of the isolated Easter island though moulded by French missionaries and Chilean officials has ten times more English words embedded in it than French and Spanish combined. And the large Oriental element in the trade and labour of the South Seas make pidgin-English their means of intercourse. The only language besides English that seems to have much chance of spreading in the ocean is the Japanese; for it belongs to a people that is naturally seafaring, commercial and colonizing.

It is not easy to answer what type of political system is likely to spread in the Pacific ocean and to dominate in the far future the world unity that is the desire and may be the goal of mankind.

Two that abut on the ocean and share largely in its traffic present each a type that has a strong chance of survival because they are capable of sheltering and unifying varied kinds of communities; and both belong to the English-speaking peoples. One is the United States; it is a federal system that permits of the freest intercourse between its separate states whilst giving each its own legislative individuality; for it has lowered all tariff barriers. The other is the British commonwealth of nations which spreading round the world keeps its units in vital intercourse by protected maritime traffic and by periodical conferences that decide how they can assist and guard one another's freedom and interests. An amalgamation of these two types may produce the

final type that will fit a unified human race. It will allow of the greatest liberty of development to each of the national units whilst watching over their freedom of commercial and migrative intercourse. It may take tens, perhaps hundreds, of thousands of years to evolve; but the first arena for its evolution will probably be the Pacific ocean

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(J M-B)

PACK, OTTO VON (*c.* 1480–1537), German conspirator In 1528 he revealed to Philip, landgrave of Hesse, the details of a scheme agreed upon in Breslau by the archduke Ferdinand, afterwards the emperor Ferdinand I, and other influential princes, to conquer Hungary for Ferdinand and then to attack the reformers in Germany Pack was sent to Hungary to concert joint measures with John Zapolya, but John, elector of Saxony, advised that the associates of Ferdinand should be asked to explain their conduct and Pack's revelations were discovered to be false, the copy of the treaty which he had shown to Philip proving to be a forgery Pack was seized in the Netherlands at the request of Duke George Examined under torture he admitted the forgery, and was executed on Feb 8, 1537 It is uncertain whether Philip was deceived by Pack, or was his assistant in concocting the scheme

See W Schomburgk, *Die Packschen Handel* (Leipzig, 1882), H. Schwarz, *Landgraf Philipp von Hessen und die Packschen Handel* (Leipzig, 1881), St Ehses, *Geschichte der Packschen Handel* (Freiburg, 1881) and *Landgraf Philipp von Hessen und Otto von Pack* (Freiburg, 1886).

PACKER, ASA (1805–1879), American capitalist, was born in Mystic, Connecticut, on Dec 29 1805 He worked as a carpenter in New York city for a time and then built canal-boats and locks for the Lehigh Coal & Navigation Company, probably the first through shippers to New York Between 1852 and 1855 a railway line was built for the Lehigh Valley Railroad Company, largely by Packer's personal credit, from Mauch Chunk to Easton He built the extension of the line into the Susquehanna valley and thence to connect with the Erie railway. In 1841 and 1842 he was a member of the Pennsylvania House of Representatives; in 1843–1848 was county judge of Carbon county, in 1853–1857 was a Democratic member of the national House of Representatives In 1865 he gave money and land in South Bethlehem, Pennsylvania, for a technical school; Packer Hall, of Lehigh University was completed in 1869; he erected a memorial library building in 1877; and the university, by his will, received nearly one third of his estate He died in Philadelphia on May 17, 1879

PACKING HOUSE: *see* ABATTOIR and SLAUGHTER HOUSE

PACORUS, a Parthian name, borne by two Parthian princes

1. PACORUS, son of Orodes I, was, after the battle of Carrhae, sent by his father into Syria at the head of an army in 52 B C The prince was still very young, and the real leader was Osaces He was defeated and killed by C. Cassius, and soon after Pacorus was recalled by his father, because one of the satraps had rebelled and proclaimed him king (Dio Cass. xl 28 *sqq*; Justin xlii. 4; *cf.* Cicero, *ad Fam.* xv. 1; *ad Att* vi. 1. 14). Father and son were reconciled, but the war against the Romans was always deferred In the autumn of 45 Pacorus and the Arabic chieftain Alchaudonius came to the help of Q. Caecilius Bassus, who had rebelled against Caesar in Syria; but Pacorus soon returned, as his troops were unable to operate in the winter (Cic. *ad Att.* xiv 9 3; Dio Cass xlvii 27) At last in 40 B C. the Roman fugitive Titus Labienus induced Orodes to send a great army under the command of Pacorus against the Roman provinces. Pacorus conquered the whole of Syria and Phoenicia with the exception of Tyre, and invaded Palestine, where he plundered Jerusalem, deposed Hyrcanus, and made his nephew Antigonus king Meanwhile Labienus occupied Cilicia and the southern parts of Asia Minor down to the Carian coast (Dio Cass. xlviii 26; Strabo xiv. 660). But in 39 P. Ventidius Bassus, the general of Mark Antony, drove him back into Cilicia, where he was killed, defeated the Parthians in Syria (Dio Cass. xlviii. 39 *sqq*) and at last beat Pacorus at Gindarus (in northern Syria), on the 9th of June, 38, the anniversary of the battle of Carrhae Pacorus himself was slain in the battle, which effectually stopped the Parthian conquests west of the Euphrates

2 PACORUS, Parthian king, only mentioned by Dio Cass lxviii 17, Arrian, *ap.* Suid., *s v.* ὠνητή, according to whom he sold the kingdom of Osroëne to Abgar VII.; and Ammianus Marcellinus xxiii. 6 23, who mentions that he enlarged Ctesiphon and built its walls But from his numerous dated coins we learn that he was on the throne, with interruptions, from A D 78–95 He always calls himself Arsaces Pacorus This mention of his proper name, together with the royal name Arsaces, shows that his kingdom was disputed by rivals. Two of them we know from coins—Vologaeses II, who appears from 77–79 and again from 111–146, and Artabanus III in 80 and 81. Pacorus may have died about 105; he was succeeded by his brother Osroes. (ED M)

PACUVIUS, MARCUS (*c.* 220–130 B C.), Roman tragic poet, was the nephew and pupil of Ennius, by whom Roman tragedy was first raised to a position of influence and dignity Like Ennius he probably belonged to an Oscan stock, and was born at Brundusium, which had become a Roman colony in 244 Hence he never attained to idiomatic purity of style. Pacuvius obtained distinction also as a painter; and the elder Pliny (*Nat Hist* xxxv 19) mentions a work of his in the temple of Hercules in the *Forum boarium* We know of 12 plays on Greek subjects, mostly connected with the Trojan cycle, and one *praetexta*, the *Paulus*, written to commemorate the victory of Pydna in 168 He continued to write tragedies till the age of 80, when he exhibited a play in the same year as Accius, who was then 30 years of age He retired to Tarentum for the last years of his life, and a story is told by Gellius (xiii 2) which is probably fictitious, of his being visited there by Accius on his way to Asia, who read his *Atreus* to him The story is designed to illustrate the traditionary criticism (Horace, *Epp* II i 54) of the two poets, the elder noted for elegance, the younger for vigour Cicero, who frequently quotes from Pacuvius with admiration, appears (*De optimo genere oratorum*, i) to rank him first among the Roman tragic poets

The fragments of Pacuvius quoted by Cicero in illustration or enforcement of his own ethical teaching appeal, by the fortitude, dignity, and magnanimity of the sentiment expressed in them, to what was noblest in the Roman temperament, while revealing a humanity of sentiment that was more unusual Among the passages quoted from Pacuvius are several which indicate a taste both for physical and ethical speculation, and others which expose the pretensions of religious imposture, tendencies common to the tragic poets of the period These poets also contributed to the development of the language into an organ peculiarly suited to oratory But the new creative effort in language was accompanied by considerable crudeness of execution, and the novel word-formations and varieties of inflexion introduced by Pacuvius exposed him to the ridicule of the satirist Lucilius But notwithstanding the attempt to introduce an alien element into the Roman language, which proved incompatible with its natural genius, and his own failure to attain the idiomatic purity of Naevius, Plautus or Terence, the fragments of his dramas are sufficient to prove the service which he rendered to the formation of the literary language of Rome as well as to the culture of his contemporaries

Fragments in O. Ribbeck, *Fragmenta scaenicae romanorum poesis* (1897), vol. i; *see* also his *Romische Tragodie* (1875); L Muller, *De Pacuvii fabulis* (1889), W. S Teuffel, *Caecilius Statius, Pacuvius, Attius, Afranius* (1858); and Mommsen, *History of Rome*, bk. iv ch 13.

PADANG, the chief port on the west coast of Sumatra and capital of the residency of the west coast of Sumatra, Dutch East Indies, population 41,238 (2,548 Europeans and Eurasians). Padang, which is 572 miles from Batavia, has prospered exceedingly since the opening-up of the Padang highlands with their

great mineral wealth, tourist traffic, and the general extension of cultivation in Sumatra West Coast residency, aided by the construction of a railway along the coast to Sungei Limau and inland to Fort de Kock and Pajo Kumbu, and, branching off from Padang Panjang, to Sawah Lunto, and the harbour facilities of Emma Harbour. The town, which is the seat of the resident, and the headquarters of the railway, with offices, workshops, etc., and is overlooked by the Apenberg or Ape mountain, right on the coast, is beautifully laid out, with fine, well-kept roads and houses surrounded by large gardens. Many of the native houses are built on piles, and have thatched roofs, and, despite its modern buildings, Padang still possesses a rustic charm, and it has a cooler climate than most coastal towns so near the equator. The port, which is approached from the sea through a multitude of tiny evergreen islets, lies a short distance south-east of the town, on the north-west side of Köninginne bay (Queen's bay), and from it are exported copra, coffee, quinine, mace, damar, hides, rattans, and coal from the great Ombilin coal-fields which, in 1925, produced 543,745 tons. Emma Harbour, constructed between 1880–1890, has two breakwaters, one 900 metres long, projecting at right angles to the coast; the other, 260 metres, running parallel with the coast across a coral bank: these give a harbour surface of one square kilometre. There are four wharves, with a total length of 433 metres, for general cargo, also a special coal wharf, and salt, petroleum and dynamite wharves. The coal wharf has a shute with a capacity of 300 tons per hour, two electric conveyers of 120 tons per hour, and a floating conveyer. Emma Harbour affords very frequent communication between Sumatra West Coast and Java and British Malayan ports, and it is a port of call for steamers from Europe, Australia, China, India and Japan. Imports in 1926 were 22,563,046, and exports 27,289,775 gulders. Padang is one of the oldest Dutch settlements in Sumatra. As early as 1606 an official of the Vereenigde Oost Indische Compagnie (United Dutch East India Company), was sent from Batavia with orders to appoint residents on the west coast of Sumatra and to found factories there, and Padang seems to have been one of the earliest of these, for in 1664 it was styled the capital of Sumatra's West Coast, and three years later a small fort and some warehouses were erected on the banks of the Padang river, to support the resident and his small staff in their tenure. The fortress was demolished by the British in 1793, and was found still in ruins when Padang was paid a visit, later in the same year, by the French buccaneer Lemesme, in his vessel "La Ville de Bordeaux." In November 1795 Padang and the west coast of Sumatra were captured by a British force, and a garrison, reinforced from Bencoolen, was maintained at Padang, the town and the district remaining under British control until May, 1819.

PADANG HIGHLANDS, the name given to the mountainous hinterland of the Sumatra West Coast residency, of Sumatra, and which, possessing magnificent scenery and a salubrious climate, has become one of the chief health and pleasure resorts of the Dutch East Indies. It can be reached either from the port of Belawan on the east coast of Sumatra, or from Padang on the west coast, since an excellent motor road runs across the country from Belawan and Medan to Padang which penetrates the heart of the Padang highlands. Fort de Kock, 2,700 ft., the mountain capital, and the seat of an Assistant Resident, has a population of 12,624 (510 Europeans), and is an ideal centre for exploring the district. From here can be reached easily, by road, the Kloof of Harau, the falls of Sungei Puar, the caves of Kamar and Baso, Sungei Jarni, and its pond with holy fishes, and Puntjak Bukit and Padang Galanggang.

PADDINGTON, a north-western metropolitan borough of London, England, bounded E. by Hampstead and Marylebone, S. by the city of Westminster, and W. by Kensington, and extending N. to the boundary of the county of London. Pop. (1921) 144,261. The north-east is the residential quarter. It contains the terminus of the G.W. railway. The name of Paddington finds no place in Domesday—it may have been included in the manor of Tyburn—and the land belonged to the abbey of Westminster at an early date. It was granted to the see of London by Edward VI. In the 18th century the rural scenery attracted artists, and even in the middle of the 19th the open country was reached within the confines of the present borough, which now contains no traces of antiquity. Bayswater is said to take its name from Baynard, a Norman, who after the Conquest held land here and had a castle by the Thames not far above the Tower. Many springs flowed forth here; the stream called Westbourne was near at hand, and water was formerly supplied hence to London. The parliamentary borough of Paddington has two divisions, each returning one member.

PADDLEFISH, the common name in North America for the spoonbill sturgeon (*Polyodon spathula*) of the Mississippi basin, which reaches a length of six feet and a weight of 150 lb. with a dark green smooth skin and long, bony, spoon-shaped snout. It is edible; the roe is made into caviar. (*See* FISH; STURGEON.)

PADDLE-WHEEL: *see* SHIPBUILDING.

PADDY-BIRD, the name given in India to *Ardeola grayii*, also known as the pond heron. About as big as a jackdaw, the paddy-bird has a pied plumage of drab and white. The name "paddy-bird" is used by whalers to denote the sheathbill (*q.v.*).

PADERBORN, a town and episcopal see in the Prussian province of Westphalia, 63 m. N.E. from Dortmund on the railway to Berlin via Altenbeken. Pop. (1925) 33,205, of whom about 80% are Roman Catholics. Paderborn owes its early development to Charlemagne, who held a diet here in 777 and made it the seat of a bishop a few years later. The city about the year 1000 was surrounded with walls. It joined the Hanseatic League, obtained many of the privileges of a free Imperial town, and endeavoured to assert its independence of the bishop. The citizens accepted the reformed doctrines, but the older faith was restored in 1604. The bishopric of Paderborn formed part of the archdiocese of Mainz, and its bishop became a prince of the empire about 1100. It was secularized in 1803 and was given to Prussia. The bishopric had an area of nearly 1,000 sq.m. and a population of about 100,000. A new bishopric of Paderborn, with ecclesiastical authority only, was established in 1821.

The town derives its name from the springs of the Pader, a small affluent of the Lippe, which rise in the town under the cathedral to the number of nearly 200, and with such force as to drive several mills within a few yards of their source. A large part of the town has been rebuilt since a great fire of 1875. It possessed a university, founded in 1614, but this was closed in 1819 The manufactures of the town include glass, soap, tobacco, boots, organs and beer; and there is a trade in grain and cattle.

PADEREWSKI, IGNAZ JAN (1860–), Polish pianist, composer and statesman, was born at Kurylówka, Podolia, a province of (then) Russian Poland. He studied music at Warsaw, Berlin and at Vienna, where he was a pupil of Leschetizky (*q.v.*). He made his first public appearance in Vienna in 1887, in Paris in 1889, and in London in 1890. His brilliant playing created a *furore* which went to extravagant lengths; and his triumphs were repeated in America in 1891. He was a great virtuoso player, and as such commanded popular applause, but he was much more than that; he brought to bear on the music he played a highly trained and original mind. The Paderewski renderings often countered tradition but they were the fruit of profound and serious study. In 1899 he married Baroness de Rosen, and after 1900 he appeared but little in public until 1920–23 when he gave recitals in England and in America as well as on the Continent.

Paderewski's first considerable work was the opera *Manru*, played at Dresden (May 29, 1901), and in 1902 at New York. Beside numerous works composed for his own instrument, including a concerto for pianoforte and orchestra in A minor (op. 17), he wrote a symphony (in B minor), which was played with success at Boston, Mass., and in London in 1909.

Paderewski's unprecedented success as a pianist all over the world never caused him to forget his own country, and to the Poles in America he delivered the following inspiring message: "The vision of a strong and independent Poland has always been the lodestar of my existence. Its realisation is still the great aim of my life." In 1910, on the 500th anniversary of the victory of Grünwald over the Teutonic knights, he presented a memorial,

which was unveiled at Cracow

When the World War broke out in 1914, he dedicated himself heart and soul to his country's service. He was *président d'honneur* of a non-party group of Poles who met at Vevey in the autumn of 1914 to organise a "General Committee of Assistance for the victims of the War in Poland" The Committee was definitely founded in Jan. 1915 under the presidency of Sienkiewicz. Paderewski established branches in Paris and London, he then went to the United States, where he remained nearly four years, giving numerous concerts and championing the cause of Poland He collected enormous sums, and created a powerful pro-Polish movement in the United States The value of his propagandist work was realised when, on Jan 22, 1917, President Wilson alluded to a "united, independent and autonomous Poland" By November 1916 every Polish organisation in the U S A was represented in the Polish National Department of Chicago, except the small Socialist group Up to 1918 Paderewski guided the political and military destinies of 4,000,000 Poles in the United States

Foreseeing in Feb 1917 that the U S A would soon enter the War, Paderewski induced the Polish National Alliance to found a preparatory school for Polish officers at Cambridge Springs. After the decree which authorised a Polish army to be raised in France Paderewski obtained on Nov. 1917 from Newton Baker, permission to recruit volunteers He secured from the Canadian Govt a vast military camp, Niagara on the Lake, where more than 22,000 Polish volunteers were trained by Canadian officers In Aug 1917 the Polish National Guard Committee, founded at Lausanne, chose him as its representative at Washington

After the victory of the Allies, Paderewski visited London and afterwards proceeded to Poland by sea in the company of a British Mission under Colonel Wade, disembarking at Danzig on Dec 24, 1918 On reaching Warsaw he declared himself independent of all political parties, and after difficult negotiations, during which an attempt was made on his life, he succeeded on Jan 17, 1919 in forming a coalition ministry, of which he became prime minister as well as minister of foreign affairs He obtained for Poland official recognition by the various Powers, and thus regularised her international position He suppressed the various military groups which hindered national unity, and at the first meeting of the Diet demanded and obtained the formation of a national army. He went to Paris on April 6, 1919 as Poland's first delegate to the Peace Conference On two different occasions, the Diet renewed its vote of confidence in him and expressed the gratitude of his country But as it was impossible for him to make a national union a reality, and, above all, to conclude peace with the Soviet government, in view of the violent opposition of the military party, he resigned office (Nov. 27, 1919). He continued however to defend Poland's interests at the Conference of Ambassadors and the League of Nations In July 1920 he protested against Czechoslovak action in regard to Teschen.

He abandoned his political career in Feb. 1921, and retired to his Californian estate, returning afterwards to resume his musical career.

See Robert Lansing, *The Big Four and Others of the Peace Conference* (1921); Eugene S Bagger, *Eminent Europeans* (1922); Frank W. Davis, *Time Exposures* (1926).

PADIHAM, urban district, Clitheroe parliamentary division, Lancashire, England, 3 m. W. of Burnley by L M S. railway. Pop (1921) 12,471. It stands on the river Calder. Its industries comprise cotton mills, quarries and coal mines The church of St Leonard (15th cent) was rebuilt in the Perpendicular style (1866–8) In 1251 Padiham was the manor of Edmund de Lacy.

PADILLA, JUAN LOPEZ DE, insurrectionary leader in the "*guerra de las comunidades*," in which the commons of Castile made a futile stand against the arbitrary policy of Charles V. and his Flemish ministers, eldest son of the Comendador of Castile, he was born in Toledo towards the close of the 15th century. After the cities, by their deputies assembled at Avila, had vainly demanded the king's return, due regard for the rights of the cortes, and economical administration, to be entrusted to the Spaniards, they resolved to resort to force, and the "holy junta" was formed, with Padilla at its head They captured Tordesillas, and sought to establish a national Government in the name of the imbecile Joanna. Tordesillas was recaptured by the nobles, and Padilla took Torrelobaton and other towns, but his army was completely routed at Villalar (April 23, 1521), Padilla being made prisoner and executed on the following day. His wife, Maria Pacheco de Padilla, defended Toledo against the royal troops for six months afterwards, but ultimately had to flee to Portugal.

See Sandoval, *Historia de Carlos V.* (Pamplona, 1681); E. Armstrong, *The Emperor Charles V* (1902); A. Rodriguez Villa, *Juana la Loca* (Madrid, 1892), Pero Mejía, *Comunidades de Castilla* (Bib de Autores Esp, xxi).

PADISHAH, the Turkish form of the Persian *padshah,* a title—equivalent to "lord king"—of the reigning sovereign In Europe it was applied to the sultan of Turkey The Persian *padshah* is from *pati,* lord, master, and *shah,* king

PADSTOW, a small seaport and market town in the St Austell parliamentary division of Cornwall, England, on a branch of the S R Pop of urban district (1921) 1,736 Padstow (Aldestowe 1,273, Patrikstowe 1,326, Patrestowe 1,346) and St. Ives are the only two tolerably safe harbours on the north coast of Cornwall To this circumstance they both owed their selection for early settlement and the Padstow region (especially Harlyn Bay) is full of prehistoric associations St Petrock, called the patron saint of Cornwall, is said to have landed here and also to have died here in the 6th century Padstow is not mentioned in the Domesday Survey It was included in the bishop of Exeter's manor of Pawton, annexed to the see of Crediton Until the Danes plundered Padstow (981), it is said to have possessed a monastery, which thereupon was transferred to Bodmin Two manors of Padstow are mentioned later—the prior of Bodmin's manor, including the rectory, and a manor which passed from the Bonvilles to the Greys, marquesses of Dorset, both were eventually acquired by the family of Prideaux Padstow appears to have been a port of considerable repute in the 14th century In 1580 Norden describes it as an incorporation and market town Carew in 1602 states that it had lately purchased a corporation and derived great profit from its trade with Ireland No traces of a charter have been found A prescriptive market is held on Saturdays, two fairs of like nature have disappeared It lies near the north coast, on the west shore, and 2 m from the mouth of the estuary of the river Camel The church of St Petrock, with a massive roodstone in the churchyard, is mainly Perpendicular, with an Early English tower Within are an ancient font, a canopied piscina and a timber roof over the nave and aisles The church of St Enodock, erected in the 15th century amid dunes bordering the east shore of the estuary, in place of a more ancient oratory, was long buried beneath drifts of sand, and from a little distance only the spire can be seen A Norman font remains from the older foundation A monastery formerly standing on the high ground west of Padstow was founded by St Petrock in the 6th and razed by the Danes in the 10th century. Pentine Point shelters Padstow bay on the north-east, but the approach to the estuary is dangerous during northwesterly gales. Padstow is a harbour of refuge, although the river channel is narrow and much silted Dredging is carried on and the sand, which is rich in carbonate of lime is used as manure The Padstow Harbour association (1829) is devoted to the rescue of ships in distress, making no claims for salvage beyond the sums necessary for its maintenance Padstow has fisheries and shipyards and some agricultural trade It imports coal, iron and timber for slates and kaolin.

PADUA, a city of northern Italy (Lat *Patavium* [*q v*]; Ital. *Padova*), on the river Bacchiglione, 25 m W of Venice and 18 m S E of Vicenza Pop. (1921) 88,443 (town), 112,021 (commune) The city is picturesque, with arcaded streets, and many bridges crossing the various branches of the Bacchiglione, which once surrounded the ancient walls The Palazzo della Ragione (1218–9) has a great hall on the upper floor; its length is 267½ ft, its breadth 89 ft, and its height 78 ft; the walls are covered with symbolical paintings in fresco, originally by Giotto; the building stands upon arches, and the upper storey is surrounded by an open loggia In 1306 Fra Giovanni, an

Augustinian friar, covered the whole with one roof curved like the hull of a ship; originally there were three roofs, spanning the three chambers into which the hall was at first divided; the internal partition walls remained till the fire of 1420, when the Venetian architects who undertook the restoration removed them. In the Piazza dei Signori, now called Unità d'Italia, is the beautiful loggia called the Gran Guardia (1493–1526) and close by is the Palazzo del Capitanio, the residence of the Venetian governors, with its great door, the work of Falconetto of Verona, 1532.

The most famous of the Paduan churches is the basilica dedicated to Saint Anthony, commonly called Il Santo; the bones of the saint rest in a chapel richly ornamented with carved marbles, the work of various artists, among them of Sansovino and Falconetto; the basilica was begun after his death in 1231 and completed in the following century; it is covered by seven cupolas. In the piazza in front of the church is Donatello's magnificent equestrian statue of Erasmo da Narni, the Venetian general (d. 1443). The Eremitani is an Augustinian church of the 13th century, containing the tombs of Jacopo (1350) and Ubertino (1345) da Carrara, lords of Padua, and the chapel of SS. James and Christopher, with Mantegna's frescoes. Close by the Eremitani is the small church of the Annunziata, known as the Madonna dell' Arena; the interior is entirely covered with paintings by Giotto. Padua has long been famous for its university, founded in 1222. Among the professors and alumni were Bembo, Sperone Speroni, Veselius, Acquapendente, Galileo, Pomponazzi, Pole, Scaliger, Tasso and Sobieski. In 1925–6 it had 2,439 students. The presence of the university attracted many distinguished artists, as Giotto, Lippo Lippi and Donatello; and for native art there was the school of Squarcione (1394–1474), whence issued the great Mantegna (1431–1506). There is an important picture gallery. The botanical garden (1545) is the oldest in Europe. Corn and saw mills, distilleries, chemical factories, breweries, candle-works, ink-works, foundries, agricultural machine and automobile works flourish.

At the Diet of Aix-la-Chapelle (828) the duchy and march of Friuli, in which Padua lay, was divided into four counties, one of which took its title from that city. At the beginning of the 11th century the citizens established a constitution, composed of a general council or legislative assembly and a credenza or executive; and during the next century they were engaged in wars with Venice and Vicenza for the right of water-way on the Bacchiglione and the Brenta—so that, on the one hand, the city grew in power and self-reliance, while, on the other, the great families of Camposampiero, D'Este and Da Romano began to emerge and to divide the Paduan district between them. The citizens, in order to protect their liberties, were obliged to elect a podestà, and their choice fell first on one of the D'Este family (*c.* 1175); but in 1237 Frederick II. established his vicar Ezzelino da Romano in Padua and the neighbouring cities.

When Ezzelino met his death, in 1256, Padua enjoyed a brief period of rest and prosperity: the university flourished; the basilica of the saint was begun; the Paduans became masters of Vicenza. But this advance brought them into dangerous proximity to Can Grande della Scala, lord of Verona, to whom they had to yield in 1311. As a reward for freeing the city from the Scalas, Jacopo da Carrara was elected lord of Padua in 1318. From that date till 1405, with the exception of two years (1388–1390) when Gian Galeazzo Visconti held the town, nine members of the Carrara family succeeded one another as lords of the city.

Padua passed under Venetian rule in 1405, and so remained, with a brief interval during the wars of the League of Cambray, till the fall of the republic in 1797. The city was governed by two Venetian nobles, a podestà for civil and a captain for military affairs; each of these was elected for sixteen months. Under these governors the great and small councils continued to discharge municipal business and to administer the Paduan statutes of 1276 and 1362. For history after 1797 *see* VENICE.

See G. Verci, *Storia della Marca Trevigiana* (Venice, 1786); Abate G. Gennari, *Annali di Padova* (Padua); G. Cittadella, *Storia della dominazione carrarese* (Padua, 1842); B. Gonzati, *La Basilica di Sant' Antonio di Padova* (Padua, 1853).

PADUCAH, a city of south-western Kentucky, U.S.A., on the Ohio river at the mouth of the Tennessee; a port of entry and the county seat of McCracken county. It is on Federal highways 45, 60 and 68, and is served by the Burlington Route, the Gulf, Mobile and Northern, the Illinois Central, the Nashville, Chattanooga and St. Louis and the Paducah and Illinois railways, and river steamers. Pop. 24,735 in 1920 (23% negroes); estimated locally at 37,500 in 1928. It is one of the principal dark-tobacco markets in the country, and ships also large quantities of corn, pork, fruits, vegetables, iron ore, lumber and cross-ties. It has railroad repair shops and various other manufacturing industries, with an output in 1925 valued at $13,054,801. Paducah was settled in 1821, laid out in 1827 by Gen. William Clark, incorporated as a town in 1830, and chartered as a city in 1856. It was named after an Indian chief. On Sept. 5, 1861, the city was occupied by Gen. Grant. It was raided on March 25, 1864, by Gen. Nathan B. Forrest, but he was unable to take the fortifications.

PAEAN (Gr. Παιάν, epic Παιήων), in Homer (*Il.* v. 401, 899), the physician of the gods. It is not known whether he was originally a separate deity or merely an aspect of Apollo. Homer leaves the question unanswered; Hesiod (*cf.* schol. Hom. *Od.* iv. 432) definitely separates the two, and in later poetry Paean is invoked independently as a health god. It is equally difficult to discover the relation between *Paean* or *Paeon* in the sense of "healer" and paean in the sense of song. Farnell refers to the ancient association between the healing craft and the singing of spells, and says that it is impossible to decide which is the original sense. Such songs were originally addressed to Apollo, and afterwards to other gods, Dionysus, Helios, Asclepius. It was the custom for a paean to be sung by an army on the march and before entering into battle, when a fleet left the harbour, and also after a victory had been won; this is already found in Homer, *Iliad*, xxii., 391. Paeans were sung at the festivals of Apollo (especially the Hyacinthia), at banquets, and later even at public funerals. Later, especially in Hellenistic times (first by the Samians to Lysander) they are addressed to more or less deified men. The word "paean" is now used of any song of joy or triumph.

See L. R. Farnell, *Cults of the Greek States* (1896); A. Fairbanks, "A Study of the Greek Paean," No. xii. of *Cornell Studies in Classical Philology* (New York, 1900); BACCHYLIDES and PINDAR.

PAEDOGENESIS, the term used in biology to denote the phenomenon of sexual maturity in a technically immature organism (larva). It occurs in the Ctenophora (*q.v.*) Diptera (*q.v.*) and other groups. (*See* METAMORPHOSIS.)

PAELIGNI, a people of ancient Italy, first mentioned as a member of a confederacy which included the Marsi, Marrucini, and Vestini (qq.v.), with which the Romans came into conflict in the second Samnite War, 325 B.C. (Liv. viii. 29) On the submission of the Samnites (q.v.) they all came into alliance with Rome in 305–02 B.C. (Liv. ix. 45, x. 3, and Diod. xx 101). Each of them was an independent unit. Thus the Vestini issued coins in the 3rd century; each of them appears in the list of the allies in the Social War (Appian, *B.C.*, i. 39). The mountain fortress of Corfinium was chosen as the rebel capital. It was renamed Vitellio, the Oscan form of Italia, a name which appears, written in Oscan alphabet, on the coins struck there in 90 B.C.

The inscriptions show that the dialect spoken by these tribes was substantially the same from the northern boundary of the Frentani to some place in the upper Aternus valley not far from Amiternum (mod. Aquila). This dialect closely resembled the Oscan of Lucania and Samnium, though presenting some peculiarities of its own, which warrant, perhaps, the use of the name North Oscan. The clearest of these is the use of postpositions, as in Vestine *Poimunie-n*, "in templo Pomonali"; *pritrom-e, i.e., in proximum*, "on to what lies before you." Others are the sibilation of consonantal *i* and the assimilation of *-di-* to some sound like that of English *j* (denoted by Ꟈ in the local variety of Latin alphabet), as in *vidadu*, "viamdō," *i.e.*, "ad-viam"; *Musesa*=Lat. *Mussedia;* and the loss of *d* (in pronunciation) in the ablative, as in *aetatu firata fertlid* (*i.e., aetate fertili finita*), where the contrast of the last with the other two forms shows that the *-d* was an archaism still occasionally used in writing.

The name *Paeligni* may belong to the NO-class of Ethnica (*see* SABINI), but the difference that it has no vowel before the suffix suggests that it may rather be parallel with the suffix of Lat. *privignus*. If it has any connection with Lat. *paelex*, "concubine," it is conceivable that it meant "half-breeds," and was coined in contempt by the conquering Sabines, who turned the *touta Marouca* into the community of the *Marrucini* (q.v.). For the history of the Paeligni after 90 B.C. *see* the references given in *C. I. L.*, ix. 290 and 296. None of the Latin inscriptions of the district need be older than Sulla, but some of them both in language and script show the style of his period (*e.g.*, 3087, 3137); and, on the other hand, as several of the native inscriptions, which are all in the Latin alphabet, show the normal letters of the Ciceronian period, there is little doubt that the Paelignian dialect lasted down to the middle of the 1st century B.C.

Paelignian and this group of inscriptions generally form a most important link in the chain of the Italic dialects, as without them the transition from Oscan to Umbrian would be completely lost. The unique collection of inscriptions and antiquities of Pentima and the museum at Sulmona were both created by the late Professor Antonio de Nino, who rescued every Paelignian monument that we possess.

For further details and the text of the inscriptions, the place-names, etc., *see* R. S. Conway, *The Italic Dialects*, pp. 235 et seq., and the earlier authorities there cited.

PAEONIA, the land of the Paeonians, the boundaries of which, like the early history of its inhabitants, are very obscure. The Paeonians are regarded as descendants of the Phrygians of Asia Minor. According to the national legend they were colonists from Troy, and Homer (*Iliad*, ii. 848) speaks of Paeonians from the Axius fighting on the side of their Trojan kinsmen. Before the reign of Darius Hystaspes, they had made their way as far east as Perinthus. When Xerxes crossed Chalcidicē on his way to Therma (Thessalonica) he is said to have marched "through Paeonian territory." They occupied the entire valley of the Axius as far inland as Stobi, and the valleys to the east of it as far as the Strymon. In consequence of the growth of Macedonian power their territory was considerably diminished, and in historical times was limited to the north of Macedonia from Illyria to the Strymon. The Paeonians included several independent tribes, later united under a single king. They adopted the cult of Dionysus, known amongst them as Dyalus or Dryalus, and Herodotus (iv. 33) mentions that the Thracian and Paeonian women offered sacrifice to Queen Artemis (probably Bendis). They worshipped the sun in the form of a small round disc fixed on the top of a pole. They drank barley beer and various decoctions made from plants and herbs. The country was rich in gold and a bituminous kind of wood. The women were famous for their industry. Herodotus (v. 12) tells the story that Darius, having seen at Sardis a beautiful Paeonian woman carrying a pitcher on her head, leading a horse to drink, and spinning flax, all at the same time, enquired who she was. Having been informed that she was a Paeonian, he sent instructions to Megabyzus, commander in Thrace, to deport two tribes of the nation without delay to Asia. At the time of the Persian invasion the Paeonians on the lower Strymon had lost, while those in the north maintained their independence. They frequently made inroads into Macedonian territory until they were finally subdued by Philip, who permitted them to retain their government by kings. The daughter of Audoleon, one of these kings, was the wife of Pyrrhus, king of Epirus, and Alexander the Great wished to bestow the hand of his sister Cynane upon Langarus who had shown himself loyal to Philip. In 280 the Gallic invaders under Brennus ravaged the land of the Paeonians. After the Roman conquest, Paeonia east and west of the Axius formed the second and third districts respectively of Macedonia. Under Diocletian Paeonia and Pelagonia formed a province called Macedonia *secunda* or *salutaris*, belonging to the prefecture of Illyricum.

See W. Tomaschek, "Die alten Thraker," in *Sitzungsberichte der k. Akad. der Wissenschaften*, xxviii. (Vienna, 1893). (*See* MACEDONIA.)

PAEONIUS, of Mende in Thrace, a Greek sculptor of the latter part of the 5th century. The statement of Pausanias that he executed one of the pediments of the temple of Zeus at Olympia, is doubtful. But we possess an important work of Paeonius in the Victory found in the German excavations at Olympia, and probably set up in memory of the battle of Sphacteria, 424 B.C. It bears the inscription "Dedicated to Olympian Zeus by the Messenians and Naupactians as a tithe of the spoil of their enemies. Paeonius of Mende made the statue, and was a successful competitor in the construction of the gable-figures for the temple." The last phrase may be responsible by a confusion for the attribution to him of the pediment.

See E. A. Gardner, *Handbook of Greek Sculpture* (1915).

PAEONY (*Paeonia*), a genus of plants remarkable for their large and gorgeous flowers; it belongs to the family Ranunculaceae. There are two distinct sets, one the strong-growing herbaceous kind, with fleshy roots and annual stems, derived mainly from *Paeonia albiflora* and *P. officinalis;* the other called the tree paeony, stiff-growing plants with half-woody permanent stems, which have sprung from the Chinese *P. Moutan.*

The herbaceous paeonies usually grow from 2 to 3 ft. in height, and have large much-divided leaves, and ample flowers of varied and attractive colours, and of a globular form in the double varieties which are those most prized in gardens. They usually blossom in May and June, and as ornaments for large beds in pleasure grounds, and for the front parts of shrubberies, few flowers equal them in gorgeous effect. A good moist loamy soil suits them best, and a moderate supply of manure is beneficial.

The garden varieties of modern times are very beautiful, the flowers being in many instances delicately tinted with more than one colour, such as buff with bronzy centre, carmine with yellowish centre, rose with orange centre, white tinted with rose, etc.

The moutans or tree paeonies are remarkable for their sub-shrubby habit, forming vigorous plants sometimes attaining a height of 6 to 8 ft., and producing in May magnificent flowers which vary in colour from white to lilac, purple magenta, violet and rose. These are produced on the young shoots, which naturally bud forth early in the spring, and are in consequence liable in bleak localities, unless protected, to be cut off by spring frosts. They require to be thoroughly ripened in summer, and therefore a hot season and a dryish situation are desirable for their well-being; and they require perfect rest during winter. They are increased by grafting in late summer or autumn on the roots of the herbaceous paeonies. There are hundreds of names given to the colour variations of both the herbaceous and tree paeonies.

In North America the genus is represented by a single species, the western paeony (*P. Brownii*), which grows on brushy slopes in the foothills and on mountains up to about 5,500 ft. altitude from southern California to Washington and eastward to Utah. It is a fleshy perennial, 8 in. to 15 in. high, with pale, smooth, ternately divided leaves, mostly clustered at the base of the stem The brownish-red flowers, about 1½ in. broad, are composed of 5 or 6 thick, leathery, flattish petals, which are but slightly longer than the roundish, concave sepals.

PAËR, FERDINANDO (1771–1839), Italian composer, was born at Parma on June 1, 1771. His first opera, *La Locanda de' vagebondi*, was published when he was only 16; and others rapidly followed. In 1797 he went to Vienna, where his wife, the singer Riccardi, had obtained an engagement at the opera; and here he produced another series of operas, including his *La Camilla ossia il Sotterraneo* (1799) and his *Achille* (1801). In 1803 he was appointed composer to the court theatre at Dresden. At Dresden he produced *Il Sargino* (1803) and *Leonora* (1804), based on the same story as Beethoven's *Fidelio*. In 1807 Napoleon saw him in Dresden, and took him with him to Warsaw and Paris at a salary of 28,000 francs. In 1812 he succeeded Spontini as conductor of the Italian opera in Paris, but in 1823 he retired in favour of Rossini. He died May 3, 1839. Paër wrote 43 operas.

PAESTUM, an ancient Greek city in Lucania (Gr. Ποσειδωνία; mod. Pesto), near the sea, with a railway station 24 m. S.E. of Salerno, 5 m. S. of the river Silarus (Salso), founded by Troezenian and Achaean colonists from Sybaris, probably about 600 B.C. for it was flourishing about 540 B.C., when the neighbouring city of Velia was founded. For many years the city maintained

its independence against the Lucanians but at last fell into their hands; and in 273 B.C. it came under Roman rule, the name being changed to Paestum. It successfully resisted the attacks of Hannibal. Under Augustus and Tiberius, the neighbourhood was healthy, highly cultivated, and celebrated for its flowers; the "twice blooming roses of Paestum" are mentioned by several Latin poets. Its present deserted and malarious state is due to the silting up of the mouth of the Silarus. In 871 Paestum was sacked and partly destroyed by Saracen invaders; in the 11th century it was further dismantled by Robert Guiscard, and in the 16th was finally deserted.

The ruins are among the most interesting and imposing of the Hellenic world. The earliest temple is the so-called Basilica. Terra cottas of the first quarter of the 6th cent. B.C. have been found, and also a fragment of a dedication to Poseidon, so that his name should be applied to this, and not to the great hexastyle temple. It is of unique plan, with nine columns in the front and eighteen at the sides, $4\frac{3}{4}$ ft. in diameter. A line of columns runs down the centre of the cella. The columns and the architraves upon them are well preserved, but there is nothing above the frieze existing, and the cella wall has entirely disappeared. Next in point of date comes the so-called temple of Ceres, a hexastyle peripteros (after 540 B.C.). The columns are all standing, and the west and part of the east pediment are still *in situ*. In front stood a sacrificial altar as long as the temple itself.

The temple hitherto attributed to Neptune, was built about 420 B.C. It is a hexastyle peripteros with fourteen columns on each side, and is remarkably well-preserved, both pediments and the epistyle at the sides being still *in situ*. The cella, the outer walls of which have to a great extent disappeared, has two internal rows of seven columns $4\frac{2}{3}$ ft. in diameter, upon which rests a simple epistyle, supporting a row of smaller columns, so that the interior of the cella was in two storeys.

The Temple of Peace (2nd cent. B.C.) was excavated in 1830, but is now covered up. Traces of a Roman theatre and other buildings, as well as of the main street (*cardo*) have also been found. The circuit of the town walls, well built of squared blocks of travertine, and 16 ft. thick, of the Greek period, is almost entire; they are about 3 m. in circumference, enclosing a roughly rectangular area. There were four gates, that on the east with a single arched opening being well-preserved. Outside the north gate is a street of tombs (the contents are in the Naples Museum). (T. A.)

PAEZ, JOSE ANTONIO (1790–1873), Venezuelan soldier and politician, was born in Aricagua near New Barcelona, on June 13, 1790, of Indian parents. After an adventuresome youth, in 1810 he joined the revolutionary movement against Spain, as leader of a band of mounted plainsmen. In numerous encounters with the Spaniards in the province of Apure (1816), in the defeat of Ortiz (1818), and in the victories of Carabobo (1821) and Puerto Cabello (1822), he showed himself an able leader, and was chiefly responsible for bringing Venezuela within Bolívar's republic of Great Colombia. In 1829 he headed the revolt in Venezuela against Bolívar, and was first president of the new republic, 1831–35. During his successor's term he crushed several rebellions, served as president, 1839–43, and was dictator in 1846. Heading a rebellion soon afterwards, he was defeated, imprisoned and exiled (1850), but after a short stay in Europe, returned in 1858 to head another revolutionary Government. In 1861 he was sent as ambassador to the United States, but was soon recalled to fill his third term as dictator-president. Unable to control the situation, he resigned peaceably in 1863, and retired first to Buenos Aires (1866) and then to the United States (1871), where he died in New York on May 7, 1873. While in New York, in 1867–69, he published an *Autobiografía*.

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PAEZ, PEDRO (1564–1622), Jesuit missionary to Abyssinia, born at Olmedo in Old Castile in 1564, entered the Society of Jesus, and was sent to Goa in 1588. Within a year he and a fellow missionary were sent to Abyssinia to act as spiritual directors to the Portuguese residents. On his way he fell into the hands of pirates at Dhofar and was sent to Sanaa, capital of the Yemen, where he was detained for seven years by the pasha as a slave. Having been redeemed by his order in 1596, he spent some years in mission work on the west coast of India. In 1603 he again set out for Abyssinia, and landed at the port of Massawa. He was summoned to court, succeeded in vanquishing the native priests and in converting Za-Denghel, the negus, who wrote to the pope and the king of Spain for more missionaries, an act which led to war with the Abyssinian priests and cost him his life (Oct. 1604). Paez died of fever in 1622.

In addition to the translation of the Catechism, Paez is supposed to be the author of a treatise *De Abyssinorum erroribus* and a history of Ethiopia, ed. C. Beccari in *Rerum aethiopicarum scriptores occidentales inediti a saeculo XVI. ad XIX.* (1905).

See A. de Backer, *Bibliothèque de la Compagnie de Jésus* (ed. C. Sommervogel) vi. (1895); W. D. Cooley in *Bulletin de la société de géographie* (1872), 6th series, vol. iii.

PAGAN, a town and former capital, in Myingyan district, Burma, 92 m. S.W. of Mandalay. It was founded by King Pyinbya in 847, and remained the capital until the extinction of the dynasty in 1298. Pagan itself is now a mere village, but hundreds of pagodas in various stages of decay meet the eye in every direction. A number of them were built by King Anawrahta, who overcame the Peguan king, Manuha of Thaton. It was Anawra-hta who introduced the Buddhist religion in Upper Burma, and who carried off nearly the whole Thaton population to build the pagodas at Pagan like those of Thaton.

PAGAN, a heathen, one who worships a false god or false gods, or one who belongs to a race or nation which practises idolatrous rites and professes polytheism. In the early Christian Church *paganus* was applied to those who refused to believe in the one true God. It thus, of course, excluded Jews. In the middle ages, at the time of the crusades and later, "pagan" and "paynim" (O.Fr. *paenime*, Late Lat. *paganismus*, heathenism or heathen lands) were particularly applied to Mohammedans, and sometimes to Jews. It was in the rural districts that the old faiths lingered, and thus it is assumed that the Latin *paganus* (villager) arose after the establishment of Christianity, but Tertullian (*c.* 202, *De Corona Militis*, xi.), has a sentence suggesting that the "soldiers of Christ" dubbed the non-Christians *pagani*, referring to the raw, half-armed rustics.

See also Gibbon, *Decline and Fall of the Roman Empire* (ed. Bury, 1896), ch. xxi. note *ad fin.*

PAGANINI, NICOLO (1784–1840), Italian virtuoso on the violin, was born at Genoa on Feb. 18, 1784. His father Antonio, a clever amateur, who was in the shipping business, taught him the violin at a very early age, and he had further lessons from the *maestro di cappella* of the cathedral of San Lorenzo. He first appeared in public at Genoa in 1793, with triumphant success. He studied strenuously, practising single passages for ten hours at a time, and publishing compositions so difficult that he alone could play them. His first professional tour, through the cities of Lombardy, was made with his father in 1797. For some years he led a chequered career, and to pay his gambling debts had to pawn even his violin. A French merchant named Livron helped him out of his difficulties, however, and gave him a fine instrument, a Joseph Guarnerius, thenceforward his most treasured possession. Between 1801 and 1804 he lived in retirement, in Tuscany, with a noble lady who was in love with him. In 1805 he started on a tour through Europe, astonishing the world with his matchless performances, and especially with his unprecedented playing on the fourth string alone. In Venice, in 1815, after having been taken up by the Princess of Lucca and Piombo, Napoleon's sister, who made him her musical director, he began a *liaison* with Antonia Bianchi, a dancer, which lasted till 1828; and by her he had a son Achillino, born in 1826. Meanwhile the world rang with his fame. In 1827 the pope honoured him with the Order of the Golden Spur; and, in the following year, he extended his travels to Germany, beginning with Vienna, where he created a profound sensation. He first appeared in Paris in 1831; and on June 3 in that year he played in London at the King's Theatre. In 1832 he

returned to Italy, and bought a villa near Parma. In 1833 he spent the winter in Paris, and in 1834 Berlioz composed for him his symphony, *Harold en Italie*. In 1838 he suffered serious losses in Paris through the failure of the "Casino Paganini," a gambling-house which was refused a licence. The disasters of this year increased his malady—laryngeal phthisis—and he died at Nice on May 17, 1840. His will left a fortune of £80,000 to his son Achillino; and he bequeathed his Guarnerius to the municipality of Genoa, who preserve it as one of their dearest possessions.

There are numerous lives of Paganini; *see* the article and bibliography in *Grove's Dictionary of Music* also Fétis, *N. Paganini* (1851; Eng. trans. 1876); *Prod'homme and Paganini* (1907), in the series *Musiciens célèbres*.

PAGE, THOMAS NELSON (1853–1922), American author, was born at Oakland Plantation, Hanover county, Va., April 23, 1853, the great-grandson of Thomas Nelson (1738–89) and of John Page (1744–1808), both governors of Virginia, the former being a signer of the Declaration of Independence. After a course at Washington College (now Washington and Lee University) when Robert E. Lee was its president, he taught a year and in 1874 graduated in law at the University of Virginia. He practised, chiefly in Richmond, until 1893, when he removed to Washington, D.C., and devoted himself to writing and lecturing.

For his start in literature he was indebted to the dialect verse of Irwin Russell, contributing a poem of this sort to *Scribner's Monthly* (later the *Century Magazine*) in April, 1877, and publishing with A. C. Gordon a volume of such pieces entitled *Befo' de War* (1888). His first reputation was achieved, however, by "Marse Chan," which appeared in the *Century Magazine*. This and several other stories of the same type, some of them written for his first wife, Anne Bruce, were collected in what is probably Page's most characteristic book, *In Ole Virginia* (1887). Page, fortunate in having spent his formative years amid the glamorous life of the old régime and the tumults of the Civil War, is one of the writers who have done most to build up the romantic legends of the southern plantation. He is at his best when through negro characters and dialect he describes the life of the Virginia gentry. From 1913 to 1918 Page was ambassador to Italy. He died at Oakland, Va., on Nov. 1, 1922.

Page wrote several children's books, the best of which, *Two Little Confederates* (1888), has some autobiographic elements. His chief books of fiction are *Elsket and Other Stories* (1891); *Pastime Stories* (1894); *The Old Gentleman of the Black Stock* (1897); *Red Rock* (1898), a novel of the Reconstruction period; *Bred in the Bone* (1904); *Under the Crust* (1907); and *John Marvel, Assistant* (1909). His other writings are thoughtful and sincere. The principal ones are *The Old South* (1892), *The Negro; The Southerner's Problem* (1904), *The Old Dominion: Her Making and Her Manners* (1908), *Robert E. Lee, Man and Soldier* (1911), and *Italy and the World War* (1920). The Plantation edition of his *Novels, Stories, Sketches, and Poems* (12 vols.) appeared in 1906. See *Thomas Nelson Page, a Memoir of a Virginia Gentleman* (1923) by his brother, Rosewell Page; "Thomas Nelson Page" in *Virginian Portraits* by Armistead C. Gordon (Staunton, Va., 1924); and the commemorative tribute to Page prepared for the American Academy of Arts and Letters by Robert Underwood Johnson (1925).

PAGE, WALTER HINES (1855–1918), American writer and diplomatist, was born at Cary (N.C.), Aug. 15, 1855. His father, Allison Francis Page, was of English descent; his mother, Catherine Frances Raboteau, of Scottish and French Huguenot. At 16, in Jan. 1872, after a preparatory course at the Bingham military school at Mebane (N.C.), and a year at Trinity college, at Durham (N.C.), Page entered Randolph-Macon college at Ashland (Va.). The greatest and most lasting influence in his life at this time was Thomas Randolph Price. Prof. Price had two enthusiasms—English and Greek literature. He became deeply attached to Page, both as a boy and as a student, and obtained his appointment as one of the first 20 fellows of the new Johns Hopkins university at Baltimore. There under America's greatest classical scholar, Basil L. Gildersleeve, Page acquired a knowledge of antiquity and a feeling for Greek literature which influenced all his subsequent habits of thought as well as his own literary style. Page's health, always frail, caused him to leave Johns Hopkins without a degree. A winter (1878–79) spent in teaching

wanted an active life among men, and in 1880 he became editor of the St. Joseph *Gazette*. The Missouri town did not hold his interest long. He left in the summer of 1881 to make a tour of the southern states, writing a series of brilliant articles that were simultaneously printed in several leading American newspapers. The next two years Page spent as literary editor of the New York *World*, but in 1883 he resigned and returned to Raleigh (N.C.). For two years he edited the *State Chronicle*, a weekly newspaper, as distinguished for the vivacity of its editorial style as for the unconventionality of its opinions. Page ridiculed the tendency to regard a Confederate war record as almost the exclusive qualification for public office; he advocated primary education for both the white and the black, the development of scientific agriculture, the building of modern highways, and the creation of local industries. All these changes North Carolina has since introduced; the youthful Page, however, was ahead of his time, and after two rather tempestuous years, in which he found himself denounced as a "Southern Yankee," he had to confess failure, dispose of his paper and resume his life in New York.

His Literary Career.—Page's opportunity came in 1887, when he joined the staff of the *Forum*. In four years he transformed a bankrupt property into a profitable one and made it an influential organ of public discussion. He resigned his editorship in 1895 and entered the Boston publishing house of Houghton, Mifflin & Co. For two years he was literary adviser and associate editor of the *Atlantic Monthly*, and in 1898 became editor-in-chief. In 1899 he joined Frank N. Doubleday in establishing the publishing house of Doubleday, Page & Co. and founding the *World's Work* magazine, on which he served as editor from 1900 to 1913. Both in his writing and in his lectures, he continued to advocate his favourite causes. Of these the leading one was popular education, especially in the backward South. As a member, first of the Southern Education Board and afterwards of the General Education Board, he aided in distributing the Rockefeller millions for this purpose. By initiating the movement for the eradication of the hookworm, he started the work that has since taken shape in the International Health Board. He served on President Roosevelt's Country Life Commission, and was a leader in introducing Dr. Seaman A. Knapp's demonstration work in agricultural areas. All these years he closely followed political affairs, and in 1911 he was one of the first to proclaim the presidential qualifications of Woodrow Wilson. One of Wilson's first acts, after his inauguration, was to appoint Page ambassador to Great Britain.

Ambassador in London.—For his five years in London Page's life had been a preparation. His passion for democracy, his belief that British institutions and literature formed the most solid basis of civilization, his long advocacy of British-American co-operation as the most satisfactory method of solving world problems—all were put to the severest test in the arduous years of his ambassadorship. He had established familiar and congenial relations with the British public and British officialdom when the World War began. Up to that time Page had also worked in complete harmony with President Wilson. It was owing mainly to Page's prompting that President Wilson persuaded Congress to repeal the discriminating Panama tolls.

In the war Page, unlike Wilson at first, saw above all an attempt of Germany to grasp the hegemony of Europe and to substitute the Prussian conception of autocracy for the democratic ideal which he regarded as the true path of human progress. It was mainly this difference that caused the historic divergence between Page and Wilson. To the outside world Page maintained an attitude of strict neutrality; in his private communications to the President, however, he made no secret of his complete sympathy with the cause of the Allies and his general disagreement with the policy of the Administration. When the "Lusitania" was sunk, Page in his letters and cablegrams to Wilson strongly advocated an American declaration of war against Germany. He insisted then, as he did afterwards, that American intervention at that time would have brought the war to an early end with an Allied triumph. Page's great moment came on April 2, 1917, when

state of war with Germany, and used arguments that Page had been forcing on his attention for two and a half years.

Page had never been in robust health; and the anxieties and labours of a terrible period gradually exhausted him. He had meditated resignation many times, and consented to remain only at the earnest request of President Wilson. In Aug. 1918, however, he became so ill that the President acquiesced in his retirement. In early October he sailed on the "Olympic" and reached New York so weak that it was necessary to carry him from the ship. His one wish was to return to "the sand hills" of his early home in North Carolina. There he died on Dec. 21, 1918.

BIBLIOGRAPHY.—The chief authority on Page's career is B. J. Hendrick, *The Life and Letters of Walter H. Page* (2 vol., 1922; 3rd vol., 1925). *The intimate papers of Colonel House* (2 vol, 1926) and *The Training of an American: The Earlier Life and Letters of Walter H. Page, 1855–1913* (1928); Viscount Grey, of Fallodon, *Twenty-Five Years* (2 vol., 1925) are also valuable. *The Rebuilding of Old Commonwealths* (1902) gives in eloquent language Page's aspirations for the revitalization of the southern states. *A Publisher's Confession* (1905) gives his creed for his trade. In 1909 Page also published under the name of "Nicholas Worth" *The Southerner*, a semi-autobiographical novel interpreting his ideas on the South. Page's literary fame will rest on his letters. (B. J. H.)

PAGE, WILLIAM (1811–1885), American artist, was born at Albany (N.Y.), on Jan. 3, 1811. He studied for the ministry at the Andover Theological Seminary in 1828–30, and in later life became a Swedenborgian. He received his training in art from S. F. B. Morse and in the schools of the National Academy of Design, and in 1836 became a National Academician. From 1849 to 1860 he lived in Rome, where he painted portraits of his friends Robert and Elizabeth Browning. He died at Tottenville, Staten Island (N.Y.), on Oct. 1, 1885.

PAGE, a term used of a boy or young male person in various capacities, positions or offices. The etymology is doubtful. (*See* KNIGHTHOOD AND CHIVALRY and VALET.)

PAGEANT, a show or spectacle. In the mediaeval drama the word was used in the sense of a scene, a division or part of a play. Thus we read of Queen Margaret in 1457 that at Coventry she saw "alle the pagentes pleyde save domesday which myght not be pleyde for lak of day," and in the accounts of the Smiths' gild at Coventry for 1450, five pence is paid "to bring the pagent into gosford-stret." A clear idea of what these stages were like when the mystery plays became processional (*processus*) that is, were acted on separate platforms moving along a street is seen in Archdeacon Roger's contemporary account of the Chester plays about the end of the 16th century. "The mane of these playes weare, every company had his pagiant, or parte which pageants weare a high scafolde with 2 rowmes, a higher and a lower, upon 4 wheeles" T. Sharp, *Dissertation on the Pageants or Mysteries at Coventry*, 1825, which contains most of the early references.

Production.—Pageant production as differentiated from play production offers the problem of outdoor distances, sunlight and shadow on colour, and the timing and marshalling of large numbers of people. Such problems should be given usually into the hands of an experienced director. Often, however, they are turned over to a committee of capable townsfolk.

The site should preferably be a natural amphitheatre, bordering if possible, on a lake or river. The ground should be gone over for its acoustics, a forest background being an asset Other considerations are accessibility by train, tram and motor, room for parking space, a relative area of open space for stage and audience, practical entrances and exits, beauty of landscape, and room behind the outdoor stage for dressing tents and gathering places for players. An ideal site has the sun in back of the audience and a prevailing wind to blow from players to spectators, thus carrying words toward the hearers.

Administrative details are usually in the hands of a group of representative citizens. The actual labour, making of costumes and properties, gathering of antiques, is all done by the townsfolk. An even distribution of work and a competent executive are necessary. Often a historic pageant is accompanied by a loan exhibition of old costumes, relics, historic furniture, books, maps, household possessions and everything pertaining to the past and present of the community.

The singing should be done by citizens, though band or orchestra may be imported. The latter, for outdoor acoustics, should be sizable. The former needs the addition of stringed instruments for softer effects. All possible effects of light, colour, movement and sound should be synchronized and used to their utmost. A liberal time for writing and planning, an abundance of group rehearsals and three complete rehearsals should make an artistic and successful pageant.

THE PAGEANT IN ENGLAND

The 20th century has seen in England what may in some respects be looked on as a revival but in general as a new departure in the shape of semi-dramatic spectacles illustrative of the history of a town or locality; to such spectacles the name of "Pageant" has been appropriately given. Coventry in its procession in commemoration of Lady Godiva's traditional exploit, has since 1678 illustrated an incident in the history of the town. A pageant consists of a series of scenes, representing historical events directly connected with the town or locality in which the pageant takes place. These are accompanied by appropriate dialogue, speeches, songs, etc., and with music and dances. The effect is naturally much heightened by the place of the performance, more particularly if this is the actual site of some of the scenes depicted, as at the Winchester pageant (1908) where the background was formed by the ruins of Wolvesey castle. The Sherborne pageant of 1905 was the first of the series of pageants. In 1907 and 1908 they became very numerous; of these the principal may be mentioned, those at Oxford, Bury St. Edmunds in 1907; at Winchester, Chelsea, Dover and Pevensey in 1908; and that of the English Church at Fulham palace 1909.

The artistic success of a pageant depends on the beauty or historic interest of its site, the skilful choice of episodes and dramatic incidents, the grouping and massing of colour, and the appropriateness of the dialogue, speeches and incidental music. It is here that the skill and talent of the writer, designer or director of the pageant find scope. The name of Louis N. Parker (b. 1852), the author of the Sherborne pageant, the earliest and one of the most successful, must always be associated with the movement, of which he was the originator. (X.)

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THE PAGEANT IN AMERICA

History.—Pageantry in America began in 1905 with Percy MacKaye's pageant in honour of Augustus Saint-Gaudens, at Cornish, New Hampshire. Within three years the Educational pageant at the Boston Normal school, the Philadelphia pageant in honour of the 250th anniversary of the founding of the city, and the superb Quebec pageant followed.

Five well-known and typical pageants may be mentioned. The Hudson-Fulton celebration in New York was a processional pageant of vast dimensions. For imaginative quality Percy MacKaye's "Caliban," produced in New York, and later in Boston, to honour the Shakespeare tercentenary, should be cited (though the author wishes this example of his work to be termed a "community masque") and for even greater poetic beauty the same writer's St. Louis masque. This last preluded the historical scenes of the St. Louis pageant, written by Thomas Wood Stevens.

"The Pilgrim Spirit" written and produced at Plymouth, Mass., by George Pierce Baker for the Pilgrim tercentenary, was marked by historic accuracy and fine dramatic quality. The Yale pageant, written by a large group of Yale graduates, has naturally a diversity of treatment in its various episodes, but also poetic prologues of high order. The Lexington pageant, by Sidney Howard, is distinguished by its somewhat expressionistic ending, which endeavours to state the significance of democracy.

Forms.—Pageantry has taken two forms. One is the strictly historic as given in the frontier States. These productions deal with pioneering, Indian fights, the gold rush, the cattle industry and agricultural developments. The other is the processional

type, usually a flower festival. The more famous of these are given annually in California and Oregon. Throughout the Southern States, also, are flower and fruit festivals and the justly celebrated Mardi Gras celebration in New Orleans.

The States along the Atlantic seaboard, especially as one moves northward to Pennsylvania, New York and the New England group, use the historical type freely.

Religious pageantry has kept step with civic. The three salient examples are "The Pageant of Darkness and Light," by John Oxenham; "The Wayfarer," by J. E. Crowther, and "Faith of Our Fathers," by Anita Ferris.

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PAGET, SIR JAMES, BART. (1814–1899), British surgeon, was born at Yarmouth on Jan. 11, 1814, the son of a brewer and shipowner. His brother, Sir George, became regius professor of physic at Cambridge and also had a distinguished medical career. After attending school at Yarmouth, James was apprenticed to a general practitioner until 1834 when he entered St. Bartholomew's Hospital, London. It was during his first winter session that he detected *Trichina spiralis,* a minute parasite infecting the human muscles. R. Owen (*q.v.*), who gave these parasites their scientific name, is usually credited with the discovery, but he merely confirmed what Paget had detected. From May 1836, Paget experienced a period of severe poverty, being too poor to secure a house-surgeoncy or even a dressership. However, in 1841 he was made surgeon to the Finsbury Dispensary, and in 1843 lecturer on general anatomy and physiology at St. Bartholomew's. Four years later, he was appointed assistant surgeon, and also Arris and Gale professor at the College of Surgeons. The lectures given under this professorship were published in 1853 as *Lectures on Surgical Pathology.* By 1851 when he was elected F.R.S. Paget had become known as a great physiologist and pathologist. His lectures on physiology were a turning point in the fortunes of St. Bartholomew's school. In pathology, he was Hunter's real successor, and together with his friend, Virchow (*q.v.*), may truly be called the founder of the modern science.

In 1851 Paget began practice near Cavendish square, London. Seven years later he was appointed surgeon extraordinary to Queen Victoria, and in 1863 surgeon in ordinary to the prince of Wales. He specialized on the pathology of tumours and diseases of the bones and joints, and was the first to urge enucleation of the tumour, instead of amputation, in diseases of myeloid sarcoma. He gave original accounts of eczema of the nipple, mammary cancer, and osteitis deformans. In 1871 he resigned his surgeoncy to the hospital and received a baronetcy. In 1875 he was president of the Royal College of Surgeons, in 1877 Hunterian orator and in 1881 president of the International Medical Congress, and in 1883 became vice-chancellor of the University of London He died in London on Dec. 30, 1899.

See *Selected Essays and Addresses by Sir James Paget,* ed. by his son, S. Paget (London, 1902), who has also written *Memoirs and Letters of Sir James Paget* (3rd ed. London, 1903).

PAGET, VIOLET: *see* LEE, VERNON.

PAGET OF BEAUDESERT, WILLIAM PAGET, 1ST BARON (1506–1563), English statesman, was born in London in 1506, and was educated at St. Paul's School, at Trinity Hall, Cambridge, and at the university of Paris. He was employed by Henry VIII. in several important diplomatic missions; in 1532 he was appointed clerk of the privy council. He became secretary to Queen Anne of Cleves in 1539, and in 1543 he was sworn of the privy council and appointed secretary of state. Paget supported Somerset during the minority of Edward VI. In 1547 he was made comptroller of the king's household, chancellor of the duchy of Lancaster, and a knight of the Garter; and in 1549 he was made Baron Paget de Beaudesert. About the same time he obtained grants of lands, including Cannock Chase and Burton Abbey in Staffordshire, and the residence of the bishops of Exeter in London. He also obtained Beaudesert in Staffordshire. Paget shared Somerset's disgrace, being committed to the Tower in 1551 and degraded from the Order of the Garter in 1552. He was, however, restored to the king's favour in 1553, and was one of the twenty-six peers who signed Edward's settlement of the crown on Lady Jane Grey in June. He made his peace with Queen Mary, who reinstated him as a knight of the Garter and in the privy council in 1553, and appointed him lord privy seal in 1556. On the accession of Elizabeth in 1558 Paget retired from public life, and died on June 9. 1563.

PAGODA, a term loosely used for any eastern temple; but more commonly restricted to the pyramidal, conical or turret-shaped buildings of India, Java and the Malay peninsula, which are more accurately known as stupas, and reserved in China and Japan for square, polygonal or circular towers of many storeys. The word was first used in the 16th century by the Portuguese in India, and is a corruption of a native word, either Pers. *but. Kadah,* a house for an idol, or Sansk. *bhagavat,* divine. Chinese and Japanese pagodas usually possess a projecting roof at each floor level and each storey is sometimes slightly smaller than the one below, so that the outline appears to taper.

Pagoda, or pagod, is also the name given to a gold coin current in southern India; *Plumeria acutifolia,* a tree indigenous to India and bearing yellow and white flowers, is known as the pagoda tree

PAGSANJAN, a municipality (with administration centre and 13 *barrios* or districts) in the eastern part of the province of La Laguna, Luzon, Philippine islands, at the junction of the Pagsanjan and Botocan rivers and quite near the Laguna de Bay. Pop. (1918) 7,538. Here is located the Pagsanjan cataract or Botocan falls, some 200 ft. high—one of the largest waterfalls in the Philippines. The district produces coco-nuts and Pagsanjan in an important market place. In 1918, it had 33 manufacturing establishments with output valued at 444,000 pesos, and 76 household industry establishments with output valued at 35,000 pesos The language spoken is Tagalog.

PAHARI LANGUAGE (properly Pahāṛī, the language of the mountains), a general name applied to the Indo-Aryan languages or dialects spoken in the lower ranges of the Himalayas from Nepal in the east, to Chamba of the Punjab in the west. These forms of speech fall into three groups—an eastern, consisting of the various dialects of Khas-kurā, the language of Nepal; a central, spoken in the north of the United Provinces, in Kumaon and Garhwal; and a western, spoken in the country round Simla and in Chamba. In Nepal, Khas-kurā is the language only of the Aryan population, the mother tongue of most of the inhabitants being some form or other of Tibeto-Burman speech. Khas-kurā is mainly differentiated from Central Pahari through its being affected by Tibeto-Burman idioms. Central and Western Pahari have not been brought into close association with Tibeto-Burmans; their language is therefore purely Aryan

Khas-kurā, as its speakers themselves call it, passes under various names. The English term Nēpālī or Naipālī (*i.e.,* the language of Nepal) is a misnomer, for it is not the principal form of speech used in that country, viz., the Tibeto-Burman Nēwārī. Khas-kurā is also called Gōrkhālī, or the language of the Gurkhas, and Pahāṛī or Parbatiyā, the language of the mountains.

Central Pahari includes two dialects:—Garhwālī, spoken mainly in Garhwal and the country round the hill station of Mussoorie, and Kumaunī. spoken in Kumaun, including the country round the hill station of Naini Tal.

Western Pahari includes a great number of dialects. In the Simla Hill States alone no less than twenty-two, of which the most important are Sirmaurī and Keonthalī (the dialect of Simla itself), were recorded. To these may be added Jaunsārī, spoken in the Jaunsar tract of Dehra Dun; Chambiālī and Churāhī, of the state of Chamba; Mandeālī of the state of Mandī; Gādī of Chamba and Kangra; Kuluhī of Kulu, and others.

But the Aryan language of the whole Pahari area is now a form of Rajasthani, exhibiting at the same time traces of the old Khaśa language which it superseded, and also in Nepal of the Tibeto-Burman forms of speech by which it is surrounded.

Khas-kura shows most traces of Tibeto-Burman influence. The gender of nouns is purely sexual, and, although there is an oblique case derived from Rajasthani. it is so often confounded with the nominative, that in the singular number either can be employed

for the other. Both these are due to Tibeto-Burman influence, but the non-Aryan idiom is most prominent in the use of the verb. There is an indefinite tense referring to present, past or future time according to the context, formed by suffixing the verb substantive to the root of the main verb, exactly as in some of the neighbouring Tibeto-Burman languages.

In Eastern and Central Pahari the verb substantive is formed from the root *ach*, as in both Rajasthani and Kashmiri. In Rajasthani its present tense, being derived from the Sanskrit present *ṛcchāmi*, I go, does not change for gender. But in Pahari and Kashmiri it is a participial tense and does change according to the gender of the subject.

Here we have a relic of the old Khaśa language, which seems to have been related to Kashmiri. Other relics of Khaśa are the tendency to shorten long vowels, the practice of epenthesis, or the modification of a vowel by the one which follows in the next syllable, and the frequent occurrence of disaspiration. (*See* INDO-ARYAN LANGUAGES.)

BIBLIOGRAPHY.—S. H. Kellog's *Hindi Grammar* (2nd ed., London, 1893) includes both Eastern and Central Pahari in its survey. For Khas *see* also A. Turnbull, *Nepalī* i.e. *Gorkhali* or *Parbate Grammar* (Darjeeling, 1904) and G. A. Grierson, "A Specimen of the Khas or Naipālī Language," in the *Zeitschrift der deutschen morgenländischen Gesellschaft* (1907), lxi. 659 *seq.* There is no authority dealing with Western Pahari as a whole. A. H. Diack's work, *The Kulu Dialect of Hindi* (Lahore, 1896), may be consulted for Kuluhi. *See* also T. Grahame Bailey's *Languages of the Northern Himalayas* (Royal Asiatic Society, London, 1908). Vol. ix. pt. iv., of the *Linguistic Survey of India* contains full particulars of all the Pahari dialects in great detail.

PAHLAVI (formerly Enzeli), the principal port of Persia on the Caspian Sea, 14 m. N. of Resht, in 37° 29′ N., and 49° 28′ E. It has a mixed population of about 20,000, including many Armenians, Turkmans and Caucasians. The port lies in the channel between two sandpits forming the entrance from the Caspian Sea to a great *murdab* or lagoon (20 m by 7 m). The entrance, about 800 yd. wide, is protected by two breakwaters 500 yd. long. The harbour is entered by vessels up to 15 ft. draught except in bad weather. On both sides of the channel are wharves, piers, tanks for oil steamers and storehouses. There is a weekly passenger steamer service for Baku (20 hours), besides other irregular services.

The tonnage of the trade of Pahlavi was 133,585 in 1925–26, or almost twice as much as all the other Caspian ports put together, carried by 319 steam vessels, of which 305 were Russian. The value of the total trade in the same year was 188,223,000 krans (£ St.=45 krans), of which 68,283,000 krans were exports, the chief items being rice (21,499,000 krans), hides and skins (12,310,000 krans), raisins (11,678,000 krans), raw cotton (8,649,000 krans), fresh and dried fruit, gums, textiles and raw silk. Pahlavi is the principal centre of the rice trade of Gilan. The port is connected with Tehran (247 m) via Resht and Kazvin by a road suitable for heavy motor traffic. In 1926 the Junkers Company was granted a concession for the transport by air of mails, passengers and merchandise between Pahlavi and Tehran, connecting with Europe via Baku. During the World War Pahlavi, then known as Enzeli, was held by the Russians. (*See* RESHT.)

PAHLAVĪ or **PEHLEVI,** the name given by the followers of Zoroaster to the character in which are written the ancient translations of their sacred books and some other works which they preserve. (*See* PERSIA: *Language*.) The name, which means Parthian, can be traced back for many centuries; the poet Firdausī (10th century) repeatedly speaks of Pahlavī books as the sources of his narratives and tells us that in the time of the first Khosrau (Chosroes I., A.D. 531–579) the Pahlavī character alone was used in Persia. The learned Ibn Moḳaffa' (8th century) calls Pahlavī one of the languages of Persia, and seems to imply that it was an official language. The passage, in which useful facts are mixed up with strange notions, is given abridged in *Fihrist,* p. 14, more fully by Yākūt, iii. 925, but most fully and accurately in the *Mafātiḥ al-'olūm* (ed. Vloten, 116). The term is now applied to Middle Persian (from the 3rd to the 7th century A.D.), whether written in the older characters of the inscriptions, which begin with the Arsacid (Parthian) kings, or the cursive writing of the Sassanian period.

The great peculiarity of the language is that though it is Iranian, it is full of Semitic (Aramaic) words. Not only Aramaic nouns and verbs, but numerals, particles and pronouns are used side by side with Persian words. It was once thought to be a mixed language, which like English had largely adopted a foreign vocabulary, but it is now recognized that the Aramaic words are ideograms, and that the corresponding Persian word was always used in reading. Owing to the defective alphabet the words are often ambiguous, and some of them cannot be recognized as Semitic, but we can always tell the Persian word intended. This view, the development of which began with Westergaard (*Zend-avesta,* p. 20, note), is in full accordance with the true and ancient tradition. Thus Ibn Moḳaffa', who translated many Pahlavī books into Arabic, tells us that the Persians had about 1,000 words which they wrote otherwise than they were pronounced in Persian. For *bread* he says they wrote LHMA, *i.e.,* the Aramaic *laḥmā,* but they pronounced *nān,* which is the common Persian word for bread. Similarly BSRA, the Aramaic *besrā,* flesh, was pronounced as the Persian *gōsht.*

We still possess a glossary which actually gives the Pahlavī writing with its Persian pronunciation. This glossary, which besides Aramaic words contains also a variety of Persian words disguised in antique forms, or by errors due to the contracted style of writing, exists in various shapes, all of which, in spite of their corruptions, go back to the work which the statement of Ibn Moḳaffa' had in view. Thus the Persians did the same thing, as when in English we write £ (libra) and pronounce "pound" or write & or & (et) and pronounce "and." No system was followed in the choice of Semitic forms. Sometimes a noun was written in its *status absolutus,* sometimes the emphatic *â* was added, and this was sometimes written as א, sometimes as ה. One verb was written in the perfect, another in the imperfect. Even various dialects were laid under contribution. The Semitic signs by which Persian synonyms were distinguished are sometimes quite arbitrary. Thus in Persian *khwēsh* and *khwat* both mean "self"; the former is written NFshH (*nafshā* or *nafsheh*), the latter BNFshH with the preposition *bĕ* prefixed. Personal pronouns are expressed in the dative (*i.e.,* with prepositional *l* prefixed), thus LK (*lakh*) for *tu,* "thou," LNH (*lanā*) for *amā,* "we."

Great difficulties arise from the ambiguous nature of the cursive characters. Modern mss., following Arabic models, introduce diacritical points from time to time, and often incorrectly. But a much more important help is found in the so-called Pāzand or transcription of Pahlavī texts, in which the Semitic words are replaced by Persian as they are to be read, and which are written in the quite clear Avesta character. Pāzand mss. present dialectical variations according to the taste or intelligence of authors and copyists, and all have many false readings. For us, however, they are of the greatest use. To get a conception of Pahlavī one cannot do better than read the *Minōi-Khiradh* in the Pahlavī with constant reference to the Pāzand. *The Book of the Mainyo-i-Khard in the Original Pahlavī,* ed. by Fr. Ch. Andreas (Kiel, 1882); idem, *The Pāzand and Sanskrit Texts,* by E. W. West (Stuttgart and London, 1871). Critical labour is still required to give an approximate reproduction of the author's own pronunciation of what he wrote.

The coins of the later Sassanid kings, of the princes of Tabaristan, and of some governors in the earlier Arab period, exhibit an alphabet very similar to Pahlavī mss. On the older coins the several letters are more clearly distinguished, and in good specimens of well-struck coins of the oldest Sassanians almost every letter can be recognized with certainty. The same holds good for the inscriptions on gems and other small monuments of the early Sassanian period; but the clearest of all are the rock inscriptions of the Sassanians in the 3rd and 4th centuries, though in the 4th century a tendency to cursive forms begins to appear. Only *r* and *v* are always quite alike. In details there are many differences between the Pahlavī of inscriptions and the books. Persian endings added to words written in Semitic form are much less common in the former, so that the person and number of a verb are often not to be made out. There are also

orthographic variations; *e.g.*, long *ā* in Persian forms is always expressed in book-Pahlavī, but not always in inscriptions The unfamiliar contents of some of these inscriptions, their limited number, their bad preservation and the imperfect way in which some of the most important of them have been published leave many things still obscure in these monuments of Persian kings; but they have done much to clear up both great and small points in the history of Pahlavī It was De Sacy who began the decipherment of the inscriptions

Some of the oldest Sassanian inscriptions are accompanied by a text known as Chaldae-Pahlavī, and belonging to the same system of writing, but with many variations in detail, and an alphabet which, though derived from the same source with the other Pahlavī alphabets (the old Aramaic), has quite different forms. It was soon replaced entirely by Sassanian Pahlavī

The name Pahlavī suggests that the system of writing was developed in Parthian times, when the great nobles, the Pahlavāns, ruled and Media was their main seat, "the Pahlav country" Other linguistic, graphical and historical indications point the same way; but it is still far from clear how the system was developed We know, indeed, that even under the Achaemenids, Aramaic writing and speech were employed far beyond the Aramaic lands, even in official documents and on coins The Iranians had no convenient character, and might borrow the Aramaic letters as naturally as they subsequently borrowed those of the Arabs But this does not explain the strange practice of writing Semitic words in place of so many Persian words which were to be read as Persian It cannot be the invention of an individual, for in that case the system would have been more consistently worked out, and the appearance of two or more kinds of Pahlavī side by side at the beginning of the Sassanian period would be inexplicable

The Pahlavī literature embraces the translations of the holy books of the Zoroastrians, dating probably from the 6th century, and certain other religious books, especially the *Minōi-Khiradh* and the *Bundahish* The *Bundahish* dates from the Arab period Zoroastrian priests continued to write the old language as a dead tongue and to use the old character long after the victory of a new empire, a new religion, a new form of the language (New Persian) and a new character There was once a not quite inconsiderable profane literature, of which a good deal is preserved in Arabic or New Persian versions or reproductions, particularly in historical books about the time before Islam Very little profane literature still exists in Pahlavī

See E. W. West, "Pahlavī Literature," in Geiger and Kuhn's *Grundriss der iranischen Philologie* (1896), vol ii; "The Extent, Language and Age of Pahlavī Literature," in *Sitzungsber. der k b Akad der wiss, Phil u hist Klasse*, pp 399–443 (Munich, 1888), and his *Pahlavī Texts* in *Sacred Books of the East* (1880–97). The fullest grammar is *Mittelpersisch* by C Salemann in vol i of the *Grundriss*. Of glossaries, that of West (Bombay and London, 1874) is to be recommended, the large Pahlavī, Gujaratī, and English lexicon of Jamaspji Dastur Minocherji (Bombay and London, 1877–82) is very full, but must be used with much caution. (Th. N ; E. J T.)

PAIGNTON, a seaside resort of Devonshire, England, on Tor bay, 2¾ m S.W of Torquay, on the S W. railway Pop of urban district (1921) 14,451. The church of St. John is mainly Perpendicular, but has a late Norman doorway, and contains a carved and painted pulpit, and in the Kirkham chapel a stone screen Among other buildings and institutions is a novitiate of Marist Fathers Little remains of an old palace of the bishops of Exeter apart from the 14th century Bible Tower Its last tenant was Bishop Miles Coverdale, who in 1535 published the first English translation of the whole Bible. The town has a fine expanse of sand and good bathing facilities.

PAIN, BARRY ERIC ODELL (1865–1928), English humorous writer, was educated at Sedbergh and at Corpus Christi, Cambridge, where he was a prominent contributor to *The Granta*. James Payn inserted his story, "The Hundred Gates," in the *Cornhill Magazine* in 1889, and he became a contributor to *Punch* and the *Speaker*, and other papers. Discerning critics had already seen the authentic touch of comedy in his earlier work when Pain suddenly achieved fame with *Eliza* (1900). In Eliza's fussy, pompous husband he had found the matter for more than local comedy. *Eliza* had sequels, carrying on the tale of the family, and other excellent studies of London life followed, and some ghost-stories. Pain possessed a rare gift of parody, and found subjects for his skits in many best sellers. One of the first of his essays in this kind was *Another Englishwoman's Love Letters*, and one of the last *Madge Askinforit* He died at Watford on May 4, 1928.

PAIN, SIGNIFICANCE OF. In health we are conscious of few bodily sensations other than a sense of well-being, of physical and mental comfort and accord with our surroundings, with the addition, at certain times, of such pleasant attributes as a glowing skin or a ready appetite The normal interruptions to this state of physiological balance are the transitory discomforts of a too-insistent hunger or a full bowel or bladder, or due to fatigue and such external agencies as heat and cold We are made aware of ill-health either by an indefinable malaise or by more localized and disagreeable sensations; of such are nausea, itching, dizziness and shortness of breath, each of which proclaims a derangement of function in certain organs or tissues The purpose of these symptoms is regarded as protective, just as a flow of tears or a winking eye-lid in response to a speck of dust in the eye is protective. The pain which accompanies and would, indeed, seem to induce the weeping and spasmodic movements of the lid is, in the conscious state, an accompaniment of the protective reflex

Biological Purpose.—Of all the sensory phenomena of disease pain in one form or another is the most frequent and frequently the most urgent It differs in kind from the types of discomfort already cited and is due to distinct causes, but the difference between many other discomforts and pain is merely a matter of degree Thus the ache of a muscle employed in some unwonted effort is probably due to the same factors as those which induce an agonising cramp, it only differs from cramp subjectively in being much more bearable. In both states the muscle-fibres are much tautened, more than is usual at rest or after mild activity; but in cramp the tautening increases until painful spasm occurs Similarly the physiological discomfort of hunger, which depends upon an exaggerated tonic and contractile activity of the muscular coat of the stomach, is only a little removed from the hunger-pain accompanying duodenal ulcer, in which tonic and contractile activity are reflexly exaggerated in moments of approaching emptiness by impulses originating in the nerves exposed by the ulcer

The biological purpose of pain, wherever it occurs, and even although this purpose may sometimes seem difficult of acceptance, is undoubtedly protective When the hand is pricked by the hidden pin it is spontaneously withdrawn to prevent a deeper injury We are careful not to bite upon the sensitive tooth The pain of a broken limb or of an inflamed joint compels disuse and an attitude of rest most favourable to healing. The pain of pleurisy compels restricted and shallow breathing to lessen the friction of the delicate lining membranes of the lung and chest-wall which have been invaded by infective agents and roughened by inflammation. The pain of angina pectoris compels instant and complete physical immobility to give the heart the best possible chance of rest and recovery in a moment of circulatory stress dangerous alike to itself and life

Thus, patently in some instances, obscurely in others, pain serves to inhibit actions which would otherwise add further injury to tissues already damaged by disease The victim of tooth-ache or some more serious agony can scarcely be expected to appreciate the methods of nature or to accept suffering as beneficial; religious devotees of varying cults may persist in claiming pain as a punishment or an expiation for sin; but the medical sciences continue to accumulate evidence which establishes pain and the other symptoms of disease as the necessary sensory element of mechanisms physiologically valuable because they prepare the way for nature's healing endeavour by the process of rest.

Physiological Interpretation.—The foregoing statement seeks to explain the biological significance of pain, but it is necessary also to consider the physiological significance of special pains and of pains felt in various organs and tissues of the body From an appreciation of the physiological significance of pain is derived information of the greatest value in medical diagnosis

and treatment. In the skin special nerve-endings, with appropriate paths in the spinal cord have been demonstrated whose service is to transmit painful sensations, which are referred to and appreciated in consciousness at the site of the actual injury. The skin is also endowed with nerve-fibres for touch, heat and cold. If we except the delicate mucous-membranes of the bodily orifices with their special sensibilities, it is doubtful whether any other tissues possess such specialized powers of appreciation and discrimination. Indeed it is clear that they have small need of them.

It is not for instance a function of muscles to appreciate touch, heat or cold, and they are never required to do so; it has also been shown in the living human being that the hollow internal organs such as the intestines, are not sensitive to inappropriate stimuli and that they can be cut, pricked or burned in the conscious subject without any sensation being registered. But tissues other than the skin have their appropriate functions and must, for their own welfare, be appreciative of excessive or inadequate activity or stimulation. Thus the muscles must be able to gauge the strength of opposing forces and must have a limit to the strength with which they can contract and to the number of times they can contract within a certain period. Extreme stretching or extreme contraction of a muscle, as in cramp, causes pain.

The pain in hollow muscular organs, like the stomach, the bowel, the bladder, the bile-ducts and the arteries, also depends upon excessive tonic or contractile action. Thus when a gallstone is impacted in the bile duct—a very narrow tube—a great increase in tension in the wall of the duct necessarily follows and severe pain results until the stone is passed or relief brought by other means. The mucous membrane (or inner coat) and the serous (or outer) coat of all the hollow organs is, as has been indicated, insensitive to the ordinary stimuli which the skin appreciates, but a bubble of wind and still more some pathological stricture by evoking muscular contraction and increased tension of the muscle-fibres in an attempt to dislodge the bubble or to overcome the obstruction, may cause pain which is referred to the deep situation of the part affected. Solid organs like the brain and liver are apparently insensitive to ordinary stimuli painful in the case of the skin. A bullet, a blade or a needle may traverse them and no hurt be felt in their substance. The delicate covering membranes of these organs, however, are responsive to inflammation or stretching, and still more to a combination of these, giving the intense headache of meningitis and the pain and tenderness of an engorged or inflamed liver.

The lung is not sensitive but its delicate pleural investment certainly is, as sufferers from a pleurisy know only too well. Arteries are sensitive but—as with other hollow organs—stretching or spasm are the effective causes of pain. Bone is not sensitive but its transparent covering, the periosteum, is certainly so, especially when its tension is increased by the swelling attendant upon bruising or inflammation. Direct stimulation of a sensory nerve causes pain and other unpleasant sensations along the course of the nerve. The rolled or injured ulnar nerve (or "funny bone") experiences pain at the point of stimulation and simultaneously an electric twitch of pain radiates down the inner side of the arm to the little finger. In sciatica, an inflammatory nerve-pain, the unpleasant sensations are often felt throughout the course of the nerve to its ultimate distribution.

In all these types of pain the sensation is located in consciousness at the part affected, but there are other types of pain which are spoken of as "referred" or "sympathetic." These depend upon the fact that the nerve-supplies to certain deep-seated structures or organs and certain superficial structures have a common origin. In some cases of tooth-ache pain is experienced in the ear or some area of the scalp which may even become tender to touch as though the skin were inflamed, and yet it shows no signs of local disease. This pain and hypersensitiveness is explained by the circumstance that the nerves to the diseased tooth and the sympathetically affected skin have a common receiving station in the ganglion of the fifth or trigeminal nerve. In angina pectoris the pain is often referred down the left arm, because the same segment of the spinal cord supplies both this region and the heart with its immediate arterial offshoots. In gall-bladder inflammation the pain is often referred to the shoulder-blade, in inflammation of the diaphragm to the shoulder itself, by reason of a similar sharing of segmental nerve-supplies. The tenderness which may develop in these surface areas of sympathetic pain may be of very great value to the physician in his decisions as to the nature and localization of deeply-seated and invisible inflammations. The stimuli in the deep-seated structures potent for the production of referred or sympathetic pain and hypersensitiveness are either some violent mechanical insult as in the case of an impacted gall-stone or kidney-stone, or some more sustained irritation such as is caused by active inflammation in the wall of the organ.

Numerous observations may be made by the physician with regard to a particular pain and each of these may have a special value in helping him to draw conclusions as to its seat of origin, its nature and its ultimate causes. Thus he can elicit information in regard to:—(1) Its character (whether gnawing, aching or burning); (2) its severity (whether easily borne or agonising); (3) its exact situation; (4) its localization or extent of diffusion; (5) its paths of sympathetic propagation or reference; (6) its duration; (7) its frequency; (8) the special times at which it is liable to occur; and, finally, (9) and (10) its aggravating and relieving factors. From such an inquiry he is able to endow pain with a *diagnostic significance* which, in the civilised community, by providing indications for its medical or surgical relief, further serves to enhance its natural value as a protective agent.

See also SKIN, SENSORY FUNCTIONS OF THE.

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PAINE, ROBERT TREAT (1731–1814), American politician, a signer of the Declaration of Independence, was born in Boston, Mass., on March 11, 1731. He graduated at Harvard in 1749, and was admitted to the bar in 1759. In 1768 he was a delegate to the provincial convention which was called to meet in Boston, and conducted the prosecution of Captain Thomas Preston and his men for their share in the famous "Boston Massacre" of March 5, 1770. He served in the Massachusetts general court (1773–74), in the provincial congress (1774–75), and in the Continental Congress (1774–78), and was speaker of the Massachusetts house of representatives in 1777, a member of the executive council in 1779, a member of the committee which drafted the Constitution of 1780, attorney-general of the State from 1777 to 1790, and a judge of the state supreme court from 1790 to 1804. He died in Boston on May 11, 1814.

See John Sanderson, *Biography of the Signers of The Declaration of Independence* (Philadelphia, 1823), vol. ii.

PAINE, THOMAS (1737–1809), English author, was born at Thetford, Norfolk, the son of a Quaker staymaker. After several years at sea and after trying various occupations on land, Paine took up his father's trade in London, where he supplemented his meagre grammar school education by attending science lectures. He was given in 1762 an appointment in the excise, was discharged for neglect of duty in 1765, but, on offering explanations and apologies, was restored, taking an appointment in 1768 at Lewes. His married life was unhappy, his finances became embarrassed and in 1774 he left Lewes, losing his post, leaving his goods to his creditors, and separating from his wife. Encouraged by Benjamin Franklin, he sailed to America, where he arrived in Nov. 1774, and was set to edit the *Pennsylvania Magazine.* On Jan. 10, 1776, he published *Common Sense*, a remarkable and powerful republican pamphlet which had an immediate success. Written in simple, convincing language, it was read everywhere, and the open movement to independence dates from its publication. Washington said that it "worked a powerful change in the minds of many men." When war was declared, and fortune at first went against the colonists, Paine, who was then serving with General Greene as volunteer aide-de-camp, wrote the first of a series of influential tracts called *The Crisis,* of which the opening words, "These are the times that try men's souls," became a battle-cry Paine's services were recognized by an appointment

to be secretary of the commission sent by Congress to treat with the Indians, and a few months later to be secretary of the Congressional committee of foreign affairs. In 1779, however, he indiscreetly published information gained from his official position, and was compelled to resign. He was afterwards clerk of the Pennsylvania legislature, and accompanied John Laurens during his mission to France. His services were eventually recognized by the State of New York by a grant of an estate at New Rochelle. From Congress he received considerable gifts of money

In 1787 he sailed for Europe with the model of an iron bridge he had designed, but his chief object was to repeat his American success His first efforts, in the *Prospects on the Rubicon* (1787), were directed against Pitt's war policy When Burke's *Reflections on the Revolution in France* appeared, in 1790, Paine at once wrote his answer, *The Rights of Man.* The first part appeared on March 13, 1791, and had an enormous circulation before the Government took alarm and endeavoured to suppress it. Pitt "used to say," according to Lady Hester Stanhope, "that Tom Paine was quite in the right, but then he would add, 'What am I to do? As things are, if I were to encourage Tom Paine's opinions we should have a bloody revolution' " Paine was indicted for treason in May 1792, but before the trial came off he was elected by the department of Calais to the French Convention. William Blake, the poet, hustled him prudently out of England, and he took his seat in the French convention Paine, who understood neither the French language nor the dreadful difficulties of the revolution, rapidly made himself unpopular with the Jacobins He incurred the suspicion of Robespierre, was thrown into prison, and escaped the guillotine by an accident Before his arrest he had completed the first part of the *Age of Reason,* the publication of which made an instant change in his position on both sides of the Atlantic, the indignation in the United States being as strong as in England. The *Age of Reason* was written from the point of view of a Quaker who did not believe in revealed religion, but who held that "all religions are in their nature mild and benign" when not associated with political systems Mixed with the unceremonious ridicule of what he considered superstition are many passages of earnest and even lofty eloquence in favour of a pure morality founded on natural religion The work in short—a second part, written during his ten months' imprisonment, was published after his release—represents the deism of the 18th century in the hands of a rough, ready, passionate controversialist

At the downfall of Robespierre Paine was restored to his seat in the convention, and served until it adjourned in Oct 1795, his last speech being an effort to save universal suffrage In 1796 he published a long letter to Washington, attacking his military reputation and his presidential policy with a bitterness due to his belief that Washington and the Americans had deserted him when in danger of death in France In 1802 Paine sailed for America, but found his popularity extinguished. He died in New York on June 8, 1809, and his body was in 1819 removed to England by William Cobbett

See the biography by Moncure D Conway (1892), Gamaliel Bradford, *Damaged Souls* (Boston, 1923), David S Muzzey, "Thomas Paine and American Independence," *Amer Review,* vol iv, pp 278-288 (Bloomington, Ill, 1926); Don C Seitz, 'Thomas Paine, Bridge Builder," *Va. Quart. Rev*, vol. iii, pp 571-584 (Charlottesville, Va., 1927); and Mary Agnes Best, *Thomas Paine, Prophet and Martyr of Democracy* (1927).

PAINESVILLE, a city of Ohio, U S A, the county seat of Lake county; on the Grand river and Federal highway 20, 3 m S of Lake Erie and 30 m N E of Cleveland It is served by the Baltimore and Ohio, the New York Central and the Nickel Plate railways. Pop. (1920) 7,272 (87% native white) It is the seat of Lake Erie college for women, founded as Willoughby seminary in 1847. The city has large nurseries and a variety of manufacturing industries. It operates under a commission-manager form of government. Painesville was founded in 1800–02 by settlers from Connecticut and New York, and was named after General Edward Paine of Connecticut, a Revolutionary officer. It was incorporated as a village in 1832 and became a city in 1902

PAINLEVÉ, PAUL (1863-   ), French politician, was born in Paris on Dec 5, 1863 He was educated at the École Normale Supérieure and became a doctor in mathematical science, soon showing himself to be a mathematician of the first rank. He became a professor at the Sorbonne, and was elected a member of the French *Académie des Sciences.* From the time of the Dreyfus case his interest in politics increased; in 1906 he was elected deputy for Paris as an independent socialist and took a special interest in all questions relating to the army, navy and air force It was not, however, until the World War that Painlevé occupied a political position of any great importance In Briand's cabinet, formed on Oct. 29, 1915, Painlevé became minister of public instruction and of inventions, but finding himself in disagreement with Briand in regard to the conduct of the war, he ceased to be a member of the Briand Government when the latter was reconstructed on Dec 12, 1916

In March 1917 Ribot became premier and gave the portfolio of minister of war to Painlevé, who proceeded to appoint General Pétain in place of General Nivelle as commander-in-chief of the French Army On the resignation of Ribot, Painlevé himself formed a cabinet on Sept. 12, 1917 He would have included the socialists in his government, but owing to their exaggerated demands he was unable to come to an agreement with them. In addition to being premier, Painlevé continued to be minister of war On Oct 19, in consequence of a vote of the Chamber, he felt that his majority was insufficient, and therefore resigned, but he at once reconstituted his cabinet, replacing Ribot by Barthou at the ministry for foreign affairs A few days later, after the Italian disaster at Caporetto, he went to Rapallo at the same time as Lloyd George to meet the Italian premier, Orlando These discussions resulted in the creation of the Supreme Allied Council at Versailles, General Foch being chosen by Painlevé as the chief representative of France On Nov 13, the Chamber having refused to postpone questions regarding "defeatism," Painlevé resigned and was succeeded by Clemenceau

After some years of restricted political activity, Painlevé with Herriot helped to form the *cartel des gauches,* which obtained a majority in the general elections of May 11, 1924 The two heads of this group, Herriot and Painlevé, became premier and president of the chamber respectively. The radicals now organised a kind of ministerial strike, with the result that Millerand was forced to resign the presidency of the Republic The attempt to replace him by Painlevé failed, and Doumergue was elected president. In April 1925 Herriot was forced to resign after a defeat in the Senate on financial questions and Painlevé succeeded him as premier, taking over the portfolio of war as well Caillaux became minister of finance, a position of special importance at that time of financial crisis

In June Painlevé went by air to Morocco, where owing to the offensive of Abdel-Krim a difficult situation had arisen, later he sent out Marshal Pétain to organise resistance and direct a counter-offensive In July he found it was impossible to remain in power without the support of a section of the opposition, for the socialists refused to accept the fiscal policy of Caillaux In October, therefore, with a view to gaining the support of the extreme left, Painlevé himself took over the ministry of finance from Caillaux But on Nov 21 he found himself with a minority in the chamber owing to his financial proposals. He was succeeded as premier by Briand; and, both in that government and in the one formed by Briand in March 1926, Painlevé continued to hold the portfolio of War He was also minister for war in the two successive cabinets formed by Poincaré at the end of July 1926 and in November 1928

Painlevé was made a member of the academies of science of France, Bologna, Stockholm and Upsala as well as of the Reale Accademia dei Lincei in Rome Among his various works on mathematics may be mentioned: *Leçons sur le frottement* (1895), and *Leçons sur la théorie analytique des équations différentielles* (1897). (P B)

PAINT. A paint may be defined as a liquid, containing in suspension a solid coloured material known as the pigment, which is applied to surfaces both for decorative and protective purposes

A paint consists of a mixture of (i) a solid pigment (or a mixture of pigments) and (ii) a liquid medium (known as "the

vehicle"). The vehicle is usually composed of linseed oil (or other drying oil), a drier, and turpentine or other volatile thinner. The linseed oil is added to furnish a binder for the pigments, the drier to accelerate the rate of drying, and the turpentine to give the paint the proper flowing consistency, and to promote ease of application. When a paint is applied the turpentine, being volatile, rapidly evaporates from the painted surface, leaving behind the pigment and oil mixture as a wet coating; this mixture gradually dries into an elastic solid skin owing to the oil absorbing oxygen from the air. The solidified oil acts as a binder for the pigments and holds them in their place; a tough paint film is thus formed which adheres firmly to the surface, and serves both to protect and decorate.

A good quality of paint should be easily applied, cover well, and be opaque, or as it is generally described, possess good "body" or hiding power. The body and covering power of a paint is dependent on the amount and nature of the pigments it contains in suspension; and, as a rule, the finer the state of subdivision of the particles of the pigment the greater the body and covering power. The durability of a paint is mainly dependent on the nature of the oil medium component, and only pure drying oils should be used in their preparation. It is sometimes stated that the oil is the life of the paint. If this were true, oil alone should be more durable than paint, which is far from being the case, since, in fact, oil films do not wear as well as paint films because the addition of pigments to the oil films tends to reinforce them and to make them dry off harder and become more impervious to air and moisture. Ordinary paints should dry with a glossy surface, but they can be made to dry with a flat finish by decreasing the oil content and increasing the proportion of turpentine or other volatile thinner.

The durability of a paint as regards its protective and wearing properties can only be determined by practical exposure tests over a series of years. Additions of heat-treated linseed oil (stand oil), and blown linseed oil to paint mediums increase their durability and wearing properties to a remarkable extent, and impart to them highly elastic and waterproof properties. The same result is also obtained by using a paint medium made from elastic copal varnishes, or Chinese wood oil (Tung oil) varnish.

On the other hand, the use of mineral oils, rosin oils, rosin varnishes or other soft rosin varnish mediums, will cause the rapid deterioration of paint films on exposure, resulting in the paints cracking and chipping off after only a few months' exposure.

The protective and anti-corrosive properties of paints vary greatly according to their composition. For example paints containing mixtures of white lead and zinc oxide pigments are extremely durable and are therefore the most satisfactory for outside use; where it is desired to protect ironwork from corrosion paints containing red lead or graphite are the most efficient.

Paints on exposure over a period of years may chalk (powder off), crack, blister or shell off; the colour of the original paint may also change or even completely disappear. A high-class durable paint for outdoor use should wear well over four or five years, retain its colour, and chalk only to a moderate degree. Paints which blister or crack are unsatisfactory inasmuch as it is then necessary to remove completely all the loose and badly adhering paint before any repainting can be done.

In this article pigments are first described, then the mediums or vehicles by which these pigments are converted into paints, and lastly the paints themselves.

Pigments.—These are finely divided insoluble coloured powders obtained from naturally occurring earth colours, or prepared by chemical manufacturing processes. In the manufacture of paint, it is essential that the colours or pigments used should be in the form of a fine dry powder; this result is achieved by subjecting them before use to a grinding and sieving process.

The pigments which are commonly used in the manufacture of paints are as follow:—

White Pigments:—White lead, zinc oxide, titanium white, antimony oxide, lithopone, basic sulphate of lead.

Inert Pigments or Extenders:—Barytes, blanc-fixe, gypsum (terra alba), asbestine, Paris white (whiting), China clay, silica.

Yellow Pigments:—Chrome yellow, zinc chrome, French ochre, cadmium yellow raw sienna, orange chrome.

Blue Pigments:—Ultramarine blue, Prussian blue, Chinese blue, cobalt blue, Brunswick blue, Antwerp blue.

Green Pigments:—Brunswick green, chromium oxide green, emerald green, verdigris.

Red Pigments:—Red lead, orange lead, Persian red, vermilion, Venetian red, Turkey red.

Brown Pigments:—Vandyke brown, sepia, umber, burnt sienna.

Black Pigments:—Vegetable black, carbon black, ivory black, graphite.

Lake Pigments:—Signal red, royal red, carmine lake, crimson lake, mahogany lake, violet lake.

For a fuller description of pigments *see* PAINTS, CHEMISTRY OF.

Media or Vehicles.—The liquid portions of paints which act as binders for pigments.

The vehicle of ordinary ready-mixed oil paint consists of raw linseed oil—or a mixture of raw and boiled linseed oil—with a small proportion of turpentine, which is added to make the paint more fluid and to promote ease of working. As turpentine is rather expensive, turpentine substitutes, made from a petroleum distillate (white spirit), are often used as a thinning agent. A small proportion of liquid driers (terebine) is usually incorporated in the medium: these driers are solutions of salts of lead, manganese and cobalt, and increase the rate of drying of the oil by what is known as "catalytic" action. The medium used in the preparation of varnish paints, which dry with a high gloss surface, consists of either an elastic copal varnish or a wood oil varnish. (*See* VARNISH.)

Artists' oil paints are usually made in the form of a stiff paste and sold in tubes; the vehicle consists of either poppy seed oil or sun-bleached linseed oil, which is used in order to retain the purity of colour of the pigment. A less satisfactory medium is "megilp" composed of linseed oil and mastic varnish. The vehicles for artists' water-colour paints are chiefly solutions in water of gum-arabic, albumen, isinglass and size. Distemper and water paints are made with emulsified glue or casein vehicles. The medium of the modern cellulose paints or enamels consists of a solution of nitro-cellulose in acetone, amylacetate or other suitable mixed solvents.

Manufacture of Paint.—The process of manufacturing oil paint consists in mixing the dry fine pigment with sufficient medium to convert it into the form of a stiff paste. This stiff paste is then transferred to a roller mill, or other grinding machine, finely ground, and finally conveyed to special paint mixing machines, where it is thinned to the right consistency.

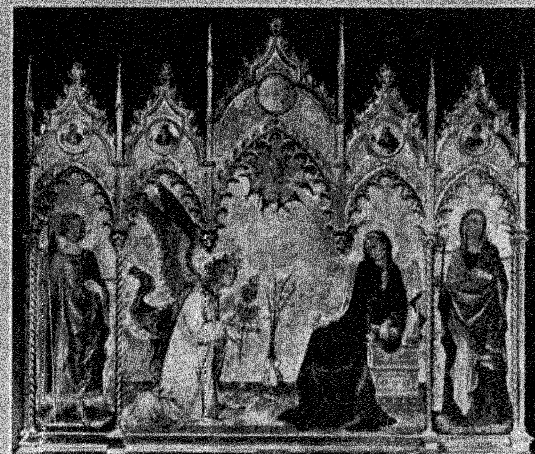
Usually a small proportion of paste driers, or liquid driers is added at this stage, to accelerate the drying of the paint.

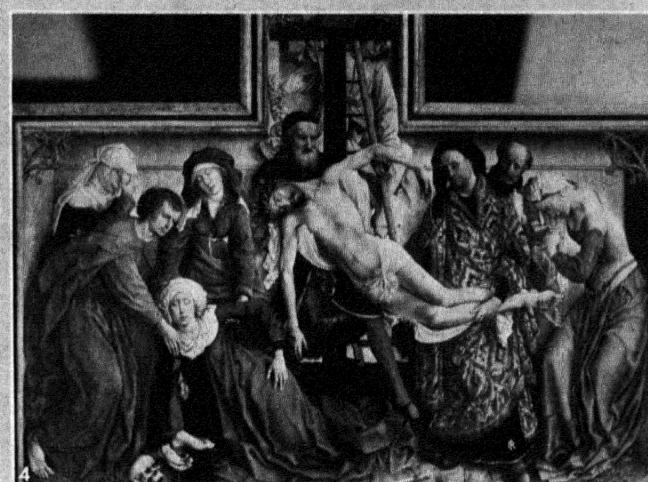
As an immense variety of paint products are manufactured for industrial uses, it would be impossible to give more than a brief description of the most important varieties in common use.

Ready-mixed Paint.—The most common and generally used paint is ordinary ready-mixed oil paint. This paint consists of pigments ground and mixed in a vehicle consisting of a mixture of raw and boiled linseed oil, with a small proportion of turpentine. Pure pigments only are today used in the preparation of most of these paints, but a proportion of some inert pigment or extender is sometimes added to cheapen the cost of the paint. These paints are manufactured in a large variety of colours. The most commonly used white paints are white lead and zinc white paints.

White lead paint possesses exceptional opacity or obscuring power, and has a peculiarly smooth working property which causes it to flow out evenly under the brush. It is considered to be more durable than paints made from other bases, and is therefore especially suitable for external painting. The chief disadvantage of white lead paints is that they are poisonous and great care must be taken to ensure absolute cleanliness after their use. They should not be used for any internal painting work such as the painting of walls, fixtures, furniture, etc. For the provisions of the (British) Lead Paint Act, 1926, *see* PAINTER WORK.

Another disadvantage of white lead paints is that they darken with age, and become discoloured when exposed to the fumes of sulphuretted hydrogen which exists to a greater or less extent in the atmosphere of all large towns. For this reason paints made





PHOTOGRAPHS, (1, 2, 4, 6, 7) ANDERSON, (3) ALINARI; (5) COLLECTION ARCHIVES PHOTOGRAPHIQUES

ITALIAN AND FRENCH PAINTINGS OF THE EARLY RENAISSANCE

1. "Death of St. Francis" by Giotto di Bondone (1266–1337). Fresco in the Bardi Chapel, church of Santa Croce, Florence
2. "Annunciation with S.S. Ansano and Judith," triptych by Simone Martini (*c.* 1283–1344) and Lippo Memmi (fl. 1317–47). In the Uffizi Gallery, Florence
3. Detail of "The Triumph of Death," a fresco attributed to Andrea Orcagna (*c.* 1308–68). On the wall of the Campo Santo, Pisa
4. "Deposition from the Cross" by Rogier Van der Weyden (*c.* 1400–64), Flemish. In the Escorial, Madrid
5. "Pietà" by an unknown artist of the Avignon School, southern France, 15th century. Now in the Louvre
6. "Adam and Eve driven out of Paradise" by Tomaso Guidi Masaccio (1401–28), Florentine School. In the Brancacci Chapel, church of the Carmine, Florence
7. "The Annunciation" by Fra Angelico (Giovanni da Fiesole) (1387–1455). Fresco on the wall of a dormitory cell in the Museum (formerly the monastery) of San Marco, Florence

ITALIAN PAINTINGS OF THE EARLY AND HIGH RENAISSANCE

Left: Fra Angelico (Giovanni da Fiesole, 1387–1455), "Coronation of the Virgin," a fresco. The figures in the foreground are Saints Paul, Thomas Aquinas, Benedict, Dominic, Francis and Peter Martyr. In the Museum (formerly the convent) of San Marco, Florence

Right: Raphael (Raffaello Sanzio, 1483–1520), "The Marriage of the Virgin," painted in 1504 for the church of S. Franceso at Citta di Castello. Now in the Brera Gallery, Milan

on a white lead base cannot be used on gas-holders or in the neighbourhood of a gas-works, as they would rapidly turn quite black.

On account of the many disadvantages of white lead paints a large demand has arisen in recent years for "leadless" or non-poisonous white paints. The chief pigment used in the manufacture of non-poisonous white paints is zinc oxide (zinc white). Zinc oxide, besides being non-poisonous, is a purer white colour than white lead, and hence lends itself admirably for all interior paint-work. It is not so opaque, *i.e.*, it does not obscure or hide so well, as white lead, but is superior in covering or spreading power. Other pigments used in the manufacture of non-poisonous white paints are, lithopone, titanium white and white oxide of antimony. Titanium white was only introduced as a paint pigment during the second decade of this century, but is rapidly coming into favour on account of its remarkable permanency and stability under all atmospheric conditions, and also because of its high obliterating power or opacity which is far greater than that of white lead. A white paint made with a mixture of zinc oxide and titanium white pigment as the base, and a vehicle consisting of heat-treated linseed oil or wood oil (tungoil) varnish, gives an excellent durable paint suitable for exterior use.

This paint has excellent covering and obscuring properties, wears well over a long period of years, and—unlike white lead—will not discolour or turn black even on exposure to sulphuretted hydrogen, acid fumes or other noxious gases. The large variety of light shades or tints in common use, are obtained by the addition of a small proportion of various coloured pigments to white paint; thus for example white paint and vegetable black give greys from the lightest to the darkest hue, depending on the proportion of white and black used. Buff is obtained by tinting white paint with yellow ochre, cream colour results from adding a touch of chrome yellow to white and so on.

The amount of oil required to convert a pigment into paint form varies with the specific gravity of the pigment; a heavy pigment such as white lead (sp.gr. 6·75) will require considerably less oil than a bulky pigment, such as zinc oxide (sp gr. 5·47) or vegetable black (sp gr. 1·72). The ready-mixed paints so largely sold in small packages (1, 2 and 7-lb. tins) for amateur use are, as a general rule, of very poor quality on account of the large amount of inert pigment which they contain; for this reason they are often deficient as regards body and covering power.

Enamel or Varnish Paint.—These types of paints dry with a brilliant glossy surface. They are made by grinding the selected pigment, or mixture of pigments, in a varnish medium, and their nature and properties depend on the type of varnish used. A quick-drying variety is made by using a cheap rosin varnish as the vehicle, it dries with a high gloss surface in about 2–4 hours, but owing to the brittle and non-durable nature of the varnish used it is only suitable for interior use. High-class durable enamels, suitable for both inside and outside use, are made by using mixtures of heat-treated linseed oil (stand oil) and elastic copal varnishes as the vehicle. They are slow-drying, taking from 12–18 hours, and are very tough under the severest climatic conditions

Flat Paint.—This type of paint is really a flat-drying enamel. It is made in much the same way as the high class glossy enamels, except that it contains less varnish and more turpentine than ordinary enamel. Some varieties contain a proportion of wax dissolved in the varnish so as to give a more perfect mat or flat finish. Owing to their pleasing decorative effect they are used for interior decorations, but are not suitable for outside use.

Anti-corrosion Paints.—These paints are largely used for protecting iron and steel structures from rusting. The best anti-rust paint is undoubtedly red lead paint; which is made by mixing red lead with raw linseed oil. As red lead in linseed oil rapidly sets into a hard mass if kept for any length of time it is necessary to mix it just before use. A non-setting red lead has been introduced which obviates this defect and will keep, when mixed in linseed oil, in a liquid condition for any length of time.

Graphite paints, red oxide paints and paints made from basic sulphate of lead are also largely used for the preservation of ironwork. Bituminous paints are also extensively used for painting ironwork, such as gas-holders, bridges, docks, etc., on account of their comparative cheapness and excellent anticorrosive properties. They are composed of an asphalt or bitumen base dissolved in coal tar or naphtha solvent. They are usually black, but other colours can be obtained, which are made by the addition of strong staining pigments to the base.

Anti-fouling Paints.—These paints are used on ships' bottoms in order to prevent the growth of barnacles and weeds.

They are as a general rule quick-drying iron oxide paints, to which a proportion of poisonous material, such as white arsenic, copper suboxide, mercury oxide, etc , has been added. In contact with sea water, these poisonous materials gradually dissolve and thus prevent any deposit or growth forming on the ship's bottom

Coach-builders' Paint.—These varieties of paints are made specially for coach-builders use. They consist of pure pigments, extremely finely ground, in a special quick-drying varnish medium known as goldsize. They are supplied in paste form, and require to be mixed with turpentine to prepare them for use. They are also made ground in turpentine, and in this form require to be thinned with goldsize, flatting varnish or other varnish medium.

Metallic Paint.—Metallic paints, such as aluminium, copper bronze and gold paints are prepared by mixing the finely powdered metals, or their alloys, with suitable varnish media. The metals must be in an exceedingly fine state of sub-division, and are manufactured from the metal leaf by special processes involving the use of intricate grinding machinery. The media used may be either thin copal varnishes or celluloid varnishes.

These paints are heat-resisting, and hence are largely used on hot-water pipes, radiators, etc. They dry with a pleasing metallic sheen.

Fireproof Paint.—These paints are made for use on woodwork, composition boards and other inflammable material. They are usually ordinary oil paints containing a proportion of fine asbestos, borax, sodium tungstate and other fire-retarding materials

Cellulose Paint.—The modern cellulose paints or lacquers consist of a pure pigment, or mixture of pure pigments, ground in a medium made by dissolving nitro-cellulose in suitable solvents

They dry very quickly with a beautiful soft lustre, which is hard, tough and very durable. They are not affected by steam, moisture, petrol or extremes of heat or cold; and may be used on all woodwork, new or old, furniture, motor-cars, floors, walls and metal work. Their popularity is due to their quick-drying properties, which enable work to be finished very much more expeditiously than by the older methods of oil painting. They are highly inflammable

See also DISTEMPER; LUMINOUS PAINT.

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PAINT-BRUSH, the name given to plants of the genus *Castilleja,* of the figwort family (Scrophulariaceae), parasitic on the roots of other plants There are about 50 species, natives chiefly of the New World, but with representatives in Asia. They are most numerous in the Rocky mountain region and on the Pacific coast. They are annual, biennial or perennial herbs, usually 1 to 3 ft. high, with alternate, often deeply cleft or parted leaves, and showy red, yellow or white flowers, borne in dense terminal clusters (spikes), the conspicuous leafy bracts of which are often highly coloured

PAINTER-WORK IN THE BUILDING TRADE. In painter-work the most important fact to remember is that the cost of applying paint is from four to five times the cost of the paint itself, and therefore to use materials of poor quality, because of their relative cheapness, is false economy. The use of paint for decorative purposes is ordinarily secondary in importance to its function as a protector of surfaces from decay. The paint used must be selected carefully according to the purpose for which it is to be employed. For outside use it is essential that the paint chosen should resist atmospheric weathering; in paints used for indoor work great durability becomes less important than a

pleasing finish. In the article PAINT a detailed description is given of the composition of the paints in common use, and of the work for which they are most suited. Until recently, the paints in most common use were based on white lead, and such paints are still very largely used. They cover well and are easy to work. Owing, however, to the danger of lead poisoning (*see* PAINT), their use for interior painting is not to be recommended and they have been largely superseded by leadless or non-poisonous paints made on a zinc or titanium base. The British Lead Paint (Protection against Poisoning) Act, 1926, makes the following regulations for preventing danger from lead paint to persons employed in or in connection with the painting of buildings:—

1. Lead paint shall not be stored, or transported, otherwise than in receptacles legibly marked as containing lead paint.
2. Lead paint shall not be applied in the form of spray in the interior painting of buildings.
3. No painted surface (containing lead) shall be rubbed down, or scraped by a dry process.
4. Every person employed in or in connection with the painting of buildings and liable to come into contact with lead paint shall carefully clean and wash his hands before each meal-time before leaving work.
5. Every person employed in or in connection with the painting of buildings and liable to come in contact with lead paint shall present himself at the appointed time for medical examination.

The tools and appliances of the painter are mixing pots, paint kettles, strainers, palette knife, scraping knife, hacking, stopping and chisel knives, sponge and pumice for washing and rubbing down, blow-lamp for burning off, and a large variety of brushes.

It is absolutely essential for good work to use brushes of a good quality. Brushes must be well cleaned after use, though for keeping overnight it is generally sufficient to wrap them in several thicknesses of paper. Some painters keep their brushes soft overnight by putting them in water. If, however, the brush is not to be used for some time it should be well washed in turpentine and hung up to dry.

Re-painting Old Woodwork.—One of the most important considerations in painting is the proper preparation of the surface to be painted. If this is in good condition it will be sufficient to scrub down with soap and water and afterwards rinse with clean water and wipe dry. If the work has become rough it will often be necessary to use pumice stone to facilitate cleaning. The pumice should be cut or rubbed to a flat surface and vigorously applied with plenty of clean water. It is essential that the work should be quite dry before any paint is applied. If the old paint is cracked or in such a condition as to be ready to break loose as soon as a new coat is applied over it, it must be removed before re-painting. The best method of removing old paint is by burning it off with special painter's blow-lamps; the heat causes the film to soften and it can then be scraped off. Paint may also be removed by strong caustic soda preparations but these are a frequent source of trouble if the soda is not properly removed before new paint is applied. Thorough washing is necessary either with water alone, or preferably with water to which a small quantity of vinegar has been added. Paint removers are now marketed made from mixtures of volatile solvents. They are very inflammable.

Painting New Woodwork.—New woodwork requires to be knotted, stopped, primed, and in addition painted with two coats of undercoating and one coat of finishing oil paint. If paint were applied over the bare knots of new wood it would be destroyed, or at least discoloured, by the exudation of resin from the knots. This is prevented by coating the knots with knotting varnish, made by dissolving shellac in methylated spirits. The purpose of the priming coat is to fill the pores of the wood and to furnish a foundation. The priming coat is a thin paint made by substituting turpentine for part of the oil in ordinary paint, and dries with a flat hard surface.

After the priming coat is thoroughly dry, all nail holes and cracks in the wood should be stopped with white lead putty; and when hard, sandpapered to give a smooth even surface. Two coats of undercoating paint are then applied to give a solid foundation for the final finishing coat.

Painting on Iron.—All structural iron and steel work must be thoroughly cleaned from scale and rust before painting by the use of hammers, scrapers and wire brushes, and all grease carefully washed off with benzine. Three coats of paint should then be applied. The priming coat should be red lead paint and the subsequent coats may be either white lead, basic sulphate of lead, or red oxide paints.

Spraying or Dipping.—The method of applying paints by the dipping or spray process is now largely used industrially, as it enables painting work to be finished much more expeditiously than by the ordinary brush process. In the spray process the paint is applied by forcing it under pressure through a spray-pistol; the dipping process consists in immersing the objects in the paint, and subsequently hanging them up to dry. For use in these processes it is necessary that the paint should be of a thin consistency.

Painting on Cement and Plaster Work.—Paint should not be applied on new cement or plaster surfaces as they contain free alkali which is destructive to paint. The best treatment is either to leave the work unpainted for about 12 months, when most of the free alkali will have disappeared, or to apply a coat of distemper. If it is essential that the work be painted immediately, then the free alkali may be neutralized by washing thoroughly with a solution of 3 to 4 lb. of zinc sulphate in one gallon of water.

Painting on New Galvanized Iron.—Paint will not adhere to new galvanized iron, because it has no grip on the smooth greasy metallic surface. To overcome this difficulty new galvanized surfaces should be treated with a solution containing 4 oz. of copper acetate, or copper chloride in one gallon of water.

Paint Troubles.—*Slow-drying.* This may be due to several causes.

(1). The use of insufficient driers. The quantity of driers required to make a paint dry in a reasonable time depends upon its composition, and also on the weather conditions when the paint is applied. Dark coloured paints, such as black paints and purple oxide paints, require considerably more driers than white lead paints, also more driers are necessary when painting in the winter than in the summer months. Painting work should never be done during damp, cold, foggy weather, as otherwise the paint may take several days to dry.

(2). Faulty preparation of the work. Paints will not dry on greasy or dirty surfaces, hence it is absolutely essential to take care that all the work has been thoroughly washed down and cleaned before paint is applied.

(3). The use of adulterated oils. Paints made with adulterated oils such as mineral oils, paraffin oils and resin oils, will not dry off hard, but always remain soft and "tacky."

Blistering. The cause of paint blistering is often due to painting on damp work or timber which has not been properly seasoned. Blisters may also be caused by the use of too much oil in paint exposed to heat, or the application of one coat upon another before the latter is properly dry.

Cracking is caused by the use of too much oil in the undercoats and too little in the top coats. It may also be due to the paint containing insufficient oil, or a resin varnish.

Loss of Gloss. If a paint is applied on a porous surface, or one that has not been properly primed, it will dry with a poor gloss owing to the paint "sinking in." Paint when applied in damp or wet weather often loses its gloss and dries with a dull finish, owing to the action of the moisture on the paint film during the process of drying.

See W. J. Pearce, *Painting and Decorating* (1927). (J. G. Be.)

PAINTING. In the occidental world, painting is as old as sculpture and it attained from the beginning an astonishing perfection. In the glacial age tribes of hunters and fishermen (though there was little real difference between them and ourselves), decorated the walls of the caves, which served them for shelter, with drawings sometimes enhanced by simple colours—black, ochre or red brown.

It is difficult to determine the intention and significance of these drawings which were executed in subterranean darkness, where they must have been almost invisible at the time they were drawn. Of the several hypotheses that have been proposed, perhaps the most reasonable, which applies also to those animal drawings on

rocks, engraved on the bones of reindeer, or slabs of schist, is that the hunters who executed them believed that they had magic powers and signified thereby both the need and the promise of a capture necessary to the life of the tribe. But what is most surprising and inexplicable is the delicacy, truth and beauty of these reindeer and bison in postures so accurately observed, so true and so full of life that in our eyes they have even that quality which we call style, and which, though drawn by men who were incapable of constructing the most primitive roof, have been unequalled centuries later by those of an infinitely higher state of civilization, who, by slow succession of painful conquest, elaborated many of the elements of art.

ANCIENT PAINTING

Egypt.—Egypt shows a remarkable knowledge of painting, and here as with the men of the reindeer age it was developed in friezes on walls, which were no longer the sides of caves but constructed by the hand of man and covered with fine chalk. In the tombs, for Egyptian art, like Egyptian religion, is mingled with the cult of the dead, images of the deceased, showing his past occupations, had a religious significance and upheld and supported the existence of the *double* on the mysterious voyage after death in the same way that they represented and upheld the existence of the living man on earth. This liturgic conception of art explains the characteristics of Egyptian painting and sculpture; hieraticism was expressed by unchangeable conventions and resulted in a unique solemnity of style. On the other hand, realism was minutely and precisely applied in the most familiar scenes. (*See* EGYPT: *Archaeology and Art.*)

Greece.—That Egypt played a large part in the formation of Greek painting as well as sculpture was recognized by the Greeks themselves, who improved what had gone before by the development of action which grew from the earliest Aegean civilization, as proved by fragments of frescoes found in Cnossos contrasting strongly with the impressive immobility of the Egyptian art. The defective state and the small number of paintings which survive are likely to deceive us as to the relative importance of the three arts: painting, sculptures and architecture. Let us remember the admiration expressed by the ancient authors for the illustrious painters Polygnotus, Protogenes, Zeuxis and Apelles, emulators in their eyes of the great sculptors Pheidias and Praxiteles, though the works of these painters have entirely disappeared. Therefore, we must turn to the Pompeian epoch for traces of Greek painting, for it was Greek artists and their pupils who executed the decorations in the villas of the rich Pompeians. Nevertheless, it is easy to believe that between these elegant and charming paintings and the grand frescoes which adorned the Poikilos (*see* Pheidias; Praxiteles) of Athens or the Lesche of Delphi lay the same difference as between the Olympian Zeus of Pheidias or even the Hermes of Praxiteles, and the amiable statuettes of bas-reliefs of the skilful workmen representing the formula of the Alexandrian school. Only from decorations on vases with black or red figures and lecythi with white backgrounds can we derive any idea of the style and principles of composition honoured in great painting during the golden age (*see* POTTERY AND PORCELAIN: *Greek*) for, so far as can be determined from these sources, drawing, in the most subtle and broad sense, is the dominating element of their painting. The Pompeian decorations, however, are more realistic, including sometimes indications of light and shade and thus pointing the way to some of the essential elements of later painting.

Early Christian.—Christian painting was conceived in the catacombs, content to utilize the types and formulae borrowed from the refectories of the Pompeian decorators and change them into symbols of the new religion. In spite of the mediocre talent of the workers in executing these paintings in which Orpheus became the image of the Good Shepherd, we find a pure and candid grace peculiar to early Christian sentiment. In the Near East the traditions of ancient art survived for a longer period, for it gave birth to Byzantine Art (*q.v.*) incorporating by its hereditary character an immovable and grandiose formula reminiscent of that of Egypt. Mosaics, to which the ancient Romans had already given an important place in the decoration of pavements, took the place of paintings as the principal form of mural decoration. Golden backgrounds surrounded the rigid majestic figures of Christ, angels and apostles, gleaming in the domes and cupolas of Christian basilicas. The luxury, brilliance and incorruptibility of the material, as well as the severe simplification of drawing and colour necessary to the technique of mosaic, was probably thought most suitable for the ornamentation of the house of the Lord in its suggestion of eternity. But this advantage is gained at the expense of all the delicate sensitive variations of true drawing and expression.

Romanesque.—Romanesque painting, which from the 11th century developed in Europe, together with architecture, is heir of the Byzantine models. So far as we can judge by the little remaining with us, it followed the Greek tradition in introducing life and movement which were sometimes carried to the point of a convulsive agitation—inherited perhaps from the Byzantine formula. But aside from the faults and strangeness of this art, as may be seen in the frescoes of St. Savin, it lives, and from this life within it flows uninterruptedly along an animated stream embracing every development of modern art.

Mediaeval.—The evolution of the 12th century art might lead one to suppose that France would be foremost in the development of painting, as she was in sculpture and architecture, but Gothic architecture, which here attained the highest degree of excellence, had the effect of reducing the use of paintings because it eliminated a greater part of the walls and replaced them with slender frame-work, giving rise to the invention of stained glass, a magnificent substitute for mural painting. At the same time, in Paris, a school of illumination rivalled that of stained glass in beauty and richness of colour, incorporating a freedom, a suppleness, an investigation of nature and a delicacy of expression impossible to the other medium. (*See* ILLUMINATED MANUSCRIPTS.)

RISE OF EUROPEAN SCHOOLS

Florentine School.—In Italy where Gothic architecture never replaced the Roman forms with their solid and spacious walls it was possible for a genius such as Giotto to develop the art of fresco which led to the rise of the first great school of painting. At the hour of Giotto's birth in Florence about 1266, a French miniaturist decorated the *Psalter of St. Louis* and it is now generally accepted (*see* Van Marle, *The Development of the Italian Schools of Painting,* Hautecoeur, Gazette des Beaux-Arts, 1925) that not only Cimabue but other painters who had belonged to the Roman School of mosaic craftsmen—Cavallini and the Cosmati, Guinta of Pisa, Nicolas of Apulia and Coppo di Marcovaldo—preceded Giotto in the transition from the mosaic to the supple and freer art of the fresco. But Giotto, while of the group, introduced into painting a grandeur of conception and strength of pathetic expression hitherto unknown. The most famous work of the time, after Giotto, was the *Triumph over Death,* which in a mixture of brutality and refinement is an eloquent expression on the walls of the Campo Santo, Pisa.

Siena School.—Another school almost as brilliant, though perhaps weaker and more delicate, developed at Siena, from the same Byzantine source. When the *Madonna of Majesty* of Duccio di Buoninsegna appeared, the whole town, headed by the bishop, lighted candles and sought to carry her in solemnity to the Duomo. In spite of the fact that she was still submitted to the prevailing convention, the public enthusiasm was awakened by the precious novelty which lay in the miraculous gentle smile that animated the features of the majestic madonna.

Simone Martini endowed religious compositions with even more suavity and it was he who first painted other than exclusively religious subjects. On the walls of the Palazzo Pubblico, Siena, he painted the equestrian portrait of *Guidoriccio da Fogliano.* Following him, Ambrogio Lorenzetti became the painter of civic life, uniting the purely Sienese tradition of Simone with the more robust style of Giotto.

With the commencement of the early Renaissance, at the beginning of the 15th century painters in Italy added scenes of everyday life to the religious compositions and began to apply

a scientific study of anatomy. Masaccio (1401–1428), a young genius who died at the age of twenty-seven, showed affinity to the ancient school, but anatomy was his passion and the nude makes its first appearance in art with his *Adam and Eve* in the Carmine, followed by Masolino in his picture the *Baptism of Christ.*

Fra Angelico, the Dominican monk (1387–1455), in spite of the fact that he seemed destined through piety to continue the profoundly religious tradition of Giotto and the Siennese follows the realistic current. But by a sort of special grace, he used his love of nature to express the purest and most mystical soul known in the history of art. Besides this group of initiators whose work was in a certain sense even more classic than that of their immediate successors, who like Botticelli did not escape a certain mannerism, several men of scientific spirit contributed to form the doctrine of the Florentine school which towards the end of the century was destined to become the model for the great geniuses of the Renaissance.

Development of Perspective.—Paolo Uccello (1397–1475) developed perspective and was so delighted with it as to make thereof a sort of mathematical poetry. Others perhaps under the influence of the great sculptor, Ghiberti, strove by incessant labour to perfect drawing by the conquest of the third dimension. Verrocchio, Pollaiuolo and Botticelli, who began as sculptors, carvers, or goldsmiths, added to this drawing which had already become so perfect a sharp metallic precision, a sort of precious hardness. One of their number, the most poetic, Botticelli (1444–1510), conceived better than any other of his time a delightful type of Virgin endowed with a mysterious grace, though at times a little morbid. He translated into painting the dreams of the humanists, and with the *Birth of Venus* and the *Primavera* a new world was revealed to painting.

Outside Florence the complete expansion of Italian art from the end of the 15th century to the first of the 16th century was developed by such painters as Piero della Francesca (1416–1496) at Arezzo. Signorelli, the mighty anatomist, was a precursor of Michelangelo. Antonella da Messina brought to Italy the brutal but expressive realism gained by contact with the Flemish school. Andrae Mantegna (1431–1506), humanitarian, geometrician, archaeologist and great wit, dominated with his imperious personality the whole of northern Italy and formed the link between Florence and Venice, whose school owed its origin to him, through his distinguished Venetian disciples, the Bellinis and Carpaccio. Now classic art is ready to appear.

France.—During this period painting underwent an individual development in the north countries, with France serving as a common ground of understanding. Unfortunately few works other than miniatures have been preserved. The portrait of *Jean le Bon* in the state in which it has come down to us is little more than an archaeological curiosity, but the date, about 1350, is significant, being little later than when Simone Martini in almost the identical spirit and time painted the *Giudoriccio da Fogliano.* Though the *Altarcloth of Narbonne,* with its vast composition in grisaille, including a Calvary, the portraits of King Charles V. and Queen Jeanne de Bourbon, and a series of scenes from the life of Christ show that the Parisian school of about 1375 had already attained a real elegance of drawing, ease of composition and a harmonious mixture of truth and style. Somewhat later, about 1415, the *Tres Riches Heures,* painted for the Duc de Berry by the three brothers de Limbourg, contains veritable little masterpieces wherein genre and landscape are treated with truth and fantasy.

Flanders: Van Eyck Invents Oil Painting.—John van Eyck (1385–1441), was the genius who became the founder of the Flemish school. The inventor of oil painting and a skilful technician, he could paint people, faces, distances, the stones of buildings, embroidered materials, and still life subjects with a veracity and precision hitherto unknown. The reredos of the *Adoration of the Lamb* was painted between 1420 and 1432 and from that moment for a century the Flemish was the dominant art north of the Alps, spreading its influence to Italy. Van Eyck had been in Portugal with Roger van der Weyden, the other pre-eminent master, in Italy. Van Eyck's influence superseded that of the Franco-Flemish on the Rhine, where the Cologne school, during the preceding generation, had shown a graceful sentimental mysticism. To the north, Holland and Germany were conquered, while in France the disasters and miseries of the Hundred Years' War impeded the progress of art. Painters worked at Bourges, Dijon, Avignon and it was in the latter that they met Italians from Siena, summoned there by the Pope. At Dijon they were with the Duke of Burgundy, the enemy of the King of France, an actual possessor of Flanders. Thus resulted a new amalgamation of French and Flemish art toward the middle of the 15th century. Much obscurity still reigns over the question of the relationship between the schools. Of the few important French works preserved, the *Annunciation* of Aix, about 1440, the *Pieta* of Villeneuve-les-Avignon, about 1450, amongst the anonymous ones, and those whose authors are known, such as the *Crowning of the Virgin* by Enguerrand Charonton, and the works happily fairly numerous of miniatures and paintings by Jean Fouquet, justify us in saying that in spite of her misfortunes France had not lost the secret of producing original artists influenced neither too much by other schools nor by one another.

Nothing in the world compares with Van Eyck's picture of an interior with two standing figures known as the portraits of *Jean Arnolfini and his Wife.* It is not too much to say that its extraordinary accuracies and unprecedented imitation of reality have never been surpassed, but the bust-portrait of the painter's wife, a simple head relieved against a plain background, may perhaps compel even greater admiration. From the very first stroke Van Eyck attained an almost unique precision and life, but he was more than a genial precursor of the master realists of Holland; he was the calm theologian composing with the logic and authority of a doctor the multiple symbols of the reredos of the *Lamb* with an even white light on figures which unite the heavenly mysteries with worldly reality.

Roger van der Weyden (1399–1464), whose masterpiece, the *Descent from the Cross,* now at the Escurial, is but a few years subsequent to the achievement of this altar-piece of St. Bavon, is the only Fleming who continued the great conception of the art of Van Eyck, and he added to it a pathos known in his country only in less strength to Hugo van der Goes. The other Flemish artists of the 15th century, dry or full of mannerisms displayed neither inventive nor emotional powers. (*See* EYCK, JOHN VAN.)

THE RENAISSANCE

Italy.—Through the genius of a small number of the most specially gifted mortals, well-nigh universal spirits, Italy reached a goal which resulted in a marvelous influence impregnating the rest of the world with the art of the Renaissance. Leonardo da Vinci (1452–1519) was the first to grasp those facts garnered through two centuries in the gradual conquest of the problems of painting, and, with them, to realize a sort of mystic unity of the real and the spiritual. Finding himself on the borders between scientific discovery and art, this man, at once an architect, sculptor, painter, alchemist and engineer, improved Florentine drawing by applying to modelling with the use of shadow and light that acute subtlety which his predecessors had applied only to outline. In the *Gioconda* and the *Madonna with St. Anne* as well as in other masterpieces the background itself became less a picturesque decoration than an echo of the inner life of a certain element in the total harmony. His picture, no longer a casual mass of detail and episode, became, through the use of the newly discovered laws of perspective, concentrated and organized in line and colour, in shadow and light to the development of a sensitive climax. (*See* LEONARDO DA VINCI.)

Striving to create and interpret the plastic equivalent of passion, Michelangelo (1475–1564), equally universal as sculptor, architect, painter and poet, imbued his art with resistance and force to the utmost limits of expression, at the bidding of his tortured soul. There is little landscape in his painting; all the sentiment, passion and thought of mankind was personified for him in the nude bodies of man and woman. He seldom presented the immobile attitude of repose, whether the figure in marble

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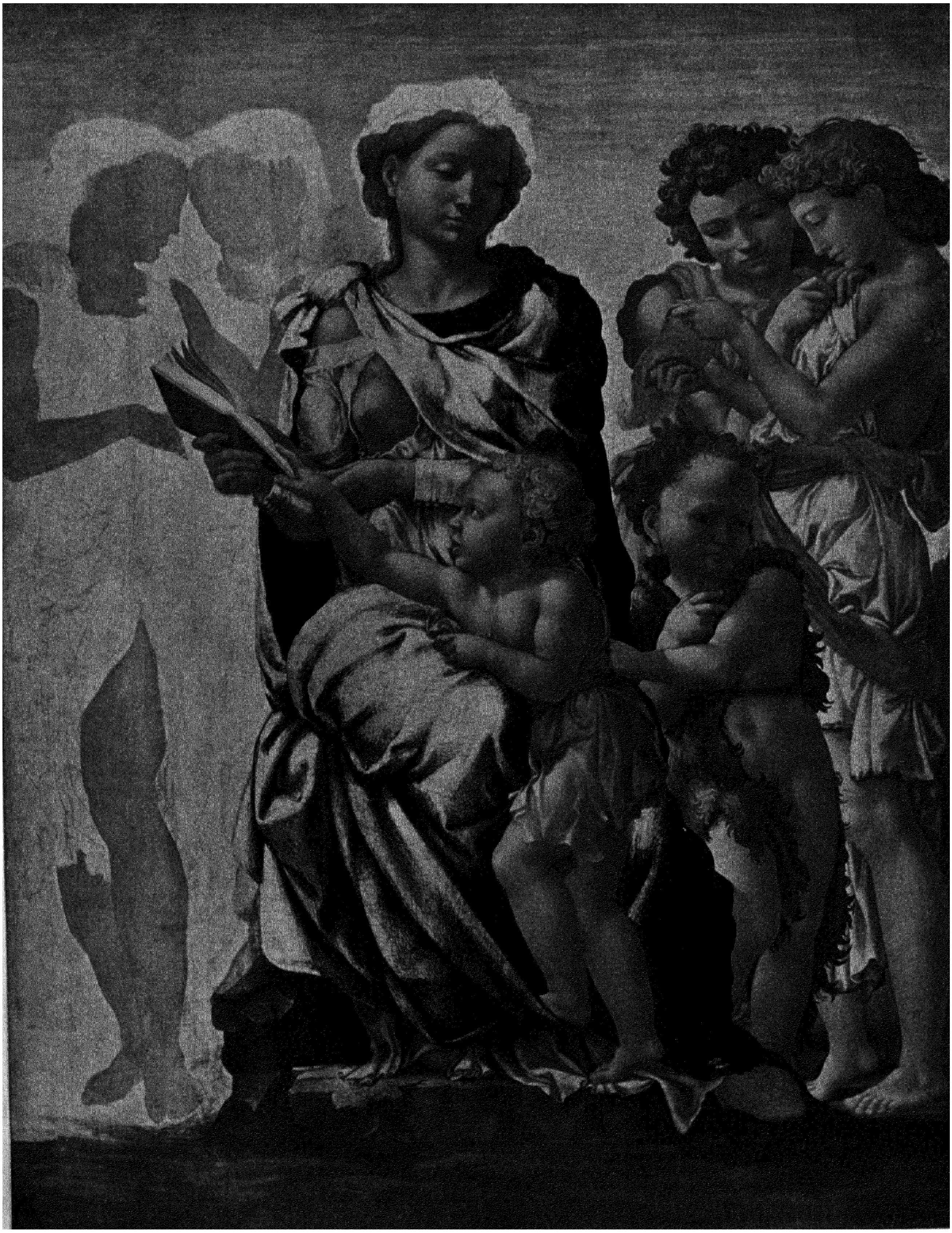
ITALIAN, DUTCH AND FLEMISH PAINTINGS OF THE 16TH AND 17TH CENTURIES

1. "Cumean Sibyl," fresco by Michelangelo (1475–1564), Italian. In the Sistine Chapel, the Vatican, Rome
2. "The Feast of the Gods" by Giovanni Bellini (1430–1516). Venetian School. In the Joseph E. Widener Collection
3. "Marriage at Cana" by Paolo Veronese (1528–88). Venetian School. In the Louvre, Paris
4. "Portrait of Helena Fourment and her Children" by Peter Paul Rubens (1577–1640), Flemish. In the Louvre, Paris
5. "Bohemienne" by Frans Hals (1580–1666), Dutch. In the Louvre, Paris
6. "Laughing Cavalier" by Frans Hals. In the Wallace Collection, London
7. "Lady and Gentleman drinking wine" by Vermeer of Delft (Jan van der Meer, 1632–75), Dutch
8. "Supper at Emmaüs" by Rembrandt van Rijn (1607–99), Dutch. In the Louvre, Paris



MICHELANGELO

"Virgin and Child with St. John and Four Angels" by Michelangelo Buonarroti (1475–1564), an unfinished painting. In the National Gallery, London

happened to be sitting or reclining, whether dreaming, meditating or commanding as those of the Medici tombs, his *Night*, the *Thinker*, or *Moses*, there is a sense of scarcely restrained agitation in his work, but even in the hands of Michelangelo sculpture imposes insuperable limitations, and it was perhaps to escape from these that he became a painter so that he could express those sentiments of his titanic being which were conceived with a sculptor's imagination but which it was impossible to make the marble reveal It was thus that in his work at the Vatican he created the most lyrical and the most epic decorations ever seen in the history of painting (*See* MICHELANGELO)

Raphael (1483–1520) was like Pheidias, who, the Greeks declared, had originated nothing but had brought every branch of art practised by his predecessors to a pitch of perfection and perfect harmony From his master, Perugino, he gathered all of the somewhat limp graces and soft light of the Umbrian school. From Florence he learned the strength and sureness that was Leonardo's and Michelangelo's With fresh rarity he composed on the traditional theme of the Virgin and the Child, painting them with a pure and perfect harmony which only their age-old fame prevents us from fully seeing and appreciating to-day. In his intimate idyllic poetry and air of eternal youth and limpid sweetness, he excludes neither breadth nor majesty of conception. Yet to our eyes even more magnificent claim to honour lies in his conception and realisation of the frescoes with which, from 1509, he decorated the "Stanza" and "Loggie" of the Vatican That sublimity which Michelangelo attained seemingly by fury and passion, he achieved by a sovereign balance of intelligence and sensitiveness: *La Disputa* and the *School of Athens*, the portrait heads, of which there are no finer examples among the works of the most famous professional portrait painters, have the suppleness of gesture, the bright life enveloping a composition all animated and dominated by the fundamental idea

Rome became not only the artistic capital of Italy but of the entire world. Artists from every country made pilgrimages there to worship the ancient capital now reborn in classic art (*See* RENAISSANCE ART)

Germany.—In Germany the greatest artist born north of the Rhine absorbed only a stimulation from the Italian influence which served to enlarge the breadth of his natural imagination Albrecht Dürer (1471–1528) had genius great enough to protect itself as did also Mathias Grunewald, in his tormented dramatism so profoundly Germanic; and Durer, almost comparable with Leonardo, stood on the borders of two worlds, that of the Gothic and that of the modern age, as he did on the borders of two arts, that of the engraver and that of the painter.

Holbein (1497–1543), born in Augsburg and living successively in Basle and England, which gave him a cosmopolitan viewpoint, attained a prodigious realism of a trenchant and precise drawing together with a certain Italian elegance which made him a remarkable portraitist

Holland.—Holland was nearly as extensively influenced as France, but not being welded together by a monarchic power permitted more individual liberty to the artist Quentin Metsys (1466–1530) was conducted by Fouquet, founder of the Antwerp school, to the art of humanism with grace and naturalness. Bosch (1450–1516) took from Italy only a curious element of contrast in the complex course of his fantastic visions, and Pieter Brueghel (1526–1569) in his unbridled humour and lively animation seemed to preserve some Gothic inspiration surviving the Italian influence.

Venice.—After the deaths of Leonardo and Raphael, and while Michelangelo still pursued his career, Venice prolonged with more brilliance Italy's glory, dimming and disappearing in the older schools, and the last great Italian painter was a Venetian of the 18th century, the dazzling decorator, Tiepolo. The first Venetian masters, the Bellinis and Carpaccio, resembled the robust and severe Mantegna, but they quickly turned to the development of the expression of colour and light and the conception of the figure in relation to the landscape with which they made an absolutely new art out of the magnificent decoration which had originally sprung up in Italy. Churches and palaces had been decorated with the same grandeur and splendour because the same religious sentiment manifested itself more or less openly in both. Now, on the contrary, a species of pagan pomp reached even the paintings destined for the churches. For some time, indeed, a human wind had been blowing in; even in the days in which the painters treated only religious subjects, they were seen little by little, in the pictures ordered by the kings and princes, to be choosing for subjects those Bible stories, which allowed either nudities of amorous or voluptuous character or array of magnificent costumes—Salome, Susan, Judith, Bathsheba—and in truth when Diana, Venus and other Olympian divinities began to appear they found the ground all prepared Nevertheless, it is a mistake to imagine that religious sentiment was absent from these sumptuous compositions of the Venetians It was only the tone of the sentiment that had changed Thus, painting, since its modest and fervent beginnings under the shadow of the church progressed in disengaging itself more and more from the didactic rôle originally given it and ceased to preach

Bellini's delicious and tender madonnas, like those of Titian, at times so homely, such as the *Virgin with the Rabbit*, at times so majestic, like the *Madonna of the Frari*, whose glances were ever lowered affectionately on the faithful spectator, have inspired and accompanied many a prayer Tintoretto, surrounded by dazzling colour harmonies of Venetian painting, retrieved the pathetic sense of religious drama, but Veronese seemed to be interested only in grouping beautiful young women and noble senators adorned with silks, brocades and golden chains, and indeed the day came when the Holy See questioned the fitness of such an assemblage of worldly appearance beside the Son of God; but Veronese when questioned said he had put it there to look well and satisfied the tribunal These Venetians were incomparable decorators and the least that can be said of their pictures is that they stirred the souls of the faithful by predisposing them to adore the divine It is also interesting to note that reclining nudes were among the original creations of the Venetian school and particularly those of Giorgione and Titian, in contrast to the Florentine nudes usually standing and so delicate and precise in their outlines as to resemble at times the precious work of the goldsmith, or, at others, marble statuary.

From his earliest days Giorgione (*c* 1477–1510), that genius who died at about the age of 30, treated feminine beauty amidst the beauty of nature in a conception at once both poetic and human On the number of canvases the subjects, such as the *Painter's Family* and the *Sylvan Concert*, are enigmatic, but thereby stir our imaginations all the more Titian developed the same theme in his own way and Bellini painted the noble and delicious *Feast of the Gods* (1514, in Widener Collection, Philadelphia), which already contained the germ, or more than the germ, of Titian's *Bacchanalia*, who later used it in variations in the pictures, *Three Ages of Man* (Bridgewater House, London) and *Sacred and Profane Love* The painter demonstrated he could dispense with the appearance of the mythological fables which remained in Bellini's pictures but which had already been eliminated by Giorgione; beautiful nude figures and others in rich fashionable costumes are assembled without any apparent reason before a vast landscape where our eyes see a mysterious reflection of the painter's thoughts and dreams Thus from Venice came our poetry of the nude, the landscape, and the composition of figures in a landscape—one might almost say three-quarters of modern painting

Eclectic Schools.—Between the Venetians and Rubens, their most legitimate heir, came the Eclectic schools of Italy, including no great geniuses but exercising a considerable combined influence In Spain these schools influenced the definite orientation of a group that had until this time followed several paths, and in the rest of the world they took a temporary premier place

Like a beautiful flowering branch broken from the great Venetian tree, Correggio, who was an initiator, a brilliant decorator, a colourist and harmonist, invested with a delightful beauty such immense compositions as those in the Parma cupola, as well as some of the finest Italian paintings, such as *Jupiter and Antiope*, the *Marriage of St Catherine*, and the *Venus, Mercury and*

Cupid. He had a natural affinity with Titian, Leonardo and Raphael, whose work he recalled. His instinctive example suggested to the Carracci the analytical doctrine applied by the founders of the Bolognese school.

Later Phases of Italian Painting.—Francesco Raibolini (Il Francia) known as the founder of the Bolognese school, whose masterpiece is believed by many to be the *Virgin with Infant Christ and St. Anne enthroned* created a style general all over Italy formed from the finest elements and founded on the great masters. Ludovico (1555–1619), Agostino (1557–1602), and Annibale Carracci (1560–1609) founded their celebrated academy in 1589. If they were partly responsible for what was afterwards called academic art, meaning formed by learned formula, their personal work is far from being negligible. They had ambition and strength enough and were great decorators. The Farnese Gallery is proof thereof, and their pupils Guercino and Domenichino may be looked upon with equal esteem.

The real original talent of those times, however, rose apart from the schools. Michelangelo da Caravaggia (1569–1609) invested his paintings with as much temperament as he did his disordered life. He painted still life, which meant painting for the pleasure of painting quite apart from the subject. This again was something new in art, and he also brought into great religious subjects his robust naturalism, violent contrasts of crude line and opaque shadows, and a taste for unusual and striking scenery, thus forming a picturesque though not undignified style.

In the following generations the most talented painters oscillated between the lesson of Caravaggio and that of Carracci. It was the romantic Salvatore Rosa and the prolific Luca Giordano who by their brilliant compositions on church walls and palace ceilings seemed to announce the coming of Tiepolo, but Venice even in this last period of her splendour still retained the same independence which had distinguished her golden age. The academic could not cool her fire nor the influence of Caravaggio dull her palette.

In the middle of the 17th century amid a surrounding decadence which she alone in Italy escaped, Venice produced inventors in the painting of manners and of landscapes such as Antonio Canaletto (1697–1768) and Guardi (1712–1793) while Piazzetta, a virtuoso of the brush, showed in his excellent pictures a more modern freedom and accent than was attained during the 19th century. Tiepolo (1696–1770) was a decorator in the grand manner of Veronese with less brilliance and less refinement of colour but with luminosity and atmosphere. His masterpiece, the *Story of Antony and Cleopatra*, on the walls of the Labia Palace, reveals his romantic sentiment and essential gaiety.

FLEMISH SCHOOL

Rubens.—In the Prado Museum there are two pieces of painting between which there is a remarkable resemblance—the *Adam and Eve* by Titian and the copy of it by Rubens (1577–1640), who intended his work to be a scrupulously faithful reproduction; however, if the original were missing and we knew nothing about it the copy would be accepted as an authentic composition of Rubens' own, so much is it imbued with the characteristic qualities of this great Flemish painter. In this painting Eve has become one of those beautiful women of Antwerp whose delightful fairness and pearly delicate skin make us forget the occasional heaviness of their forms and whose beauty is so often epitomised in the likeness of his beloved Helen Fourment whom Rubens never tired of introducing into his compositions. To complete the reflections suggested by these examples, the Brussels Museum shows another very curious example. On the same wall one can see the *Miracles of Saint Benoit*, a large composition by Rubens, 1628, and a copy a little reduced which Delacroix painted when, in 1838, preparing to paint his *Entrance of the Crusaders into Constantinople*, he went to consult in the place where Rubens had worked and lived—this man for whom, of all the heroes of the secret Parnassus he had raised in his heart, he felt the most enthusiastic and constant admiration. These two landmarks symbolize in some degree the expanse of a mighty, happy and easy genius who showed the way for the future two centuries.

Humanist in the manner of the great men of the Renaissance, and, as none has ever been after him, anxious to know all and understand all, entering more than any of them into the big affairs of the day, possessing his prince's confidence and only using it on his diplomatic missions to work in those troubled times with true Christian ardour for peace, Rubens was one of those rare mortals who are really an honour to mankind. He was handsome, good and generous. His laborious life was well-regulated. The creator of so many delicious pagan feasts attended mass every morning before entering his studio. He was the most illustrious type of happy and perfectly balanced genius. He conciliates within himself passion, science, ardour and thought. He was a good and honest husband, youthfully in love with a good and charming wife, and, after her death, with a delightful, fair child-woman who with her smiling youth brightened for ten years some of his most beautiful and personal compositions. With these two virtuous loves he created an unexampled cycle of lyrical joy running through a procession of happy nudities, laughing faces and loosened hair, but he expressed drama as well as joy, for nothing human was foreign to him, and he gave, when he wished, a pathos of colour and expression, to such allegories as the *Horrors of War* as well as to his religious masterpieces, the *Descent from the Cross*, the *Road to Calvary* and the *Crucifixion, le coup de lance*. (*See* RUBENS, PETER.)

Van Dyck.—There is not often to be seen a closer resemblance between the master and his disciple than there was between Rubens and Van Dyck, or on the other hand a resemblance which allowed so much freedom of conception in the disciple, this being, in other words, an example of the forming of a great painter by a great master genius. Van Dyck inherited in drawing as in colour Rubens' marvelous ease and his touch had at times a charm and elegance unknown to his master. But this facility was not as with Rubens the instrument of a great and encompassing intelligence, though he endeavoured to amalgamate Italy and Flanders and did at times in certain paintings succeed, more particularly in his canvases of *Madonnas, Holy Families* and *Calvaries*, and his *Descent from the Cross* as well as a few mythological compositions. But Van Dyck's fame rests more securely on his portraits which surpassed those of his master in elegance and aristocratic strength rivalled only by the great English painters of the 18th century for whom he set an example. The *Portrait of Charles I.* in the Louvre is unique in its sovereign elegance.

Van Dyck, beautiful as a woman, was fanciful, nervous, capricious, and his precocity was irresistible beneath this charming surface. He was cold, hardened and much disillusioned; his life was a perpetual festivity. He travelled even more than Rubens and was appreciated everywhere. In 1632 he found the country of his choice and attached himself to the court of the Stuarts, realizing a sort of pre-established affinity with England, and in time he became the greatest exponent of English painting. He died at forty-two, exhausted, only two years after the death of his master, Rubens.

Around these two masters there worked a number of excellent painters from the city of Antwerp, who since the first years of the 16th century settled at Bruges, the centre of Flemish art. Several of them helped Rubens in the execution of his large decorations, such as the *Life of Marie de Medici*. Snyders and Paulus de Vos, among these, were excellent animal painters; Fyt was a still life painter. Cornelius de Vos (1585–1651) was a remarkable portraitist, more interested in expressing the truth than in revealing himself. Jakob Jordaens (1593–1678) had a forceful temperament and in contrast with the aristocratic Van Dyck he developed the vein of exuberant good health which is to be found in their master, Adam van Noort. He sometimes confused force and verve with vulgarity, but in his inspired days his painting came very near to greatness, lit by a fine healthy nudity such as may be seen in the *Child Jupiter* at the Louvre and *Fecundity* at the Brussels Museum. David Teniers (1610–1690) found in Rubens (*Kermesse*) the elements for his portrayal of dancing and drinking peasants and delicate landscapes, but his joviality is taken a little for granted and his observation inclined to be superficial, turning easily to caricature; however, his sureness of

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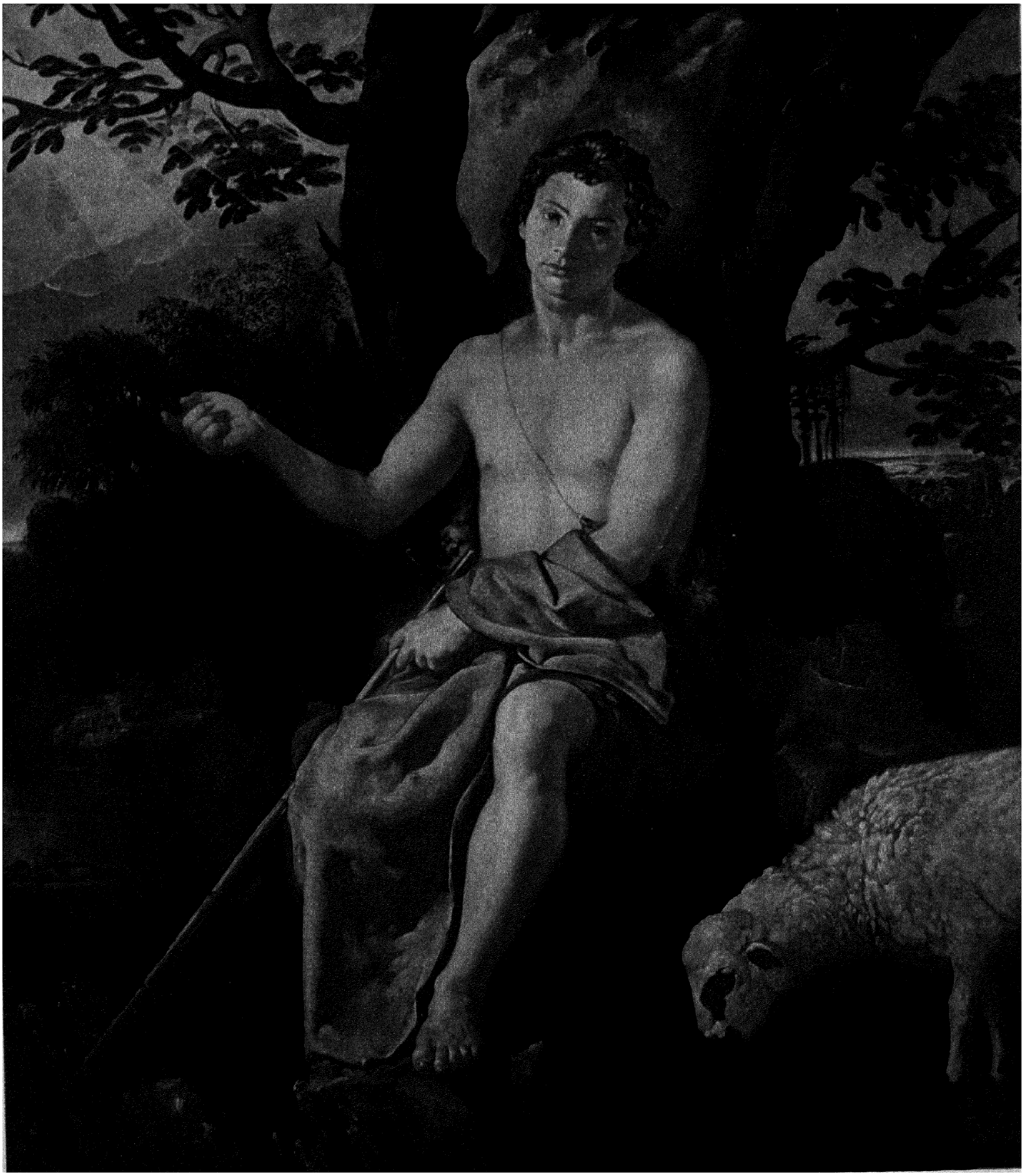
PAINTINGS OF THE 18TH AND 19TH CENTURIES

1. Sign for Gersaint's shop, by Antoine Watteau (1684–1721). French
2. "The Governess," by Jean Baptiste Chardin (1699–1779). French
"Mrs. Robinson (Perdita)," by Thomas Gainsborough (1727–88). English. In the Wallace Collection, London
"Nelly O'Brien," by Sir Joshua Reynolds (1723–92). English. In the Wallace Collection, London
Baigneuses," by Jean Honoré Fragonard (1732–1806). French. In Louvre
6. "Ulysses deriding Polyphemus," by Joseph Mallord William Turner (1775–1851). English. In the National Gallery, London
7. Portrait of the Artist's Son, by Francisco Jose de Goya y Lucientes (1746–1828). Spanish
8. "The Hay Wain," by John Constable (1776–1837). English. In the National Gallery, London
9. "The Family of Charles IV.," by Goya y Lucientes. In the Prado



AN EARLY VELASQUEZ

"St. John in the Wilderness" by Diego de Silva Velasquez (1599–1660), one of the finest examples of the Spanish painter's early period. It may be dated, according to authorities, about 1620, when Velasquez was twenty years old, and before he went to Madrid in his ambition to become court painter. The figure is life size, outlined against a dark landscape; a diffused nimbus glows behind the head, detaching it from the dark mass of the tree in the background. The golden tone of the flesh, which is characteristic of Velasquez' early manner, is accented by the red-violet drapery. The painting, which has passed through many hands, was at one time in the Spanish collection of Louis-Philippe of France, and hung for several years in the Louvre. It came later in private ownership to England and is now exhibited at the Art Institute of Chicago as an anonymous loan

touch, the transparent quality of his colour, both brilliant and fine, deserve unqualified praise, and it is his landscapes, especially with his delicate greens and silvery light, which are outstanding. Jan Siberechts (1627–1703) shows less skilful execution and less agreeable colour, but in his peasant pictures he showed a more original and sincere observation of country life than Teniers. Adrien Brouwer (1605 or 1606–1638) whose life was short and disordered, did few works and he painted mainly tavern subjects similar to the subjects of Teniers and his followers and landscapes which remind us of Rembrandt's. (*See* VAN DYCK, ANTHONY.)

HOLLAND

In Holland at this time there was a tremendous development in art which put in a sudden appearance and which was quite different from what might have been expected from its rather confused beginnings. From the last part of the 15th century until the end of the 16th century the Dutch were not easily distinguished from the Flemish; the painters treated the same religious subjects in the same manner. Gerard of Haarlem (or more correctly, Van Sint Jans) (1465–1493), to whom can be traced a few authenticated works, was almost the only one of these North Flemish primitives of outstanding merit.

In the generation following, Lucas van Leyden (1494–1533) was truly original and his portraits are almost as incisive as those of Albrecht Dürer, who was his elder by twenty years. Like Dürer also, he was more of an engraver than a painter. Images were forbidden in the churches of the Reformation and this meant the end of religious painting, and the naturalistic current which since the Renaissance had spread through the world, reigned from that time on in Holland without obstacle or compromise. There were no more commissions for painters from the king, court or church. The painters had only a republican people to please, and paintings were therefore for elegant, rather small houses and their themes were portraits, landscapes, and genre, thus preparing and introducing to a great extent the program which followed. Official civic art existed only in the form of collective portraits showing groups gathered around a table, a banqueting or council board, the town magistrates, professors, syndicates of a corporation, or the officers of a company of volunteers. Frans Hals (1581–1666) was the first to win distinction, immediately followed by the great Rembrandt and then by Van der Helst (1613–1670). The individual portrait painters include besides these masters some able workers: Mierevelt, Morales, Ravesteyn, Thomas de Keyser and Bol. (*See* PORTRAIT PAINTING.) Within the limits of a revolutionary prosaic conception the Dutch took a high place and showed a perfection of craft perhaps never surpassed. Perhaps the original idea of painting such subjects as card players, drinkers, concerts, and merry companions, which were multiplied indefinitely for more than two centuries originated with Caravaggio and indeed the unity between Italy and Holland is seen in the person of Gerard van Honthorst (1590–1655), who lived many years in Rome where he was called Gherardo della Notte, and who brought back to his country two or three themes borrowed from his master Caravaggio as well as the taste for effects of light either natural or artificial in interiors. But the Dutch painters soon abandoned the decorative and romanesque intentions of the Caravagesque Honthorst and sought only to reveal the truth and to obtain recognizable likenesses of subjects of domestic life, such as scenes in the kitchen or the dining room, incidents of the streets, or of the country; of the seashore and of the sea itself, which was naturally of great interest to this nautical people. Frans Hals painted little else but portraits and he was the first of a school which produced in so short a time a number of talented men.

Landscape art had been brought to a high degree of accomplishment at the time when French miniaturists were illustrating *Tres Riches Heures* for the Duc de Berry; later the Venetians in works of a new richness and rhythm had come close to nature and at this same hour painters such as Ruysdaels, Van Goyens, Van de Veldes, Hobbemas, Wynants, Paul Potters, Albert Cüypes and Van der Heydens flourished; Poussin at the same time was adopting the Venetian idea and adding to it more universal sovereignty. It was reserved to the Dutch to make for the first time in the history of western painting masterpieces of subjects furnished by their native land and with no other apparent ambition than an exact representation of ordinary things, previously judged to be too uninteresting to merit the attention of an artist. The part they took in innovating *genre* pictures was not less great, though the first inceptions may be found among the Flemish primitives such as Van Eyck's painting of *Arnolfini and His Wife*. Therefore, the great painters of Holland, who include Adrian van Ostade, Pieter de Hooch, and Vermeer of Delft, hold a unique position in the field of art and may rank with the most illustrious.

Vermeer.—These essential traits that we attribute to the mass of Dutch painting apply to most of the painters but others soared above the well-defined limitations. Rembrandt, Hals, Steen and Vermeer are the great original geniuses of Holland. Vermeer (1632–1675) is the only one answering to the idea we have of the Dutch national placidity. The impression is that he pursued his task slowly but with an unfailing sureness, and that he took as much interest in painting a reflection on a decanter, a tapestry on a wall, or the material of a carpet or dress as in painting the faces of women and men. No apparent virtuosity, no display of brushwork, no attempted style, but everything brought to a perfection and maximum of photographic effect in accuracy, his cold blues, his pinks, yellows and grays—making rare original creations. Vermeer's women are generally doing nothing but standing or sitting in a room divided by shadow and light; sometimes they are writing a letter or touching the strings of an instrument, and even though the composition contains several figures there is no drama and sometimes no perceptible subject. However, these women make us dream, and we do not forget their mysterious seductiveness. One must go to Corot to find a similar appeal, and one almost as difficult to explain. The explanation is not to be found in the fact that this kind of painting was conquered and practised for its own sake, nor because of the personal quality (such as that of Corot in his pictures the *Vue du Forum, Roma*); but the *Little Street* and the *View of Delft*, wherein a prodigious accuracy is inexplicably arrived at, embody a sort of subtle poetry.

Steen.—In the three other great painters of the Dutch school it would be difficult to discover the least sign of placidity. With Hals and Steen all is movement and even agitation. Their painting might be described as boisterous. Before the *Feast in an Inn* and many other of Steen's pictures (1626–1679), one can almost hear the heavy thumps on the backs of the drunkards who are jostling each other, their shoes stamping the ground; and sonorous bursts of ribald laughter, while a musician blows hard enough to burst his lungs into an instrument which seems almost silenced by comparison with the infernal charivari. His work was very unequal, but when he was inspired he lavished on the licentious scenes which he loved to paint of popular inns or more elegant surroundings, harmonies of brilliant colour and a vigorous touch. He was a satirist and moralist in the manner of old Brueghel and Hieronymus Bosch and he had something of their fantastic imagination.

Frans Hals.—Similar observations apply to Frans Hals (1581?–1666) the oldest of the Dutch painters of the 17th century except that moral intentions were entirely foreign to him and they were the more significant in that his manner and taste for action had not much room in which to expand, for when he painted a portrait of some rich and important person how could he permit himself to indulge the impulses of his own fancy? It is the same in those groups of the *Arquebusiers of St. George*, or the *Saint Adriaen* which made him famous. Hals, with his prodigious ease, his impressive direct brushwork, his gift of conjuring up with broad strokes a living being in all his reality; the expressive movement in the faces, the restless eyes, the speaking mouth or the hands about to seize an object! He did not forget in those civic pictures the broad treatment of the garments and the picturesque quality of the flags, the folds and stripes of which made such attractive backgrounds, but he was certainly at more ease when painting the popular models which inspire such fanciful figures as *La Bohémienne* in the Louvre, the *Lute Player* now in Robert de Rothschild's collection, and the *Hille Bobbe* at Berlin. These fanciful figures seen half-length are certainly derived

from Honthorst's concerts and Caravaggio, though Hals was surely a portrait painter infinitely superior to both, and is unequalled in everything pertaining to pure painting.

Rembrandt.—In spite of the mysterious and august peace which pervades some of his religious compositions such as the *Pilgrims of Emmaus,* or the *Carpenter's Home,* Rembrandt (1606–1669) had little trace of the Dutch placidity. Everything was mysterious, his mind, character, life, work and methods of painting and what little can be guessed through his paintings and the incidents of his unhappy life, evokes troubled and generous ideas, of contrary impulses emerging from the depths of his being as the light and shade emerged from his pictures Yet his life has a fusion identifying intelligence with thought and heart, just as in his painting there is a fusion of many varied elements It seems that his sentiment, broad, free, hardy and unaware of any encumbrance induced in him the most varied meditations which resulted in the unprecedentedly pathetic and unparalleled character that he impressed on all that he painted no matter what the subject There is much unevenness in his work, however, and the inspired sublimity which was such a man's natural vocation could not possibly be a daily occurrence This singular and strangely attractive, at the same time almost enigmatic personality seems to have developed very slowly He showed early talent and an original outlook on the world as is proven by his youthful etchings and the first portraits of himself, as early as about 1630. It was some time, however, before he could find in painting the means of expressing the special things he had to say, and many years before he arrived at that bold, broad and personal expression which we admire in the masterpieces of his maturity and which in his day in spite of all his subtlety were considered coarse, and only acted to estrange him the more from the public In his early painting he adopted a somewhat smooth style little different from that afterwards used by the little masters of his country and which ended by degenerating into minute feats of skill of which Gerard Dou's are the best examples. If Rembrandt had left us only those large, full-length and costumed portraits that made him successful with the rich burghers of Amsterdam or even such celebrated pictures as the *Lesson in Anatomy of Professor Van Culp* (1632), he would no doubt rank among the most excellent painters, but he would not be the man in whom we salute a prophetic recluse, the creator of a new language translating pain, pity, kindness and all the contradictions in the lives of the disquiet human being

From the beginning light played an important part in his conception and he made of it the principal instrument of his expression For him it constituted the poetry of human phenomena when he painted his meditating philosophers, or that *Holy Family,* so charmingly shown in its modest intimacy, and previously called the *Carpenter's Home,* or the *Angel Raphael Leaving Tobit* (both in 1637); but after these he enlarged on it

The *Night Guard* (1642), marks at the same time the height of his reputation and the beginning of his downfall. The important persons—the officers of the Civic Guard who commissioned this great canvas—intimated by the giving of the commission that they considered him capable of rivalling Frans Hals' famous corporate portraits Rembrandt thereupon took it for granted that he had sufficient authority to break away from the rules of genre painting He had already done portraits richer in deep humanity than the more superficial and lifelike ones of Hals and he felt the need of some imaginary or fanciful treatment to relieve a theme which seemed to him too prosaic. Apart from such enigmatic figures in the picture as the little girl carrying a cock (or at least from those which he gave an enigmatic appearance, for this little girl resembling an apparition simply held the prize for the soldiers' shooting match), he had a warm inspiration which was entirely misunderstood and with it applied for the first time that instinct which has in a manner transfigured all of his paintings, even those of the most ordinary subjects. As Fromentin who better than anyone else has realized the essence of Rembrandt's methods has said, the conception consisted of "illuminating an actual scene with light that did not exist—that is to say, giving to an event the ideal character of a vision," and with the painting of this picture Rembrandt realized the full extent of his own abilities Not attempting to paint light for its own sake, as the impressionists did later, he used it like an instrument so that when properly projected it expressed the invisible and the imponderable. No, he did not love light for its own sake or shadow for its mystery, for, to quote Fromentin, "All emerges into a bath of shadow; light itself is plunged therein except when it is extracted to appear far off, more radiant, surging in dim waves around bright centres, shading them, piercing them, rendering the darkness more or less transparent, the half-light easy to penetrate, giving, indeed, even to the strongest colours a sort of permeability which prevents them from being black." And in this use of light and shadow it was not the method which he loved but its result in the portrayal of weak, tortured and miserable humanity, a divine and human figure appears to those who have the eyes to see and mingles with the vicissitudes of the life of the humble; the figure of Christ who bends over the wounds of soul and body, healing and pardoning, and saying "Remember, I have a gentle and humble heart " It is no small honour to Rembrandt to have evoked a few features, and those not the least, of our Saviour's countenance: infinite bounty and compassionate pain. It is no exaggeration to say that after the Primitives, Rembrandt was, with El Greco, the most religious of painters, while at the same time being perhaps the most humane He had pupils, disciples, imitators; a few of them were talented—Nicolas Maes, Govert Flinck, Ferdinand Bol, Gerbrand van der Eeckhout, Aert van Gelder, Jan Lievens Carel Fabritius is an exquisite painter, but though one of Rembrandt's pupils, is nearer to Vermeer. None of these can be compared with Rembrandt, for at their highest they reached only the level of his least good and least personal work

In the pursuit of such a new and difficult ideal, half-failures are inevitable and for that reason misfortune cast its shadow over Rembrandt's genius He was not the sort of man who should be asked to work to order and that is why the rather ordinary portraitist of the great burghers of Amsterdam up to about 1640 became the admirable, incomparable and ceaselessly renewed painter of those many pictures he has given us of himself, and above all that tragic representation of his old age the *Rembrandt with the Silk Handkerchief* in the Louvre and that one in which goodness mysteriously shines in a beautiful maid's features, his faithful friend, Hendrickje Stoffels. All his work was uncompromising, nay almost bald in its truth, and yet with him the true was inseparable from the imaginary Not once did he paint those real life subjects that formed the repertory of his Dutch fellow painters, but he did paint the *Slaughtered Ox,* an almost repulsive object from which all the still life specialists would have recoiled in horror, and in fact this painting is such that even Chardin, the best of still life painters, could not have conceived it. He had a universal curiosity and he saw, meditated, dreamed, and painted withdrawn into himself. Everything he derived from truth, and even the works of others became under his hand instantly transformed into the substance of his own thought. But with the constant, indissoluble, though undeliberate mingling of the imaginary with the true, we are continually being reminded of Shakespeare in his first masterpieces, though Rembrandt's are pure plastic creations without a shadow of literature.

After this magnificent efflorescence, at the end of the 17th century there appeared the first signs of the decadence in Holland which the 18th century completed through the trivial ideal of minute execution which ended in dryness and insipidity

SPAIN

Those years of the 17th century which showed such enormous progress in Flemish and Dutch art also brought into line with universal art a school which had until this time stood somewhat apart. There is much obscurity on the subject of origins of painting in Spain. Catalonia was apparently the principal home of art in the 13th, 14th and 15th centuries and it was here that artists first worked under the sole influence of the French miniaturists to which was added later the influence of the Sienese and still later the art of the Flemish. Until the extreme end of the

15th century, works gracefully and finely executed, such as those of Jaime Huguet (whose name seems to indicate a French origin), show that in the midst of a general production, apparently, but really a continuation of Flemish painting, there existed at least in Barcelona a certain style derived from France. The 16th century in Spain as in Flanders was the epoch of romanticism, and artists who were more theorists than painters adopted a cold scholarly combination of Flemish realism corresponding with the inclination of Spanish imagination and the classical models of the Italian Renaissance.

It is curious that the 16th century man who seemed the most authentic representative was Antonio Moro (1512–1575), who, born in Holland, was known as Anterony Mor van Dashorst, and who, patronised by the courts of Brussels, London and Madrid, painted portraits admirable in truth and dignity such as that of the Duke of Alba.

El Greco.—Another brought to Spain an art which reflected her own mystic and chivalrous spirit. The Cretan, Domenico Theotocopoulos, called El Greco (1545–1614) had studied in Venice in Titian's studio, and his first works showed the mark of their Venetian origin and the influences of Correggio and Michelangelo. He arrived in Spain about 1580 and was soon established at Toledo. Doubtless there was a mysterious affinity between this belated Greek who seemed to retain in his imagination the heretic figures with the distracted eyes of the Byzantine mosaics, and this town, the veritable heart of religious and military Spain where all was ardour, mystery, and a kind of passionate austerity. In Venice El Greco had preferred the dramatic tormented inspiration of Tintoretto to the balanced conceptions of his master, and when he went to Spain he came straight to the city whose monuments and soil to-day appear as though torn by internal drama. He lived the life of an eccentric gentleman painting spasmodically and perhaps it is because of this abstraction that his work holds a species of fascination; and though he appears more mediaeval to us than most authentic primitives, much of his work seems to express the pure essence of art and the specific attitude of the artist. What has been almost sensuous feeling to painters of the 19th century was to El Greco the soaring of the soul, and in spite of the spiritual abyss between the two principles, the plastic results are much the same. Perhaps no one has appeared more indifferent or disdainful of material truth. His figures, disproportionately elongated and twisted, ignore the most elementary rules of anatomy and in spite of the portraitist sense in him the construction of his faces is no more correct. He twisted lines and colours to his despotic fancy, but if after conceding these rights of criticism one is content to observe, the spell of his extraordinarily unique art works upon us and those undulating lines tending toward the vertical, along with the colour in which black and white predominates, impoverished by a kind of aesthetic will, make us perceive that all moves toward an extraordinary intensity of expression. Those strange lines in truth have the trembling elevation of a prayer or ecstasy and they form a marvelous melody upheld by this colouring as of an evening sky over which enpurpled clouds float silvery pale with yellow flashes of lightning and green glimmerings. This man, unable to exist by ordinary laws, was, when he cared, by some miraculous paradox, a portrait painter, and he invested with ardent life, livid visages in which never a drop of blood circulated. His *Crowning of the Virgin, Assumptions,* and *Resurrections* show him to be the only painter who has ever really unfurled celestial visions before dead eyes, and painted them as if he actually saw them, and in the great canvas that was his masterpiece, the *Burial of the Count d'Orgaz,* he realized as no one had ever done before, or may ever do again, harmonies and reactions that appear quite natural, between supernatural and earthly things. Below, a corpse nearly doubled in two in his black steel armour is supported by two saintly beings descended from celestial abodes. Courtiers in sombre and severe costumes are grouped around this miraculous scene, and the painting of all, including the dead man and his blessed pall-bearers, is real and like portraiture. Above them, the irradiated firmament opens and there Christ and the Virgin await the departing spirit while angels with huge curved wings come and go between the region of eternal life and this earth. One feels that this marvelous picture appeared suddenly to the artist's imagination in all its daring composition.

An almost uncompromising realism, paralleled by a spontaneous mysticism, were the two poles of Spanish art, and though the realism at times seemed to predominate, a sort of mystic vibration was never wanting. We see this later in several great painters representing diverse regional tendencies: in Valencia—Ribera (1589–1652); at Seville—Herrera, the Elder (1576–1656), and also Zurbaran (1598–1662), who came under the Italian influence, Ribera being at the beginning a real Neapolitan, called Spagnoletto. Indeed he returned to Naples to die, albeit to a Spanish Naples governed by a Castilian viceroy. Zurbaran went to Rome, but with all of these artists the national temperament was so strong that there was no danger of reviving the 16th century adventure or that of the Romanists. They did not adopt academic formulae from the Italian models but turned to the masters of naturalism, particularly Caravaggio, and each applied his own style to every subject, whether religious, profane or popular, showing a disdain for the conventions which imparted a new outlook to traditional themes. There was something inexplicably crude, even brutal in their vision of reality, and always a feeling for the picturesque and the drama latent in life's spectacles. The celebrated *Franciscan* in the National Gallery shows how Zurbaran, the best balanced and most idealistic of the three, arrived at an extraordinary intensity of spiritual expression by realistic means as much in the individual character of the half-visible face under the monkish hood as in the striking rendering of the fustian robe and the violent contrast of light and shade from which he drew in turn realistic effects of tragic horror as well as suavity, for this frenzied imagination, served by an infallible science and a prodigious virtuosity of the hand, conceived the painting of ragamuffins, beggars, the squalid, dwarfs, and cripples with every human deformity, not in fantastic compositions as the examples of Bosch or Brueghel, but as isolated figures occupying the whole canvas and presented in a manner that until then had been reserved for kings and princes; he infused a sort of cynical verve, a partly harsh, partly fraternal sentiment, that is not without a masculine breadth, and these conceptions no doubt satisfied some obscure predilection in the Spanish soul, for they persisted for years following. The *Club-foot* and similar works of Ribera can claim kinship with the popular types of Velazquez, with Murillo's beggars and many grimacing or burlesqued figures by Goya, and their descendants are to be found even in certain youthful works of Manet. Doubtless the image of suffering was relieved by the idea of the heroic martyrdom authorized by the love of God, but it cannot be denied that Ribera took a sort of savage pleasure in spreading before our eyes scenes rendered with unprecedented precision, of flowing blood, twisted limbs, exposed entrails, victims being flayed, or tortured with red hot pincers, dismembered or burned alive. Polomino (1653–1725), painter and historian, tells us that the picture now in the Prado Museum in which Ribera represented Ixion attached to the wheel and tortured by a dreadful demon, was the cause of a premature confinement of a noble lady who had it before her eyes in a room. However, this same Ribera sometimes took pleasure in conjuring up from black depths the tender figure of a saint with luminous body, and he, nearly alone of the Spanish school, painted the nude. (*See* RIBERA, JOSÉ.)

Velazquez.—Velazquez (1599–1660) owed much to these excellent painters. When in 1629 he visited Ribera in Naples he must have felt gratitude though he only passed by Herrera; and though he was not the pupil of the frenzied Spagnoletto his youthful works show the obvious influence of Zurbaran. His master, who later became his father-in-law, Francisco Pacheco, was not very talented but was a scholarly connoisseur unusually cultivated. If we allow for the differences between the Spanish gentleman, with graceful reserved manners, and the exuberant son of Flanders, the life and career of Velazquez as well as the part he played in the art of his country are reminiscent of Rubens—both represent a magnificent expansion following a period of fruitful preparation;

both were the favourites of the princes of their time and led brilliant lives. Court functions occupied an even greater place in Velazquez's existence than in that of Rubens. At the age of twenty-eight he was an officer of the chamber. From 1624 when he received the title of painter to the King until his death he never quitted the court except for two tours to Italy at intervals of twenty years and even these tours were official missions. He filled many ranks of office which were by no means sinecures and which involved very absorbing work, and he died a grand marshal of the Palace and Chevalier of Saint James. In fact he may have been prouder of these honours and of the king's friendship than of his genius. He admired El Greco and even possessed a few of his canvases. He met Rubens when that master visited Madrid and like Rubens himself he studied the great Venetians whose masterpieces ornamented the royal palace. But all of these advantages would have been insufficient without the gift of genius. One has the impression that this extremely intelligent passionless artist, this highly accomplished example of civilized man, had an almost limitless power over his faculties. He commenced by learning the principles of his craft; he exercised eye and hand by working in the manner of Zurbaran at still-life studies and pictures of popular types and succeeded with wonderful ease. He was only nineteen years of age when he painted that *Water-seller of Seville* which is in the Duke of Wellington's collection, London; the distribution of light and shade, the true and natural attitudes of the types, the theme both sober and rich, all is perfect, and from that moment it was evident he was destined before everything to be a great portrait painter. If one insists on finding an excuse for criticism one might perhaps say that even though the three personages of the picture are perfect their perfection is eclipsed by that of the two "alcarrazas," earthen water-coolers placed in the foreground. Never have there been seen in painting two pitchers so marvelously realistic and they are done with ease and great breadth. Hê might have remained content with such results and have pursued, with the aid of his scholarly craft so early acquired, the development of his personality but a short time after his arrival at Madrid and as soon as he was appointed painter to the King (1624) he changed his style. He resolved, by a deliberate act of intelligence and will, upon that easy and rapid execution in which it seems that by the same stroke the brush renders form, expression and light; a really incomparable style, close to perfection in painting, incorporating the rare quality of satisfying both the public and the connoisseur. A canvas by Velazquez, particularly a head painted by him, since he was first of all a portraitist, makes an immediate appeal even to the spectator least versed in the secrets of the art, in its effortless life and simple, striking effect; whilst the initiated who know the mysteries of the painter's art may delight in the wonderful science, the subtlety and refinement. Velazquez would have been the last to deny that he owed much to Rubens and many generations of painters have consulted both, but nowhere could be acquired a technique of painting comparable with that of Velazquez. It seems that this man to whom everything was easy except the expression of passion, doubt, or agony, considered with a calm mind the various obligations of life. His reason for adopting the new technique was undoubtedly a necessity caused by the short time he had for painting, because his life was becoming increasingly involved in the king's service. Manet has said, as had many others before and after him, that Velazquez was the painter's painter.

A few murmur, "Yes, one can see that he was an incomparable painter, but this amazing imitator of life had no imagination," and these severe censors may be right if they refer to the faculty of plastically translating legendary themes and mythological fables, of composing allegories and depicting winged creatures on the sky of a ceiling, or perchance those who fly without wings and whose gestures have nothing in common with terrestrial habits; but it seems imagination, and of a kind best suited to a painter, to evolve with a restricted palette an entirely new scale of colours, full of distinction, fineness and strength, on which he can play with the infallible results of an accomplished musician. These sober and refined harmonies which were very personal to him contribute towards the particular impression which we feel before Velazquez's masterpieces, whether they be portraits or compositions in which the portrait is always the essential element. The truth impresses itself upon us with such force that we are tempted in the vividness of the sensation to accuse all other painters, even the greatest, of falsehood—poetic falsehood, pathetic falsehood, and all the most beautiful forms of falsehood, if you will, but nevertheless falsehood. However, if the picture takes possession of us it is not merely because it shows us that which our eyes under certain circumstances might have seen had they been trained to see, but because it opens before us an unknown world created by art before which we all stand speechless, holding our breath as though before some magic apparition.

Velazquez's portraits of the king, the infantas, princes and lords were often repeated and in none of these did he attempt to do away with individual awkwardness or peculiarity as does the average portrait painter in a mood of flattery, but by virtue of the supreme elegance and distinction which are innate in him he avoids offense. His portraits are charmingly attractive, imposing or disquieting, and they intrigue us indefinitely, like enigmas. Perhaps he did not entirely succeed in his few attempts at religious painting, but in these again can be observed the original trait of his personality. If his *Coronation of the Virgin* may be to some extent reproached with coldness the composition is of a perfect and original elegance, and the type of Mary is like no other. His *Christ Crucified,* now in the Prado, suffices and is perhaps the most beautiful modern representation of the subject simply conceived and painted with the most scholarly craft. Another great artist, Goya, less perfect but more passionate than Velazquez one day thought himself great enough to rival the master whom he nevertheless profoundly admired. His *Christ* in the same museum in spite of his charming subtleties appears both flabby and vulgar as compared with that of Velazquez.

Finally, three important compositions put the seal on Velazquez's fame; his originality is entirely proved, as well as his sovereign elegance by *Las Lanzas,* or the *Surrender of Breda, Las Meninas* and *Las Hilanderas. Las Lanzas* was an official picture commanded by the King in honour of a military event considered glorious to the monarchy. It filled exactly the same function as, a little later, the canvases of Van der Meulen glorifying the pageantry of Louis XIV. But without belittling the faithful picturesque annalist, Van der Meulen, there is a world of difference between his work and this noble composition with its delicate pervading light, its chivalrous air, these noble portraits and this blue and silver sky crossed by the barrier of lances, which make it the finest historical picture in existence. *Las Meninas* and *Las Hilanderas* are still finer. His own personal technique in the development of these subjects makes them very different from what they might have been if handled by one of the little Dutch masters who would at best have translated them into some agreeable genre picture. There is some secret probably due to those years of study and technique which in itself does not suggest anything calculating or contrived. These two big canvases representing, one a corner of the tapestry factory of St. Isobel, and the other, a room in the Royal Palace with Velazquez himself painting the portraits of Philip IV. and his second wife, Maria Anne of Austria, are unique works; they are, in their way, without precedent and unrivalled in later days, including enough material to provide endless lessons to the succeeding generations of painters. In the foreground of one the spinners are occupied with their work while in the background under a quite different light and in a different plane, deer, whose presence seems accidental, have just entered the factory and gaze on the tapestry representing themselves. The whole gives a sort of fairy-like sense of apparition without being marred by any discord or feeling of incongruity. In the other picture the whole foreground is occupied by three elegant and charming figures: a little infanta, stiff in her rich attire, and two ladies in waiting pressing forward to serve her. In the shadows are two dwarfs and a big dog. It is usual to call the picture *Las Meninas,* even though the supposed subject is that of Velazquez painting the portraits of the king and queen. Velazquez is indeed there, but

in the second plane and in shadow, the back of the huge easel before him cutting the whole left of the composition. It is not easy to find the august models. In the background in the depths of the chamber under a light subdued by the window curtains there are, side by side, two bright rectangles, one lighter than the other, which come from an open door on a staircase in which is standing a man turned towards us and a mirror in which is reflected the far-off image of the king and queen posing for their painter. We are confronted with the enigma of this painting in its subject and intention, or apparent absence of intention, but his art re-acts on us as a magic evocation of truth and light.

Good painters continued in Madrid for some time under the impulse given by this master. Velazquez's son-in-law, Mazo (1615–1667), to whom is now attributed the charming little picture in the Louvre, *Meeting of Thirteen Gentlemen,* and Carreño de Miranda (1614–1685), who was a good portrait painter, were of them, but a great genius does not found a school, and twenty-five years after Velazquez's death art in Madrid had faded into mediocrity. (*See* VELAZQUEZ.)

Murillo.—It was in the south, in Seville, the birth-place of Velazquez that during his time he met a rival in Esteban Murillo (1617–1682) and to contemporary eyes the latter may have appeared even the more admirable of the two, for his popular sentimental art was much better calculated to touch the heart of the public than was the lucid, intelligent, unemotional and infallible mastery of the painter of *Las Meninas.* But in truth he was rightly admired with enthusiasm and gratitude by a pious Spain to which after the reign of the great court painter he gave an art which expressed in simple language the tender ecstasy and adoration of an innocent and profound faith. He, too, following Zurbaran, began by painting in a realistic manner, which he did not entirely abandon even later in those roguish subjects which he found in the streets of Seville. The *Young Beggar* of the Louvre and other pictures in the same style are enough to show us on what a solid foundation of observation his ideal creations rested. His first compositions were pious, such as the *Miracle of San Diego* in the Louvre. He found a way of uniting in a harmony that has all the appearance of spontaneity, a realistic execution with mystic sentiment. Therein lies one of Murillo's greatest merits. Perhaps in the past his *Immaculate Conception* in the Louvre was overrated, but one should not exaggerate one's criticism in the negative direction. Murillo was one of the most suave painters of the Madonna we have seen, besides Velazquez, who might be compared to Raphael. Murillo holds about the same rank as Andrea del Sarto and after him decadence came quickly. Only Valdes Leal (1630–1691), with his dramatic talent which sometimes bordered on the horrible, stood out against the vapidity that invaded religious painting. In the 18th century in Spain there were only second-rate French painters summoned there by the Bourbon kings, the German, Raphael Mengs, a good portrait painter, and for a short while, Tiepolo, the last of the great Venetians who came from Italy to decorate the Royal Palace, and who died in Madrid. (*See* MURILLO.)

Goya.—Goya (1746–1828) had an entirely different type of temperament from that of Velazquez, and in his personal style is unequalled. It is through him that the fine Spanish tradition, which for nearly a century and a half almost disappeared, was renewed. He was less perfect, less sovereign but infinitely more varied. No effect that could be attained by means of painting was unknown to him and all of his inequality was the result of extreme fecundity. He was as original a draughtsman, etcher and lithographer as he was painter, but unlike Velazquez he did not arrive easily at mastery. At first he abandoned himself to a life of pleasure at any price. In spite of his unrestrained coarseness, his strong personality, gaiety and humour attracted everybody. Though he was married and his wife gave him twenty children he was to be found anywhere but at home. He frequented both bad and good company; he became the lover of the Viranas and he eloped with the Duchess of Alba. Then, having quarrelled with her, he revenged himself by mocking her in drawings and paintings, insolently, impudently and cruelly. But everything was forgiven him. At the age of thirty he was painter to the king and an academician, though had he died at the age of forty it is possible he would not have left a single one of the works which made him famous. That is a significant fact, for this impulsive man, therefore, we may believe, was a thinker. He was of those who, being born to create a new form of art, have no other masters than themselves and their own experiences in life. He was one of the three great geniuses of Spanish art and even more than the great Velazquez he reminds us of the most illustrious name in his country's literature, Cervantes, because of the blending in the works of both of them of lyricism and grotesque pathos and satire. Like Greco and Velazquez, he was an admirable portraitist. One might even go so far as to say that portraiture was the basis of his art; that even in his works of pure imagination the understanding of character peculiar to the portraitist persisted everywhere. It was so in the two typical masterpieces of Greco and Velazquez, and the *Family of Charles IV.* brings this out strongly, for it seems only a collection of portraits, a good-natured old king, a queen with the bearing of an imperious sorceress, princes and princesses of all ages loaded with silk, velvet embroidery, necklaces and precious gems. The animation of the brushwork, the sparkling and mysterious colour scheme so entirely new, are in themselves sufficient to distinguish this unique composition, but all these admirable inventions of the colourist and virtuoso are stripped of half their beauty if we do not perceive, first and foremost, all the brilliant and subtle variations on the tragi-comic theme of human psychology. Goya renovated and innovated everywhere; whether working for the churches or painting political pictures, he was always doing the unexpected. His cartoons for tapestry show that he had studied Boucher and Fragonard; but there was nothing conventional in him. In the scenes he painted—gallant, joyful or dramatic—everything—costumes, types, attitudes—has an accent of convincing realism. His constantly renewed inspiration found a fruitful field in his little genre pictures, though the term is inadequate to describe these little masterpieces of invention, observation, emotion, and irony. In *La Romeria de San Isidro,* a landscape unique in its time, as much for the fine clearness of its atmosphere as for the free spiritual and precious notation of the hundreds of tiny figures on foot, horseback, or driving, sitting, eating, drinking, speaking or gesticulating, we get the illusion of being in the middle of this Madrilenian crowd on a public holiday on the borders of the Manzanares. Then there are the carnival scenes, like the *El Entierro de la Sardina* and street processions like the *Flagellants,* interiors of prisons and lunatic asylums, and so many other subjects, strange, melodramatic, romantic, anecdotal and satirical which are a constant surprise and revelation. If we wonder how such subjects would have been treated by other painters we appreciate the more what this magician has done with them by producing such marvels of fantasy and mystery. There is something nocturnal in the imagination and sensibility of Goya as there is in the colour he employed. The etchings, *Los Caprichos* and *Desastres de la Guerra,* give this impression to the point of nightmare, and the same quality can be found in certain of his portraits. It is not merely because one of these two pictures represents an execution at night by the light of a lantern that we are impressed by that feeling in those two pathetic works inspired by his country's misfortunes: the *Dos de Mayo* and the *Tres de Mayo* (the Charge of the Mamelukes and the Fusillade). In spite of the luminous and voluptuous lights of the flesh tints it is again this nocturnal atmosphere which pervades these two celebrated figures of *La Maja Vestida* and *La Maja Pynuda.* This extraordinary man was the author of the most beautiful nude existing in Spanish painting, and to complete the universality of his genius, this profligate and libertine had his hours of Christian inspiration. The *Last Communion of St. Joseph of Calasanz* is perhaps the most beautiful religious painting executed during the 18th century. It palpitates with emotion, reminding one of Rembrandt. But never does the mystery come, as with Rembrandt, from a source of light flowing from the shadows, but from the infinite gradations of a grey twilight—once more a nocturne. For San Antonio de la Florida, Goya provided his religious and decorative masterpiece. The ecstatic angels robed like court ladies and singing like beauti-

ful cantatrices are more of his most delightful inventions. Never has anything been seen similar to these greys and blacks which play the part of the bass "sotto voce" in a clear, airy harmony. Nocturne, always nocturne. Goya was the father of the 19th century art and of all modern art. In his place he left only one clever imitator, too servile but with a certain animation, Eugenio Lucas (1824–1890). In France are to be found his best and most faithful followers. At the 19th century court, however, apart from the brilliant but dry narrow art of Fortuny, one felt that Spain always held the germs of possibilities capable some day of favouring the production of a great painter. (*See* Goya, Francisco.)

FRANCE

The first part of the 17th century was in almost all countries a time of varied geniuses including many of the greatest originality. What remarkable chance unites by date such masters as Caravaggio, Rubens, Van Dyck, Rembrandt, Hals, Velazquez, Ribera, Murillo, Poussin, Claude Lorrain, and Le Nain. If the word "Renaissance" had not in France the special meaning belonging to the great classical Italian movement and its consequences it is to the 17th century that it should be applied. The 16th century marked the period of stagnation in painting. Only Italians or Italianized Flemish of the first and second Fontainebleau schools seem worth mentioning. Authentic French taste could be found in the little portraits of the Clouets, Corneilles of Lyons and their disciples. How can this eclipse of creative genius be explained? The fact is most singular in so brilliant a reign as that of the Valois whose leader merited the name of Father of Letters and Arts. Did Francis I. and his successors summon the Italian painters to France because France no longer had talent to offer or, on the contrary, was it the king's personal preference for Italian art that sterilized French genius? The first hypothesis seems the more probable, for despite the lack of painters the sculptors and architects show a remarkable originality. Strange enigma that painting alone should have fallen so low in a country that produced Ronsard, Rabelais, and Montaigne, the architects of the castle of the Loire, the sculptors Germain Pilor and Jean Goujon!

Simon Vouet.—It was the artists so strongly influenced by Italy who, after a long sojourn beyond the Alps were the founders of this Renaissance in France. Simon Vouet (1590–1649) was extremely precocious. At fourteen he had already such a reputation as a portrait painter that he was invited to go to England to paint a portrait of a lady of quality. He had similar success in Constantinople where he was attached to the French embassy, in Venice, and in Florence where he received the title of Prince of the Academy of St. Luke, and lastly Genoa where he decorated the Doria Palace. Recalled to Paris by Louis XIII. in 1628 he was covered with honours, and for twenty years he exercised a sovereign power over the arts, decorating palaces, churches and castles. To-day most of his decorative works have disappeared and his glory is almost forgotten. We look at him through Poussin's eyes and Poussin, not loving him, saw in him only the father of academicism. Doubtless he let himself be carried away by his facility but his light palette and decorative feeling have played a part in the evolution of French painting. He had much more influence than Poussin himself on Le Sueur, Le Brun, and Mignard and consequently on the work of Louis XIV.'s reign—the decoration of Versailles. Boucher derived much from him and through Boucher a large part of the 18th century art as well.

Poussin.—Poussin (1594–1665) was but four years younger than Vouet but his influence was not felt until considerably later; he was one of those great men who required time for thought and meditation and whose inspiration came only with maturity of mind and body. Knowledge of Poussin's career dates from about the time of his arrival in Rome in 1624 to study Raphael. He was not disappointed in the master of the Farnese, but Titian was a revelation to him and from that moment he seemed to have sought to reconcile the spirits of these two great artists. Applying the theory expressed in his celebrated letter to Monsieur de Chantelon, he appeared to have alternated between two magnetic poles, at one time favouring the linear element derived from Raphael, and at another the warm colourful atmosphere which was Titian's. To-day this dual admiration appears natural to us, but this was not the case in 1624 when the artists, gathered together in Rome, understood only the academic art which sprang from the Bolognese and the brutal naturalism of Caravaggio. Poussin detested the one as much as the other and with his philosophic frankness condemned them unconditionally. Of what seemed to him empty virtuosity he accepted only Domenichino on account of his seriousness and modesty, and because he believed him to be nearer to Raphael than to his brilliant colleagues. Thus this indefatigable champion of classicism was in reality original and independent.

Going to Rome to study, he venerated and adored the Eternal City, its monuments, the surrounding country and its imposing history, understanding this city better than the Italians themselves for in it he saw in his imagination the descendant of Greece, a sort of golden age, he thought, of poetry and human art. Thus the love of antiquity, in spite of all the scruples for accuracy he imposed on himself, was for him not a pretext for vain and cold aping of archaeology, but a source of living, new poetry. The only man who can be compared with him in artistic expression so influenced by the love of antiquity is Goethe. It was the memory of Titian and Giorgione which inspired him to new discoveries. He was one of the greatest landscape painters known in the history of painting. His drawings made in the course of walks in the Roman countryside or done from memory in his studio can be compared with the finest of Claude's and, in the opinion of the writer, are even superior. Some are done with two or three strokes of the pen and a few touches of wash, reminiscent of the quick notes of Turner. With a background of fact, seized with emotion and neatly defined, Poussin painted landscapes such as the marvellous Homeric and Virgilian poem which is the setting of his *Polypheme* and the Elysian glades that contain the dancing processions of his *Bacchanals* or shade his sleeping nymphs. Like Titian, Poussin found in nature things corresponding with the thoughts and passions of men, though he was inferior to the great Venetian in richness of palette as well as in sureness and purity of form.

Claude Lorrain.—Claude Gelée, called Claude Lorrain (1600–1682), was not so great as Poussin but his genius cannot be denied and he was an original inventor in the classic manner. He lived nearly all his life in Rome, but was not over-influenced by the Italian painters. In his essential personal quality he created the French landscape, and for more than two centuries all those in France who have sought to express the beauties of nature have thought of Claude and studied his works. Among them were Joseph Vernet in the 18th century, as well as Corot in the 19th. Outside France it was the same and in England among many enthusiastic disciples were the great landscape painters from Richard Wilson to Turner. There is mystery in the vocation of this little almost illiterate peasant who knew French no better than he knew Italian and who made notes on his drawings in a queer language all his own.

What attracted him to Rome and what held him there? Could he not have painted in Nancy, Paris or elsewhere, his *Village Fairs, Aeneas Hunting the Stag on the Coast of Libya,* or even his *Cleopatra Disembarking at Tarsus,* his *Enchanted Castles* and *Sea Ports?* For this admirable painter drew most of his pictures from within himself, though he worked from nature at times, and in his pictures the imaginative side predominated more and more, in proportion as he became conscious of his own genius.

His first masters were the German, Wals, and a Florentine, Tassi, pupils of Adam Elsheimer, and they transmitted to Claude the doctrine of this man who, though not a great painter himself, was the first to paint landscapes wherein a radiation coming from the depths of the shadows formed the center of interest, if not the whole significance of the landscape. Elsheimer's was a great destiny and he was less honoured for his talent than for his ideas—ideas which though not entirely expressed in his own paintings showed the way to both Claude Lorrain and Rembrandt. When Claude Lorrain started he had rather a timid style; the leaves of his trees were painted with a minute finish and were somewhat

hard. It was Poussin who freed him from his shackles while they lived almost next door to each other on the Pincio, and this quick absorption of the lessons of Poussin perhaps indicates that this illiterate dreamer had more intelligence than might have first been suspected. Listening to Poussin and watching him paint, he grew to understand that a sort of intellectual background would add to his dreams and visions, and from that time, about 1639–40, he composed his most unforgettable masterpieces, the *Sea Ports,* a combination of water and sky and light transforming them in a frame of noble buildings which resemble no actually known spot.

Besides these two great painters a wealth of original French artists came into being during the first part of the 17th century, repaying her for the sterility of the preceding century. Poussin held an incomparable prestige, but his influence was remote and, with the exception of his own disciples, Gaspard Dughet, called le Guaspre, and Jacques Stella, served only as an inspiration. When one sees the intellectual and classical simultaneously arising in literature it is easy to believe that the painters would have followed this trend even without the influence of Poussin, but the general influence of his dominating genius set an example to all but a few of the painters who died too young, or for some other reason escaped its inspiration, such as Valentin de Boulogne, called le Valentin (1591–1634), who like Poussin spent nearly his whole life in Rome with plenty of opportunity of seeing his great colleague's work but who preferred that of the realistic, violent, brutal Caravaggio, whom Poussin had refused to recognize. Apart from his skilful and robust execution le Valentin's picturesque scenes, the *Inns* and *Card Players,* interest us mainly because they form a link between Caravaggio and the Le Nains.

Jacques Blanchard (1600–1638) was another who did not succumb to Poussin's influence. Dying young, he has left us only a few brilliant examples, such as his *Cymon and Iphigenia,* in the Louvre, inspired by the Venetians but still French in character.

The French school has always possessed good portrait painters perhaps because of the national inclination for the establishment of precise fact. In the 16th century when the future of painting in France seemed jeopardized, portraiture alone continued to live. Later, at the end of the 17th century when academic convention threatened to stifle any originality, Largillière and Rigaud painted pictures, full of life, strength and beauty, of the princes, great ladies and magistrates of the time. Two men who follow each other in succeeding generations, Philippe de Champaigne (1602–1674) and Robert Nanteuil (1625–1678) were not brilliant painters like the former, but as portraitists or recorders of fact they were superior in the seriousness and gravity of an art which disdained embellishments. Philippe de Champaigne, born in Brussels, was only nineteen when he went to Paris. His work, completely imbued with French spirit, showed traces of the advice which he received from Poussin and he was another of those who profited by the master's genius without the slightest loss to his own personal style. He was strongly influenced by his religion, and his admirable portrait of *Cardinal Richelieu* and of the gentlemen and nuns of the Port Royal, besides being essentially French, have left to us invaluable documents on Jansenism. Inspired by paternal and religious sentiments, he painted in a bare cell a picture of his daughter, *Sister Catherine of St. Susan,* cured in the presence of Mother Agnes Arnauld by the miracle of the Holy Thorn, which is an austere and moving masterpiece unique in the history of painting. (*See* PORTRAIT PAINTING.)

Nanteuil was more draughtsman and engraver than painter, and there is not a single oil painting which can be absolutely authenticated as coming from his brush. This matters little, however, since with his pencil, his pastels, or his engraving points he has produced portraits, particularly of men, which are among the finest and most profound in the history of art. His pastels are of such merit as to have established him as the precursor of the brilliant school of French pastellists of the succeeding century. His portraits were only heads, but what concentration of emotion and insight he could apply to the drawing of an eye, the crease about a mouth, or the wrinkle in a forehead!

Although some years earlier Jacques Callot (1592–1635) was another engraver and an independent draughtsman of genius; there are no pictures in oils that can be attributed to him with certainty, which is a surprising fact when one sees what real pictorial qualities he put into his etchings, and when one notes that it is those painters, who are so entirely painters, Watteau and Goya, who seem long afterwards to have best remembered his lyrical masquerades and his *Miseries of War.*

Sebastien Bourdon (1616–1671) is a sort of Proteus of painting. He imitated Poussin, the little Dutch masters, and the Bolognese. Indeed he imitated everyone available, with intelligence and brilliant facility, but in his self-portrait in the Louvre, or Touquet's at Versailles, or the *Portrait of an Unknown Man* at Montpellier he imitated no one.

Eustache le Sueur (1616–1655), born in the same year as Bourdon, died before attaining the age of thirty-nine. He had a less brilliant but more engaging personality; his sweetness, attaining a delightful suavity, seldom becomes feeble, and he was truly original in all his art. A pupil of Vouet, he made frequent use of the light tonality learned from his master which was an outstanding feature in an age when a dark palette was generally in favour. The candour of his tender pious soul as that expressed in the 15th century manuscripts may be seen in his picture *The Virgin Appearing to St. Martin,* very much akin to the feeling and spirit of the paintings of Fra Angelico, a feeling of religious emotion unique in the works of the time. In his series of pictures of the *Life of St. Bruno* and in the charming decorations he did for the Lambert Mansion, *Love's Bower* and the *Chamber of the Muses,* there is the freshness of the primitive in colour and innocent grace.

Had Poussin ever seen a picture by the brothers Le Nain, he would doubtless have passed it by, and it is sure that he would have felt that his biographer, Felibien, honoured them too greatly when speaking of them in his descriptions, thus: "The Le Nain brothers painted portraits and scenes, but in a style of little nobility often representing simple subjects and without beauty." But these simple pictures portraying the lives of peasants, which appeared to lack beauty during those days, we find to-day serious and full of a modest and penetrating poetry. To divide between the three brothers' works, which had come down to us under the general signature "Le Nain Pinxit" for a long time seemed impossible, but the writer believes that he helped a few years ago toward the solving of the problem. Antoine le Nain (1588–1648), pupil at Laon of a "foreign painter" (probably Venn of Flanders), composed little panels in a style and with a palette more or less derived from the Flemish, in which were assembled in modest interiors groups of people of the middle classes, rather than rustics. His style, though a little archaic, one can readily see, shows the love of humble truth which is the source of inspiration in the most original and beautiful works signed by these brothers. Louis (1593–1648) was the man of genius. It was he who, between 1640 and 1648 painted those gatherings of peasants around their tables, before their houses or in their fields, which are expressed so frankly and with so much dignity and understanding of humanity and which are notably different from those painted of similar subjects by Italians and the followers of Caravaggio, as well as the Spaniards, the Flemish and the Dutch. Mathieu (1607–1677) had less depth, although his work shows him to have been almost as good a judge of human character. He preferred family groups drawn from the higher classes in the same rustic surroundings.

After this generation of original and independent men, it might be said that the social state of French art changed under the influence and patronage of an absolute monarchy. King and nation were united. The French believed the best way to promote their glory consisted in working for the honour of their king and thus in 1648 was inaugurated the French Academy in Rome, an act of Colbert's inspired by Le Brun at the instigation of Louis XIV. When the young king saw the magnificence which Le Brun accomplished in decorating the castle of Vaux-le-Vicant for Superintendent Fouquet, he realized that here was the man he required Charles Le Brun (1619–1690) really possessed few of the qualities that lovers of painting most prize. Though he had done some excellent portraits and good pictures, ingenuously composed in

various styles, none of them give us the satisfaction, or inspire us with the emotion that more apparently modest works are capable of doing. Nevertheless, his place in the history of art is great, and curiously this father of academicism executed a work which can only perhaps be compared to the construction of cathedrals of the middle ages, and to the great works of the Acropolis under Pericles and Pheidias. At Versailles his was the master mind commanding an army of architects, painters, sculptors, goldsmiths and upholsterers, showing that he possessed a genius for decoration, of which the Gallery of Mirrors at Versailles and the Gallery of Apollo at the Louvre are glorious examples. Supported by the royal confidence for twenty years he reigned over the empire of art.

Pierre Mignard (1610–1695) on returning from Italy, where he had been brilliantly successful for twenty-two years, tried to contest Le Brun's leadership in a personal rivalry, though not one of doctrines, for both were equally hide-bound in Italianism, and while claiming to be followers of Poussin they were really more influenced by the Bolognese. Both were clever but Le Brun had the energy, ambition and foresight of a leader and one can well perceive the value of his conception when his disagreeable colour schemes and impersonal touch is replaced by a material beautiful in itself. There are few tapestries more beautiful than the series of the *History of Louis XIV*. When Le Brun was no longer there to animate the troop of painters, upholsterers, etc., an immediate lack of his uniting personality was felt, similar to the almost parallel phenomena, one hundred and twenty years later, when the pupils of David, another painter of despotic temperament, lost his rule. Happily for France, however, no sooner did Le Brun disappear than the reaction against Italianized academicism manifested itself in the quarrel between the followers of Rubens and those of Poussin. Poussin's name was wrongfully evoked by the supporters of Le Brun. A part of the French school discovered that there were ideals better than these Italian ones, that colour had as much value as drawing and that grace, intimacy and freedom are elements of art as well as nobility and grandeur. Jean Jouvenet (1644–1717), Antoine Coypel (1661–1722), and Charles de la Fosse (1636–1716) were pupils and collaborators of Le Brun, but in colour and sentiment the proclaimers of the 18th century. The portrait painters also followed the movement and Jean de Troy (1645–1730) painted animated and delightful portraits. Hyacinthe Rigaud (1659–1743) added to him virtuosity and often grandiose composition without injury to the statement of facts or the expression of his style as is seen in the celebrated portrait of Bossuet. Nicolas de Largillière (1656–1746), who was born in Paris, studied at Antwerp and later in London with Sir Peter Lely, was an excellent technician and vivid colourist in the French style. Nattier (1685–1751) was less veracious and painted amiable princesses adorned in mythological disguises, translating into painting the decorative style of the Regency.

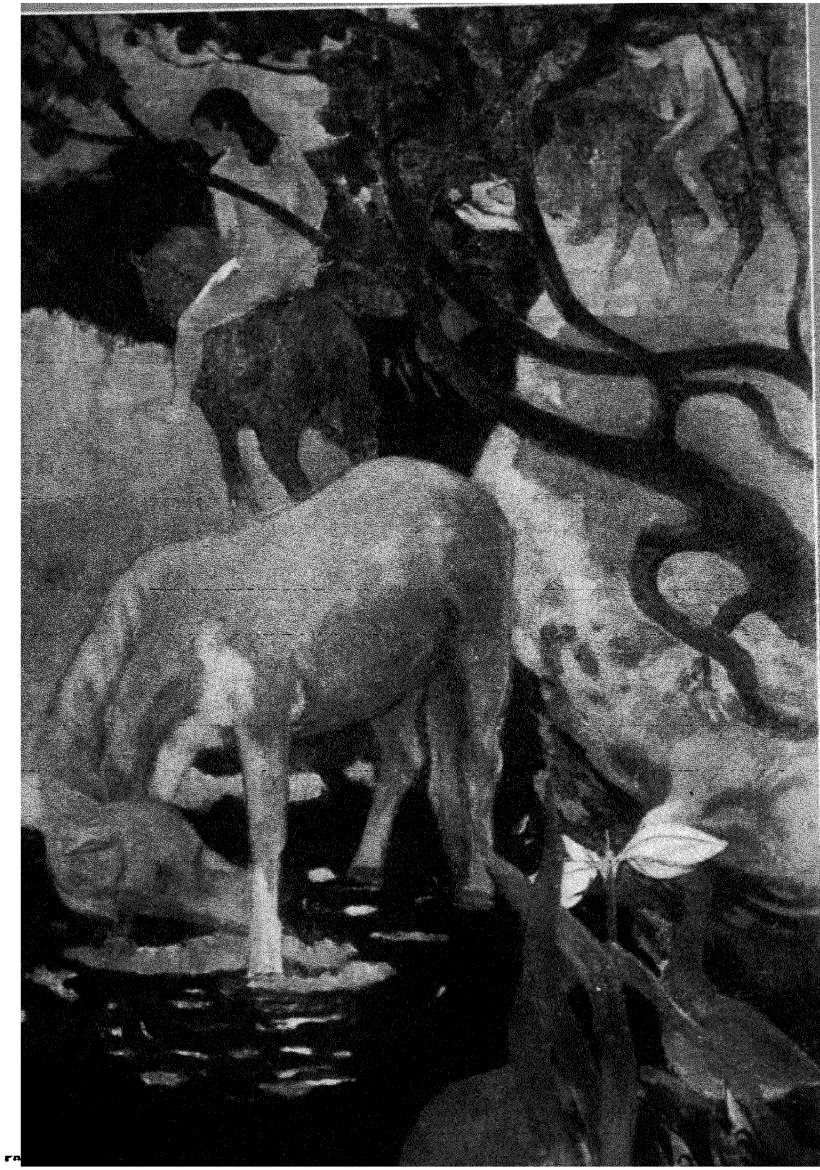
The animal painters, Desportes (1661–1766) and Oudry (1686–1755) adapted to this style Snyders' hunting subjects, the greatest merit of which in our eyes lies in the very modern feeling they had of landscape. In Largillière's masterpiece, the *Painter's Family*, the sky behind his charming daughter who is standing with a roll of music in her hand, her eyes raised, singing, reminds us of Watteau, as well as of the romantic quality in some pictures by Charles de la Fosse.

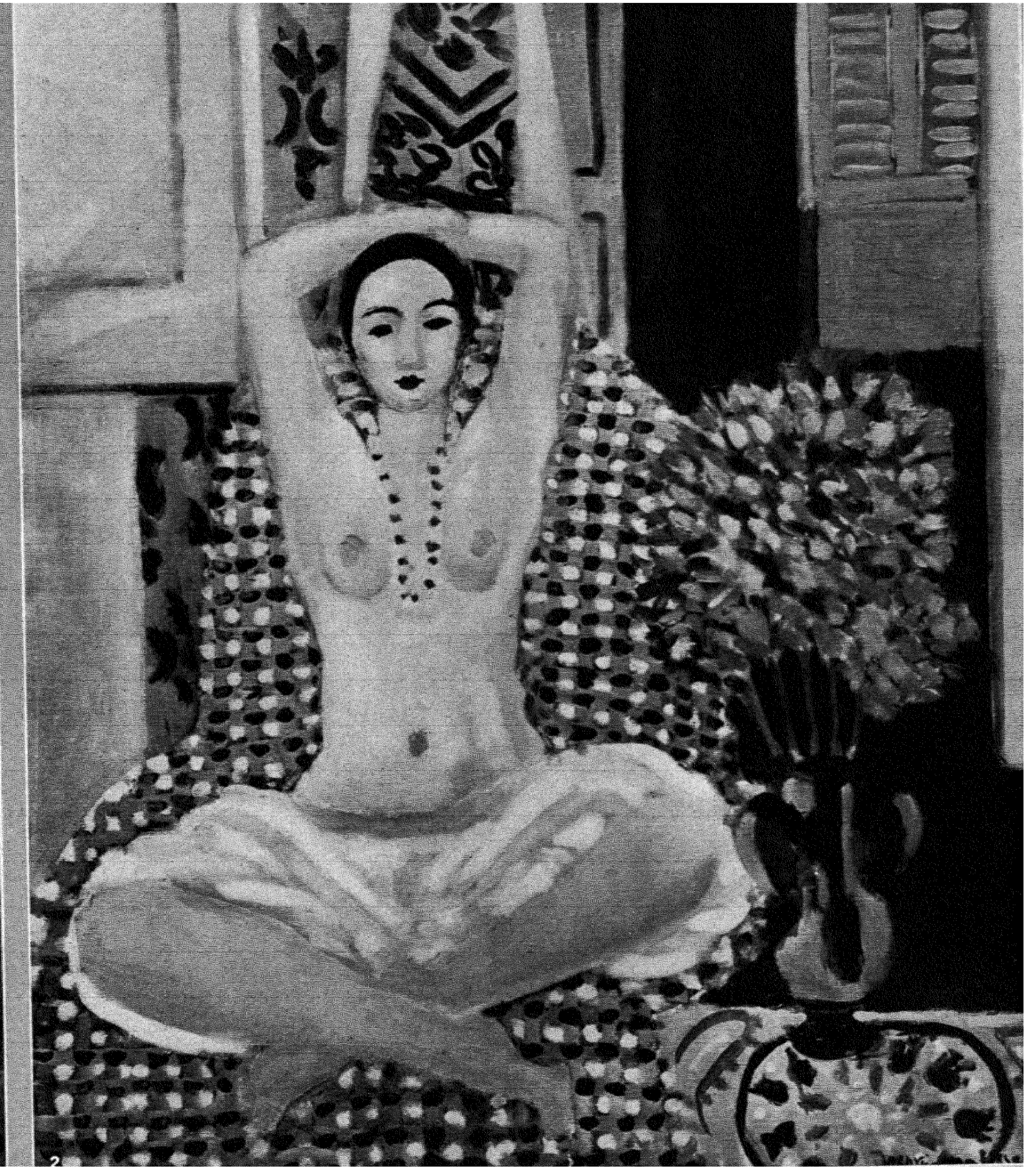
Watteau.—Watteau (1684–1721) was the incarnation of every grace and poetic spirit of the 18th century, during which French taste triumphed over the whole of Europe. Of him we may say that he stood alone, and had he not existed doubtless things would have taken a different turn, and the little masters Lancret, Pater, Bonaventure de Bar would have missed their line of destiny. Their work was not less charming than Watteau in the depiction of dances, *fêtes galantes* and gatherings in parks. Doubtless the same decorative taste, the same light paintings with gallant nudities and amiable mythologies, though not at all in the spirit of Watteau but harmonizing with architectural transformations, would have developed without him. The immense galleries and solemn apartments so loved by the early kings were replaced by elegant drawing-rooms and boudoirs, but on the other hand, if Watteau had not existed a unique enchantment would have been lost. He had inherited some of the Flemish traits which predisposes him to understand Rubens better than anyone else and in fact the first idea of his *Fêtes Galantes* might have been found in the paintings of Rubens, two variations of the *Garden of Love*, for when he was employed in Audran's studio at the Luxembourg he studied Rubens' *Life of Marie de Medicis,* and later at Crozat's he copied drawings of this master and compared them with those of the illustrious Venetians. *Jupiter and Antiope* shows the amalgamation of the Antwerp and Venetian influences together with a strong originality. Watteau also studied under Gillot the painter of masquerades, but none of these facts account for the harmonious softness and mystery which was his own. His drawing was replete with poetry and an exquisite atmosphere of pathos in which his landscapes are plunged—great trees in parks or glades, marble basins and statues which veil the glances of lovers; that aristocratic grace of the *Indifferents* and *Finettes,* of these young women and men arrayed in satins and laces whom he invests intentionally with something of his own spirit, for he was a slender invalid doomed to an early death, absorbed, incapable of looking after his own affairs, ironical and tender in turn, with the innocence and ingenuity of a child. After all, this idea of enchantment, comedy, comedians and actresses, fantastic disguises and furtive serenades, the beauties courted by gallants full of emotion and uncertain of their fortunes, the aimless walks and departures for unknown isles, was just as true as is our daily life. All this suffices to make him famous, but two or three years prior to his death this young genius who had no time to lose became bolder. The *Embarkation for Cythera* is a termination, not a beginning. It is like the climax of a romantic fairy tale, but Watteau was not content to remain the painter of the *Fêtes Galantes.* He felt he could make poetry of the subjects of everyday life and painted the *Gilles,* another theatrical character, but the spirit had altered. Then followed the *Gersaint's Shop-sign,* a picture of people in the dress of the time looking at pictures in a shop, which may go under the heading of genre. Watteau continued to aim high and then realized an unprecedented masterpiece, the sequel of which was to follow much later, and the dream of which in the 19th century was developed by Courbet, Degas and Manet. Thus realism, inherited from the old French artists, was reconciled to style.

Boucher.—François Boucher (1703–1770), cannot be ranked with Watteau, for whereas Watteau was essentially a poet, Boucher was an artist whose ambitions are obvious and absolutely in proportion to his faculties. He wanted to please his contemporaries, to ornament walls and ceilings for them, and in his best moments he succeeded perfectly in what he set out to do, creating a success so striking that he was barely able to execute all his commissions, and he wore himself out before his old age. As Le Brun had served Louis XIV. so he served Louis XV. He had a genius for decoration and a gift for composition, easy, elegant and always perfectly balanced, and his versatility included the accomplishment of an immense production, as well as the illustrating of a book, of a fan, in either of which he could compose amiable mythologies or people the sky and waves with roses and fair nudities. His masterpiece in this manner is probably the *Triumph of Galatea* in the Stockholm Museum, but he also painted excellent portraits as the *Young Lady with the Muff*, in the Louvre, and treated with brilliance and precision intimate scenes like *Le Déjeuner*, in the Louvre and *Modiste,* in Stockholm, of which a replica is to be found in the Wallace Collection in London With the exception of his later years when his work shows fatigue, his brush was sure and his colouring, though not refined, was rich, light and brilliant. What was missing to make of him a great painter? He loved his art and he worked hard. As a decorator he has gifts not inferior to those of his fascinating contemporary, Tiepolo. His cartoons for tapestry were admirable and, worked by the virtuosos in wool, his finest pieces have a fairy-like beauty. Though he was preceded in his path by a man of talent, François Lemoyne, he was an inventor. He had two illustrious pupils who owed much to him, Fragonard and David and through them his influence, more or less deviating, reached the 19th century. What therefore was missing that he could not be really great? Perhaps

A FESTIVAL PROCESSION IN VALENCIA, BY SOROLLA

A mural painting by Joaquin Sorolla y Bastida (1863–1923), distinguished as a painter of brilliant sunlight effects. He depicts here a festival in Valencia, his native province, showing the native costumes, gay trappings of the horses and banners bearing the arms of Valencia, which give vividness and colour to its fête days. This is one of a series of mural decorations representing Spanish festivals and other scenes in the life of the people painted by Sorolla for the Hispanic Society of America





TWO LEADERS OF POST-IMPRESSIONISM

1. "Le Cheval blanc" by Paul Gauguin (1843–1903). In the Luxembourg Gallery, Paris
2. "L'odalisque au vase de fleurs," by Henri Matisse (1869–). In the collection of Paul Guillaume

it is that his work only expresses satisfied pleasures, and art which in the language of the hopes, dreams and passions of restless humanity requires more. His *Le Déjeuner* and *Modiste,* dated 1739 and 1746 respectively, were not isolated in that epoch, for they had been preceded by Carl van Loo's *Hunting Breakfast* shown in the Salon of 1737, and others. Thus, even amongst court painters a vein of realism derived from the Flemish was seen in France side by side with gallant mythologies and decorative pastorals.

In 1750 Oudry painted the *Farm,* a picture that had been commanded by the Dauphin which was shown in the Salon of 1751 under the significant title "Picture in the Flemish Style." In the generation which followed, Lépicié continued the same movement of realistic peasant portrayal in his *Farm Courtyard* in the Louvre. All these painters proclaim more or less the little Dutch masters who were at this time in favour amongst the French amateurs.

Chardin.—Chardin (1699–1779) did not wait for these examples to demonstrate his ability as a painter of small subjects. In 1728 he was received into the Academy with two big canvases which were still life—the *Skate* and the *Buffet.* The technical quality is the first thing in his work which strikes us. They are pieces in which all the richness and subtleties of oil painting are wonderfully handled, and already one senses that intimacy and the poetry of humble things which placed Chardin apart from the thousands of others who painted still life and genre. He is notably superior to his contemporary Jeaurat, who treated the same subjects agreeably but not without hardness, and with a tendency to an anecdotal conception. Chardin was a truly original artist and purely French. His perception was more like that of Louis le Nain a century earlier than that of the light, superficial, brilliant spirit which dominated the so-called realism of his times. Unlike his predecessors, he did not search for his models among the peasants but painted the Parisian middle classes, in the surroundings in which he was born and lived; but this difference, small as it was, did not prevent him from depicting the same modest virtues. One gets from him almost as much as from Le Nain's picture *Blessings.* But more than a century had passed, the customs were gentler, the middle classes far removed from the austere peasants of the Le Nains. Chardin's housewives are simply but well dressed, and the same cleanliness is to be seen in the houses they inhabit. The spirit of good-natured elegance is the charm of these pictures of domestic life, which are superior to the masterpieces of the little Dutch masters, Vermeer excepted. At an equal distance of time from Louis le Nain and Corot, Chardin attained, without rhetoric or philosophic pretensions, this charming quality. In more than one of his contemporaries, however, metaphysics, which was then invading literature and which is one of the greatest enemies of good painting, was making itself felt both in France and in England.

Greuze.—Greuze (1725–1805) corresponds to Hogarth. It was not that he had been subjected to the direct influence of the author of *Marriage à la Mode.* It was rather his misunderstanding of Chardin that roused him to outbid this painter in a choice of subjects and scenery which he felt to be more interesting and moving. The public agreed with him and the writers applauded this mixture that was something new in painting, and in literature. The *Village Marriage,* the *Father's Curse,* the *Son Punished,* these almost too ingenuous compositions in which every detail is like an actor playing a part, were borrowed, as one imagines, from some tearful play or melodrama of the period. In spite of the cleverness of execution there was a weakness and falsity of sentiment in them, and they lacked the passion to overcome the unquestionable risks of literary painting. It was the bitterness of Hogarth's satire that saved him, and nothing like this could be expected from the mediocre soul of Greuze, who was, the writer believes, the first example of a painter who gained success bordering on glory which has not been ratified by posterity. He had, however, qualities as a painter which doubtless might have been happily employed had he not strayed into a false conception of art. Apart from their artifice and sentimentality, his young girls' heads possess a certain charm, and he was a good portrait painter.

La Tour.—Maurice Quentin de la Tour (1704–1788) was more draughtsman than painter, and, for a man so disposed as has been seen with Nanteuil and will later be demonstrated with Degas, pastel is the best medium for releasing an artist from the encumbrance of oil painting. In drawing, La Tour was indifferent to his medium, and crayon or pastel were only a means of securing the personality of his model, for human faces and expressions were all that he cared about, and these he loved passionately, with a sort of impartial frenzy. This man who understood others so well described himself in an often-quoted phrase and one that deserves to be remembered: "They believe I catch only the features of their faces, but I dive into their depths without their knowledge and I get them absolutely." Sometimes in his big portraits, in trying to be too precise and perfect he was liable to impart an impression of overwork; but his head studies which he termed "preparations" really answered to the words by which he confesses his aim. Nanteuil might have been more serious and profound, but Nanteuil could never have grasped so well the combination of vivacity, nobility and sparkle of the 18th century. Perronneau was neither a faultless constructor of faces nor a passionate analyst of expressions, and was far inferior to La Tour, being often careless, but what charm he had at his best! Vivacity animated his portraits no less than those of La Tour, but it was expressed with a less sensitive touch. He was, however, a born colourist and he had not the same reasons as his illustrious forerunner and rival for showing a preference for pastel. He painted a number of excellent portraits in oil, but La Tour having made pastels the fashion, Perronneau and many others decided to follow it. Pastel with its delicacy and unalterable freshness seems to be an invention harmonizing with the spirit of this age, the light woodwork of the apartments, and the elegance of feminine fashions, and it was left to Perronneau alone to discover charming colour schemes in it.

It was in this century in which women dominated, that women painters conquered a position which had never before been assigned to them, dedicating their talents principally to portraiture. In Watteau's time the Venetian Rosalba Carriera, was brilliantly successful in Paris and contributed to making pastel fashionable, subsequently introducing her crayons and amiable mannerisms into all the European capitals. In Fragonard's time a Frenchwoman, Madame Vigée le Brun (1755–1842), reigned supreme in portraiture and shows us all the graces of this dying century in her pictures of kings and great ladies, and particularly in the canvases where she depicted herself with her daughter. She travelled as Rosalba had done and was triumphantly received all over Europe. This brilliant school of French portraiture received reinforcements from foreign lands. Sweden, which up till then had been more or less ignored in the history of art, formed contact with Paris, with the portraitists and miniaturists, Roslin, Holl and Lafrensen—who in France was known as Lavreince. The last two named had the honour of giving a decided impulse to an art which had already had a fashion in the preceding centuries, and which, renewed, filled with grace, refinement and life, became one of the most charming expressions of the taste of the 18th century.

Fragonard.—Among these amiable artists, Fragonard (1732–1806), delightful, impertinent, inconstant, nonchalant, impetuous, a painter to his fingertips, closes in a shower of fireworks the art of the 18th century which was opened by Watteau with fairy poems of love and sadness. This man had so much grace and knew so well how to delight us that he was allowed a daring gallantry on certain subjects that would have been insupportable in the work of another. At times he threw off a canvas with the abandon of an improviser in an hour; at others he painted with the most delicate precision some tiny picture full of charm and mystery. At Grasse he decorated a house with five large panels which showed him almost a rival of Goya, the Goya of the cartoons and tapestries. His drawings have an exquisite delicacy, transparency and grace. In landscape he was rivalled by his Roman comrade, Hubert Robert (1735–1808), who made of the art a decorative theme derived more or less from the antique ruins by the Italian Panini, with an added romantic charm and a luminous harmony which is a far off reflection of Claude.

The first signs of a change may be noted in these paintings; a

return to the painting of fact which became the keynote of the 19th century. Already Desportes' studies were remarkable for their respectful feeling for nature. Vernet (1714–1789), in his French *Ports,* and in the *Rotto Bridge,* and the *Castle of St. Angelo* (Louvre) shows what he might have done had he been able to withstand the influence of fashion. They form a link between Claude's *Campo Vaccino* (Louvre) and the studies by Corot done during his visits to Italy. Louis Moreau, known as Moreau the Elder (1731–1805), a relation of the Vernets, noted very simple motives with delicate touch and forecasts the coming of Rousseau; and lastly, the charming picture in the Carnavalet Museum, the *Demolition of the Centre Arches of Sevres Harbour* shows the brilliant decorator, Hubert Robert, to have been a landscape painter who portrayed nature without mental reservations. Only the stimulus that eventually came from England was necessary to develop the centre of art in France in the 19th century.

French taste had spread all over Europe in painting, architecture and furniture, and her artists were called by royalty to Spain, Russia, Sweden and Germany, while Germans, Dutchmen, Flemings, Swedes, Italians, Swiss, and Russians flocked to France to study.

OTHER COUNTRIES

Sweden.—The Swedes, Wyrsch, Liotard and Angelica Kauffman, Roselin, Holl and Lavreince studied in Paris, while Pilo (1711–1793), Elias Martin and Wertmuller remained more loyal to their native taste.

Russia.—Russia at this time showed both Italian and French influences; and the fashionable Viennese portrait painter, Lampi, was then popular. For centuries the Russians had constantly repeated the mysterious beauty of Byzantine Ikons. Dmitry Levitsky (1735–1822), was influenced by French tradition and his portraits, and more especially the paintings of the school girls of the Smolny Institute, are full of tender romantic charm. This school, like many others founded on French art, was chiefly that of portrait painters, though in Russia a certain realism naturally led in this direction. Borovikovsky (1758–1826) though somewhat reserved was an observant painter of state portraits, and even the genre painters like Venetzianov (1780–1847) were portraitists in their way. The best Russian painting of that epoch was due to them, until, from another source, the rays of French impressionism penetrated to Moscow and St. Petersburg. Elsewhere a group of artists somewhat after the manner of the reforming musicians known as the "Five" set out to create a more authentic Slavic art impregnated with Oriental picturesqueness.

Germany.—Germany was dominated for some time by a charming French painter now almost forgotten, Antoine Pesne (1683–1757), a portraitist and the decorator of the music room of the Palace of Sans Souci. Then a new ideal, inspired by the archaeologist Winckelmann, attracted artists to an arbitrary and pedantic Hellenism beside which the academicism—that of David—appeared full of suppleness and life. Winckelmann's influence is comparable with that of Viollet-le-Duc a century later. Both were scholars and initiators who truly helped the progress of art, one bringing back the spirit of the Greek and the other the principles of the Gothic, but the influence was the reverse of that intended, for in trying to deliver artists from the influence of the frivolous contemporary art they succeeded only in subjecting them to an infinitely more withering pedanticism.

The first and most regrettable victim of aestheticism *a priori* in art was Raphael Mengs (1728–1779), who had the gift of painting as is proven by his portraits, but lost all of it in the academic compositions which enhanced his reputation. Until the middle of the 19th century Germany bore the brunt of another mistake that was continued in a cold style by the Overbecks (1789–1869), the Corneliuses (1783–1867) and others known as the "Nazarenes" who, under the pretext of consecrating themselves to Christian and Germanic themes based on the Italian primitives, rather than on the Greeks, believed that they were reacting against Winckelmann's influence. However, the paradoxical result of this return to the antique was the emancipation of the national schools which until then had taken their cue from France. Actually France was just as overwhelmed by the infatuation for the Greek ideal, but the movement was more fruitful, thanks to David's strong personality, and in the other countries such artists as Mengs, Thorwaldsen in Denmark and Canova in Italy should have gone to the Greek originals for they did not require David's assistance. Strangely enough, by another paradox, when this artificial classicism tumbled of its own weight the schools that attempted to show their own national character only revived by again joining up with the French tradition as was the case, in Scandinavia, of Christian Krohg and Anders Zorn. Under Frederick II., about 1850, Adolphe Menzel who was a better draughtsman than painter departed from both the Winckelmann and Nazarene schools using true observations in even his pseudo-historic compositions as did Wilhelm Leibl, scrupulous painter of peasants, and Hans von Marees, a descendant of French Protestant refugees, in his poetic and decorative compositions not unlike Puvis de Chavannes and Gauguin; and finally impressionism influenced the art of the north countries through such artists as Liebermann.

FRENCH PAINTING—18TH AND 19TH CENTURIES

As indicated in the discourses at the Academy by the Count de Caylus on Watteau's life, it was apparent that reaction had started against the influence of the antique and of the frivolously graceful type of painting. It was in 1748, several years before the discoveries of Herculaneum and Pompeii which had enraptured the scholars in 1755, and even before Winckelmann's first publications, the *History of Art Amongst the Ancients,* wherein he recapitulated ten years of his work (although his *Reflections on the Imitation of the Greeks in Painting and Sculpture* was already known in France), that Madame de Pompadour copied antique cameos under the direction of the engraver, Day, and encouraged the great change in architectural and interior styles. Thus came about the great period of "Louis XVI." actually started in the middle of the reign of Louis XV. whilst that called "Empire" was practically formed under Louis XVI. Vien (1716–1809) found inspiration from Pompeian painting. His rather feeble archaeology he transmitted to many pupils.

David.—David (1748–1825) worked in Vien's studio but owed little to him; Vien's authentic pupils, Vincent and Regnault, are nearer to Prud'hon than to David. The future author of the *Horatii* and the *Leonida at Thermopylae* was a pupil of Boucher before going to Vien, and until his departure for Italy when after persistent trials he obtained the "prix de Rome," his paintings were fairly docile imitations of Boucher, showing a slightly greater taste for the antique subjects. At Rome he suddenly adopted Winckelmann's doctrines with all the uncompromising enthusiasm of his nature amplified by the French writer, Quatremere de Quincy, whose pen was no less authoritative than David's brush in his *Considerations on the Arts and Drawing in France,* written in 1791. These two set the standard of the new aesthetism, the truly beautiful of the Greek masterpieces, and accepted the reasonable form in them dependent of course chiefly upon sculpture, as Greek painting had disappeared, and consequently proclaiming the superiority of drawing over colour. These influences are shown in the *Oath of the Horatii* (1785) which proclaimed David's name to the skies and indicated the promise of a revival in art of what was then called republican virtues through an heroic ideal; and David became the author of the most radical rupture in French aesthetic tradition, aided by the support of that terrible political revolution, in which he played an important part. David, a true artist, was strong in passions, and more dictator than theorist, and though Frenchmen love a game of ideas in which they often excel, they are too fond of life and realism to be dominated long by the abstract.

David harmed others more than himself, for being weaker than he, many who showed in their sketches the qualities that animate true painters, stripped themselves in their large canvases to obey the rigid aestheticism of the master. David was saved by the love of truth which inspired him to excellent portraiture, and many of these portraits have nothing to do with the antique ideal, such as *M. and Mme. Pécoul* and others, extending until the last years during his exile in Brussels when he did *Mme. Morel de Tanguy and Her Daughters.* Perhaps nothing is more realistic than the

An example of the work of Hilaire Degas (1834–1917), a French painter of the Impressionist school, best known for his many paintings and drawings of ballet dancers. In the Louvre

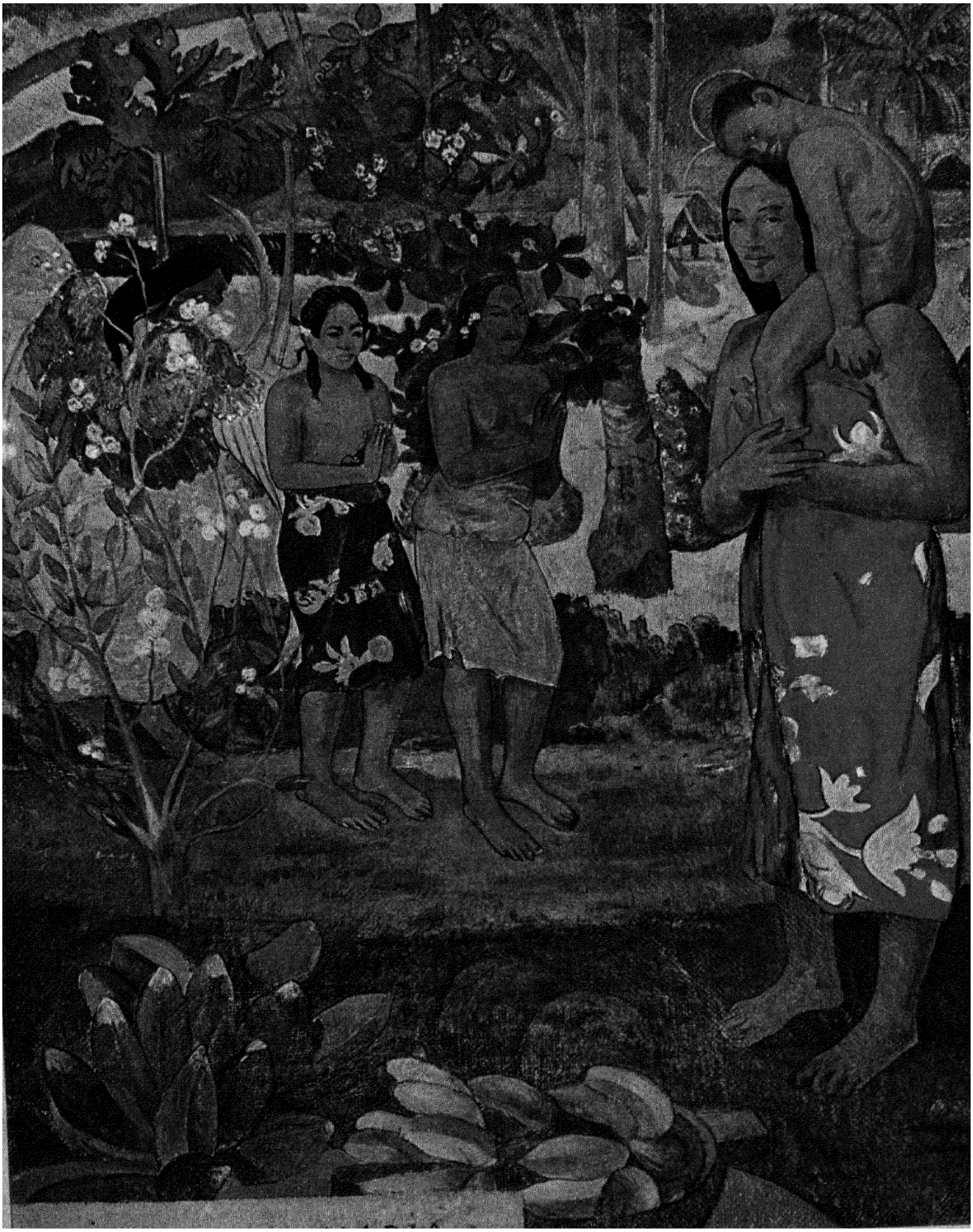
We must not forget that in Protestant England preaching was not as in the Latin countries reserved to the priests and confined to the churches. England is a country where everyone at any hour or place appears to have the right or duty to moralize and reprimand his fellow creatures. That spirit which oscillates from utilitarian moralism to poetic fantasy embodying all that is most individual to the English school produced Hogarth and Blake, two geniuses of incontestable originality and of equal strength and rarity. Hogarth's case is curious. The famous series of paintings the *Harlot's Progress*, 1732, the *Rake's Progress*, 1735, and the *Marriage à la Mode,* 1745 are examples of moralizing which seem to us absolutely out of bounds in the dominion of art, particularly of art as it is understood by the moderns, though perhaps some such examples could be recalled in the middle ages—more particularly in literature than in painting; but even the popular productions of the middle ages show a higher spirituality. In Hogarth the moral preoccupation was infinitely more important than art or beauty and he took the trouble to tell us so himself. He painted "comedy" and considered it a work of "public utility." His moralising was composed of good, coarse, practical truths untouched by any trace of the heroic. This devil of a man put into it all such a verve and powerful vitality! He defines and puts into motion before us such a gallery of violent types and characters that they dazzle our eyes; all criticism is silenced and the reserves of the sensitive are overpowered. A comparison between the grand and noble Nicolas Poussin, philosopher and poet, and this pamphleteer whom no triviality, no coarseness frightened, seems a challenge to good sense, but Hogarth was, the writer believes, the only painter who possessed to the same degree as Poussin the faculty of inventing human drama wherein each actor had the gesture and expression his part demanded. He did not compose from the Doric, Ionic or Lydian styles, or from any of those that the author of the *Ballo della vita umana* believed to be borrowed from the Greek. His was the cynical style, but the difference of eminence in taste does not diminish his rare merit as a painter of human comedy. He had, like Poussin himself, an impersonal craft with just the necessary colour and matter to interpret his ideas. Many details of still life, drapery, or landscape, show that Poussin, if he had cared, could have produced in his pictures all the harmonies, riches and brilliance attributed to great painters, but his conception was opposed to materialistic charm. Hogarth by instinct, no doubt, obeyed the same law of reason. He had all that was best in a painter or colourist as can be seen in the few portraits he left to us, and in the celebrated study known as the *Shrimp Girl,* but in his satirical and moral pictures he was content to use the more sober and most simple means without colour effects or obvious virtuosity, thus obtaining his objective all the more surely.

Reynolds.—This dictator, this disdainer of all culture, this Englishman who would be naught but English, had an influence on the most cultivated, refined, intelligent, learned and cosmopolitan of the great painters: Sir Joshua Reynolds (1723–1792). It is impossible to imagine a greater contrast between two men and their works, yet it might be said that Reynolds was in a way the legitimate heir and successor of Hogarth. All that was required to place this original school upon an equal footing with its rivals was science and elegance of taste, and Reynolds was the predestined man to give the most perfect expression to the highest aspirations of his country in a manner up to this time impossible. He achieved his aim by introducing into English art the treasures of experience accumulated during centuries by other schools. He was influenced more by Hogarth than by his estimable official master, Thomas Hudson (1701–1779), but his debt to the great masters of the past was even more considerable—to Titian, Rembrandt, even Raphael, Michelangelo and the Bolognese, not to mention Rubens and Van Dyck, who to an Englishman of those times hardly seemed like foreigners. He studied them not as a dilettante but as an aesthetic practitioner, and assimilated all that their genius and technique could give, to endow his country with an art worthy of its other traditions. In his writings he has set up the doctrine of imitation for which he has sometimes been reproached, but unjustly, since he knew how to assimilate to his own personality what he borrowed and make of it a composite creation of homogeneous personal and national character. In England the different nations melt into a sort of unified entity that she designates as "the Continent"; for this reason imitation is less dangerous to her, particularly when practised by a Reynolds, gifted with much intelligence and good taste. The only danger in imitation for an artist lies in being entirely under the sway of one master, but on account of their diversity and distance Europe's influences when they reach England have already undergone a metamorphosis.

At the age of ten Joshua was already reading works on the theory of painting. After his studies in London several years of travelling gave him an even more profitable culture. On his return to his country at the age of twenty-nine his memory, imagination and hand were ready to serve him in any enterprise of his art; and because the Englishman of those times could think of no other use for his talent he became a portraitist. He tried historical painting, adding a little to his fame, but he invented an original conception of portraiture arranged as for a picture so that thus understood the portrait required no less imagination than historical painting. In those fine pictures of great ladies with wonderfully dressed hair and beautiful gowns, important men, soldiers or scholars, delightful children, fair and rosy, there are horses and dogs as elegant as their owners, smiling or stormy skies, great overhanging trees, princely parks, terraces, columns, draperies of silk and velvet, ribbons and laces; everywhere an ingenuous composition ceaselessly renewed; everywhere a rich and subtle craft which only errs through excess of complication. The supreme aristocracy of his art lay in spreading over all the luxury and elegance an air of familiarity, amiable abandon and romance; and one day this virtuoso seemed to forget all his calculations and depicted his dream of womanhood in his most perfect painting, the portrait of *Nelly O'Brien* (Wallace Collection).

Gainsborough.—Thomas Gainsborough (1727–1788) was four years younger than Reynolds and his rival in fame. With nothing about him of the theorist, doctor or schoolmaster, he remained uninfluenced by the masters of the foreign school. He never left England and after a few years' apprenticeship in London passed the greater part of his youth at Sudbury where at the age of nineteen he married a seventeen-year-old Scotch girl, a natural daughter, it is said, of the Duke of Bedford. Later he went to Ipswich and Bath and lastly returned fo London. At Bath which was then the haunt of fashion and the most elegant society he had ample opportunity for the exercise of his art as a portrait painter and his success was so great that he was without loss of time admitted to the Royal Academy which finally brought him to London in 1774. He had, however, a French master at the age of fourteen, Gravelot, who had a studio in London. His drawing was not impeccable; his compositions were not as scholarly and balanced as those of Reynolds. Often his figures seemed to be carelessly posed on the canvas. But he had charm. He was instinctively a poet of ceaselessly vibrating sensibility, capricious and fantastic but always natural. Though he did a few good portraits of men he was above all the painter of women and children. He had a profound admiration for Van Dyck and took him as his model, but this robbed him of none of his originality. Doubtless he thought of Van Dyck whilst painting his *Blue Boy*, but this celebrated painting enchants us by its poetic mystery and musical quality to which the prodigious author of the *Charles I.* portrait was an entire stranger. The *Blue Boy* might be a young brother to Watteau's *L'Indifférent* rather than of the supremely elegant but absolutely realistic young *Princes* of Van Dyck. It is unfortunate that this picture has not a name taken from one of Shakespeare's comedies for the *Blue Boy* deserves it hardly less than that pearl of feminine pictures by the same painter, the portrait of the lovely actress who was the Prince of Wales' mistress, *Perdita,* which masterpiece of Gainsborough is in the Wallace Collection.

During the years of his youth at Sudbury and Ipswich Gainsborough acquired his love for the beautiful country so that almost without thinking about it he became the true creator of the great English school of landscape painting.



"I GREET YOU, MARIA," BY GAUGUIN

A Tahiti study by the French painter, Paul Gauguin (1848–1903), one of the pioneers of the Post-Impressionist movement. The last years of his life were spent in Tahiti, and to this period belongs his most mature and characteristic work. In the Adolph Lewisohn Collection

Richard Wilson (1713–1782) was fourteen years older than Gainsborough and started landscape painting late having first concentrated on portraiture. He visited Rome where he remained for six years and was encouraged by Zuccarelli and Joseph Vernet, and there painted his first landscapes. Returning to England he continued his career in the classical style, sometimes varying his reminiscences of Italy in favour of the beauty of the country of Wales where he was born, but always remaining faithful to the formula derived from the Italianized Dutchmen, particularly Claude.

In spite of monotony one must admit that Wilson's canvases reveal a charm of noble serenity, especially those in which light from his immense limpid skies is reflected in the waters of a lake framed by harmonious lines of mountains. Gainsborough also began by imitating the Dutch when he painted Harwich Road or the country around Sudbury, but it was his style which English landscape art followed, more especially in those canvases painted between the ages of twenty and twenty-five which already suggest Constable's early works He put into his pictures *The Watering Place* and *Returning from Market* an accent of nature which was then unknown.

After Gainsborough and Wilson there were a number of landscape painters in England. Nasmyth (1758–1840) and Thomas Barker (1765–1847) deserve notice, particularly the latter because of his robust unforced colour. John Crome, known as Old Crome (1768–1821) was entirely different. Except in 1815 while in Paris where he painted a fine picture, the *Boulevard des Italiens,* he resided in Norfolk and established there a tradition which became the keynote of the 19th century. He conceived nature from the viewpoint of a portrait painter, renouncing conventional arrangements and distinguishing between resemblance and expression, between the objective and the subjective, which during the 19th century continued to grow, allowing the most original variations from Constable and Turner to the French impressionists. Crome, uneducated and the son of a workman, learned his craft without a master by studying the works of the Dutch whose influence can be felt in his first pictures. He divided the elements of landscape into three divisions: (1) the sky with its infinite gradations; (2) the ground structure; (3) the trees. Only Théodore Rousseau loved great oaks as Crome did. Of Crome's pupils, Cotman, Stark and Vincent, the first was the most gifted, and it was he, with Thomas Girtin and Cozens, who revived the watercolour, a form of painting which later became an institution.

At the same time three men of very different calibre showed themselves as much more original; two geniuses, Constable (1776–1837) and Turner, and a charming painter, a delightful colourist who had he lived long enough would doubtless have become great —Bonnington. John Constable, the first to be influenced by the Dutch, owed much to Rubens' landscapes, so full of passion and vigour, but his real model was Gainsborough. It was not that his choice of subjects was so original, for his *Watering Places, Fords,* and *Hay Waggons* show the same motive as those of Gainsborough, but he inaugurated a new era both in technique and sentiment. With the exception of François Desportes, who at least a hundred years earlier painted a number of little fragmentary studies which have only come to notice lately, Constable was the first to consider that the essential duty of a landscape painter was to study directly from nature. On a certain day, at a certain hour the artist stops before a natural spectacle which impresses him either on account of its serene beauty, or because of its dramatic aspect, or some other shade of expression, and the picture that he could make and feels that he wants to make appears before his imagination. So as to lose nothing, nor allow the emotion he feels to cool, he tries to fix with a few rapid sweeps of the brush, lines and colour representing masses, and light, and it is this momentary expression, the most individual and least reproductive, which, contained in his study, becomes the soul of his future picture, and in the more or less slow work on the big canvas it is his goal to enrich and complete rather than transform or construct. In his work he attempts to keep the first freshness. It was to these two preoccupations, what might be called the research in the field, and its development and construction in the studio, that Constable gave himself up, with a kind of lucid intoxication developing the palette of an original colourist and a vibrating technique proclaiming from afar the advent of the French impressionists. He audaciously introduced an almost acid green into painting which had known until then blue, yellow and more often brown spectacles. Sometimes in his passion not to neglect detail he compromised the unity of his picture, but he always dazzles and refreshes us, and those inestimable treasures, his sketches, are so fresh and vivid that they seem to have been painted only yesterday.

From 1820 criticism started to relax and in 1824 Constable exhibited several important canvases at the Paris Salon where they triumphed. Constable's paintings were a revelation to Eugène Delacroix, the proof of which can be seen in his *Journal* and *Correspondence.* It is said that after seeing the canvases of this illustrious English painter the day before the Salon opened he hurriedly repainted the background of his large picture the *Massacre of Scio.* So strong was Constable's influence that all painters of the 19th century were affected by it excepting only Corot. (*See* COLOUR PLATE—LANDSCAPE PAINTING.)

Bonington.—Bonington (1801–1828) formed a more marked connecting link between England and France. From the age of fifteen he studied at Calais with Louis Francia, a good teacher and clever water-colour technician. Then he entered Gros' studio in Paris and at the age of nineteen was admired by Delacroix who was then working on his *Dante's Barque.* Thirty years later in a letter to Th. Silvestre, Delacroix still talked of that charming young man who was so marvelously gifted. During fully the last seven years of his life Bonington travelled in France and Italy executing water-colours which are little masterpieces of brilliance and limpidity, and oil paintings no less seductive. He painted *Francis I. and the Duchess d'Estampes* and *Anne of Austria and Mazarin,* investing them with a grace and conception of colour that were entirely his own, and lastly in a few landscapes, such as the *Lake at Versailles* and the *View on the Normandy Coast* (Louvre), he showed a broadness of vision and a sureness of touch that indicate the great painter he might have become had he not died, leaving fame to both the English school and the French, at the age of twenty-six.

Turner.—Turner (1775–1851) was equally precocious. At the age of fifteen he had already exhibited a *View of Lambeth* and soon after made a reputation as an amazingly clever water-colourist. A disciple of Cozens and Girtin, he showed in the choice and presentation of his compositions a picturesque imagination which seemed to indicate a brilliant career as an illustrator, for it was the fashion in England at that time for artists to do illustrated albums showing stages of a voyage or celebrated views, and all his life Turner was a prolific illustrator of voyages. His most famous collection was the *Rivers of France* (1833–1835), but he travelled in Germany, Switzerland and Italy and after studying profoundly all of Claude's canvases that he could find in England he copied and imitated them in a marvelously perfect way, and out of admiration for this master he asked that his *Sun Rising through Vapour* (1807) and his *Dido Building Carthage* (1815) be placed beside one of Claude's masterpieces in the National Gallery, where they are still to be seen. There was a secret affinity between Claude and Turner: the light, the immense sky spreading over mirroring waters, the frame of noble architecture and fine trees amongst marbles—a scene for a mysterious opera whose songs have never been heard. All that was in Claude is reflected and multiplied in Turner. He was composed of contrasts, difficult of humour, though capable of generosity, avaricious, and yet showing the most fastidious, magnificent disdain of everything, even his fame, though he did recognize with most meticulous precision the programme of posthumous honours due to him. Thus he was filled with irreconcilable aspects but was always imperturbably himself. At the height of his glory and fortune this great artist died in an extraordinary manner under a false name in a garret where after having donned shabby clothes he went to find a woman who was neither young nor beautiful to whom he gave just enough to prevent her dying of hunger, and who thought him a member of the provincial middle class. One could dream for-

ever over such an unprecedented adventure as one might dream before the picture *Ulysses Deriding Polyphemus* or the *Palace of Caligula*. He never told his secret, and doubtless organized this double life in a madness for solitude, a longing for liberty, a wish to escape the narrow conditions under which he had to live surrounded by honours, luxury, flattery and applause, which though first intoxicating always welds chains of servitude in the end. He clung, however, to his golden chains as much as to his miserable incognito, plunging into the troubled depths of the ocean and then, when he wished, rising to the surface radiant and majestic. Who has not dreamt under one form or another of escaping himself, and is this not the explanation of the desire for travel which seems to us so natural and normal in the artist?

It was only in 1819 that Turner visited Italy for the first time and then again in 1829 and 1840, and it was the beauties of the country that helped him in his art more than the influence of any painter or school of painters. He could not have dreamed the light of his skies before the iridescence of a sea-shell, and it was undoubtedly in Italy that he acquired much of the colour which could never have been imagined in England. Humanity really only inspired him when united to an idea of death, but a singular death and a lyrical swoon like the close of an opera. Compare his *Polyphemus* to that of Poussin. Turner's picture fascinates us, but we think of nothing precise or human—all is phantomlike in unforgettable colour. What a theme for Turner was the *Funeral at Sea of Sir David Wilkie,* one of his most striking compositions: those two vessels alongside each other in the misty radiance of the setting sun, and the coffin disappearing into the depths of the waters!

England had at that time other visionaries, in turn or together puritanical and romanticist. Milton, Shakespeare and the Bible were their principal sources of inspiration, but none of them had gifts comparable with Turner's. The Swiss, Henry Fussli, known in London as Fuseli (1741–1825), writer and painter, belonged to this school with its fantastic style. One of his pictures is called *Nightmare* but nearly all, even those supposed to illustrate some delightful scene of *Midsummer Night's Dream,* might have the same title. John Martin (1789–1854) illustrated *Paradise Lost,* though his talent is more evident in his mezzotints. His painting displayed an imagination in composition far superior to the academic dementia of Fuseli. His most celebrated picture is the *Feast of Belshazzar*.

Blake.—William Blake (1757–1827), poet, draughtsman, engraver and painter, was animated by similar pre-occupations. His art was formed of the same elements—Gothic art, German dreaminess, the Bible, Milton, Shakespeare, Dante, and a certain taste for linear drawing which through Flaxman brought to him the great classical movement begun by Winckelmann and continued by David. This is the only point of contact between Davidian classicism and English art, and how indirect, how different the spirit! Blake was the only mystic of the English painters, perhaps the only real mystic among painters of those times. He was ingeniously so and transcribed in his personal imaginations or in his interpretations of the poets a pure and candid soul, like the title he gave to his first work of poems which were composed, illustrated, and put to music by himself: *Songs of Innocence*. But he attained grandeur and strength, and above all depth in certain paintings, such as his *Spiritual Form of Pitt Guiding Behemoth* For a long time he was misunderstood and his works considered the incoherent ravings of a madman, though today he is accepted as one of England's most illustrious and original artists.

Besides such individuals as Turner and Blake the second generation of portraitists came into being: Romney (1734–1802), Hoppner (1759–1810), and Raeburn (1756–1823) who were excellent painters, and only the unique genius of Reynolds and Gainsborough obliges us to place them in second rank. Romney has left us innumerable pictures of the celebrated Lady Hamilton and he displayed a distinguished talent in his family group. The pictures of young men and girls painted by Hoppner are full of charm. And Raeburn had a rich warm palette and his touch was broad and accented. He arranged his sitters with decision and really had the talent of a great painter. But we must also mention Beechey, a clever practitioner but more ordinary, and there were many others in England, at this happy time, who did good portraits: Benjamin West, who succeeded Reynolds as president of the Royal Academy; Gilbert Stuart, Opie and John Russell, who was the pastellist of the school. To Russell's amiable but somewhat insipid art add the worldly elegance of the miniaturist Richard Cosway (1742–1823) and his disciples Engleheart and the Plimers. (*See* MINIATURE PAINTING.) Downman (1750–1824) hovered between the pastel and miniature painting, between which there seems to be a certain affinity, for in France there was also a return to the miniature at the time of the great pastel fashion.

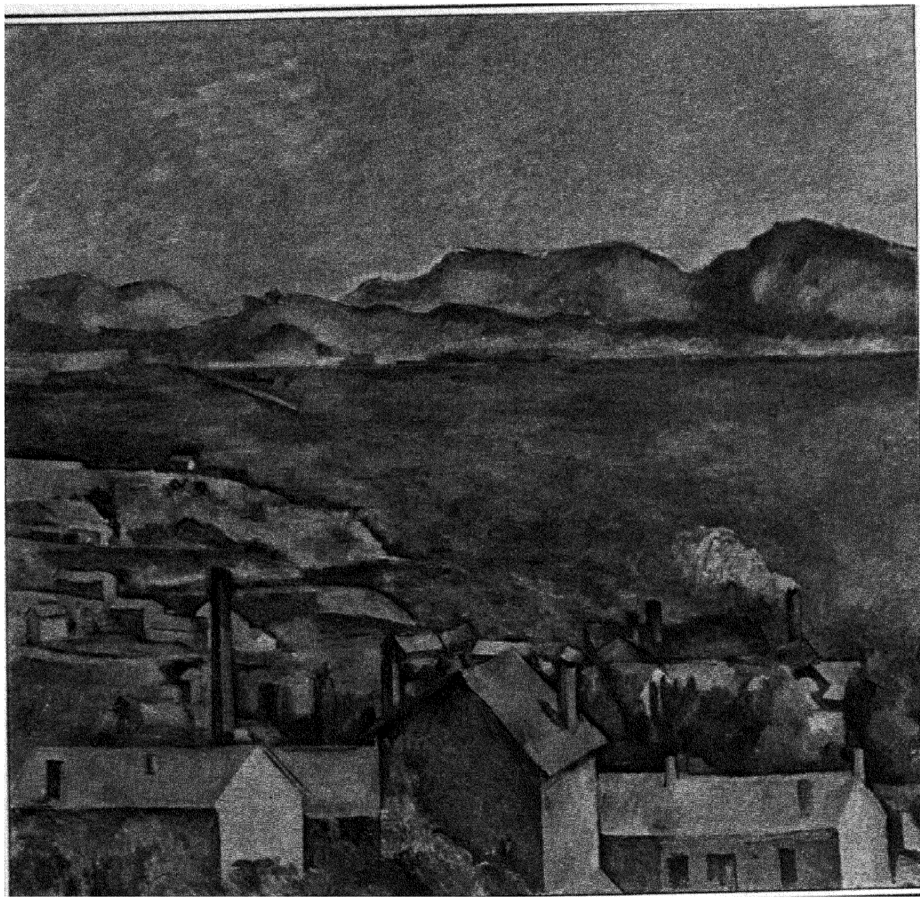
Lawrence.—Lawrence (1769–1830) carried his triumphant brush into all the courts of Europe and thus the first century of the English art of portraiture terminated with a great name. This painter of kings, princes, diplomats, warriors and even the Pope presents his sitters with a sovereign reserve and elegance. The *Holy Alliance* is among the thirty-four canvases of Windsor Castle in the collection of official portraits. Lawrence surpassed Reynolds in success and in precocity, though he did not possess the thoughtful science and rich, fine imagination of his predecessor. At the age of ten he was a portrait painter and at twenty-two he had painted the ravishing picture of Miss Farren, later Countess of Derby, and he quickly became a member of the Academy and a favourite of the king. He has as much coquetry in painting as many of the beauties whom he painted and these two coquetries made a pact for our pleasure. There is superficiality in it all, and artifice, but an artifice manoeuvred with such allurement and life that it becomes naturally beautiful. This clever fastidious courtier was refined and intelligent. He collected a remarkable group of drawings. In 1825 Eugène Delacroix, aged twenty-seven, was received by Lawrence in London. He was charmed by the man and admired his talent, for though Lawrence was a snob in his painting, it was his way of being himself and English, and in spite of these qualities we have a striking evidence of the impression he made on the young artist from France, for in the portrait Delacroix made of his friend, Baron Schwiter (National Gallery), this famous Englishman's influence is visible in the colour, the arrangement on the canvas, the model's pose, and even the will to attain elegance accented by elongating the proportions, though in the facial expression and the drawing of forms Delacroix was himself with all his complexity and inward excitement—those spiritual things to which Lawrence paid no attention. In England there were only feeble imitations of Lawrence, and later in the time of the pre-Raphaelites he was accused of empty virtuosity, but when Delacroix went to London, seeking to reconstruct traditions of France which had been compromised by the systematic dryness of the Davidian school, Lawrence showed him that in a return to harmony, richness of colour and grace of touch not unlike that of the old masters, an entirely modern art could be created. Thus Lawrence stimulated French energies with as much efficacy as Constable, and later had an influence on Carolus Duran and Sargent.

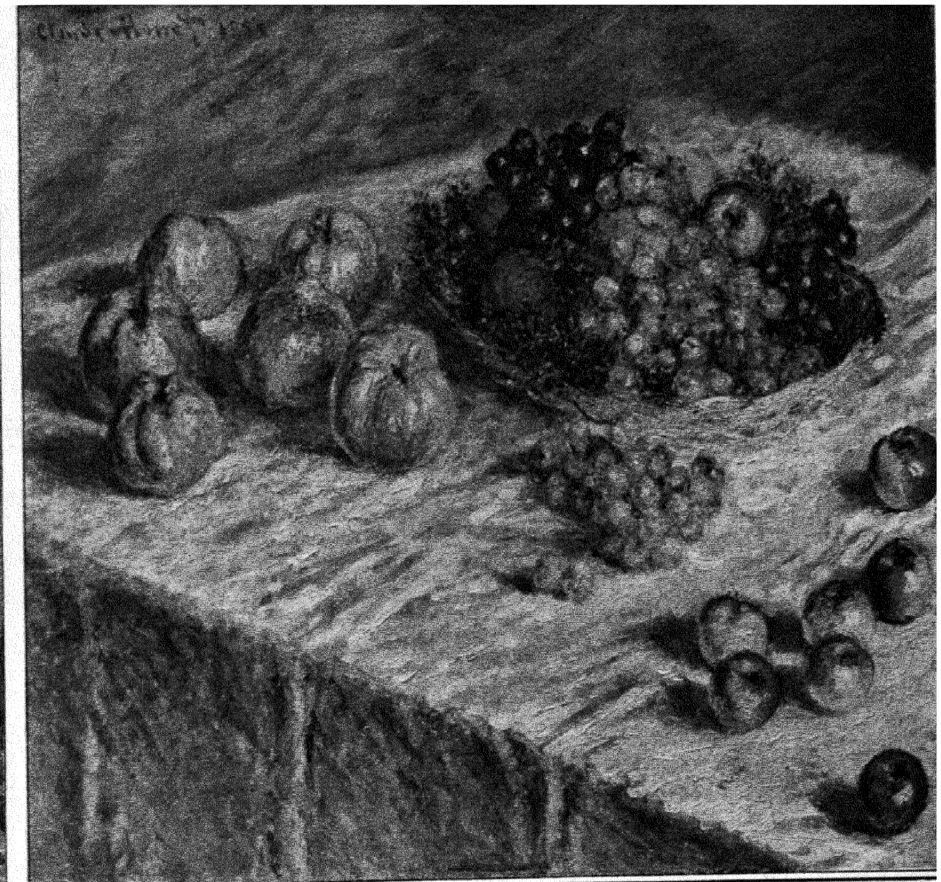
After this period in which English painting led the world there was a decline, partially due to a most praiseworthy effort the result of which proved it to be in vain. It might be said that the pre-Raphaelites were a prolongation and transformation of the idealistic movement oscillating from the fantastic to the mystic, from which came at the beginning of the century Fuseli and Blake. Thomas Stothard (1755–1834), with his pictures inspired by Shakespeare or Chaucer, in a way continued this movement. A little later Ford Madox Brown (1821–1893) painted his first Gothic pictures with dry precision and scrupulous attention to detail. In 1848 the new school or brotherhood found its name, for, under the influence of John Ruskin, who was a fanatic and in a way a poet, impregnated with puritanism and aesthetic spirit, the group took on an almost religious character and each adherent had to follow his signature with the initials P.R.B. (Pre-Raphaelite Brotherhood). They wanted to react against the facility and frivolity of the art sprung from Lawrence, but they precipitated decadence and a result far removed from the academicism for which Raphael himself was responsible, and an artifice, more literary than plastic, made itself felt everywhere in their works. Per-

BY COURTESY OF (1, 3, 5, 6, 7) THE REINHARDT GALLERIES, (2) THE PHILLIPS MEMORIAL GALLERY; FROM (4, 8) THE CHESTER DALE COLLECTION

EXAMPLES OF MODERN EUROPEAN PAINTING

1. "Figure in an Interior" by Henri Matisse (1869-). One of the leading members of the Post-impressionist group in France
2. "Early Spring" by Pierre Bonnard (1867-). Contemporary French
3. "Les Amoureux" by Pablo Picasso (1881-). Spanish
4. "The Mother" by Pablo Picasso
5. "Portrait of a Girl" by Amédée Modigliani (1887–1920). Italian
6. "Landscape with Figures" by Charles Dufresne. Contemporary, French
7. "Girl in Pink" by Jules Pascin (1885-). French
8. "The Matador" by Ignacio Zuloaga (1870-). Spanish





CÈZANNE AND MONET

Left: "L'Estaque" by Paul Cézanne (1849–1906). Cézanne was trained under Pissarro in the principles of Impressionism. He later departed from the Impressionist technique, however, placing his emphasis on form and colour in a manner which has exerted a strong influence upon painting in the 20th century

Right: "Fruits" by Claude Monet (1840–1926), French, leader of the Impressionist school. The Impressionist technique is well illustrated here in the use of colour to indicate the effect of various lights upon the white surface of the table-cloth

haps this was because in the origin of their school was strongly felt the influence of two literary men, Ruskin and Dante Gabriel Rossetti, who was a poet and even a journalist before being a painter. Strange association uniting an enthusiastic *doctrinaire* as narrow as Cromwell's Roundheads and the son of a revolutionary refugee in London, ambitious, unquiet, voluptuous, subtle and uncertain! The miracle lies in the fact that from these two contrary elements sprang an art of truly English character. The P.R B. group contained a serious Christian, Holman Hunt (1827–1910), who was a painter after Ruskin's heart, but his works were cold in style and crude in colour. John Millais (1829–1896) was superior to Hunt and Rossetti as a craftsman, but finally changed, almost surpassing his pre-Raphaelite precision in the painting of sentimental anecdote laboriously made into the form of a large canvas, and ended by doing portraits. All that poetry which was too literary but at times sincere in emotion, was to be found in Rossetti and Burne-Jones (1833–1898), and these two created a new type of feminine appeal, more trouble in the former, purer and more chivalrous in the latter, a type of girl in which there was more mannerism than plastic force but whose enigmatic charm is undeniable; true quintessence of English sentimentality, which, one knows not how, persuades us that the race of Virgins or Botticelli Venuses had their natural descendants on the borders of the Thames, and to have created a type of woman is something in an artist or school that posterity can never forget.

Pre-Raphaelitism bore fruit beyond the domain of painting into decorative arts, thanks to William Morris and Walter Crane. George Frederick Watts (1818–1904), with the resources of modern painting, tried to express his rather lofty and confused ideal and introduced the symbolism that developed in France and elsewhere during the last years of the 19th century. His portraits are his best works Leighton (1830–1896) and Alma Tadema (1836–1912) retained something of the scrupulous precision of this school, but with them it became pure academic virtuosity and only served in inserting an elegant insipidity into conventional archaeology Whilst Burne-Jones was continuing his rather morbid but distinguished dreams, whispers from outside changed the English atmosphere little by little. They came first from France as realism and then impressionism They came also from America where was discovered, re-discovered, indeed, those brilliant truths in painting that an idealistic interlude had made England forget for a time

AMERICAN SCHOOL

The first American-born painters worthy of mention belong to the latter half of the 18th century. Gilbert Stuart (1754–1828), who painted Washington and most of the heroes of the War of Independence, Benjamin West (1738–1820) and Copley (1737–1815), though they extended their careers in London where they obtained success and honours, but none of these were distinguishable from the moderate English painters of those times, and only after 1870 the founding and rapid enriching of large museums and great private collections created an atmosphere more favourable to artistic vocations. At the moment the prestige of the Barbizon school, especially Millet and Rousseau, was immense, and American artists preferred to travel in France than in England However, the greatest American name combined the influences of both countries with work that was incontestably original.

Whistler.—James McNeil Whistler (1834–1903) had the gift of seizing with a subtle intuition the vital current of ideas that periodically agitate the world of art. Living in Paris and then in London directly after the Universal Exhibitions of 1855–1857, in which the arts of China and Japan were shown, he began to divine sources of renewal and original inspiration they offered European artists (*see* ART—*Far Eastern Methods;* CHINESE PAINTING; JAPANESE PAINTING AND PRINTS; CHINA, AESTHETIC DEVELOPMENT; POTTERY, NEAR AND FAR EAST) Whistler's father was an engineer in the Russian service, and at the age of twenty-one his son, after having led a nomadic childhood, arrived in Paris and almost immediately his independence and irregularity caused him to sympathize with the young artists of the day, Monet and Fantin Latour. Of the preceding generation he admired Courbet and Troyon. His bitter sarcasm made him many enemies, especially in London, and among them Ruskin put up a violent opposition to the painter who ridiculed the pre-Raphaelite commandments. Whistler was also witty with his pen—his *Gentle Art of Making Enemies* is a record of bitter polemics. In France, on the contrary, the friends of this youth remained faithful to him and it was from there that we have canvases that are celebrated today, as the portraits of his *Mother,* that of *Carlyle and Miss Alexander* which obtained the first favourable notices from the critics. The portrait of his mother was acquired by France and kept in the Luxembourg until it went to the Louvre. After 1890 he was much preoccupied with landscape. He had long been a master of etching; and the training he had undergone enabled him to use to the best advantage all that was individual in his perception of landscapes, interiors and the nude. His painted landscapes also serve to express that element of his soul, so aristocratic, so disdainful of noise, agitation, and almost of life itself. He required the calm and mystery of night as expressed in his nocturnes, harmonies in blue and gold, etc Despite his relations with Degas and others, he escaped the influence of impressionism, though he created a sort of impressionism of his own, mysterious, intimate and spiritual, which was just the opposite to that of Claude, Monet and Renoir (*See* PAINTING, MODERN)

Mary Cassatt.—After Whistler, the name that brought the most honour to the United States was that of a woman who found in impressionism the necessary atmosphere for her development Like Whistler, Mary Cassatt (1845–1926), surpassed her circle and, founding her method on his, using pastel both as an incisive instrument of drawing and as a means of obtaining fresh though sometimes heightened colour. She had a personal style with a frank and healthy sentiment in depicting mothers with their children and children in nursery scenes, which were her favourite subjects.

Sargent.—John Singer Sargent and William Dannat, contrary to the mysterious subtle and aristocratic Whistler and the intimate Mary Cassatt, represent all that is most exterior in painting—skill, broad vigorous sweeps of the brush and brilliant and fluid colour They both studied with François Carolus Duran. A few of Sargent's portraits in the Tate Gallery in London are comparable to those of Lawrence with somewhat greater depth and less facility, and he was a master of true water-colour. (*See* WATER-COLOUR PAINTING.)

Amongst landscape painters, George Inness must be mentioned as well as the Canadian W. J Morrice, who came under Whistler's influence in Paris. Walter Gay was more French in feeling and painted interiors that required no human presence to give an impression of life, with a charming distinction, but up to this time Whistler is the only American who had made an outstanding original addition to the treasures of universal art. His name dominates all others, as did that of Edgar Allan Poe in poetry. It is to be noticed as a curious fact explanatory of the genesis of America that the two brilliant personalities did not speak in the naive language one might expect from a young people, things unheard till then arose from two subtle and rather disabused souls who expressed themselves as though they had centuries of culture behind them

After a period of misunderstanding Whistler's influence was great in England and contributed to upholding the painters of that country in an aristocratic tradition It was also great in France and the effects are distinguishable in Eugène Carrière, Charles Cottet, Jacques Blanche and even Albert Besnard. An even higher French suffrage pleads before posterity for Whistler, that of Stephane Mallarme The poet of suggestion recognized in the painter of Nocturnes at least some part of the magic mystery which was to him the essence of art

EUROPEAN SCHOOLS

English School—End of 19th Century.—In England at the end of the 19th century the most distinguished painters were those influenced by Whistler's mysterious radiance Thus did J. W. Morrice paint his views of Canada, Paris and elsewhere. Thus also does Walter Sickert with his refined twilight palette

make from Whistler and Degas a personal mixture. In spite of his variation of colours, his violent contrasts of shadow and light and his romantic predilection for pirates and adventurers, Frank Brangwyn, painter and etcher, is also of Whistlerian origin. Wilson Steer is a landscape painter who used diffused light and broken colour to portray creations of brilliant imagination. Augustus John ushers in a new orientation, and henceforth Whistler is not thought much about for British artists have turned again to France, but with a determination not to lose their national accent. Thus the English school, though not maintaining the height it reached from Hogarth to Turner, keeps its independence. It almost ignored David, Ingres and Delacroix; the classic and the romantic, and even the impressionism had a rather late effect.

Belgium: 19th Century.—In spite of his virile genius, David was very nearly responsible for the emasculation of French art. England escaped this pseudo-classicism. Yet this same David, exiled as a regicide after the return of the Bourbons, spent the last eight years of his life in voluntary exile in Brussels, and by his influence helped to create a new school in this great centre where art now seemed on the point of extinction. If the name "Flemish" be reserved for the art of the great earlier masters it may be said to have been dead, but the moment that Belgium was gaining her independence a new school was born to flourish throughout the 19th century and promise future possibilities. (*See* DAVID, JACQUES LOUIS.)

François Navez (1787–1869), though he kept his liberty, became an admiring disciple of David, giving an individual rendering of the lesson of the master, just as Ingres was doing in France at that very time. His masterpiece "The Hemptinne Family" is not unworthy of comparison with some of the finest portraits of David and Ingres.

In Switzerland, notably in the case of Léopold Robert (1794–1835), David's influence plus a sugary realism hardened into pretentiousness and culminated in anecdote.

Decline of Romanticism.—The new Belgian school kept step with French painting, though it had not the benefits, unfortunately, of a Delacroix. Romanticism in a superficial form developed antiquarian imagery. Instead of an artist who, without care for a nice adherence to facts, reproduced in plastic form the emotion which meditations on the great events and heroes of history produced, there were only chroniclers who through petty details aspired to reconstruct little more than an authentic record. This spirit spread over Europe and brought fame to painters now relegated to oblivion. It started in France with Horace Vernet (1789–1863) and Paul Delaroche (1797–1855). In Germany it produced the Düsseldorf school of which Rethel (1816–59) is the most sincere representative, retaining something of the old Germanic spirit. Piloty (1826–86) and the Munich school followed. Its influence extended to the Slavonic countries and was prolonged to the end of the century by the Viennese Makart (1840–89) the Pole Matejko (1836–93) and the Hungarian Munkacsy (1844–1900). Gallait, a pupil at the Tournai Academy of the Frenchman Hennequin, himself a pupil of David, is of all these devotees of romantic imagery the one who most closely resembles Delaroche; but soon, in a similar formula as literary and falsely historical, Henri Layse (1816–60) showed by pictorial means that the old Flemish inheritance was not altogether lost, influencing humbler subjects like the little genre pictures of Madou and F. de Braekeleer. In the wake of these honest journeymen of the brush, under the influence of the French masters of 1830 and later of Courbet and Millet, Belgian painting returned more and more to that realism natural to the Flemings. Charles de Groux (1825–70) in his *Pilgrimage of St. Guido,* recalling Courbet's *Burial at Ornans,* blends this realism with sober sentimentality, a pity for the poor—to which Constantin Meunier (1831–1905) was to give new expression—showing at the same time a reality more external and intimate. Interiors were painted with or without figures by Henri de Braekeleer (1840–1888), rivalling Pieter de Hooch, Alfred Stevens (1823–1906) and Jan Steen, and at times expressing an ardour of emotion sufficient to justify his minuteness and wealth of technical virtuosity. Alfred Stevens was a society painter and more modern: his portraits of women generally show Parisians. Stevens was a friend of Manet and of French men of letters, and it was he who directed the artists of his country toward the movement *L'Art Libre.*

Landscape took an increasingly important place in painting. Hippolyte Boulanger (1837–74), who died too young, painted the forest glades with a vigour and naturalism derived from Théodore Rousseau and in turn fathered a succession of good landscape painters in French naturalism and impression: Émile Claus and Albert Baertsoen. The *Art Libre* movement was succeeded by what was known as the *Libre esthetique,* reacting to the influence of Paris and including symbolism as well as impressionism. The allegories of Léon Frédéric with their multitudes of figures are saved by their Flemish realism and their colouring, which is fresh to the point of crudity. Evenepoel, who died young, displayed the artistic gifts of a portrait painter. Félicien Rops (1833–1908) is more draughtsman than painter and some of his surreptitiously circulated work has won him a dubious celebrity. He was part, however, of that strange tendency which, currently with the realism characteristic of the time, carried an entire group of Belgian artists into visionary satire and mystic ideology. Henri de Groux combines the nightmares of delirium with dreams of the sublime. Eugène Loermans introduces Brueghel-like figures into his landscapes; but the greatest artist of this period and the only one who synthesized its confused or contradictory elements was James Ensor, who was fantastic, violent and subtle, the authentic creator of a new mode of feeling and as inventive in colour as in vision. From him derive the best of the succeeding generation from Rik Wouters to Constant Germeke. He held in their eyes an analogous position, though more variously endowed to that which the Austrian Kokoschka held in the art of Germany.

Holland, 19th Century.—In the middle of the 18th century the Dutch school seemed to be dying slowly of anaemia. There is no name worth mentioning after the death of Cornelius Vroost (1697–1750), a mediocre painter of amusing comic scenes. First, David's, at the beginning of the 19th century, and then the romantic influence was felt by way of Belgium, but both were lifeless and impotent. Two artists of this time had, however, a great influence on modern painting: Jongkind (1819–91) and Van Gogh (1853–90), and both by a curious chance or fateful instinct came to France in their youth where in truth their art is more native. Jongkind paved the way for impressionist landscape, for he was original though no theorist. At first he was the pupil of Isabey, but though gentle and childlike he was obstinate and independent. His water-colours which are perhaps the finest of his works aided him to discover a freer method. On his larger canvases his touch was heavy but his little pictures are so full of air and light and so freely handled that Jongkind is one of the most original artists of his age.

Van Gogh.—Van Gogh (*q.v.*), who appeared at the beginning of the impressionist triumph, wasted no time in imitation and made discoveries with which he expressed the mysticism and lyricism through which his vivid genius envisaged nature. Not the least surprising part of his story is that to only a few years of his short life belonged all that made him a great painter. He was already twenty-seven when he made up his mind to be a painter. Up to that time he had hesitated between art and religion but found it impossible to master the rudiments of theology. However, another side of his personality is shown in the most unbridled violence of his quarrel with Gauguin which ended in his cutting off one of his own ears, and another was the insensate act by which he terminated his life. But this madman had a simple goodness of heart and for a space of three or four years displayed genius. After wandering through Holland and Belgium in February 1886 he came to Paris and found the brilliance of French art. Then his originality blazed up like an explosive thrown into a fireplace. At Paris, at Arles and at Auver-sur-Oise he painted extraordinary pictures in composition, in colour and in feeling which will be the wonder and inspiration of many generations of painters.

During the romantic age another son of Holland, Ary Scheffer

WORK OF MODERN EUROPEAN AND AMERICAN PAINTERS

1. "Landscape in Southern France" by André Derain (1880–), French
2. "Every Saturday" by Arthur B. Davies (1862–1928), American
3. "Tormore" by Rockwell Kent (1882–), American
4. "The Way of the Cross" by Albert P. Ryder (1847–1917), American
5. "The Earring" by Ambrose McEvoy (1878–1927), English
6. "Ennui" by Richard Walter Sickert (1860–), English
7. "Emma and her Children" by George Bellows (1882–1925), American
8. "Intimacy" by Jean Edouard Vuillard (1868–), French
9. "Portrait of Dr. Schwarzenwald" by Oskar Kokoschka (1886– Austrian
10. "Rue d'Alésia" by Maurice Utrillo (1883–), French

JUNGLE PAINTING BY HENRI ROUSSEAU

"The Repast of the Lion" by Henri Rousseau (1844–1910), exponent of French folk-art. A naïve simplicity and directness like that of the primitives characterises his work. The illustration is from one of the many fantastic paintings of jungle life made by Rousseau during his last six years. Now in the collection of Adolph Lewisohn

1785–1858) became a Frenchman by adoption, but during the arlier and better part of his career he trod a little too closely in he footsteps of Delacroix, though his romanticism had his own ote of mystical sentimentality. He painted the *Souliot Woman* hree years after the *Massacre of Scio.*

About the time when Jongkind was leaving his country there ras at The Hague a group of good painters who followed with dmirable proficiency the path which they had chosen. These rere Joseph Israëls (1824–1911), Jacob Maris (1837–99) and is brothers, Willem and Matthijs; Anton Mauve, Bosboom, 3lommers and Mesdag. Of course, France had some influence; sräels studied Millet, and Maris, Mauve and Mesdag were ware both of Rousseau and Dupré, but whether painters of mndscapes or interiors they brought a sober and rather enigmatic nelancholy not unlike a kind of alliance of mysticism and realism vhich is the soul of the art of Van Gogh. All those who count or something in modern Dutch art, from Verz Cate (1858–1907) o Toorop, have followed the trail blazed by that unhappy genius.

Italy, 19th Century.—David's influence was not required to pread classicism in Italy, for it was in Rome that the classicism riginated by Winckelmann had its birth, and found an illustrious xponent in the sculptor Canova. Unfortunately, no painter of hat time produced any work comparable to those which in pite of his partiality to a certain academic grace, placed Canova n the ranks of great sculptors. Appioni of Milan has only a ertain scholarly aptitude. The Florentine Benvenuti (1769–844), a pupil of David's, is even more lifeless and Camuccini 1768–1844) is no less so. A romanticism not derived from Eugène Delacroix but from Paul Delaroche did not succeed in reathing life into this academicism and did no more than divert he art of painting towards sentimental anecdote of which *The Kiss* by Hayez (1791–1882) is the best example. Later, even vhen the school of realism known as "verism" took the place of cademic traditions, this spirit remained the goal of painters who vere otherwise quite efficient, such as Paolo Michetti, Ettore Vito, and Emma Ciardi. The last is the name of a woman and t is in her work that the lyrical note is most clearly heard. The im of these painters differs little from that of the contemporary Spanish virtuoso, Fortuny. De Nittis (1846–84) though less kilful in technique, was a true and delicate artist who caught he atmosphere of Paris where he lived most of his life. But the ionour of Italian art in the 19th century is vested above all in hree men of much stronger personality, who kept apart and ollowed their own dreams without thought of immediate success: Antonio Mancini, master of impasto and of painting in polyhrome touches, who attained an element of mystery in this echnique; the austere Segantini (1858–99), the apostle and iermit of the mountains to whose harsh grandeur he gave expression: and Antonio Fontensi (1818–82), landscape poet, who s not without affinity to Ravier of Lyons.

French School, 19th Century.—In France the reaction igainst the too rigorous authority of David began while he still ived. Prud'hon (1758–1823), who had neither the force nor iuthority of David but who had charm and almost feminine ensitiveness, preserved the treasure of French tradition and iardly acknowledged David's ascendancy. Prud'hon was also enthusiastic for the antique, but his viewpoint was that of the elegiac poet rather than the archaeologist. His portraits of vomen resemble the Muses and yet acquire that most living expression of the particular charms which these women had in he eyes of their lovers. Delacroix has justly devoted one of his est essays to him, for Prud'hon before Gros and Géricault, prepared the way for the reaction against David, which, thanks o the genius of the painter of the *Massacre of Scio* and of the *Barricade,* restored in France the true principles of the fine art of painting—suppleness of composition, charm of touch, richness ind harmony of colour.

Gérard (1770–1837), in his allegorical and mythological composition is still academic, but once at least when he painted a celebrated canvas *L'amour et Psyché* (Cupid and Psyche) he ichieved elegance and charm. This charm lends value to his portraits which are the best part of his work, more especially those of women, *Mme. Récamier* (Museum at Versailles), *La Comtesse Regnault de Saint-Jean d'Angely* (Louvre), and in the painting of Isabey with his little daughter, he almost equalled the true masters of portraiture. Gros (1771–1835) was more forceful and a master technician with a feeling for drama. There is true tragic grandeur in his vast canvases *Pestifères de Jaffa* and *La Bataille d'Eylau* in which he appears as the authentic precursor of romanticism and of Delacroix. But a curious fidelity made him fall under the influence of David and paralyzed his natural impulses in the latter part of his career. Géricault (1791–1824) had the stuff of a great artist in him and found under David's influence the foundation of classic art into which he breathed passion and life, but unfortunately he died too soon (*See* GÉRICAULT.) *Le Radeau de la Méduse* (1819) proves what he would have been, as does his painting *The Derby at Epsom* which was the happy result of his journey to England in 1821

Delacroix.—These three artists understood and encouraged a young man destined to become one of the great French painters, Eugene Delacroix (1798–1863). There is not one of his early works in which there is not evident the influence of Géricault, not excepting the finest and most original from *La Barque de Don Juan* and the *Massacre of Scio* to *La Mort de Sardanapale,* and even to that masterpiece which seems without a precedent, realistic and lyrical at the same time, the *Barricade,* but his passion is less physical; its springs are loftier and more complex than were those of the painter who so influenced him. Delacroix had the advantage of being a great intelligence as well as a great painter and was predisposed to critical analysis and psychological introspection not entirely necessary to artistic genius. He was not content to publish writings about art and artists nor with being its brilliant talker in the salons of his time, loved and admired by some and feared by others. He has left us a book, his *Journal,* in which at more or less regular intervals he confided his thoughts, and which forms a book that links up Delacroix with such writers as Montaigne and Stendhal as well as being a sincere confession of his moral, spiritual and intellectual life. There was at the same time in France another favoured artist, Baudelaire, who by a rare coincidence first understood and explained Eugène Delacroix's genius, and his profound and brilliant pages are the masterpiece of art criticism in the 19th century. This duality of poet and critic blended into harmony in both artists marks them as being among the elect. (*See* DELACROIX, EUGÈNE.)

The rivalry between Ingres and Delacroix occupied nearly the whole of the first half of this century and the champions of classicism in the controversy which arose claimed to be the defenders of order, and accused the romantics of anarchy. In reality, however, romanticism was an inspiration toward some liberty, poetry and lyricism Ingres himself was romantic and Delacroix repudiated the title of leader of a school and prided himself on being a pure classic. Nor was he wrong and it might be said that in spite of appearances and the honest belief of contemporaries the more classical of the two was he who was both acclaimed and decried as the leader of the triumphant revolution

Ingres.—Ingres (1780–1867) made a brilliant beginning at portrait and historical painting under the influence of David, and there is a picture of the Horatii which bears their combined signatures, but Ingres soon emancipated himself and in 1805 he painted the portraits of *Monsieur, Madame and Mademoiselle Rivière* (Louvre) and *La Belle Zélie* (Rouen Museum), showing an original talent which is a little mannered but with a manner full of charm and the undulating delicacy of line which is as far as possible from the harsh realism which gives strength to David's portraits. Ingres was the high-priest of the cult of Raphael and a great admirer of the classic sculpture of Greece and the masterpieces of the Italian Renaissance, but his secret preference was for those little objects which are not without a certain preciosity: intaglios, cameos and Greek vase paintings, at that time called "Etruscan." He was one of the first to collect the works of the painters of the *Quattrocento* which were inexpensive at that time and it was his taste for the archaic and curious which his unfriendly contemporaries were criticising when they called him a "Goth" and a "Chinaman." The sculptor, Preault, said that he

was a "Chinaman astray in Athens." There is a certain strangeness in some of the finest works of Ingres. A pedant looking at the back of the *Grande Odalisque,* the neck and arms of Thetis in the picture *Jupiter and Thetis* (Aix Museum), the neck of Angélique in the picture in the Louvre where that lovely victim is rescued by Roger, and certain exaggerations of form in the *Turkish Bath,* would cry out at the faults of drawing in this incomparable draftsman but they are not faults. These elongations and distortions, these slender and fragile arms, distended throats, which appear to be cooing like turtle-doves, are the means, though mannered, with which an artist of extreme sensibility has attempted to translate his passion for the bodily beauty of women. In the assembling of a large number of figures, such as the *Apotheosis of Homer* or the *Age of Gold,* Ingres never attained to that ease and freedom, vitality and unity which claim our admiration in the superb decorative compositions of Eugène Delacroix, but in those pictures in which he depicts a single image, erect or recumbent, of that female form which was the enchantment and torment of his whole life, there is an original taste and aptly fertile invention. *La Grande Baigneuse, Venus Anadyomene* and the *Source* are not unworthy of being set beside the most radiant daughters imagined by the painters of Italy.

An ardent docility of nature explains why Ingres was a great portrait painter, one of the greatest that France can boast of, and his technique in precision was suited to this art which he rendered not only with great accuracy in faces, figures and costumes but in which he revealed the intimate secrets of the soul. Finally, his original efforts placed him beyond the flat and harsh colouring which the critics often censured in other works. Such pictures as *Bertin l'Aîné* and *Mme. de Sénones* are solid, profound masterpieces which need never fear to face the caprices of popular taste. (*See* INGRES, JEAN.)

The development of landscape painting is one of the most significant features in French painting of the 19th century. "Historical" landscape painting was soon disavowed by Rousseau, Dupré, Huet, Decamps, Flers, Cabat, Diaz, Troyon, Chintreuil and Daubigny, who represented nature in a grand or familiar aspect. Millet, too, should be added, though he was late in beginning to paint pictures in which landscape was the principal feature. They commenced to paint the country about man as he appeared in the clothes and attitudes befitting labours in the fields. Some of them were hardly known to Paris, such as Ravier, of Lyons, and Morestel. This group also banished from the realms of art the literary and historical scene and even discredited attempts at intellectual seeking in composition. However, they equalled the Dutch landscape painters of the 17th century and one man rose above his peers.

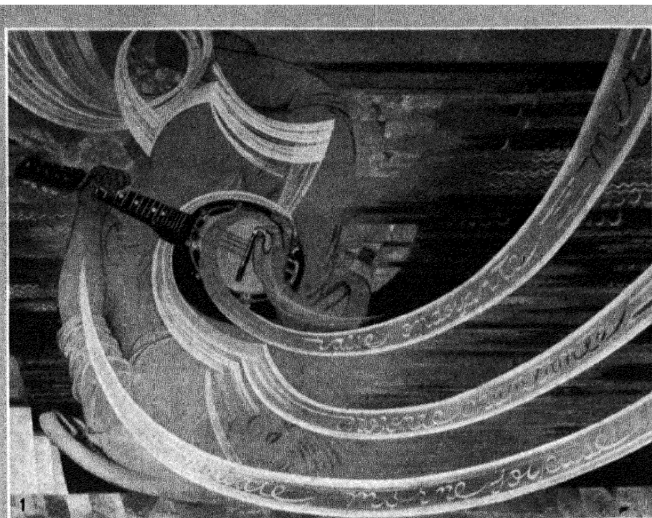
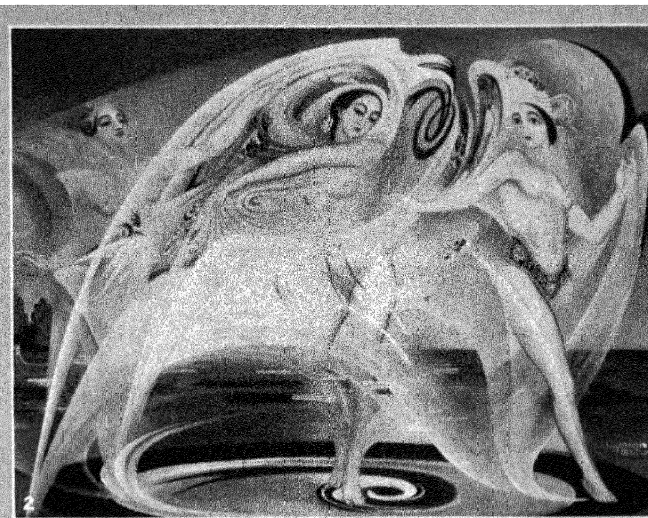
Rousseau.—Théodore Rousseau (1812–62) is a French Ruysdael. He profited from the works of Delacroix, but in him there was a philosophical spirit which lends to even his minute work an appearance of austere grandeur. Beginning with almost scientific analysis, Rousseau ends in generalizations which turn the edge of the forest or a mass of chaotic rocks into a microcosm expressing terrestrial force. One would think that before painting the trees of his forests at Fontainebleau he approaches them, touches them with his hands, feels them, and measures them, while his spirit senses the pulse of the world.

Corot.—Corot (1796–1875), in spite of appearances, was not entirely foreign to this group of landscape innovators. He belonged to another generation, but the leaders of the new school accorded to their elder all the marks of great deference as much on account of his enduring simple goodness as on account of the perfect dignity of his life. Yet they would doubtless have been surprised had they been able to see how posterity has admired the most delightful landscapes painted at that time. The writers of the period poured their sarcasm upon Bidault and Bertin, who was Corot's master and held in high regard by his pupil. Corot's position with regard to the innovators is analogous to that of Eugène Delacroix and his relationship to Ingres. Corot is perhaps the most thorough classic French painter of the century, though he was also prompted by a humble devotion to nature and even in his mythological or allegorical paintings, such as *Danse des Nymphes, Diane au bain, Concert Champêtre, La Toilette,* he lends a fresh sincere quality of life to the noble inspirations springing from Poussin and Claude Lorrain.

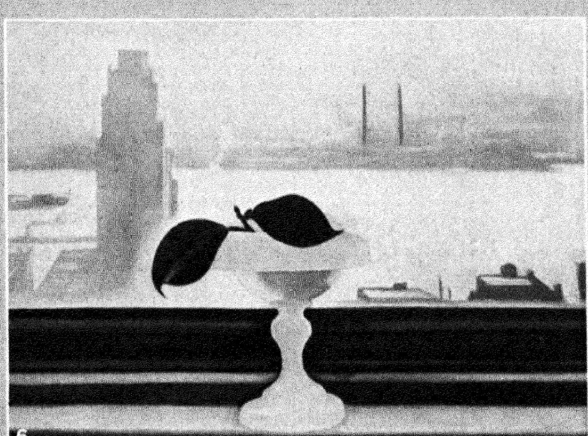
Whether they recognized it or not, Manet and the impressionists, Cezanne and those who reacted against impressionism, as well as those like Puvis de Chavannes, who attempted to find a new classic order in the association of human figures with landscape, are tributary to the painter called the "*bonhomme Corot*" just as in the 17th century they said "*bonhomme La Fontaine.*" They all derive from Corot, who, setting up his easel out of doors in 1826 and 1830, painted *Forum Romain* and the *Cathédrale de Chartres* and forty-five years later with the same young heart painted *le Beffroi de Douai.* (*See* COROT, JEAN BAPTISTE CAMILLE.)

Millet and Daumier.—Millet (1814–1875) and Daumier (1808–1879) introduced the painting of manners not in the form of anecdote as in genre painting but with a dignity previously found only in the works of Chardin and the Le Nain brothers, and in Eugène Lami (1800–1890), before reaching Meissonier (1815–1891), who is one of the most extraordinary, most precious, most impeccable virtuosos of painting without a soul. Doubtless there was mingled in both Millet and Daumier (*qq.v.*) a little of that mystic humanitarianism which inflamed many hearts in the year 1848. It was this which made Delacroix and Baudelaire mistrustful toward Millet, who painted in an epic style the peasants labouring in their fields and following their domestic lives. Millet expressed himself by saying, "A peasant I am, a peasant I shall die." He had meditated on the Bible and on Virgil. He became a student of the most differing masters but was especially devoted to Michelangelo and Poussin. Beginning with painting in the romantic manner, very lofty in tone, little by little he divests himself of the unessential, simplifies his drawing and colour, but always preserves through study his contact with nature. He is one of those rare beings who have engendered in the life of art the subjects of their inspiration and have created at the same time a language without which this inspiration could not have been communicated to the world. This task is so difficult that one must not be surprised if there is at times a certain laborious painful quality, a kind of heaviness or dryness in his paintings; but his drawings are always forceful and graceful as are his water-colours and etchings. His oil paintings which were entirely composed in the studio are rather the creations of a reflecting will assisted by memory methodically applied. *The Gleaners* is perhaps the most consummate example of this bare art, almost meagre, chosen to deliberately express in all its primitive power profound, grave, and primitive feeling. After 1865 he slightly modified his manner, developing more freedom, more suppleness and more clearness. The pastels increased in number and landscape painting became more and more important. In *Le Printemps* there is a perceptible attempt to seize an effect of light as the impressionists do, a fugitive effect and an exceptional effect which has never before been observed nor represented with so much truth. In it there is no symbolic figure, but swift drama extending from sky to earth: the rainbow is painted against the storm and makes the young foliage wet with rain gleam and seem detached, almost as if varnished against the dark background of the sky where fleecy clouds are floating. (*See* colour plate LANDSCAPE PAINTING.) But Millet does not seem in the least affected by the new movement in impressionism. He did not like to be associated with Courbet, and Courbet did not trouble himself about this comparison. He probably did not see what the young painters in the group around Manet were doing, nor did the impressionists seek in his example any support for their theories. It is a curious fact that it is rather Puvis de Chavannes who was indebted to Millet for he was struck by the harmony, which was new at that time in the *The Gleaners,* between a true landscape and sculptured figures with simplified gestures.

Daumier in a longer life but a life consumed by the demands of lithography could unfortunately devote only brief hours to painting. He has left few canvases and still fewer completed paintings, but they are animated with such a spirit of life, they are composed





BY COURTESY OF (3) MRS. PAUL REINHARDT, (4) JOSEPH STELLA, (5) MRS. FRANKLIN LOCKWOOD, (6) ALFRED STIEGLITZ, (7) THE FERARGIL GALLERIES

PAINTINGS SHOWING THE NEW INTEREST IN RHYTHM

1. "Méditerranéenne" by Louise Janin. Images of things normally separated, coalesce to evoke a familiar mood that the lilting rhythms intensify. The viewpoint is from above looking down on a seated figure
2. "Ballet" by Louise Janin. The rhythms of the dance are suggested by abstract "veils"
3. "Two Girls" by Marie Laurencin. The repetition in form creates a pleasantly passive rhythm
4. "The Bridge" by Joseph Stella. An excellent example of the beautiful rhythms to be found in modern construction
5. "Blue Dancer" by Maurice Sterne. A similar use of forms to Fig. 2 but less extensively carried out
6. "Pink Vase with Green Leaves" by Georgia O'Keeffe. Contrasting two rhythms, the vase and leaves in flowing curves and the background in straight horizontal and perpendicular arrangement
7. "Into the Moving Night" by Arthur B. Davies. One of the most successful uses of abstract rhythmical forms applied to the human body

on such a structure of design, so expressive and so true does his brush apply the colour and with such imperious intensity, that nothing more could be wished for in these powerful rough drawings.

It was at the beginning of 1848 that Daumier made his public appearance as painter, taking part in the competition which had been announced by the management of the Department of Beaux-Arts, for a figure representing the Republic. His sketch which one can see in the Louvre was a powerful woman seated on a throne, with head erect. She holds the tri-coloured banner in her hand and is nursing at her breasts two hearty infants. Daumier's *La République* has a certain similarity to Millet's which expresses the bonds of sympathy which naturally united these two men. They resemble each other particularly in the quality of design and in their search for a certain secret grandeur in familiar objects.

Daumier is at bottom more completely a painter than Millet, and his technique approaches more nearly that of Decamps (1803–60), whom he admired and who is neglected to-day because of the tedious virtuosity of his genre painting. Also Daumier prefers to show peasants in a *Wagon de 3e classe* rather than in their native fields and he observes them with the mocking eye of a city dweller. His landscapes too were unimportant and none were done directly from nature, though some of his pictures such as *Emigrants* show invented horizons in tawny tones as do also his numerous *Don Quixotes* in drawings, water-colours and oils.

Daumier loved the cities and the people of them and he was, perhaps, the first to explore in the strange world of the theatre, with its noble, tragic and ridiculous passions. His chief work, the *Drama,* shows an understanding of both the spectacle and the audience. The effect of the footlights interested him, for he was always looking for novelty in his work. An artist before his easel, a laundress bending under her load, or any other human subject interested him, and with a perfect ease in a stroke of the brush, a gesture which seems involuntary, or a wrinkle around the eyes or mouth, he reveals to us secrets which were at that time still unknown after all the centuries since mankind first became the proper study of man, and thus he had affiliations with Manet, Degas and Lautrec. As Romanticism ruled the first half of the 19th century, so does Impressionism in the following period, and it was Gustave Courbet who, although not without a certain romantic effervescence in his naïve and confused soul, was to become the ensign-bearer of those who felt that Romanticism had come to an end with all its dramas of history and Oriental picturesqueness.

Courbet.—Gustave Courbet (1819–1877) seemed at the beginning to follow the manner of painting of the old masters, and in his large, robust style he naturally opposed the imitators of Delaroche. Thomas Couture (1815–79) began with similar endowments but if Courbet's head was not very steady Couture's was even less so, for though he only did excellent bits he believed he was a modern Veronese, and the success of his immense canvas *Les Romains de la Décadence* served to make his error irremediable. His future career became a succession of plans and failures. It was Courbet's misfortune, on the other hand, to encounter certain metaphysicians and aestheticians of realism, and had it not been for these he would probably have continued to produce masterpieces of good painting without any indirect purpose, such as *l'Homme à la ceinture de cuir, l'Après-dîner à Ornans, l'Enterrement à Ornans,* and *les Demoiselles de la Seine,* and the world would have gained by this as well as himself.

A misunderstanding between artist and public dated from about 1830, which seems almost monstrous to-day, developed and became the rule in their relationship. Delacroix was the earliest of the illustrious victims. He was disdainfully amazed at the malice and unfriendly stupidity of the things that were being written and said. Corot was treated in a different manner. There were little or no polemics in his honour. The canvases which he sent to the Salon were hardly noticed. That genius may not be perceived is understandable, but at this time France showed hostility rather than indifference and did not recoil from any means to travesty the great artists of the day and make them something grotesque or odious. Courbet, however, attracted the attention of Ingres and Delacroix who admired his skill, and in spite of the fashionable groups who felt that his subjects were too vulgar, satisfactory relations might have been established between himself and the public, but Courbet under Prud'hon's persuasion allowed the social revolution to turn his head and felt that he had a mission to fulfill in employing his brush for the emancipation of the people. But luckily he forgot Prud'hon most of the time. He gained the respect of public officials and had the satisfaction of repelling them ostentatiously. But when the uprising actually took place it was no longer a case of showing one's colours. It was necessary that he become a revolutionary in deeds. After the victory of the regular government he came out of prison, unhappy, exhausted and broken in spirit and went to Switzerland where he dragged out his last days. *L'Atelier* represents his greatest effort and is one of those audacious paintings which in spite of bizarre and incoherent features may be ranked among such masterpieces as Rembrandt's *The Night Watch.* No one has ever equalled him in representing the mysterious influence of music on people as he has done in *l'Après-dîner à Ornans.* Who has ever revealed as he has done in *la Curée* or in *La Remise des chevreuils* the elemental poetry of a winter evening falling upon triumphant hunters in the solitude of the forest or in the mist of snow? And thus he stands unrivalled in his own age and perhaps in his century.

Ricard (1823–73) and Monticelli (1824–86) had rich and learned technique and though they were both interested in tonal graduation, harmony and contrast, the expression of a spiritual ideal was the main aim to which they devoted themselves, which to Monticelli meant visions of strange princesses walking in fairy parks and to Ricard the divination of the depths of the soul. Fantin-Latour (1834–1903), whose career ran parallel with the impressionist movement was the painter of middle class family groups. Among painters still living, Ernest Laurent, who, with Aman-Jean was a product of the post-impressionist group in which Seurat was evolving the elements of the new style, was to be the tender and subtle interpreter of the feminine soul.

Russia, 19th Century.—Until late in the 19th century modern Russian painting was unknown to western Europe. What had been seen of it in international exhibitions showed the traditions of primitive European art, with a distinct vein of barbarism. In the early 'fifties, painters were less bent on art than on political agitation; they used the brush as a means of propaganda in favour of some political idea. Peroff showed us the miserable condition of the serfs, the wastefulness and profligacy of the nobility. Vereschagin made himself the advocate of the soldier, painting the horrors of war long before the tsar's manifesto preached universal disarmament. Art suffered from this praiseworthy misapplication; many pictures were painted, but very few rose to the level of modern achievement in point of technique. It was only by the St. Petersburg art journal *Mir Iskustwa,* and by a small exhibition arranged at Munich in 1892 by a group of Russian landscape painters, that it was realized that a younger Russian school had arisen, fully equipped with the methods of modern technique, and depicting Russian life with the stamp of individuality. At the Paris Exhibition of 1900 the productions of this young Russian school were seen with surprise. A florescence similar to that which literature displayed in Pushkin, Dostoievsky and Tolstoy seemed to be beginning for Russian painting. Some of these young painters rushed into art with unbridled zest, painting with primitive force and boldness. They produced historical pictures, almost barbaric but of striking force; representations of the life of the people full of deep and hopeless gloom; the poor driven by the police and huddled together in dull indifference; the popes tramping across the lonely steppes, prayer-book in hand; peasants muttering prayers before a crucifix. There is great pathos in *The Karamasow Brothers,* or *The Power of Darkness.* At the same time we feel that a long-inherited tradition pervades all Russia. We find a characteristic ecclesiastical art, far removed from the productions of the *fin de siècle,* in which the rigid tradition of the Byzantines of the 3rd century still survives. And, finally, there are landscapes almost Danish in their bloodless, dreamy tenderness. Among the historical painters Elias Repin is

the most impressive In his pictures, *Ivan the Cruel, The Cossacks' Reply to the Sultan,* and *The Miracle of Saint Nicholas,* may be seen—what is so rare in historical painting—genuine purpose and style. Terror is rendered with Shakespearean power; the boldness with which he has reconstituted the past, and the power of pictorial psychology which has enabled him to give new life to his figures, are equally striking in *Sowing on the Volga* and *The Village Procession.* He was the first to paint subjects of contemporary life, and the work, while thoroughly Russian, has high technical qualities—the sense of oppression, subjection and gloom is all-pervading But he does not "point the moral," as Peroff did; he paints simply but sympathetically what he sees, and this lends his pictures something of the resigned melancholy of Russian songs. Even more impressive than Repin is Philippe Maliavine. He had rendered peasants, stalwart figures of powerful build; and, in a picture called *Laughter,* Macbeth-like women, wrapped in rags of fiery red, are thrown on the canvas with astonishing power. Among religious painters Victor Vasnezov, the powerful decorator of the dome in the church of St. Vladimir at Kiev, is the most distinguished figure. These paintings seem to have been executed in the very spirit of the Russian church; blazing with gold, they depend for much of their effect upon barbaric splendour. But Vasnezov has painted other things: "The Scythians," fighting with lance and battle-axe; horsemen making their way across the pathless steppe; and woods and landscapes pervaded by romantic charm, the home of the spirits of Russian legend. Next to Vasnezov is Michael Nesterov, a painter also of monks and saints, but as different from him as Zurbaran from the mosaic workers of Venice; and Valentin Serov, powerful in portraiture and fascinating in his landscape. It is to be remarked that although these artists are austere and unpolished in their figure-painting, they paint landscape with delicate refinement.

Schischkin and Vassiliev were the first to paint their native land in all simplicity, and it is in landscape that Russian art at the present time still shows its most pleasing work. Savrassov depicts tender spring effects; Kuindshi light birch-copses full of quivering light; Sudkovski interprets the solemn majesty of the sea; Albert Benois paints in water-colour delicate Finnish scenery; Apollinaris Vasnezov has recorded the dismal wastes of Siberia, its dark plains and endless primeval forest, with powerful simplicity.

A special province in Russian art must be assigned to the Poles. It is difficult indeed to share to the full the admiration felt in Warsaw for the Polish painters. It is there firmly believed that Poland has a school of its own, owing nothing to Russia, Austria or Germany; an art which embodies all the chivalry and all the suffering of that land The accessories are Polish, and so are the costumes. Jan Chelminski, Wojcliech Gerson, Constantine Gorski, Apolonius Kendzrierski, Joseph Ryszkievicz and Roman Szvoinicki are the principal artists. We see in their pictures a great deal of fighting, a great deal of weeping; but what there is peculiar to the Poles it is hard to discover

IMPRESSIONISTS

Manet.—Manet (1832–83) was attacked by the press and regarded as a revolutionary and this group, Degas, Renoir, Monet and the rest, including Cézanne (*see* CÉZANNE) who stands a little apart, were deluged with the sarcasm of the critics. (*See* following article, PAINTING, *Modern.*) How was it that in this century the breach continually widened between the artist and the public? Formerly the artist had worked for a select class, for a king, for princes, for a court, or his other noble patrons of art and he found no difficulty in adapting himself to the needs and wishes of that select class. The artist because of his superior gifts was better understood by aristocracy though he may have suffered from their caprices and arrogance But the coming of democracy changed all this, and the public to whom he must make himself understood no longer represents the highest civilization of the day, with tastes similar to his own. The artist may be the child of the people but nothing can efface the brilliant sign which he wears on his brow, and even in the midst of poverty and misery he is a privileged being. Therefore, as such, he is a suspect. Thus true artists gradually passed from anger or regret to contempt or indifference, and they no longer strove to be understood except by a small number of initiates, endowing their works with a secret and esoteric character. Some good may arise for art out of this false situation, for by being isolated and being driven back upon himself the artist has thought himself justified in concentrating on the one thing which seemed to him as essential—the development of his own personality, and if tendencies toward eccentricity, aestheticism and abstraction are to be feared, never, on the other hand, has there been seen such originality as that evident in the works of Manet, Degas, Cezanne, Renoir, Monet, Berthe Morisot, and, in the next generation, Gauguin, Van Gogh, Seurat, Lautrec.

Degas.—Degas (1834–1917) contemporary of Manet and man of the world, though at the same time solitary, was more reserved, deeper, more restless and less happy. He is perhaps the only painter of the 19th century deserving to be placed not far from Delacroix in the category of great minds and had not only creative imagination but a gift of critical analysis. Manet and Degas had some of that universality which characterized the great artists of the Renaissance and we feel that had destiny not permitted them to be painters they would nevertheless have been leaders. After their time particularism becomes more dominant.

Degas was less impressionist than Renoir and was really a draughtsman to be compared with Holbein and Dürer. He was a painter of dancing girls, laundresses, women at their toilet, modistes, singers, café-concerts, and jockeys as well as horses, seizing in each, with an extraordinarily definite and expressive brush stroke, certain gestures or movements which the eyes of painters had not noted until that time. He was an amazing portrait painter achieving an impression of a striking unvarnished truth. Moreover, he had important effects in the development of modern painting through his experiments in technical execution.

Morisot.—Berthe Morisot (1841–95) was one of the impressionists who showed the most original woman's talent of all times, due undoubtedly to the fact that this woman of the upper class did not try to be a man but remained a woman, and a woman of the world.

The name of impressionism (*q.v.*) had been bestowed upon this group by chance and in derision, but they soon accepted it as a rather apt rallying-cry and it became charged with a philosophical meaning extending beyond the field of painting. It had the distinction of exasperating the opposition which chose to forget that it had invented the name It was attacked with violence. People saw a school whose followers seemed to obey a mysterious rule and practise a new method of painting which disconcerted the *habitués* of the *salons* and even of the museums. They made little distinction between the painters and took as criteria only those three methods—*plein air* (out-door painting), *peinture claire* (painting of light) and *division du ton* (breaking up or separating of colours), though we to-day on the contrary particularly admire the individual distinction of these artists, while impressionism as the doctrine of a school interests us comparatively little.

Renoir.—Renoir (1841–1919) showed an affiliation with Delacroix. He was the most sensitive imaginative and richly endowed colourist of the group and he openly declared that *les Femmes d'Alger* was one of the finest paintings in the world, and it was this which inspired his first attempt at an important composition.

Monet.—Claude Monet (1840–1926) is the true founder and only teacher of this so-called school and he exercised extraordinary authority upon his comrades, but what we love in him to-day is his brilliant genius as a colourist, his ingenuous feeling for feminine charm that is a trifle animal but very young and healthy, his desire for abundance in composition, all of which was quite contrary to the principles of impressionism.

Cézanne spent a term of his career in impressionism and then turned even farther away from it than Renoir when he proclaimed that they "must return to the ancient masters by way of nature" and that they "must make of impressionism as firm and lasting an art as that of the museums." (*See* CÉZANNE.)

To whom, then, can we accord the right of fully representing the name of impressionist? There remain only the pure landscape painters, or those who were first and foremost landscape

painters—Monet, Pissarro (1830–1903), Sisley (1839–1899), and indeed at one time so nearly alike did these three paint that without seeing the signature it was difficult to tell from which source a canvas had come, though with their best works this was of course not the case. Sisley was in no sense a theorist, but a charming minor poet of the country and the seasons in the spirit of the gentle Lépine (1835–92) and the good Corot himself. Monet's passion and energy made him, against his original intentions, a visionary and a lyric poet.

Pissarro too did not adhere strictly to pure impressionism and even in certain of his paintings where a first glance reveals only his preoccupations with technique, we discover his will toward order and organization which the doctrine of impressionism did not encourage. Because of this he was worthy of the curious and glorious rôle of mingled actions and reactions which he played by turns next to Cézanne.

It would, however, be an injustice to impressionism to deny that in spite of the defeat of its doctrine it has bequeathed precious acquisitions by which painters have profited and will continue to profit whatever their conception of art, and their vision of nature and of life.

Seurat.—Seurat (1859–91) as expressed by the very name of his technical invention *Neo-impressionism* owed much to Claude Monet. This technique consisted of an almost scientific systemization of the division of colour. To-day all these differences are only external aspects of the same thing in our eyes but we recognize Seurat's personal contribution, the force and dignity of his art; and his intellectual reaction was necessary at this time

Chavannes.—Puvis de Chavannes (1826–98) was endowed with a genius for monumental painting and it has been shown how his technical influences and achievements as a colourist were kept alive in the art of impressionism.

Gauguin.—Paul Gauguin (1849–1903) found his point of departure in the combined influences of Puvis de Chavannes and impressionism His character, life and work are alike marked by contrasts which were doubtless in his blood from his birth and the characteristic features of his power are summed up in his father, a little French *bourgeois* and journalist of liberal leanings and in his grandmother, the beautiful, passionate, adventurous Flora Tristan, born in Peru of a good Spanish family, who in France became an apostle of Saint-Simonism and of revolution. Gauguin after being in the navy and in finance became a painter late in life with a fierce violence and a mingling of brutality and refinement, of impetuousness and reflection. He boasted of being a savage and settled in Tahiti where after years of fury and enchantment he died in wretchedness Initiated by Pissarro into the secrets of impressionistic vision and technique he later met at Pont-Aven, in 1886, Émile Bernard who had invented a method called *synthesism* or *cloisonnism* based on the simplification of design and colour, using flat areas of colour with strongly defined outline, giving an effect similar to enamel or stained glass. The movement which was first called *Symbolism* sprang from Gauguin rather than from Cézanne.

Eugène Carrière (1849–1906) tried to make the emotional significance of painting supreme and even went so far as to dispense with colour. Vincent Van Gogh (1853–90) applied paint with violent impast while Henri de Toulouse-Lautrec (1864–1901) applied it as lightly as one does a pastel, but in both cases the whole is made up of striped and hatched tones. Yet the brilliant and irreducible originality of Lautrec as a draughtsman and as a biting satirist, and the unequalled colouring and daring invention of powerful pictorial hallucinations of Van Gogh make them interesting.

At the conclusion of a survey of this agitated period it is evident that it is individual artists and not schools which must be examined. It is impossible that schools could exist in our day and it will be long before the traditions of a fine art or craft will be transmitted and perpetuated from master to pupil for personality asserts itself more and more clearly. Thus we realize how much painting has become transformed in the course of the century since the time when it was scarcely separated from sculpture and architecture which have been governed by basic laws. The mediums of music and painting are infinitely more flexible and indeterminate. Apparently the field of suggestion will open up without limit for painting as for music until at last following our present stage of evolution painting will become music, and music, painting. (*See* Biographies of Painters.)

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MODERN PAINTING

The first twenty-five years of the 20th century have been marked by an extraordinary ebullition in art. Formerly, art movements, even in France, progressed in a more or less leisurely way, reaching a logical conclusion. They attained their zenith and declined as their interest waned, as stimulus was lost and the principles they practised degenerated into mere formulae. This was followed by a reaction and a new movement came into being

The classicism of David and his disciples was succeeded by the romanticism of Delacroix, Géricault, Delaroche, etc., and in landscape by the Barbizon School (*q v*) of *plein air* with Corot, Rousseau, Daubigny, etc. At the same time the Realist movement with Courbet at its head, was developing. With Courbet were Daumier and Millet; or the latter may be said to have belonged to both groups, as it was not always possible to separate completely one from the other.

The school of Corot developed, under the impulse of certain discoveries made by Chevreuil concerning the simultaneous contrast of colours, into the Impressionist movement (*see* Impressionism) with Monet, Manet, Pissarro, Sisley and others as the chief exponents This movement had a very far-reaching influence on modern art, as it introduced a fundamental change in colour perception, in the treatment of light and atmosphere, and changed the point of view of painters in regard to art and nature.

At the beginning of the 20th century, the direct influence of Impressionism as a creative force of a marked character was on the decline. Its true influence had been absorbed and was no longer a separate activity. In the hands of painters like Maufra, Moret

and Loiseau it had degenerated into a formula, not without charm, but no longer life-giving or inspiring.

Neo-Impressionism had proved itself in the hands of Georges Seurat, a sensitive and even flexible medium for the expression of minute truth of atmospheric and light effects not only in landscape but even in groups of figures on a large scale. It appears to have been a highly personal method which ended with Seurat, who was its greatest and most perfect exponent. As practised by Paul Signac it degenerated into a formal and almost mechanical use of a fantastic and unrealistic nature and far removed from its original purpose which was the realisation of the exact truth of natural conditions at a given moment.

There were other painters who practised *pointillism* more or less incidentally, such as Maximillian Luce, Theo van Rysselbergh and even Camille Pissarro employed it, with beautiful effect on a few canvases.

Although Ernest Laurent, La Sidaner and Henri Martin adopted a variation of the method for pictorial purposes, theirs was not a true *pointillism* and the end was no longer inevitably related to the means.

Influence of Cézanne.—The true development of Impressionism was quietly proceeding in another direction through the work of Paul Cézanne, who had been a pupil of Camille Pissarro, from whom he had learnt the principles of Impressionism in their strictest form. Cézanne died in 1906 but he, even more than any other painter, has influenced the art of the present day; not only in his own country but throughout Europe and America.

Cézanne gradually discovered what was the inherent weakness of Impressionist art; its lack of solidity and, frequently, of design. His determination to give to art—meaning—"Impressionist art as he felt it"—"The solidity and enduring quality of ancient art"—"Of the art of the museums" has been often quoted. His principles have been usually misunderstood and misapplied. The path that angels fear to tread has been trampled by the feet of most of the younger artists of the day.

Cézanne approached his solidarity by way of the most subtle and refined colour analysis and he produced pictures of landscapes and figures, interiors and portraits, of a rare beauty in which the perception of colour is almost incredibly sensitive and profound. His imitators have produced ugly pictures, coarsely treated, in which the colour approximates, as nearly as possible, to that of mud. They have, on occasion made a method of his mannerisms—as has happened so often before in every branch of art. If Cézanne used a blue outline to correct or recover his drawing then the canvases of his imitators were covered with blue outlines.

The twentieth century opened, then, with the waning influence of Impressionism and the growing influence of Cézanne, the child of Impressionism, who had but recently, and late in his life, received recognition.

POST-IMPRESSIONISM

Development in France.—Modern art in all countries is essentially French. All the movements, great or small, have originated in France. France is like a great central fire sending sparks all over the world which fall on a variety of fuel and burn with varying force and character. It is therefore but logical to consider France—the home of strange-isms—before other countries.

The demand for something new on the part of young artists is natural and inevitable. The old is no longer stimulating or exciting. But the new has no intrinsic value as such. No work of art has survived merely or mainly because it was new in its time. Novelty has a value, a different value—it may lead to something that is fundamentally and universally important. Usually it does not. But at least it keeps art alive and excites interest, which is not bad for art. But posterity, or should it be eternity, demands something more.

The first twenty-eight years of the twentieth century have been remarkable for the number of new movements that have arisen. Some have sunk and left no traces, others have modified or changed the direction of art to some extent. But it must be remembered that art—the essential art—goes on inevitably. Velazquez and El Greco may be the chief or only survivors of the Spanish art of the 16th and 17th centuries, but there were hosts of other painters and no doubt movements, ebullitions, -isms. The essential art is what is finally and permanently distilled.

So it is, too, with modern art. That which seems so important to the inventors of and participators in, new movements may be forgotten possibly as quickly as the movements have arisen. (*See* POST-IMPRESSIONISM.)

Fauvism.—The first definite revolt against Impressionism was made in 1906 when a number of artists, who were tired of the prevailing influence, revolted against discipline of any sort. They were called, once again in derision, *Les Fauves.* There was no special technique which distinguished the movement. They revolted from what they considered the limitations of Neo-Impressionism. The movement was merely a restatement of the universal demand for "Free Speech." The leaders of the movement were Matisse, Braque, Van Dongen, Vlaminck, Dufy and Friesz. They reacted not merely against Impressionism but against academic and all other rules of art.

Instead of the conception of art as nature seen through a temperament, they wished to substitute a temperament which no longer served nature. It was a revolt against naturalism in art, which they regarded as no better than an inventory of natural effects. They pretended to choose from Delacroix's *dictionnaire de la nature* only what would help them to the production of works of constructive art which would add to the conquests of the Old Masters, aesthetic revelations unknown to those Masters.

In their enthusiasm they studied the works of the Greeks and the Egyptians, of the Byzantine period and even negro art. The passion of modern collectors for negro art dates from that period. Good and bad resulted, for art, being an expression of the artist's personal impression of nature, may or may not be fed by a variety of things. And the attempts to feel things with the emotions of a past age are inevitably still-born.

Naturalism.—Concurrently and opposed, though possibly unconsciously, to Fauvism, there developed the school of Naturalism. One branch, merely sensual and concerned entirely with material things, was described by Adolphe Basler as the "School of the Greasy Dishcloth." The painters were more or less academic. All of them had studied to some extent at the École des Beaux-Arts. Such artists as Bouche, Gromaire, Conrad Kickert, Gritchenko, etc., were members. One group, known as "L'École du Pré-Saint-Gervais" was led by Loutreuil, who died quite young in 1925, after a miserable existence. His companions were the painters Billette, Chotin, Caillard, etc. In dismal and dirty tones they expressed the misery of life.

Cubism.—The most important movement, and one which had considerable vogue for a time, was one which, strictly speaking, had little to do with art. Its conception was either intellectual or pseudo-scientific. It supported the portentous name of Cubism with which it was endowed, it is believed, by Matisse If it was conceived as a *jeu d'esprit,* its inventors had hard work to live up to its cubic reputation, for it was taken quite seriously by certain dealers of the Rue de la Boëtie and by certain collectors who believe what dealers tell them. Seldom has a joke reacted more painfully on its perpetrators. It was supposed to be an attempt to reduce nature to its geometric elements. What became of art as a means of expression or how the personalities of the practitioners survived these geometric dreams is not clear

Picasso himself, who is credited with being its inventor, told the writer that it was a sort of "impressionism of form." He showed him, on one occasion, several paintings which were incomprehensible until Picasso arrived at one which he seemed to recognise as a view from the artist's window in Montmartre. However, the writer was mistaken. It was a symphony in form derived from different objects on various pages of an illustrated catalogue of furniture!

One of the claims made for Cubism was that it made no attempt to imitate or organise nature—in this it was quite successful—another was that it produced works which were complete and beautiful in themselves just as a diamond is intrinsically beautiful and needs no setting or other aid to reveal its quality. The beauty

of the object is said to exist in the eye of the beholder and some eyes are peculiar!

It was an attempt at "objective" art with an ignorance of the contradiction in terms which such a thing involves. Art being an expression of the artist's personal feelings about, or his reaction to, nature, the use of the term "objective" art is merely an expression of ignorance.

The chief members of the conspiracy were, besides Picasso, Georges Braque, Albert Gleizes, Jean Metzinger, Juan Gris, Fernand Léger. They made their début about 1910.

The principles of the movement were, amusingly enough, supposed to derive from the paintings of Cézanne That painter had died in 1906, so that his child, born four years later, was too posthumous for its parentage to be entirely above suspicion

The only artist who has emerged from Cubism and actually derived something from it, is Georges Braque. One does not, of course, count Picasso, to whom Cubism were merely one of many incidents Braque, definitely influenced by Cubism, has evolved an art of design, which is derived from nature, although it takes liberties with its subject, and is harmonious and complete in itself Some years later there was an aftermath in which the mannerisms of Cubism were imitated without any reference to their supposed utility. So there appeared on the market, angular, distorted, outlined paintings by such men as Marcoussis, La Fresnaye, Herbin, Picabia and Filla

Futurism.—In 1911, the art world, scarcely recovered from the birth of Cubism, was compelled to submit to the onslaught of a new movement, originating this time from Italy. It was known as Futurism, chiefly because the impressions of the immediate past were involved in its productions Its conception was mainly due to the exuberance of the hysterical poet F. T. Marinetti, who had issued his first manifesto at Turin in 1910 He organised an exhibition in 1911 of a group which consisted of Umberto Boccioni, Carlo Carra, Giacomo Balla, Luigi Russolo and Gino Severini It was, according to its creator, a species of plastic dynamics, but it was nothing more than instinct become self-conscious It reviled and repudiated old and petrified art.

"The simultaneousness of states of the soul at a given moment (that is, the moment of producing a picture) is the basis and end of our art"

In painting, for example, a person on a balcony, the Futurist painted not only the scene actually before him, but the feelings engendered in him by the happenings in the street and also the emotions left in his mind by the happenings of the night before Obviously such an art, founded on confusion, had in itself the germs of the ridiculous

It had a brief and laughter-provoking career, its entrance almost synchronising with its exit Although its origin was really Italian (it had something full-blooded and lacking in reason, foreign to the French nature) it made its début on the Parisian stage before coming to London, where it made a bright and brief appearance at the Sackville Gallery and where an entertaining dinner was given to Signor Marinetti.

Symbolists, Synthesists and Eclecticists.—After Futurism a group of artists of already proved ability were associated in a movement which has been called Symbolism, Synthesism and Eclecticism Their aim was to fuse naturalism with the idealistic tradition of the museum, that is, to serve up realism in a classical form, to see contemporary life through the eyes of the past. It involved discipline and imitation and was, in effect, realism limited by pastiche The idea attracted many artists, some of whom have developed some definitely personal style from it, such as Gauguin and André Derain Other artists of renown who followed the movement were Maurice Denis, Emil Besnard, Odilon Redon, K X Roussel, Felix Valloton Many younger artists were attracted and, naturally, individual preferences among the classical painters were followed Favory followed Rubens, Alix and Georg were inspired by Daumier, Friesz was haunted by his remembrance of Poussin and Delacroix

Modigliani, a charming artist who died young, painted figures in strange and frequently distorted poses Dufy, Dufrenoy, Frelaut, etc., had their preferences.

Intimistes.—The Intimistes formed a small group but hardly a movement. They chose simpler subjects of ordinary life and painted them, as it were, for their own sake. They included Charles Cottet, painter of the life of Breton fisher folk; J. E. Blanche, an intimate portrait and genre painter; Le Sidaner, painter of scenes of village and town life, mostly under artificial light, Prinet, who painted incidents of home life, and also René Ménard, Ernest Laurent and others

Orphists.—Orphism, or abstract painting, in which the painters sought to paint without subject, expired for lack of interest.

Purists.—Purism derived from Cubism or was, perhaps, a protest against the later abuse of it The leaders were Ozenfant and Jeannert; they were followed by Peri, Servranck and Bauermeister. Their principles were the purification of the plastic language and the selection of forms and colours for the creation of a key-board of expression, which should be necessary and sufficient, combining economy with intensity They sought to determine the ideas and sentiments naturally associated with forms and colours. They produced arabesques which expressed, in simple terms, the natural forms of objects without denaturalising them In this respect, Purism departed from Cubism which held itself free to distort or to discard nature if and when it suited its purpose to do so. Purism created an object within a picture, while Cubism created a picture which was a complete object in itself. It sought to make a distinction between painting that pleases and painting that moves and certainly the paintings produced in its name, lack any kind of charm

The lyricism which may be produced by an association of mere shapes, with limited attraction of colour, such as the "purists" produced is inevitably limited in its appeal The attempt to find a close analogy in expression between painting and music, is really an unnecessary confusion In Purism the colours were rigorously designed—a certain form of red, for example, was held to correspond exactly in its use with the *la* in the diapason in music

Certain colours were considered to be exciting and dynamic—such as the pure colours of the spectrum; others were constructive and human (natural earth colours, for example), etc But a picture composed of colours having their special properties was ineffective unless the spectator was already enlightened as to their purposes It became a mere code which was meaningless except, perhaps, to those who possessed the key

Dadaism.—In time of such artistic unrest, one movement followed another, without producing any enduring satisfaction Dadaism was born in 1920 A certain Spanish painter Joan Miro, who later became the head of the Surrealist school, was the inventor of this diversion It was a noisy and amusing demonstration which had a momentary success owing to the fact that it was well organised and extensively advertised It produced a lively revue "391" and a ballet by Picabia, called "Relache," which was produced by Rolf de Maré and danced by Jean Borlin It had no definite technique and no principles and left nothing but the memory of a few charming and spirited compositions With Miro and Picabia were associated Marcel Duchamp, Jean Crotti and Ribemont-Dessaignes

Surrealists.—The next movement, if it may be dignified by such a name, originated among certain writers, who had been affected by the picturesque confusion of the Dadaists They indulged in all sorts of romantic and ridiculous extravagance They called themselves the Surrealists They were a product of the time of unrest following the World War and it had been predicted that the movement would come to an end with the settlement of affairs They were reinforced by a section of painters who were influenced by the romantic movement, having its origin in Germany, known as Expressionism Technically they imitated Braque, Picabia and Picasso, although they were opposed to Cubism and attempted to substitute for its objective conception one which was entirely subjective.

In their productions, technique counted for very little The Surrealist doctrine, derived from Freudism, believed in the expression of thought without the control of reason and sought to paint dreams and states of mind by any means whatsoever Its

followers sought to suggest the mystery of the subconsciousness by translating ordinary objects into strange, horrible or sentimental forms.

A number of painters, Pierre Roy, Viollier, Masson, Malkine, etc., of varied abilities, combined under the leadership of Joan Miro, who declared *Je veux assassiner la peinture,* an elegant ambition which he may or may not have achieved, and at one time Giorgio de Chirico, a painter of rather more ability, came under their influence.

"Popular" Painters.—A symptom of the times—of the rise of democracy—was the interest shown in the work of certain untrained painters of humble rank, who were engaged in other occupations. These painters were not associated and cannot be said to have formed a movement, yet they have had considerable influence particularly on some of the younger painters in England, who have deliberately cultivated a school of self-conscious naïvété.

This outbreak of painting among the lower classes, which was called in France *l'art populaire* has been fostered by the facilities for art study and by the exploitation of such painters by dealers. It has developed during the last twenty years following the success of the *douanier* Rousseau, whose canvases were the remarkable and unaffected expressions of a childlike vision. Following Rousseau, who was the first and most important of the "popular" painters, came André Bauchant, a farmer in Touraine, whose work with all its naïvété is curiously reminiscent of the museums. His subjects are drawn from history and not from the daily life of his environment. He held his first exhibition in 1921 and was elected a member of the Salon d'Automne—an instance of the new liberal-mindedness of such institutions.

The early work of Utrillo—landscapes in the Parisian suburbs—painted with a direct and untutored naturalness might come under this category. Utrillo was the son of Suzanne Valadon, who had been an acrobat and had posed for Puvis de Chavannes and Renoir before taking up painting herself. Her own work was "popular" in feeling, although there is some trace of sophistication in it, due to the fact that she had seen so many paintings and known so many artists.

Other painters of *l'art populaire* are Bombois, a navvy, who only recently felt the desire to paint. Like all primitive painters he excels in painting lights and reflections. His work has a certain purity of style that is certainly innate. Emile Boyer is a seller of fried potatoes. Unlike most "popular" painters, he dislikes anecdotal subjects. Le Gay, the *agent* and Emile Gody, the chimney sweeper, are other painters of the same class. Their work has a sincerity, a directness and freshness of vision and often a power of invention which gives it a value sometimes greater than that of the followers of the pretentious movements which have been described.

Current Painting and Painters.—As might be expected in the turmoil following all the movements which have agitated French art in the 20th century, the work of the younger artists is confused and uncertain. Their aims are varied. There is no school or movement. Cubism, which perhaps had in it some germs capable of development, is too recent either to be considered judiciously or to give birth to a genuine reaction.

The sane belief that each artist should seek the means of his own personal expression, contains within it an element of doubt—a fear that something is being missed. The tendency is towards forming groups or movements which actually more often than not act as a deterrent to free expression, committing the painter to certain doctrines and methods which do not truly represent his personality.

It is a period of transition. The lessons of the discoveries, reiterations, follies and suggestions of the immediate past are in process of being digested or repudiated. The main force inspiring the young is still Çézanne, but he has yet to be really understood, the majority of the younger painters still being in the stage of imitation or misinterpretation.

So we have a number of young painters, of varying degrees and ability, groping for expression. Perhaps the note which is common to all their work is a certain Romanticism which has, perhaps naturally, been evident since the World War. R. T. Bosshard (b. 1889), a painter of nudes, is an eclectic combining various influences going back to Courbet and not without some trace of futurism. André Beaudin (1895–) is a decorative painter who might be described as a symbolist, who seems to derive from Odilon Redon and the Chinese, but who is still seeking a completely free means of expression. Jean-Francis-Laglenne (1898–) is an interesting artist who owes much to Vuillard and something to Braque and Matisse; Auguste Mambour (born at Liège in 1896–) whose nudes have weight and volume and sometimes an aggressive solidity, represents a classical strain developed through Cubism. Menkès expresses a kind of mysticism modified by Cubism. In the work of Roland Oudot (born about 1898) one sees the ideas of Renoir inoculated with the modern ideas of volume and, in his figure paintings, a remote echo of Le Nain. Térechkovitch, born at Moscow in 1902, an imitator of Van Gogh; Pascin, born in Bulgaria in 1885, of Spanish and Italian parents; Suzanne Roger (born about 1899); Soutine, with a fondness for subjects of the kitchen and the butcher's shop; Halicka, (1894–), whose work shows conflicting aims; Moïse Kisling (1891–) influenced chiefly by Picasso and Modigliani, are the most promising of the younger artists.

So rapidly have events moved that the painters of yesterday, who were regarded as innovators, have become old-fashioned to-day.

Dunoyer de Segonzac is now sober and solid if a little dismal. André Derain, influenced by the Cubists, is found to be somewhat Spanish in the sobriety of his still-life paintings and somewhat classical in his solid stylistic landscapes with their limited range of colours. Marquet, another stylist, founded on Matisse, is noted for the economy of his means and his restraint; Dufresne is a romanticist and an interesting painter who has gathered much from many sources. Raoul Dufy is a pattern maker, with a calligraphic style, and a frank imitator of Matisse. Vlaminck's work, often violent and crude in his landscapes, has developed something of the qualities associated with pavement artists. Van Dongen disguises the mediocrity of his mind under a certain flamboyant extravagance. All these artists are now well-known and accepted, and it has become extremely difficult to be revolutionary.

Although it is natural that strange movements by their novelty and violence should attract most attention, the current of art moves on inevitably and certain painters of established reputations have pursued their paths unperturbed though, perhaps, not entirely uninfluenced, by the ebullitions of the more youthful elements.

Such painters as Bonnard and Vuillard, derived originally from Degas and the Impressionists, produce works of an intimate beauty Aman Jean, the gentle sentimentalist, with his refined and delicate colour; Lucien Simon, with his appreciation of native character and a fluent and vivid style, are still painting. Prinet, a Degas without poetry, Milcendeau, Desvallières, with his confused symbolism; Pierre Laurens; Odilon, with his exquisite flower pieces and mystical paintings; Maurice Denis, the symbolist; K. X. Roussel, with his charming lyrical spirit; Lebasque, the warm colourist of the South; Charles Guérin, Jean Puy and Flandrain are the best of what may be called the older school of painters.

Matisse, who started as a realist of a more or less academic kind and has developed a simple crystalline form of expression with the strictest economy of means, has shared with Cézanne the honour of having the most vital influence on the younger school.

MODERN DEVELOPMENT IN ENGLAND

In English art, although it was influenced by France and, later, by the general state of affairs, the agitation was less extreme. Compared with the placidity of the 19th century, when the Pre-Raphaelite movement seemed a desperate revolution, the time would have appeared full of turmoil. The Royal Academy pursued its dull path without excitement and without change. The brilliant if superficial cleverness of J. S. Sargent had a certain influence but not a salutary one. The New English Art Club, founded by W. J. Laidlay in 1886, offered an opposition to the Academy and provided a place of exhibition and a point of con-

centration for the more independent and younger painters. The main influence, at the time, was that of French Impressionism although it was neither strong nor extensive in England.

Some years later, about 1910, a number of painters combined to form a centre and meeting place for painters of a more modern tendency, and their friends. They held weekly exhibitions at a studio at 19 Fitzroy St., London. The chief promoters were Walter Sickert and Spencer Gore. Lucien Pissarro joined them later and Augustus John was a member at one time. Other members included Gilman, Ginner, Manson, Bayes, Drummond. The influence of the group, although not immediately apparent, led to other things. Lucien Pissarro brought from France a new influence, that of French Impressionism, which, previously, had had little effect on English art. Walter Sickert, now known as Richard Walter Sickert, one of the most genuine and most personal of modern artists, had practised a form of Impressionism (not strictly based on colour values) which was nearly akin to that of Degas and related to that of his artistic French cousins Bonnard and Vuillard, who, however, were looser, both in perception and handling, and more inclined towards a lyrical expression of colour. And P. Wilson Steer, one of the leading artists of the New English School had exploited French Impressionism in the 1890's to abandon it, soon after, for the native English form which derives from Constable and Turner.

The fine exhibition of the French Impressionists held at the Grafton Galleries in 1905, which contained splendid examples of all the masters of the school and included pictures such as "La Loge" by Renoir, Manet's "Eva Gonzales," "Wandering Musicians," etc., Degas' "Carriage at the Races," which have since become world-famous, attracted attention but had little influence.

In 1911, the members of the Fitzroy Street Group, desiring to obtain wider publicity for their work, formed the Camden Town Group, with Spencer Gore as president. The desire to enlarge the group, in order to include other and more modern phases of art, led to the formation, in 1913, of the London Group and its first exhibition at the Goupil Gallery in 1914. The Group has now considerably increased in size and influence and includes in its membership the more prominent of the "advanced painters."

A remarkable exhibition, which had an immediate and definite influence on the younger English painters, was the Post-Impressionist Exhibition held at the Grafton Galleries from November 1910 to January 1911. Many artists, who have since been recognized as masters, were introduced to the majority of English painters for the first time Cézanne, Gauguin, Picasso, Van Gogh, Matisse were remarkably well represented and Manet, more familiar, was seen in many phases of his development. His pictures included the famous "Bar aux Folies Bergères," now in Mr. Courtauld's private collection.

The influence of the exhibition was seen mainly through Roger Fry and the small group who followed and supported him: Duncan Grant, Vanessa Bell, Keith Baynes, Clive Bell (writer), etc. The effect was a little too immediate to be entirely logical or convincing.

The painters began to talk of their "reactions." They became self-conscious about the matter. That which should have worked sub-consciously was dragged into the full consciousness of reason and the "reaction" was sometimes, in consequence, of doubtful genuineness and led to the suspicion that it was made to suit the school, so remarkable was the resemblance, at least at first, between the works of the different artists. Solidity was aimed at, rhythm was cultivated and, curiously enough, only so-called ugly things provided "reactions" on the group. Colour as an essential means of expression disappeared.

The work developed, the artists gradually becoming more individual. They were later combined, with the addition of F. J. Porter, Bernard Adeney, etc., forming the London Artists' Association. This was a scheme by which certain collectors guaranteed the artists a certain income based upon the probability of their sales.

Too Much Encouragement for Young Artists.—The time is notable for certain things whose effect on art, *per se*, is problematical. There is a remarkable increase in the facilities for exhibition, the increase of small art galleries, the support given to young and often quite untrained painters. It is often a case of fools rushing in. In former times a painter had to be qualified to some extent before he could hope to exhibit. Now it is a question of competition to secure something new and naïve that can be exploited before it is proved to be utterly worthless. But there is no one employed who is capable of deciding who is worthy of help and the young student is taken from the cradle and "helped" by the Contemporary Art Society, by funds and by well-meaning, but quite ignorant, collectors. And the young student, before he has mastered the rudiments of his art, before he has had any experience, before he has had time even to digest the elementary principles which his master has tried to implant in him, is taken up, fed on the fruits of success and poisoned by his own choked-up artistic "lazy colon." A virtue is actually made by a certain small number of artistic "snobs" of collecting the works of the so-called "naïve" school—a contradiction in terms; a confirmation in folly.

Post-Impressionism, one of the vaguest terms ever used in the strange jargon of art critics, covered a multitude of incompetence. It operated mainly in one direction and that, strangely enough, was supposed to receive its impetus from Cézanne. Cézanne was an exquisite colourist; the quality which his so-called followers neither perceived nor felt, was colour. Cubism influenced two painters worth mentioning: Wyndham Lewis and W. Roberts. The former, with his brilliant cleverness, exploited a bastard version of Cubism until it ceased to amuse him; the latter developed a system of angular construction which, though nothing to do with Cubism in essence, was amusing for a time. That sort of thing meant a small gain and a real loss—a gain of pattern and, perhaps, of strength; a loss of mystery, poetry and truth.

The philanthropic impulse towards young artists, characteristic of the age, is very dangerous. It seems that a young painter receives a reward without having earned it and without having proved his worthiness for it. It stultifies development. It has been fostered by the most prominent art masters of the period through a spirit of philanthropy and the desire to make use of what funds are available.

Mural Painting.—Another modern development, and one worthy of encouragement, is the increasing demand for mural decoration In 1912, a movement, fostered by Charles Aitken, director of the National Gallery, Millbank, resulted in an exhibition of designs for mural decoration; many of them sent in for competition. A certain number of mural paintings had been executed before this exhibition; notably those in the Chelsea Town Hall under the direction of J. S. Sargent and Charles Sims; and others of a more modern tendency by Duncan Grant, Etchells and A. Rutherston working under Roger Fry at the Borough Polytechnic. The exhibition bore little immediate fruit, but in 1928 and previous years there have been many instances of artists, particularly young artists, being employed for the mural decoration of buildings.

The chief of these were the decorations in the Refreshment Room at the Tate Gallery by Rex Whistler; the Refreshment Room at Morley College by Royal College of Art Students under Prof. W. Rothenstein; the Peel Institute by Prof. Tonks's students; lunettes for the L.C.C. Hall by the pupils of Walter Bayes, etc.

Schools.—In regard to the teaching of art, the Royal Academy's methods have from time to time been the subject of much adverse criticism, principally on account of the "academic" outlook of its art standards. Despite its remarkable effort in electing Augustus John and Richard Walter Sickert to its ranks, it has not changed its methods or its qualities; for two swallows could not make an artistic renaissance in Burlington House.

The best schools were the Slade, the Royal College of Art and the Westminster School of Art. At the former, Professor Henry Tonks succeeded Professor Fred Brown. The tradition of teaching the students at this school to draw like old masters was uniformly carried on. The teaching of Professor W. Rothenstein at the Royal College has been most fruitful, while at the Westminster Sickert carried on a tradition which was essentially artistic,

teaching a student to find his inspiration in real life and giving him a flexible means of expressing his perception. Sickert was succeeded by Walter Bayes, a sound constructor of pictures, in whose teaching scientific means predominated over emotional perception.

An event of artistic importance was the opening, in 1926, of a wing for Modern Foreign Art at the Tate Gallery.

Current Painting.—In London, as in Paris, the younger painters are undecided. The two main influences are Matisse and the *douanier* Rousseau. The latter is the more popular as being easier. After all, he was untrained, and had a great posthumous success. The former influence is fatal. The victims of it endeavour to imitate the end without having known even the beginning. Two young painters, Ben and Winifred Nicholson, attempted to combine both influences. Only one painter, C. R. W. Nevinson, attempted to imitate the Italian Futurists, after their exhibition in 1912. He had a brief success and became a realist, of uncertain quality, more or less after the Central Continental pattern. Two other painters who have had success in the dawn of the Post-Impressionist movement were John and Paul Nash—particularly the latter. Although he is sometimes an artist within a strictly limited range, he is more often an illustration of the limitations of this method—which is its tendency to substitute ingenuity for art.

As is the case in Paris and elsewhere, the main stream of art flows on almost undisturbed by the agitations which make copy for journalists and so agitate the desires of the collector. The few undoubted and accepted artists of the time pursue their own line of development. Richard Walter Sickert, Lucien Pissarro, P. Wilson Steer, Ambrose McEvoy and Augustus John are names on which the historian can rest with some degree of certainty. Although the French influence has been a predominating factor in modern English art, it has been proved that English art is at its best when it is purely English.

MODERN PAINTING IN GERMANY

The Germans are an intellectual, philosophical and musical people. But their artists (painters and sculptors) have been few. Curiously enough, they have always taken an interest in French art and long before French Impressionism had dawned on England, the German collectors had been acquiring masterpieces of that school of painting. They have had two good first rate painters: Adolf Menzel and Max Liebermann. But they have always been extremely active in following French development and have attempted to originate movements of their own.

In 1900 the predominating influence on German painting was the newly founded "Berliner Sezession." It was organized by Max Liebermann and Paul Cassirer, the prominent art dealer. The main interests of their exhibitions from 1900 to 1908 were provided by the paintings of Manet, Monet, Degas, Renoir and Liebermann. Their influence caused the formation of the German Impressionists under Louis Corinth and Max Slevogt.

Coincidentally with the developments in Paris there arose in 1908 a movement which sought to abolish Impressionism, both French and German. The leaders of the new movement were Oscar Kokoschka of Vienna and Max Pechstein of Berlin. They were stimulated, if not directly influenced, by the paintings of Van Gogh, Gauguin and Matisse. Another influence came from Russia from such painters as Javlensky, who became known in Berlin at the time.

Expressionism.—The movement was called "Expressionism" in contradiction to "Impressionism." The Expressionists, then unaware of Cubism, painted in crude colours and in an exaggerated manner. They united with an association known as "Brücke" (Bridge): Otto Heckel, Eugen Kirchner, Schmidt-Rottluff, Otto Müller and Emil Nolde. Various sub-groups were formed; one of them called "Sturm" (Tempest), under the leadership of the writer Herwarth Walden, pushed matters to such extremes that the movement became grotesque.

About 1910, Picasso and the Cubists made their appearance in Germany. A new Sezession was formed in the Rhineland, known as "Sonderbund" (Special League). They exhibited Picasso and other Cubist painters. But Cubism had little success in Germany and few—the chief of whom is Lyonel Feininger—still practise it. The influence of Futurism was as short-lived in Germany as in France and England.

Expressionism survived but in modified forms; it took on an academic complexion with Weisgerber of Munich; a semi-cubist manner, with Franz Marc, also of Munich; Renoir's and Matisse's influence was noticeable on August Macke of Düsseldorf. All three painters were victims of the war.

The most active of the later followers of Expressionism were Kandinsky, a Russian naturalised in Germany, who practised a kind of abstract painting, consisting of lines and patches of beautiful colour, Paul Klee, Heindrich Nauen and Campendonck.

After the war an attempt was made to introduce a new movement, "Neue Sachlichkeit," corresponding with the French "Surréalism," which marked a return to naturalistic forms, not in an impressionistic but in a naïve-realistic manner. The movement received some impulse from the work of the *douanier* Henri Rousseau. This new realism attracted some gifted painters and is still in force to-day. Its chief representative is Otto Dix.

MODERN PAINTING IN U.S.A.

North America.—The art of North America has submitted in turn to many influences. At first, in the 18th and early 19th centuries, the influence came from England and some of the leading painters, such as West, Copley, Gilbert Stuart, actually took up residence in England and played prominent parts in the art there. Others, like Matthew Pratt, Trumbull, Vanderlyn, remained in the U.S. and practised sound tradition with success.

As the younger painters migrated to Europe for the purposes of study, the centre of influence was shifted; at first, in the 1850's, to Düsseldorf, Munich and Antwerp, where such painters as Eastman Johnson, Dielman, Chase, Duveneck worked. The last named had a school in Munich, with J. W. Alexander, Vinton, De Camp, etc., as his pupils. The influence of the French Barbizon School then began to be felt in the work of W. M. Hunt, George Innes and La Farge. This was succeeded by the potent influence of French Impressionism which has had beneficial effect on the work of Alex. Harrison, Benson, Alder Weir and particularly Childe Hassam.

The establishment of the Society of American Artists in 1877 with La Farge as President did much to organize and strengthen American Art.

This brief review of 19th century art in the U.S. shows that American artists have always received educational stimulus from Europe. The same is true to-day, but the influence is now derived almost exclusively from Paris. In spite of the claim of many American writers, there is no art that can be acclaimed as definitely and peculiarly American. The American stock in art is fundamentally academic and it is particularly susceptible to European influence.

Three or four names are especially prominent in American art, but they, strictly speaking, belong to the late 19th century both in theory and in practice. North America's greatest practitioner, Winslow Homer (1836–1910) was influenced mainly by Courbet. He was a strong realist. Certain distinguished artists, Whistler, Sargent, Abbey, Mary Cassatt, although American in origin, have been claimed by other schools. The first was a law unto himself and might have been claimed, with equal justification, by Japan or Paris. Sargent was Carolus Duran raised to the nth power, Abbey was academic and Mary Cassatt, a delightful artist, belonged to and was the product of the French Impressionist School.

The main influence on American art of the present day is that of the so-called followers of Cézanne. That is, on the younger painters, like Samuel Halpert. There is in America, as in all other countries, a strong and steady current of art which is not definitely influenced by modern events, but which is really the main stream into which modern tributaries flow, changing its character almost imperceptibly. W. M. Chase (1849–1916), a sort of Sargent without Sargent's peculiar snap, but with a certain added reticence, and J. W. Alexander (1856–1915), a charmingly decorative portrait painter, are in no sense innovators but belong unobtrusively to the main stream. There are many other art-

ists who have attained varying degrees of fame without definitely influencing present-day art. Frank Duveneck (1848–1919), who studied in Munich, is known as a follower of Whistler. J. R. de Camp (1858–1923), who followed after; A. H. Thayer (1849–1921), whose influence was German *cum* Italian 17th century with a religious tendency; G. de Forest Brush (1855–), the portrait painter with an interest in Indian subjects; Kenyon Cox (1856–1919), a decorative painter not uninfluenced by J. F. Millet; Howard Pyle (1853–1911), a strong illustrator, all belong to the 19th century so far as their art is concerned Other names, which are more or less well-known, are Gari Melchers (1860–), who was nursed in Germany and Holland; Cecilia Beaux (1863–), whose portraits are popular; C. D Gibson (1867–) who began and ended as an illustrator; Albert Sterner (1871–1918), a charming illustrator; J. F Folinsbee (1892–), a good painter of running water in the manner of Thaulow. Among the younger painters one finds the essential American academicism, superficially influenced by the doctrine of so-called Post-Impressionism and, one may note that American writers appear to attach a special meaning to that vague term. George B Luks (1867–) is a painter with a solemn air. Although he was educated at Pennsylvania Academy, and in Paris, Düsseldorf and London, he now professes to scorn all academic training. It is claimed that he paints "in the way Whitman wrote." E. L. Blumenschein (1874–) seeks to emulate Gauguin; A. B. Davies (1862–) practises a sort of academic and somewhat remote imitation of Puvis de Chavannes; G W Bellows (1882–1925) is strongly realistic; the work of Rockwell Kent (1882–) is reminiscent of Cameron, with an added crudity which passes as strength, Samuel Halpert, a follower of Cézanne and Derain, is one of the most promising of the younger school.

According to at least one American writer, there is a school of "Virile Impressionism," but its tenets or its peculiarities are not apparent. This writer says that "Matisse is moved by a spirit fundamentally different from that which animates Davies, Arthur, Jerome and Eddy" Kroll, one of the leading members of the school, is a striking example of the prevailing idea of Impressionism There are many facilities in America for the popularisation of art. The art galleries are well built and admirably organised. The art schools are perhaps the most up-to-date in the world. Art and artists have every opportunity

PROGRESS IN EUROPEAN COUNTRIES

Belgium.—Belgium, being a near neighbour of France, has naturally been susceptible to the influence of the various movements in Paris There was the definite influence of Impressionism on such painters as Emile Claus, A J. Heymans and, to some extent, James Ensor, but, as in France, there was the inevitable reaction against such influence This was expressed at first in the work of a certain group of painters who, before the war, concentrated and worked at Loethem St. Martin, a village in the Valley of the Lys, in the district of Ghent. They gathered round the sculptor George Miune, whose home was in the neighbourhood. The chief members of the group were Valerins de Medelsar, Gustave Van de Woestyne, Constant Permeke, Albert Servaes, Gustave de Smet, Fritz Van der Berghe and Albert Saverys. This group was influenced by the German Expressionism.

The influence of Cézanne, Gauguin and Van Gogh was especially strong, particularly in Brussels and its neighbourhood Rik Wouters, a prominent follower of Cézanne, has become an artist of a very personal quality He, with Auguste Oleffe, exercised considerable influence on the Brussels school, which, after Expressionism, sought a more synthetic art

The chief painters of the Brussels group are Phil Cocks, W Paerels, A. Dekat, C. Dehoy, R. Parent, J Brusselmans and J. Albert. E. Laermans, a Brussels painter, is the leader of the Synthetic School. Several artists of distinction can be said to belong to no definite school. Opromes and Daeye, at Antwerp; Millaert at Ostend, Tylgat at Brussels. Among the painters who may be described as traditional or academic, may be mentioned Delaunois of Louvain, L. Fréderic of Brussels, Rossenfosse of Liége, Franz Heus of Antwerp and Jacob Smits of Moll

Holland.—The Dutch genius is very far remote from that of France. In the whole history of the art of the Netherlands there is no strong evidence of direct French influence The Dutch character leans towards a sort of intimate realism and even in their grandest and most inspiring moments their artists have never forsaken that essential character

The Maris family had a certain following but theirs was a triumph of individuality and personal feeling rather than the exploitation of new ideas or the submission of extraneous forces The subjects made popular by Jacob and Willem Maris were national and homely in character Among the modern painters the most prominent are Jan Toorap, a gifted painter; Monnickendam, an artist whose admiration for Rembrandt is reflected in al his work, even in his still-life subjects which represent a great part of his work Lizzy Ansingh, a gifted painter with a rather unusual phantasy, is influenced by the Russian Ballet if by anything. A group, which practised an abstract form of painting, suggestive of stained glass windows composed exclusively of geometric shapes included Van Doesburg, P Mondrian, Van der Leck, Vilmos Huszar and Van Tongerloo

Scandinavia.—Among the northern nations, the influence of Munich has been stronger than that of Paris Both in Norway and Sweden the prevailing character is that of a vigorous and personal realism In painting, Sweden has probably been more active than Norway, although the latter country has had some notable painters who have not risen, however, above a certain respectable level Edvard Munch is probably the greatest of their painters He has been influenced by both Matisse and Marquet, particularly the former Dagfin Werenskiold, a painter of character, whose "Peasant Family" was shown in London at the Norwegian Exhibition in 1928, would appear to be influenced by Van Gogh, although his strong and personal work is the result of a direct and uncompromising perception. The landscapes of Harold Sohlberg and Henrik Sorensen are notable; those of the former being lyrical and reflective, while the latter's show a rugged sincerity. Per Krogh, who is considered to be one of the most modern in technique, displays a certain vulgarity which is certainly more German than French. He executed decorative panels for the Grand Hotel Restaurant in Oslo

It was in the early 'eighties that Swedish artists became really active They had then become acquainted with the work of the French Impressionists and had learnt something of the value of the new vision and a closer and more direct approach to nature

The results were seen at the "Opponents" Exhibition in Stockholm in 1885. The exhibition was greeted with the derision accorded to all new movements, but many of the exhibitors united to form the "Konstnarsforbundet" in 1886, which marked the definite foundation of the modern Swedish School. The prevailing influence of Dusseldorf had been succeeded by that of Munich and finally by that of France, but the new artists determined to throw off all foreign influence, which was a healthy if an impossible attitude. One of the leaders of the new movement was Ernst Josephson (1851–1906) He was supported by the more widely known painter, Anders Zorn (1860–1920), whose brilliant gifts of execution almost rivalled those of J S. Sargent Zorn however, was a superficial observer who sacrificed everything, both in painting and etching, to brilliant personal technique His influence, like that of all painters whose work is merely the exercise of personal cleverness, was not a salutary one nor capable of development His immediate followers were Larsson (1853–1919 and Liljefons Carl Hill (1849–1911) was the chief of those influenced by Impressionism

August Hagborg (1852–1921) and Hugo Salmson (1843–1894 were prominent members of the "Opponents" group; like Pe Ekström (1844), they lived and worked in France George Paul (1855) practised fresco painting, using that medium for the decoration of the staircase in the Gothenburg Museum. He was affected by most of the modern French movements and finally adopted a cubist manner. Hanna Pauli (1846–), figure and portrait painter; Acke (1859–), marine and genre painter Oscar Björck (1860–); Richard Berg (1858–) are other well-known names in Swedish art K Nordstrom (1855–), .

prominent leader of the "Konstnärsforbundet," Wilhelmson (1866) and Hesselborn played a part in the movement which led to the formation of the national school of painting.

The movements known as Expressionism (from Germany) and Cubism (from France) had a certain number of followers in Sweden, of which the more prominent were Isaac Grünewald (1889), Gösta Sandels (1887–1919), Leander Engström (1886).

Finland.—The chief influence in Finland came from Sweden, of which country Finland formed a part until its conquest by Russia in 1808. The influence was general and not confined to art. The people are distinguished by a natural love of colour which was expressed in their richly coloured rugs and the naïve paintings which covered the walls of country churches. But there was little serious art previous to the 19th century.

There were no art patrons and few facilities for the study of painting. The modern school, such as it is, dates from the foundation of the Finnish Art Union, which provided funds to establish a school of art. It is not advanced in character but resembles the more academic side of Swedish art. The chief painters are B. Lindholm (1841–1914), A. Edelfelt (1854–1905), V. Westerholm (1860–1919), who was trained at Düsseldorf and afterwards followed the French "plein air" school, Hélène Schjerfbeck (1862), M. Enckell (1870–1925), Hugo Sunberg (1873–1917), a strange personality, somewhat akin to William Blake, and Marcus Collin (1882) of Swedish origin, who follows Expressionism.

Russia.—Russian art, in spite of the impact of modern movements, has maintained its national characteristic quality, a sort of direct, almost primitive, realism.

More or less superficially it has been affected by contact with Paris for most of the Russian artists have found their way there. But the process of modernisation which has been felt, in varying degrees, in all countries, has been less drastic, has operated in a less imitative way in Russia.

Many Russian artists have been attracted by the theatre and the ballet; in the designing of costumes and in *décor* they have been peculiarly successful. Among the artists who have given the best of their attention to this branch of art, Leon Bakst (died in 1924), Alexandre Benois, Ivan Bilibine, Mstislav and Rostislav, Dobuzinski, Golovine and Koustodiev are the most notable. In spite of an intermittent tendency to the fantastic (which is yet rooted to earth), such as one sees in the paintings of Chagall, the majority of the painters are realists. Certain artists have a religious preoccupation, such as Stelletzki. The chief realists are Gregor Chiltian, whose work is almost photographic in its directness, Boris Grigorieff, Jacovlev, Nathalie Gontcharova (Spanish subjects), Gritchenko, Schoukhaeff, Zenaïde Serebriakova, Polunin, Nadia Benois.

Italy.—The southern countries were but little affected by the modern activities of Paris. In Italy, the almost isolated outbreak of Futurism, under the poet F. T. Marinetti, was speedily transferred to the more fruitful soil of Paris and appears to have had little influence in the country of its origin. The standard of modern Italian art is not a very high one, but there is a good average of production, mostly academic in character.

The main characteristic of the latter part of the 19th century was a sort of picturesque Courbet-ism with an occasional flavour of Fantin-Latour and even of Proud'hon. Monticelli was also a potent influence. This was succeeded by the influence, particularly in the northern districts, of the fine painter Segantini, who died in 1899. In the work of certain painters, Luigi Galli, for example, the influence of the Old Masters, particularly Michelangelo, is strongly felt.

On the work of very many of the portrait painters the pernicious influence of Carolus-Duran has left its mark.

A description of modern Italian art consists, almost inevitably, of a list of names, as there appear to be no definitely marked schools of painting or movements.

Antonio Mancini (born in Rome 1852), the portrait and figure painter, is strongly individualistic, not to say vulgar, in his methods. In his later work, in which the paint is extraordinarily thick in parts, he has used various means to produce an effect, even employing pieces of glass, bits of tin, buttons, paper, etc.—a device which he used before the Futurists employed it. His earlier work, in a broad academic manner, is fine in character and drawing. Gaetano Previati (1852–1920) was superficially influenced by Segantini, but lacks the subtle colour analysis of that master; the same influence is perceptible in the work of Mario Puccini (1869–1920); Eugenio Prati (1842–1907), who is thought highly of, was influenced in his later work by Monticelli; and Emilio Gola (1852–1923) was a sort of Sorolla (the Spanish painter), with a warm academic quality and some reference to Monticelli. Arthur Rietti combined the quality, very much removed, of Menzel and Degas. The Venetians, Frederico Zandomeneghi (1841–1917), akin to Besnard plus a certain austerity, and Guglielmo Ciardi (1843–1917) showed an admiration for the early Corot, while Pietro Fragiacomo (1856–1922) painted night effects on the Lagoons with a rare subtlety.

Angelo Morbelli (1853–1919) practised a kind of up-to-date decorative symbolism. Other notable painters were Bartolommeo Bezzi (1851–1923), Cesare Tallone (1853–1919), Mario de Maria (1852–1924), Michele Cammargno (1835–1920), Antonio Leto (1844–1913) and E. Delbono (1844–1915).

Czechoslovakia.—About 1900 there was an outcry on the part of certain of the Czech artists against the "free tendencies" of French art, which were considered to be a menace to the national productions, such as they were. But French art prevailed and in 1902 a pavilion was built for an exhibition of Rodin's work. This was followed by an exhibition of paintings by Manet, Degas, Renoir, Sisley, Carrière, etc., and in 1908 at Prague, of Daumier, Pissarro, Monrisot, Bonnard, Vuillard and of Cézanne, Gauguin and Van Gogh. The influence, therefore, was mainly French, but early in the century some of the younger painters discarded Impressionism in favour of Cézannism. They formed a small society of "Eight," which led to a quarrel with the Mánes Society and a subsequent reunion. This society was named after Joseph Mánes (1848–1891), who had substituted the direct study of nature for the idealism of Cornelius and Overbeck.

Antonin Slaviček became known as the Master of Czech Impressionism; with him were A. Hudiček, Oldřich, Blažiček, Otokar Nejedly and Průcha.

Jan Preisler was one of the founders of the Mánes Society and Max Svabinsky was an active member. Karel Myslbek was influenced by the Spanish painter Zuloaga. F. Simon, Spillar, Boetlinger were all definitely French in feeling. Nechleba, Obrovsky, Mayer were notable names; Emile Filla led the younger painters towards Cubism and Expressionism.

Switzerland.—Swiss painting has not been prominent in any review of art, either for its quality or its quantity; nor has it been ever very distinctive in its blended qualities of Munich and North Italian; but there has been a certain improvement in modern art, particularly in sculpture.

The painter Ferdinand Hodler (1853–1918) was the most notable national figure. His work in landscape, figure, portrait and genre has had remarkable virility and some originality. Others, E. Morgenthaler, R. H. Pellegrini, A. Blanchet (influenced by Gauguin and Derain), C. Amiet (Impressionistic influence), may be mentioned.

Spain.—Spain remains conservative and very little influenced by the art of its neighbour.

Zuloaga, a daringly direct observer, is well-known through exhibitions in Paris and his paintings in the Luxembourg; Sorolla is a virile painter of contemporary life, who might be compared with Sargent; Zubiaurre combines a primitive instinct with the directness of Zuloaga; Solomayer, the realist, has adopted a style somewhat reminiscent of Lucien Simon.

Buenos Aires.—Buenos Aires has become a centre of remarkable artistic activity; the annual Salons there reveal the existence of a large number of painters of a high level of artistic ability.

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PAINTINGS, RESTORATION AND PRESERVATION OF. It would be extremely difficult, if not impossible, to determine at what date the restoration of painting was first undertaken.

Ancient restoration does not reveal any technical processes of much interest; no real progress was made in the art of picture restoring until the 19th century. It is true that such men as Le Primatice, J. B. van Loo and even Chardin, were sometimes entrusted with restorations; but it was the exception for them to undertake such work. As a general rule the touching up of damaged pictures was, and unfortunately only too often still is, entrusted to inferior artists who regard the restoration of paintings as an unimportant work.

The result of this has been that during past centuries, no tradition has grown up, and in consequence of the low esteem in which that branch of art has been held, no outstanding personality has devoted his authority and skill to putting an end to this regrettable state of affairs. It must be added that at those periods when the art of painting stood high in popular favour, the most skilful forgers have been found among the restorers of pictures. Such men often had considerable skill in their own way, even though they were without real talent; and a study of the history of painting frequently shows that unscrupulous restorers have made use of their knowledge in order to make alterations or additions to pictures for purposes which certainly had nothing to do with art.

We may leave on one side the undesirable activities of bad workmen, and turn to the development of the art of restoring pictures which has now been brought about by experts.

Elements of Pictures.—The restoration of pastels and drawings would need for its adequate description an essay to itself. In engravings the paper is of the greatest importance. Stains on the paper will disappear on the sheet being dipped in a series of baths, the composition of which varies according to the practitioner. One of the most efficacious methods is:—(1) Dip engraving in a solution of permanganate ($\frac{5}{1000}$) for several minutes. (2) Wash in clear water. (3) Add to the permanganate solution hyposulphite of soda ($\frac{10}{1000}$). Leave the picture in this solution for ten minutes and add ten drops of hydrochloric acid. (4) When the paper has become white, wash it in water for half an hour and dry the whole between sheets of blotting paper.

The diseases from which paintings may suffer are of various kinds. Their treatment may not be so urgent as that of human ailments, but it is just as difficult and delicate in its own way. It necessarily varies with the different schools, pictures and artists, since the problem of restoration is closely bound up with the whole technique of the picture to be restored.

A picture, no matter at what date it may have been painted, consists from the material point of view of two elements: (1) the supporting structure, which may be wood, canvas, paper, cardboard, a wall, etc.; (2) the paint which is superimposed on the supporting structure, and which constitutes the picture itself.

In addition to these two principal elements there are two other factors which appear to be of a secondary character, but which are nevertheless of great importance. The supporting structure is almost always covered with a layer of fish-glue on which is applied some isolating substance such as plaster, carbonate of lime or white lead. Modern painters, it is true, sometimes paint their pictures directly on the canvas, or on a wood panel; but in the course of centuries it has always been found better and more convenient to cover the supporting structure with some isolating substance before beginning to paint. This substance is an element of such importance from the point of view of the restorer that it must be considered separately.

Finally, the fourth element which constitutes the picture is the final varnish, which is in some cases replaced by a thin coating of encaustic.

It will be seen from the above what the vulnerable points of a picture are. At the same time it will be shown that it is rare for one element only to be affected; when one of the elements which constitute the picture is injured, the effects generally make themselves felt on the remaining elements.

Damp and heat are the chief natural destructive agents. In addition there is the possibility of splitting in the case of a wood panel, and tearing in the case of canvas, owing to violent treatment.

Injuries to the supporting structure may be repaired by cradling in the case of paintings on wood panels, by re-lining in the case of pictures painted on canvas, and by *transference* in the case of either kind of picture. The same processes can be applied to pictures painted on paper. Pictures are also occasionally painted on slate, copper or other metals; in such cases there is very little possibility of repairing any damage to the supporting structure, since the coating of paint which constitutes the picture can only be refixed from the front.

Cradling.—When a picture painted on a wood panel splits owing to rough treatment or changes of temperature, it becomes necessary to join up the pieces which have become separated and to restore an absolutely flat surface to the panel. In order to do this, the pieces are fitted together carefully and are laid, with the painted side downward, on a sheet of marble or glass. They are then subjected to heavy but gradual pressure so that the straightening out of the wood may not be too sudden. If the panel is a thick one, it is better to shave it away so that it may be straightened more easily without there being a danger of its splitting again. It is also a good thing to make the surface of the reverse of the picture perfectly flat so that the cradling may be carried out more satisfactorily. If the panel is very badly damaged it may be backed with another; the actual cradling is then carried out on the second panel. Cradling consists in gluing a series of small pieces of wood at small and regular intervals over the whole surface of the reverse of the picture. The wood selected must obviously be perfectly dry; and in order to prevent any fresh damage due to changes of temperature, care is taken not to glue the pieces of wood to one another at the points of intersection.

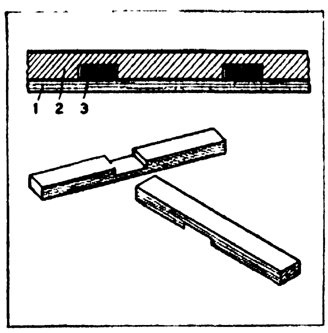


FIG. 1.—CRADLING

Re-lining.—The tearing of the canvas of a picture by a fall or some other accident always impresses the general public as a particularly serious disaster. The injury may in fact be serious if the vital parts of the picture are affected, but it may be comparatively slight if only the less important parts are damaged. If the canvas on which the injured picture is painted is in good condition, the process of re-lining is applied; in other words, the damaged fabric is reinforced by the process described on next page

The painted side of the damaged canvas is first covered with a sheet of paper for protection, and the reverse side is then carefully cleaned and covered with two coats of fish-glue. It is then covered with gauze applied by means of a special kind of glue made of a mixture of rye flour and wheat flour,

fish glue and a little Venetian turpentine or molasses. The new canvas, which must be of pure linen and carefully sponged, is then stretched on a temporary frame larger than the picture to be re-lined. These preparations having been completed, the new canvas and the reverse of the old canvas are glued together by means of the special glue described above; when the two canvases are placed one against the other; any inequalities in the thickness of the glue are pressed out with a spatula. The re-lined canvas is then ironed several times; this is of great importance in order to make the junction between the two canvases complete. When the junction is effected and the glue has completely dried, the protective covering of paper is removed from the picture and the re-lined canvas is stretched on its permanent stretcher. Any gaps in the painting made by the tear are filled in with a mastic made of carbonate of lime, fish glue and a little Lyons glue. It need hardly be said that this is only an outline of the process of re-lining, and similarly, only an outline of the process of transference will be given; it will be readily understood that these operations require the most detailed attention, and that proper time for drying must be allowed between the different stages.

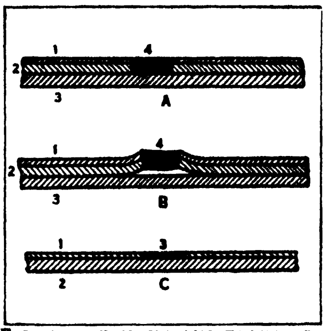


FIG. 2.—RELINING AND TRANSFERING

It has not been thought necessary to deal with the summary, but only too common, method of repair which consists in gluing a patch at the back of a tear in the canvas. Only the very smallest tears can properly be mended by means of patches. If the patch is of any size it gives the original canvas insufficient support, and after a certain time the surface of the picture will be spoilt by undulations. Re-lining is the least that is necessary if the two edges of a tear are to be absolutely prevented from showing. If re-lining is not done properly, the remedy is worse than the disease. Supposing one canvas were simply to be glued hastily on to the other, there would soon be a number of air-bubbles between the two, while in other places there would be spots where the glue was too thick, and these would ferment and cause mildew. In addition, the edges of the tear would gradually detach themselves from the new canvas and would rise up. Hundreds of celebrated pictures have been re-lined, Velazquez's "Venus" (National Gallery), Rembrandt's "La Religieuse" and so on.

Transference.—It is frequently necessary to repair wood panels which have become worm-eaten or are not strong enough to support the weight of a heavy painting, or sometimes have rotted owing to damp. Again, it may happen that the isolating preparation covering the panel or canvas, which was mentioned as one of the elements constituting the picture, does not adhere properly to the supporting structure, or does not adhere to the actual painting, so that it scales off or forms blisters. In such cases as these, re-lining is clearly useless; it becomes necessary to save the painting itself. The operation which aims at preserving nothing but the coating of paint which forms the actual picture is that known as transference. The painting is removed from the damaged panel or canvas and transferred to a new supporting structure which is in good condition. The children's game known as "transfers" will give some idea of the process of transference.

In order to prevent any portion of the original painting from falling or being displaced, two thicknesses of tarlatan and two of paper are first lightly glued to the painted side of the picture. The painting itself being thus protected, the picture is turned over, and the process of removing the supporting structure is begun. If the support in question is a canvas, it can as a general rule be removed fairly easily either by damping it, or by subjecting it to heat so as to dissolve the original glue between the canvas and the isolating coating on which the actual painting was done. If there is no glue it is more difficult to detach the canvas, and it has to be gradually scraped away until the isolating coat is reached. This is the case where the support is a wooden panel; the only possible means is generally to plane it away. When the reverse of the picture has been laid bare in this way, it only remains to re-line it. This can be done by several methods, more or less simple or complicated as preferred by the operator. Some cover the reverse of the painting with a coating of white lead in order to strengthen it, and interpose layers of tarlatan between this and the new canvas; others glue the new canvas as directly as possible to the painting by means of *caséine*. Here again it must be remembered that the process involves a number of detailed operations which it is not necessary to mention here, and that the utmost care and great skill are required.

Difficult as the operation is, it may unhesitatingly be recommended in preference to re-lining. However skilfully re-lining may be carried out, it necessarily involves fixing closely together two tissues of different composition and age, which are not equally sensitive to changes of temperature. It follows that after a certain lapse of time the two canvases undergo dissimilar changes and become loosened; the edges of the old tear in the picture cease to adhere to the new canvas, because the place of the tear is a weak point since at that point there is only one thickness of canvas; it thus forms a sort of hinge which comes into play whenever the canvas is expanded or contracted by heat or damp.

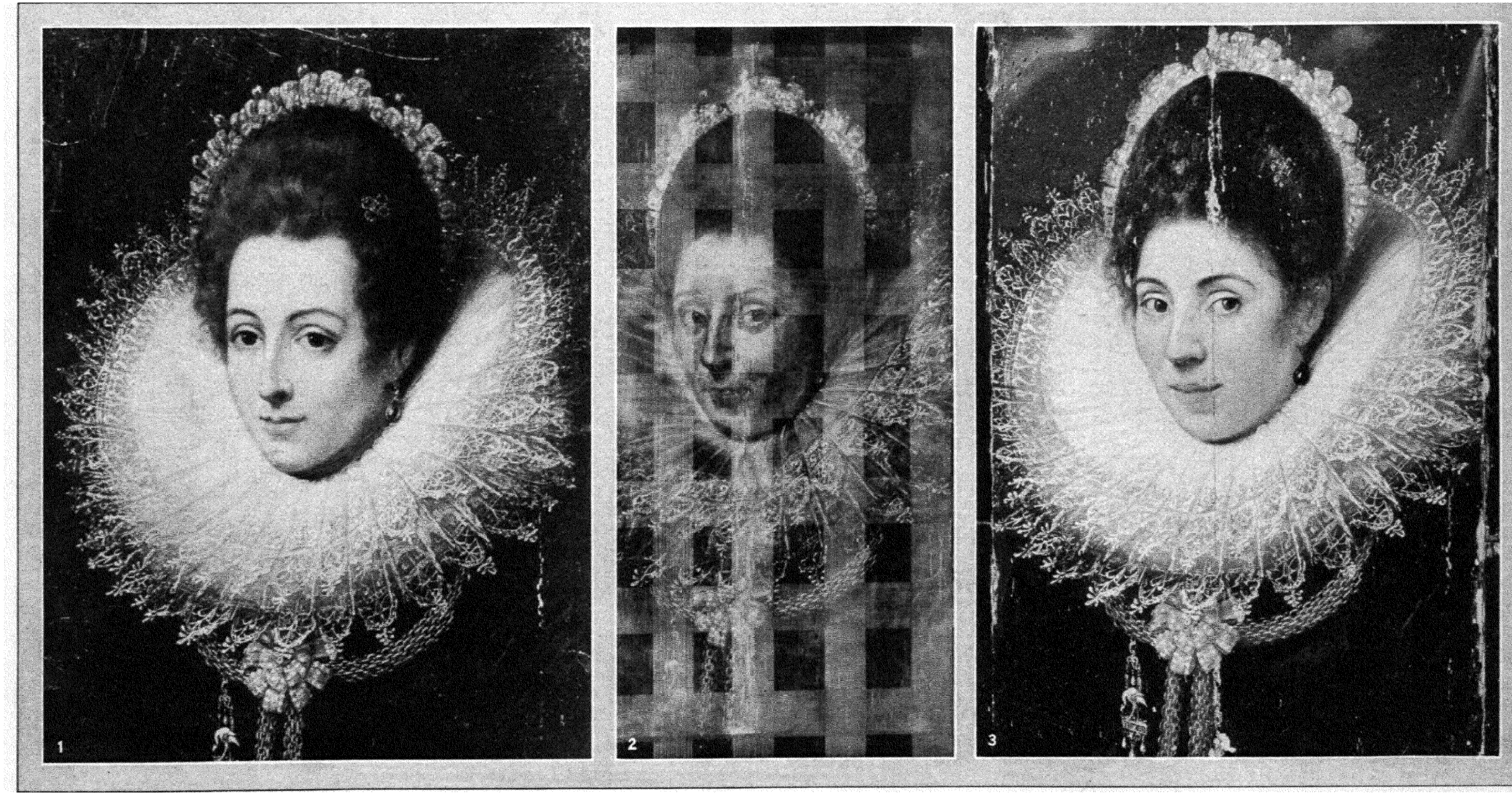
After a certain time the mastic which has been used to fill the gap made by the tear is bound to scale off because it is inelastic; the foundation of the restoration is thus destroyed. The importance of this danger has no doubt been exaggerated in the above account in order to make clear the possible defects of re-lining. No such danger however exists if the process of transference is applied, since there is only a single tissue to be affected by variations of temperature; in addition, the volume of the mastic used to fill the gap is negligible, since its thickness is only that of the layer of paint and not that of the canvas.

The public is still very much impressed by the difficulty of the process of transference, and since the operation is a long one and cannot be carried out except by a really expert worker, picture restorers often hesitate to undertake it. Thanks to transference, we still have masterpieces like Raphael's "La Petite Sainte Famille" and "Saint George." They were treated by Picault in 1751 and this is probably the date of the invention of the process.

De-varnishing.—It is logical to deal first with the varnish, since the restorer has to deal with it before actually restoring the painting, and because, owing to the action of various factors, it is rare for a picture to retain the original quality of its varnish. There are cases in which the original varnish can and should be preserved; but as a general rule, if the restoration which a picture requires is at all extensive, it is necessary first to remove the varnish. Of all the problems which arise in connection with picture restoring, that of de-varnishing is by far the most important. Defective re-lining can be remedied, and repainting which has been badly done by an ignorant operator can be removed without damage to the original picture, but bad de-varnishing may do irreparable harm.

Varnish is made of resin dissolved in oil, essence of turpentine, or alcohol—to mention only the most usual solvents. Just as the fusing of siliceous sand, itself an opaque substance, produces a transparent substance, glass, so the solution of resin produces a transparent substance, varnish. The principal use of varnish is that it preserves the intensity of colour of pigments. In addition, however, even the extremely thin layer of varnish which is all that should be applied to a picture has an extraordinary isolating effect. Varnish protects a painting from emanations of all kinds which might destroy the brilliance of its colouring as well as from the dust which progressively accumulates on it owing to the dampness of the air.

There are some old pictures which have never been varnished; in such cases it is an exceedingly difficult matter to remove the impurities adhering to the painting itself; the painting is also injured by the fact that its different colours have been differently affected by chemical action. For example, it has occurred that in a picture representing the setting sun, what was originally the brightest part of the sky has been transformed into a dark patch because it contained vermilion, a colour containing sulphide of



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DETECTION OF FRAUD IN PAINTING BY THE X-RAY

1. "Portrait of a lady," supposed to have been painted by Franz Pourbus the Younger (1570–1622). Flemish. This was the state of the painting, with the face completely repainted, before the X-ray test was made
2. Shadowgraph, X-ray view of "Portrait of a lady," by Franz Pourbus the Younger, showing a different face. The X-ray reveals an inside view, showing the strokes of the under-painting or preparatory workmanship, which are covered by repaint
3. "Portrait of a lady" by Franz Pourbus the Younger, after the painting was cleaned, showing the same face as seen in the X-ray

EXAMPLES OF PAINTING RESTORATION

1. "Tribute to the Good Thief," by François Eisen. This picture depicts the dealers of the period with damaged paintings which are about to be altered in secret studios in imitation of the styles of famous painters. They are being laid before "The Good Thief" to invoke his protection. 2. Example of a picture filled in with mastic. After relining, the missing portions of the picture have been filled in with a special mastic over which the painting will be restored. 3. "The Holy Family," by Raphael. This famous picture was the first to be transferred from wood to canvas in Paris. This was effected by Picault in 1750. 4. Example of a torn picture. Once however it has been relined, filled in with mastic and carefully restored, its defects will no longer be discernible. 5. Example of a picture with damaged surface. Because of an injurious process of cleaning, the coating of paint has been rubbed until the texture of the canvas shows white through the paint. 6. Example of a scaled picture. In such a case relining will not suffice and it is necessary to transfer the picture

mercury, which is particularly liable to deteriorate. This would not have occurred to nearly the same extent if the painting had been varnished. The influences which damage paint also damage varnish, but the varnish can be removed, and the painting itself is then found intact, without injury to the specially vulnerable colours.

Varnishes are of course not all of equally good quality, and they may become darkened to a serious extent. This is generally due to the excessive use of varnish often made by collectors or dealers who want to give an appearance of increased freshness to the pictures in their possession. Even the best varnish, however, does not retain its specific qualities if it is applied at more than a certain thickness; it darkens and becomes opaque.

It may happen that a picture requires revarnishing. Before this is done, however, an attempt should always be made to regenerate the old varnish. If the old varnish has ceased to be transparent, it is possible to re-dissolve the molecules of resin which cover the painting by means of alcohol vapour. This is an ingenious method by means of which it is possible to restore the varnish to its original condition, which it will retain for a considerable number of years, without loading the painting with a fresh coat of varnish. Thus was Rembrandt's "Ronde de Nuit" restored in 1889 (fig. 3).

In order to regenerate old varnish, the picture must first be wiped, and then washed by means of wads of cotton dipped in water without soap. This removes the dust which has been more or less fixed on the picture by the moisture in the air. A receptacle (1) the exact size of the picture and 15–20 centimetres deep is then prepared; a wooden box will serve. The bottom of the receptacle is covered with a layer of down thoroughly soaked in 90% spirit. (2) The picture is laid on the box with the painted side downwards, *i.e.*, facing the down soaked in spirit. The time required for the regeneration of the varnish varies in the case of different pictures from 15 minutes to several hours; in some cases the desired effect is not produced at all.

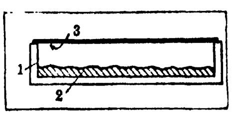

FIG. 3

If a picture has been damaged and needs to be restored, or if the colours are altered by too many coats of varnish, it needs de-varnishing. One is often painfully impressed by seeing famous masterpieces in the various museums of Europe the colours of which are completely distorted by the darkening of the varnish; and a general de-varnishing of thousands of pictures might be undertaken with advantage. In theory it would be better to see great pictures as the artist painted them rather than as they appear under the influence of old varnish. Unfortunately, however, it must be admitted that the work cannot be carried out because there are not enough expert workers available. It is therefore better to exercise great caution, and not to be in too great a hurry to restore fine pictures, but to wait for the day, which must soon come, when a sound tradition has been created. It is only fair however to recognize the good work which has been done in the past by intuitive artists who have tried processes which, if they had been developed, might have hastened that day. But the experiments which were tried were isolated, and no tradition was created. Thus only too many restorers have, with a desire to avoid trouble, tried to de-varnish pictures simply with a mixture of essence of turpentine and alcohol. This method is easy and rapid and unfortunately it sometimes gives excellent results. We say "unfortunately" because the fact that the method is sometimes successful leads to its being applied in all cases, and this is to be regretted because the method sometimes causes damage which cannot be foreseen. Some pictures which are painted strongly, in light tones and without scumbling will stand the process perfectly well; in others the surface is at once spoilt, and in addition, alcohol is dangerous for dark and transparent tones and for all scumbling.

What is needed for de-varnishing is not a rapid solvent, but something which will soften the varnish gradually. It is necessary to keep the operation well under control the whole time, and not to use a method which gets out of hand. The work must be slow if it is to be safe. A Van Goyen, painted in transparent browns applied directly on wood, a Reynolds, the colour of which is sometimes applied simply by scumbling on a ground of *grisaille*, or a Debucourt, are extremely difficult to de-varnish properly. Excellent and sure results can however be obtained if we have patience to attack the varnish not all at once (as is done by alcohol, alkali, soap containing potash, or acetic acid applied without precaution) but gradually. This makes it possible to modify the process in the middle of the operation when one coating of varnish has been removed, and we arrive at another coating which may be of an entirely different composition. For it may be taken almost as an axiom that all pictures have been varnished more than once.

Many people advocate the rubbing off of varnish. It is true that certain varnishes can be rubbed off by the fingers, and that this method can be used for de-varnishing small pictures painted on a smooth surface; but it is defective and irregular, if not impossible, if there is much *impasto.* On the other hand, oil of aspic, copaiba balsam, cedar oil, sulphuric ether and xylol may be used successfully either separately or in combination; they have the advantage of allowing a trained expert to recognize the nature of the varnish which he has to remove and to choose the most appropriate formula for his work. If judiciously used alkali, acetone and acetic acid which have been mentioned as dangerous may be of great value. It must be emphasized, however, that de-varnishing ought to be perfectly successful and perfectly safe. Different methods should be used according to the nature of the picture and the varnish with which it is covered, for in this work each case should be considered individually. If there is nothing wrong with the picture except that the varnish is too dark it is sufficient to revarnish it lightly after the old varnish has been removed. It is, however, better to wait before doing this for a sunny day so as to be sure that no moisture is retained between the paint and the varnish.

Restoration.—It is now necessary to consider the case of pictures which have to be restored after the old varnish has been removed. It very rarely happens that an old picture has not suffered from scratching, if from nothing worse. The preceding paragraphs have dealt with re-backing and transference; these processes presuppose some injury to the painting itself which has to be repaired.

It would take too long to distinguish between all the various kinds of damage which may necessitate the restoration of a picture, that is to say the reconstitution of the painting itself. For the sake of clearness they may be divided into two categories: (1) *absence of paint,* which may be due to a hole, a tear, or to scaling off; (2) *wearing of paint,* which may be due to changes occurring in the paint itself; *e.g.,* when a red or brown ground works through scumbling which has been applied over it too lightly, or to friction by foreign bodies, or, what is unfortunately the most frequent cause, to previous cleaning operations which have worn away lightly painted details or damaged fragile colours, such as scumbling on the one hand and all dark tones on the other.

Retouching.—In addition to the above two kinds of injury, there is another factor of great importance—that of old retouchings. By "re-touchings" we understand restorations which go beyond the area of the injury which they were intended to repair. When this has been done, the work of restoration is rendered doubly difficult, because if the work is to be properly done it is first of all necessary to remove all the additions which have been made to the original painting. A trained eye can generally detect re-touchings at once, and can guess whether they have gone beyond the actual area of the accident.

Ultra-violet rays and X-rays are of great service in this connection. Under the action of ultra-violet rays, colours, at any rate if not covered with varnish, are transformed in accordance with their chemical composition, and it may happen (though it is not safe to generalise) that "values," or colours which closely resemble one another by natural light, are completely differentiated by ultra-violet rays. If the paint used for re-touching is not of the same chemical composition as that of the original picture, it will at once appear under ultra-violet rays as a patch of a different colour.

X-rays perform a similar service for a different reason. It is well known that the greater the atomic weight of a body, the

more difficult it is for X-rays to pass through it. (*See* X-RAY.) Consequently a re-touched area, which represents a greater body of material on one part of a picture, is shown up by the fluorescent screen. Here again it is unsafe to generalize, for certain colours, such as browns, emerald green and madder, are of such low atomic weight that they are scarcely shown by X-rays. On the other hand, X-rays reveal the exact limits of an injury. When we see that a painting has been retouched, or even, as sometimes happens, completely painted over, we may hope that the real extent of the injury is not so great as the re-touching would lead us to suppose. By the use of X-rays it is generally possible to discover the exact area of the mastic underneath the retouching, as the atomic weight of the mastic is sure to be different from that of the wood or canvas on which the picture is painted.

When a picture restorer wishes to remedy a loss of paint due to a hole, a tear, or scaling off, he should confine himself to reconstituting that part of the picture from which the paint is absent and has had to be replaced by mastic. We do not consider that he is morally entitled to go one-tenth of a millimetre beyond the area of the mastic.

If the paint is rubbed or worn away, a much higher technique is needed for its restoration, for it is a temptation to employ the easiest method, which would be to repaint it. On the other hand taste, power of selection, respect for the artist whose work is being restored, and a thorough comprehension of his art are needed to restore scumbling which one is certain has been worn away. In any case, no attempt should be made to repair the effects of wear unless they really interfere with the unity of the painting.

There was actually a time when great picture galleries re-varnished all their paintings whenever an important personage was to make them an official visit. Similar errors have been committed in the actual restoration of pictures; there is absolutely reliable documentary evidence to show that in some of Rubens' pictures the red draperies have been entirely repainted, and that when there was an injury to an arm or a leg, the whole of the arm or leg was repainted. This was what happened also to Raphael's "St. George" mentioned above. One of the legs had been entirely repainted and these useless retouchings had to be removed. Many similar restorations may still be seen at the present time. There is another reason which explains why ancient retouchings, even if conscientiously carried out, are so conspicuous at the present day; this is that they were done with oil paints. This brings us to important aspects of the technique of retouching in the strict sense of the term.

It would at first sight appear normal to retouch oil paintings with paints prepared in the same way. It must not however be forgotten that all paints are subject to more or less rapid modification under the influence of time. In the case of tempera, fresco and gouache painting, the transformation is almost instantaneous, while oil painting does not complete its development until months and sometimes many years after it was executed. When that stage is reached, if the painting as a whole is in a good state of preservation, the colour harmony may be considerably different from the colouring of the painting when fresh. Retouchings executed with oil paints, even very skilfully, on an old picture the colours of which have been modified by time, may be perfect when it is done, but will only remain so for a few days or at the most for a few months; after that the new colour, which at first exactly matched the old, will in its turn be modified and will inevitably show. A clever restorer will of course take pains to prepare a very light ground with unmixed colours and will cover this with a very light film of colour in order to arrive at the tone finally required, and in this way will do all that is possible to prevent the paint from changing a great deal. In spite of everything, however, the results thus obtained will only be satisfactory for a certain time, and attempts have therefore been made to mix oil paints with all sorts of other ingredients in order to retard the action of time on them. The next experiment was to grind colours with turpentine and without oil, and in order to give them consistency, to paint with varnish with a resin and turpentine basis. This represented real progress. The colours were still subject to modification, but they changed more rapidly, and it was easier to foresee the future effect of restoration. Most restorers still use this process. Although the varnish complicates the work, the colours remain easy to handle, and it must be admitted that restorations executed in this way may last for a long time, particularly if the ground is carefully prepared and the final coat very light.

The object in view is not, however, to carry out restorations which will have to be done over again, even at a comparatively distant date. After a number of experiments with water-colours, gouache colours, etc., it was decided to try restoring pictures with brilliant tempera colours, *i.e.,* colours ground with yolk of egg. It is true that this process renders the task of the restorer incomparably more difficult. Tempera colours dry very rapidly; long practise is necessary to make them produce the fluid effect of certain old paintings. Moreover, the colour becomes much higher in tone after a few hours, and the extent of the change varies enormously according to the mixture used. It is thus necessary to foresee what the colour will be after it has changed in order to bring it into accord with the fixed colour of the original work. It will readily be understood that much experience is needed in order to obtain satisfactory results with tempera colours. On the other hand, the change which takes place in tempera colours after a few hours is complete in a few days. In other words, the transformation which takes many years for oil paints is accomplished in a week. Moreover, tempera painting takes varnish just as well as oil painting.

It was stated at the beginning of the present article that what the art of picture restoration has lacked throughout the centuries is a sound tradition. Really encouraging results have been achieved, but it must be clearly understood that restoration is a vocation rather than a trade. In order to practise it, it is first necessary to be a real painter, and in the second place to make a constant study of the practical methods which the old masters used to achieve their artistic aims. However much their works are searched, the number of discoveries which have been made remains limited. At any rate a study of this kind will show that the one supreme quality which a restorer should possess, if he is to try his hand on great works of art, is the gift of respect.

(J. G. G.)

Restoration and Preservation: L. B. Guyton de Morveaux and others, *Rapport sur la restauration du tableau de Raphael connu sous le nom de la Vierge de Foligno* (1802); Horsin-Déon, *De la conservation et de la restauration des tableaux* (1851); U. Forni, *Manuàle del pittore restauratore* (Florence, 1866); O. E. Ris-Paquot, *Guide pratique du restaurateur amateur de tableaux* (1890); C. Dalbon, *Traité technique et raisonné de la restauration des tableaux* (1898); G. Meusnier, *De l'entretien et de la restauration des tableaux* (1909); A. Jehn, *Chromatisme revivifié: Transparence obtenue tout en conservant les anciens vernis et les patines* (1911).

DETECTION OF FRAUD

The existence of countless fraudulent paintings is generally acknowledged. Apart from the more obvious cases which have reached law courts and publication, there are numerous references in the note-books of artists to the making of copies which, although legitimate in their original purpose, have become fraudulent in the hands of opportunists. In a similar way the work of pupils, supervised or corrected by a master, and put out originally as shop work, has been made in later times to pass for the work of the master. One therefore must distinguish between the several types of forgery. The work deliberately manufactured at first hand in imitation of older work constitutes an important first class—sometimes most difficult to detect. Next to this are the groups dealing with the transformation of something already existent into something else, such as the refinishing of a crude school piece in the master's manner, or the remounting of fragments of an old picture to serve as the skeleton of a finished work, or even the mounting of an overpainted chromolithograph on a decayed piece of wood or canvas to imitate the appearance of an old picture. Perhaps there should be a separate classification for some kind of repair work on damaged pictures; in this group the forgery consists in falsifying what remains of the original. But in all kinds, the forgery may be considered as a substitution,

whether of colour, or brushwork, of subject, or of spirit and conception, with or without the intention to deceive. In order to guard against this imposition the expert must be able to recognize the clues which point to its existence.

The material differences between the true and the false suggest chemical and physical analysis; the spiritual differences suggest psychological and historical analysis. In effect the expert makes use of any means that suggest themselves to him. Chemical tests may determine the composition of colours, of which the date of discovery is known. (*See* PAINT, CHEMISTRY.) The presence of Prussian blue, for example, in a painting supposedly of the 15th or even the 17th century is absolute evidence of forgery or repainting. The needle test, mainly of anecdotal value, shows whether or not the oil in an oil painting has hardened; if the paint cracks when the needle is inserted, the oil has solidified; if the needle's hole is round and unbroken at the edges, the oil medium is probably less than 30 years old, according to some, or less than 50 years old, according to others. A strong magnifying glass or low-powered microscope may determine whether apparent cracks are natural or have been drawn in with a sharp point. Polarized light has been suggested as a means for seeing beneath the dirty varnish, glaze and repaints in certain types of painting.

By far the most common method, however, if it is properly a method, for determining forgery is by means of the emotional sensitiveness which develops from long familiarity with works of art Critics, necessarily in sympathy with their subject, mark slight deviations in spirit, form and style which indicate the presence of something alien—a forgery or imitation of a known model. Detection of such deviations presupposes, of course, a complete knowledge of the art imitated and a range of information wide enough to develop what are at first merely suspicions into proofs, demonstrated by whatever historical and inferential facts can be found to support the primary emotional one. The critic's hypothesis ordinarily is derived from emotional experience, and the proof from technical data.

Recently the X-ray has been added to the expert's equipment. And it has become exceptionally useful, when useful at all. It combines in one test opportunities to study the physical consistency of a picture and the psychology of the artist. It reveals the variations in density and thickness of the material forming the work of art, thus recording the touches of pigment which differ from one another in kind as well as in handling; it also may show the strokes of underpainting or preparatory workmanship not visible on the surface Consequently the X-ray film records an inside view and adds to the technical data at the critic's command.

The efficacy of the X-ray depends on two conditions First, the pigments in use to-day lack generally the density of the pigments in use prior to about 1800, a date that seems to mark the beginning of extensive research in the chemistry of colours. This means that a forgery in chemically compounded materials differs in density and thus differs in appearance on the X-ray film from a picture painted in mineral and earth colours that have been coarsely ground by hand. Secondly, the degree of skill and sensitiveness of an artist is usually manifested in his brushwork or habits of applying pigment And this means that a modern forger, even if he uses dense colours ground ever so skilfully in imitation of an old method, nevertheless leaves traces of his personality and peculiarities as an artist in his brushwork.

Unfortunately the X-ray itself has not been perfected to the point where the critic can wholly control it; the rays, for instance, have their effects in straight lines and must penetrate all of an object in order to be recorded on a sensitized film. For the purpose of art criticism it would be valuable to direct the rays through only one layer of material, that is, to obtain an X-ray of pigment only, without having to penetrate a ground of gesso or lead paint, as well as a panel or canvas, sometimes coated on the reverse with more material, all of which confuses the appearance of the artist's workmanship. This limitation, however, does not affect the X-ray's value under better conditions. Given a picture forged in modern material, regardless of style or craft, the X-ray shows the lack of density of the paints and the incompleteness or shallow nature of the cracks which, when hammered or scratched on the surface, differ from the cracks which have developed with the slow drying and long condensation of the materials. If the forger has utilized an old picture as the basis for a new one, the X-ray easily reveals the hidden part. Repair work that borders on the fraudulent is consistently visible in the X-ray test, since no amount of skill on the restorer's part can blend fresh paint and old paint so accurately that they match in density, thickness and style Finally the X-ray aids a just choice between two pictures that are alike in pigment, aesthetic effect and age. By revealing which picture contains changes in design or corrections characteristic of an artist creating a picture, and which does not, it betrays the mere imitator. With the X-ray's help the critic may explore the process and even the progress in the making of a forgery.

In this way the expert keeps one jump ahead of the forger, who is ever forced to new efforts as the scientific aids in the detection of false painting are developed

BIBLIOGRAPHY.—Among popular books on this subject are: P. Eudel, *Trucs et Truqueurs;* R. Nobili, *The Gentle Art of Faking;* E. Bayard, *L'Art de Reconnaitre les Frauds.* (A. BU.)

PAINTS, CHEMISTRY OF. The character and value of paints may be considered in relation to their use, either for artistic and decorative purposes, or as preservative coatings. In the former case, for a given medium, the choice of pigment rests primarily upon the colour effects desired; in the latter case the medium plays a more important part, whilst the choice of pigment depends on its chemical and physical properties and on a consideration of cost. Through scientific progress an almost unlimited variety of colours is now available

The opacity or transparency of a pigment in a medium is determined by the amount of refraction and reflection which light undergoes in a paint film. This depends upon the difference between the refractive indices (to air) of the pigment and the medium respectively, the pigment approaching transparency as such difference diminishes As the refractive index of oil is higher than that of water, the opacity of a pigment will be greater in the latter vehicle than in the former. In the case of oil colours the refractive index of oil increases as the drying proceeds, and thus produces a lowering of tone owing to the increased transparency of the pigment; in water colours the refractive index of pigment to water being less than that of pigment to air causes an increase in opacity of the colour on drying. Opacity is generally intensified by increased fineness of the pigmentary particles. Reduction in the particle size may also modify the colour of a pigment as is shown in the manufacture of lead chromes and antimony sulphides. For this reason colours such as vermilion are materially altered during the process of grinding in oil, unless special care is exercised in the operation. Pigments ground in oil exhibit a great variation in behaviour. This is manifest in the amount of oil required to grind them into a paste (known as their "oil absorption"), and in their influence on the drying of the oil and on the subsequent character of the paint film, rendering it soft and pliable or hard and brittle. Differences in oil absorption are well illustrated in the cases of vegetable black and white lead, the former requiring about twelve times as much oil as the latter.

Pigments classified according to their colouring principles fall into two main groups: (1) mineral or inorganic colours, and (2) colours produced from the natural or synthetic dyes (*q v.*). As the manufacture of mineral and inorganic colours is directly associated with their chemical constitution, which varies over a wide range, their preparation cannot be generalized Broadly a division might be made between those pigments, *e g.*, the chromes, made by the "wet process" and involving the precipitation of the colour from solution, and those pigments, *e g*, the cobalt colours, where the desired result is obtained in a furnace at a high temperature. Some colours, such as lithopone, require treatment by both processes. By whatever method the colour is obtained, adequate washing is essential. This is usually carried out in the "striking" or precipitating vats by decantation, the process being repeated until the wash water is free from salts. The washed colour is pumped through a filter press to remove excess of water and dried in a drying-room at a low temperature or in a vacuum stove

The manufacture of organic colours is equally complex and

diverse. The term *lake* is applied to all pigments prepared by the precipitation of dyestuffs upon a "base" or "carrier." This base, which contributes largely to the physical properties of the lake and is selected according to particular requirements, either adsorbs the dye, enters into direct chemical combination with it or forms the substratum on which the dye is fixed by a precipitant. The choice of dye is naturally governed by the demands of the lake user; such considerations as price, permanency and insolubility in the medium may serve as determining factors.

As bases, are used the hydrate and certain salts of alumina (for transparent lakes), barium sulphate, china clay, zinc oxide, lead sulphate, red lead, litharge, green earth and others. Besides entering into chemical relationship with the dyestuff, these bases may further serve as *extenders* (or diluents) or combine both properties. Extenders are employed in both classes of pigments and cannot be considered only as adulterants; thus, when used for producing paler shades, for increasing opacity and obscuring power ("body") of colours, or for modifying the properties of a pigment to suit a particular need, they serve a special purpose.

White Pigments.—*White lead,* of which Flake White and Kremnitz White are varieties, approximates in composition to the basic lead carbonate $2PbCO_3 \cdot Pb(OH)_2$, and possesses greater covering power than most white pigments. Used as an oil colour, its films are prone to yellowing in the dark; this discoloration, which is attributed to the basic character of the pigment and is less marked with the normal carbonate, disappears on re-exposure to sunlight. Though readily blackened by sulphuretted hydrogen, it has great atmospheric durability and is unaffected by light and sulphur dioxide. Its resistance to sulphides is greatly influenced by the presence of lead acetate as impurity; pure white lead in oil is stated to be compatible with ultramarine, cadmium yellow and vermilion without discoloration. On account of its poisonous nature many attempts have been made to replace it, but always with a sacrifice of covering power or durability when used for external painting. Of the more notable substitutes, the following may be mentioned:—Mulhaus White (lead sulphate); Freeman's non-poisonous White Lead, a mixture of lead sulphate, zinc oxide, magnesium carbonate and barium sulphate; and Sublimed White Lead, a basic lead sulphate containing zinc oxide. Lead sulphate being deficient in body is used mainly in admixture with other pigments, *e.g.*, lead chromes, to produce paler shades.

Zinc White (Chinese White, Zinc Oxide) was first proposed as a white-lead substitute by Courtois of Dijon in 1780 and became generally adopted as an artistic and industrial colour in 1840. It is a brilliant white possessing considerable covering power though lacking in opacity, is non-poisonous, and is unaffected by light or sulphuretted hydrogen. As a water colour it is incompatible with most pigments, this being more marked when gum arabic is used as a medium. In oil the paint dries slowly to a hard film having a tendency to scale; it is extensively used in white enamels. As an artists' colour it is sometimes preferred to white lead, but owing to its higher oil absorption it is more readily lowered in tone by the physical changes in the oil. *Lithopone* is a white pigment obtained by precipitation of zinc sulphide and barium sulphate simultaneously in approximately molecular proportions and subsequent calcination. The properties of Lithopone depend largely on its purity and method of manufacture; thus in particular may be mentioned its tendency to darken in sunlight. This discoloration is reversible and the white colour is restored in the dark. Owing to its non-poisonous nature, stability to sulphuretted hydrogen and atmospheric influences, and its good covering power, it is used in considerable quantities as a water, size and oil colour; in textile printing; in the manufacture of linoleum and in many other industries. *Titanium White* (Titanox, Titanium Oxide) is a white pigment of exceptional body and covering power, far exceeding that of white lead or zinc oxide, in admixture with which latter pigment it is often employed. Owing to its chemical inertness, it is unaffected by atmospheric influences and is non-poisonous. As a paint its films do not crack or peel but show a strong tendency to "chalk," a defect arising from the gradual destruction of the film in moist air. *Antimony White* (Timanox, Antimony Oxide) was introduced as a white-lead substitute during the World War, and has since found extended use in the manufacture of paint and linoleum. It is non-poisonous and is less prone to discoloration than white lead.

Among the white pigments are also found most of the bases used in colour-making as extenders and adulterants: Barytes (Barium Sulphate), which occurs naturally as "Heavy Spar" and is produced artificially as "Blanc Fixe" (Permanent White); Hydrate of Alumina (White Lake); Whiting (Calcium Carbonate); Terra Alba (Calcium Sulphate); China Clay; and others.

Yellow Pigments.—*Lead Chromes* form by far the most important class of yellow pigments. These cover a variety of bright shades of yellow ranging from a pale primrose (in which the chrome is intimately admixed with lead sulphate or arises direct as a precipitation of a lead sulpho-chromate) to a deep orange-red. The orange and deeper shades owe their colour more properly to the formation of basic lead chromates; the physical state of the pigment, however, plays an important part and is largely dependent upon the condition under which the chrome is made. The lighter varieties of lemon (neutral) lead chromates, Chrome Yellows, are produced at a low temperature, by using very dilute solutions or otherwise controlling the process so that the precipitate is maintained in a very fine state; such chromes possess good covering power, a property diminishing as the shade deepens, owing to the consequent increase in the specific gravity of the colour. The raw materials employed in the manufacture are lead nitrate or acetate and the precipitant is the dichromate of sodium or potassium; for the deeper shades, basic salts of lead are used, or the chrome receives subsequent treatment with caustic alkali.

Zinc Yellow (Zinc Chromate) is inferior to Chrome Yellow in body and covering power but is not blackened by sulphuretted hydrogen. It is used mainly as an oil and water colour in the production of lime yellows, and in the manufacture of the non-poisonous Zinc Greens by admixture with Chinese Blue. *Cadmium Yellow* (Cadmium Sulphide) possesses excellent covering power and is largely used as an oil and water colour. The shades of pure cadmium sulphides depend essentially upon the method of preparation and vary from bright lemon yellow to orange. In the manufacture of cheaper varieties of the paler shades, the cadmium sulphide is often admixed with cadmium carbonate, giving a product of good body but prone to fade in moist air. A cheap pigment fast to light is obtained by the simultaneous precipitation of cadmium and zinc sulphides, providing no carbonate is present. Compounds of cadmium sulphide with cadmium selenide in varying proportions form a further series of colours covering a range from orange to maroon-crimson according to their composition; such pigments are largely applied in the ceramic industries owing to their heat-resisting properties. A new series of compounds have been recently introduced in which cadmium sulphide (with or without selenide) is precipitated together with barium sulphate to form Cadmium Lithopones (*cf.* Lithopone, above), which on account of their comparatively low cost lend themselves to more extended industrial applications. Cadmium yellows form a stable series of bright greens with Ultramarine. *Aureoline* (Cobalt Yellow), possesses only moderate stability to light, but is unaffected by sulphuretted hydrogen and is used mainly as an artists' oil and water colour and for the production of pure blue shades in glass and porcelain painting. It is transparent in oil and turns brown in excess of this medium.

To the yellow pigments belong also the Ochres, King's Yellow, Orpiment and Naples Yellow.

Red Pigments.—*Red Oxides of Iron,* by far the most important series of this group, vary in colour from a deep bluish-red of ferric oxide, Fe_2O_3, which they contain. Ferric oxide occurs to a pale red-brown according to their purity and the percentage naturally in numerous varieties of the red iron ore, haematite, in red ochre, red bole or raddle, in crude red iron-stone and micaceous iron. The conversion of these ferruginous minerals into pigments is relatively simple and consists generally in grinding and levigating the material to remove impurities and to attain the required degree of fineness; in many cases the shade of the product needs to be modified by calcination whereby any ferric hydroxide is

changed into the red ferric oxide with consequent reddening of tone (*cf.* OCHRES). Large quantities of iron compounds, by-products of industry, are now economically worked up for the production of artificial iron oxides of great purity, their shade depending on their method of treatment and the temperature at which they are "burnt" or heated. Iron oxides are marketed under various designations according to colour and purity, such as English Red, Indian Red, Persian Red, Turkey Red, Caput Mortuum, Colcothar, Rouge, Venetian Red and many others. In certain cases, *e.g.*, Madder Indian Reds and Tuscan Reds, the oxides are brightened by the addition of a permanent red lake; such toning is readily detected by chemical means. When of high ferric oxide content, they possess considerable covering power and opacity and are highly resistant to atmospheric influences; they are used extensively as oil colours, as a pigment in rust preventive coatings, in calico printing, for colouring porcelain and glass and in many other industries.

Red Lead is a lead tetroxide represented by the formula Pb_3O_4, produced by heating litharge (PbO) in air at about 480° C. The commercial varieties usually contain from 6 to 12% of free litharge. It is a bright scarlet-red pigment possessing good covering power, opacity and permanence, and on account of its anti-corrosive property is extensively employed as a priming coat for iron and steel structures. It exerts a strong drying action on linseed oil and its hard-setting properties render it valuable in this medium in making cements, lutes and packing for steam joints. It is used as an oil colour, as a base for organic lakes, for manufacturing lead and optical glass, enamels, in other industries.

To the red pigments also belong Vermilion, Carmine, Cadmium Scarlet (*cf.* Cadmium Yellow), Antimony Vermilion, antimony trisulphide, Chrome Red and a large number of organic lake pigments.

Green Pigments.—Two main classes of green pigments are in use: the "elementary" and the "composite."

(a) Elementary Greens.—*Chrome Oxide Green*, chromium sesquioxide, Cr_2O_3, is produced by the reduction of potassium dichromate at a high temperature, by calcination of ammonium dichromate or chromic chloride, and similar processes. It is one of the most permanent pigments known, and is unaffected by heat, light, acids, alkali, chlorine and other reagents. It is used as a water, lime and oil colour; in printing inks, in which it possesses non-actinic properties; as a mordant in calico printing and dyeing; as an abrasive for polishing steel and precious metals; and in many other industries. *Guignet's Green* (Viridian) is a hydrated chromium sesquioxide produced by heating potassium dichromate in the presence of boric acid or other flocculating agent. It is a pigment of great permanence, possessing similar properties to chrome oxide green, from which it may be distinguished by its solubility in boiling hydrochloric acid. Its covering power and strength are only moderately good; it is used for chrome oxide green and also admixed with chrome yellow as a pale green for landscape painting. *Cobalt Greens* are not true chemical compounds but solid solutions of zinc and cobaltous oxides obtained by calcination in a manner similar to the cobalt blues. They possess great permanence and are unaffected by heat, light, sulphuretted hydrogen, etc., are non-poisonous and are used as artists' oil and water colours. *Green Earth* is a natural alkali–aluminium–magnesium–ferrous silicate of variable composition. It is an inert and permanent pigment deficient in colour and is used as an artists' oil and water colour, in fresco painting, and as a substratum for organic lakes, basic dyes, fixed by its silicic acid content, being in some cases rendered fast to light.

To the elementary greens belong Green Ultramarine and the copper greens: Verdigris; Schweinfurt Green and Scheele's Green, copper arsenites; and Malachite Green, a native copper carbonate, which are no longer used, being poisonous.

(b) Composite Greens.—*Chrome or Brunswick Greens*, by far the most important class of greens in general use, are an intimate mixture of Chrome Yellow and Chinese Blue. They possess great brilliancy, good covering power, and cover a wide range of greens according to the relative proportions of their constituents, which determine their chemical stability and permanence. In oil these greens dry well and are darker and more glossy than in water. Being composite in their nature, they are more prone to colour changes, becoming yellower or bluer according to the condition of exposure. Brunswick Greens prepared by grinding together the required proportions of Chinese Blue and Chrome Yellow show a tendency to "float," *i.e.*, the blue rises to the surface of the paint; this is largely obviated by the wet process of manufacture, the two colours being mixed in the striking or precipitating vat, washed and dried. Chrome Greens are extensively used as oil colours; as size colours for paper; in printing inks; in textile printing; and in the manufacture of linoleum. *Zinc Greens* are similar to the Brunswick Greens being a mixture of Zinc Chrome and Chinese Blue. Though more permanent than Chrome Greens, they lack the body and covering power of the latter and on account of their higher price are not extensively employed. They are used as an artists' colour, for tinting enamels and in oil paints and printing inks.

Blue Pigments.—*Prussian Blues* are complex alkali ferric ferrocyanides containing potassium, ammonium, or sodium according to preparation. The most valued blues are "potash" blues prepared from potassium ferrocyanide and ferrous sulphate, with subsequent oxidation. According to the method of oxidation, a number of Prussian blues are obtainable, varying in chemical composition and physical properties. These blues are of low opacity, but possess considerable covering power and are reasonably permanent, though readily destroyed by alkali. Prussian Blue is a dark reddish-blue with a red undertone. By special treatment, blues are produced possessing a high bronze-lustre, known as Bronze Blues, which are much valued in printing. Chinese Blue, the basis of Chrome Greens, is a paler blue than Prussian Blue and is characterized by a violet shade with a greenish undertone. Still lighter blues are the Milori and Steel Blues. Celestial Blue is a paler blue containing barium sulphate. Antwerp Blue is a Prussian Blue formed upon an alumina base. Prussian blues are soluble in oxalic acid; by treatment with this acid and subsequent salting out, Soluble Prussian Blues are obtained. Other soluble blues are made by precipitating ferric chloride in excess of potassium ferrocyanide or by precipitating ferrous sulphate with potassium ferricyanide (Turnbull's Blue). These blues are extensively used as oil and water colours and in spirit and oil varnishes, in printing inks, for staining paper, in textile printing and dyeing, and for toning blacks. *Cobalt Blues* are among the most permanent colours known, and exist in two forms: (1) Smalts, potassium cobaltous silicates of varying composition, King's Blue being richest in cobalt and Azure Blue darkest in colour; and (2) Cobalt Blue or Cobalt Ultramarine, cobaltous aluminate of variable composition ranging from a greenish-blue, which may contain combined zinc, to Thenard's Blue of reddish tone, prepared from alumina and cobalt phosphate. Coerulean Blue is a cobaltous stannate containing magnesium. Somewhat restricted through high cost, they are used as artists' oil and water colours, in oil paints and enamels, for printing inks and in the ceramic industries.

Other blues in extensive use are the Ultramarines and a number of Organic Lakes. The copper blues: Egyptian Blue, Bremen Blue, Mineral Blue, etc., are practically obsolete.

Black Pigments.—*Carbon Blacks* form the main source of black pigments and have as their colouring principle amorphous carbon; these blacks vary in colour and strength according to their origin. Vegetable Blacks are nearly pure carbon, obtained from the incomplete combustion of mineral oils, and are of a deep black shade giving a bluish-black tint on reduction. Lamp Blacks are brownish blacks of rather less intensity, being poorer in carbon, often giving as much as 25% of ash on ignition. Carbon Blacks, obtained chiefly from America by burning the natural gases, are very deep black in colour, denser and more granular than Vegetable Blacks, and are extensively used in the paint and printing-ink industries. Ivory Blacks were originally produced by charring ivory cuttings in closed vessels; these have been largely superseded by the Bone Blacks, which are bluish-black in colour and are considerably denser and weaker than Carbon Blacks, containing only about 10% of carbon admixed

with calcium phosphate and calcium carbonate. Vine Blacks are prepared by carbonizing vine twigs and other non-resinous woods; they are beautiful bluish blacks with great depth of tone and are largely used in printing inks and are much valued as an artists' colour. Mineral Black is a dry grey shale containing about 30% of carbonaceous and 70% silicious matter. It is also prepared from waste coal dust and is largely used in cheap black paints, often tinted with Vegetable or Carbon Black. Graphite is another variety of carbon of absolute permanence, used as a pigment for special purposes, *e.g.*, in anti-rust paints and in the manufacture of "lead" pencils. *Black Oxide of Iron* is a triferric tetroxide, Fe_3O_4, which occurs in nature as the mineral magnetite. It is used as an oil and size colour and in the ceramic industry.

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PAISIELLO (or PAESIELLO), GIOVANNI (1741–1816), Italian composer, was born at Taranto on May 9, 1741. He studied under Durante at Naples, and his first compositions were produced at the conservatorio there, where he was an assistant master. At Naples, too, he produced a series of successful operas, and some church music. In 1776 Paisiello was invited by Catherine II. to St. Petersburg, where he remained for eight years, producing his masterpiece, *Il Barbiere di Siviglia*.

Paisiello left Russia in 1784, and, after producing *Il Re Teodoro* at Vienna, entered the service of Ferdinand IV. at Naples, where he composed many of his best operas, including *Nina* and *La Molinara*. He was invited to Paris (1802) by Napoleon, but the Parisians received his *Proserpine* so coldly that he requested, and with some difficulty obtained, permission to return to Italy. He died at Naples on June 5, 1816. Besides his operas Paisiello composed eight masses, fifty-one instrumental compositions and many detached pieces.

See F. Schizze, *Vita di Paisiello* (Milan, 1833); A. della Corte, *Settecento italiano* (Turin, 1922); H. Short, *Paisiellos Buffokunst und ihre Beziehungen zu Mozart* (1919).

PAISLEY, burgh of barony and parish of Renfrewshire, Scotland, on the White Cart, 3 m. from its junction with the Clyde, 7 m. W. by S. of Glasgow by the L.M.S. railway. It is connected with Glasgow, Renfrew and elsewhere by tramways. Pop. (1921) 84,837. In 1791 the river, which bisects the town, and is crossed by several bridges, was made navigable for vessels of 50 tons. Later it was further deepened, and is now navigable for vessels drawing 15 feet. The old town contains most of the principal warehouses and mills; the new town, begun towards the end of the 18th century, occupies much of the ground that once formed the domains of the abbey. To the munificence of its citizens the town owes many of its finest public buildings, among them the town hall, the free library and museum, the observatory, the John Neilson Endover Institute, and the fine Thomas Coats memorial church. Of parks and open spaces there are Brodie Park; Fountain Gardens; St. James Park, with a racecourse; Dunn Square and the old quarry grounds converted and adorned; and Moss Plantation. The burgh returns one member to Parliament and is governed by a council. In the abbey precincts are statues to the poet Robert Tannahill (1774–1810) and Alexander Wilson (1766–1813), the American ornithologist, both of whom were born in Paisley. John Wilson ("Christopher North") was born here.

The village originally grew up around the abbey of Paisley, and the town Paisley has been an important manufacturing centre since the beginning of the 18th century, but the earlier linen, lawn and silk-gauze industries have become extinct, and the famous Paisley shawls (imitation cashmere), are little woven. The manufacture of linen thread gave way in 1812 to that of cotton thread, and Paisley is now one of the chief world centres of thread manufacture. The large mills of J. and P. Coats and Clark and company employ many hands. Other industries include bleaching, dyeing, calico-printing, weaving, engineering, tanning, iron and brass founding, timber yards, and the making of starch, cornflour, soap, machinery and chemicals, besides some shipbuilding.

The abbey was founded in 1163 as a Cluniac monastery by Walter Fitzalan, first high steward of Scotland, the ancestor of the Scottish royal family of Stuart, and dedicated to the Virgin, St. James, St. Milburga of Much Wenlock in Shropshire (whence came the first monks) and St. Mirinus (St. Mirren), the patron-saint of Paisley, who is supposed to have been a contemporary of St. Columba. The monastery became an abbey in 1219, was destroyed by the English under Aymer de Valence, earl of Pembroke, in 1307, and rebuilt in the latter half of the 14th century, the Stuart kings endowing it lavishly. In 1553 Lord Claud Hamilton, then a boy of ten, was made abbot, and the abbacy and monastery were erected into a temporal lordship in his favour in 1587. The abbey lands, after passing from his son the earl of Abercorn to the earl of Angus and then to Lord Dundonald, were purchased in 1764 by the 8th earl of Abercorn, who let the ground for building purposes. The abbey church originally consisted of a nave, choir without aisles, and transepts. The nave and tower have been restored, and careful work has been done on the choir. The nave is used as the parish church. Robert III. was interred before the high altar of the choir in 1406. Over his grave a monument to the memory of the Royal House of Stuart was placed here by Queen Victoria (1888). In the south transept is St. Mirren's chapel (founded in 1499), with the tombs of abbot John Hamilton and of the children of the 1st lord Paisley, and the recumbent effigy of Marjory, daughter of Robert Bruce, who married Walter, the Steward, and was killed while hunting at Knock Hill between Renfrew and Paisley (1316).

About 3 m. S. of Paisley are the braes of Gleniffer, and 2½ m. S.E. stand the ruins of Crookston castle, which is at least as old as the 12th century.

The Romans settled in Paisley in A.D. 84, and built a fort called Vanduara to the west of the White Cart.

PAITA, a port of northern Peru, in the department of Piura. Population (estimate 1920) 5,000. Paita has one of the best natural harbours on the coast, and is the port of the departmental capital, Piura, with which it is connected by rail (58 m.). The town, built on a sandy hillside, is desolate in appearance. There are a few modern necessities such as electric lights, telephones, telegraph, hospital and schools and water supply from the Chira River. Though free from yellow fever, sanitary conditions in Paita have continued to be so bad that much of the town is now (1928) being rebuilt, water and sewer systems repaired, and the port permanently improved. The principal buildings include Customs House, Post, Telegraph and Cable Offices, a cotton-seed oil mill and a few branch export and import houses which control trade. Cotton constitutes ⅞ of total exports, other items including cattle, kid-skins, tobacco and Panama hats. (*See* PIURA.) Paita was a prosperous port in colonial times.

PAIUTE. This tribal designation is applied to two distinct divisions of Shoshonean Indians in the Great Basin, western United States. The true or Southern Paiute are close relatives of the Ute and inhabit south-western Utah, north-western Arizona and southern Nevada. They are virtually indistinguishable from the Chemehuevi of south-eastern California. The northern Paiute or Paviotso are separated from the southern by the Shoshone, inhabit north-western Nevada and south-eastern Oregon and are close relatives of the Mono of California and Bannock of Idaho. Their mode of life is an adaptation of a non-agricultural population of meagre culture to an arid environment.

PAJOU, AUGUSTIN (1730–1809), French sculptor, was born in Paris on Sept. 19, 1730. At eighteen he won the *Prix de Rome;* at thirty he exhibited his *Pluton tenant Cerbère enchâiné* (now in the Louvre). His portrait busts of Buffon and of Madame Du Barry (1773), and his statuette of Bossuet (all in the Louvre), are amongst his best works. When B. Poyet constructed the Fontaine des Innocents from the earlier edifice of P. Lescot (*see* GOUJON) Pajou provided a number of new figures for the work. Mention should also be made of his bust of Carlino Bertinazzi (1763) at the Comédie Française, and the monument of Marie Lesczinska, queen of Poland. Augustin Pajou died in Paris on May 8. 1809.

PAKHOI, a treaty port in the province of Kwangtung, South China (21° 29′ N. and 109° 7′ E.), situated on a small peninsula at the head of the Gulf of Tongking. The harbour is easily

accessible from the open sea, but has only one tide in 24 hours. The port was opened to foreign trade by the Chefoo Convention in 1877 and in the succeeding period a considerable traffic to and from Yunnan, Kweichow and Kwangsi converged on Pakhoi, and was carried by coolies and transport animals across the mountains which separate the port from the Si-kiang valley in the interior. Thus it developed as a "side-door" through which traffic could pass free from the trade exactions imposed along the Red River and Si-kiang routes into Yunnan. In 1889, however, Mengtsz was opened as a treaty port, followed by Wuchow in 1897, and Kwangchow-wan (French) as a free port in 1898. With the relaxation of trade restrictions, the Red River and Si-kiang were established as the natural trade routes into Yunnan. Consequently the commercial importance of Pakhoi declined and its trade sphere is now limited to its somewhat poor and sandy neighbourhood, between the coast and the mountains behind.

The total maritime customs revenue of the port in 1924 was Hk. Taels 159,607, showing an increase over recent years.

In 1924, the net foreign imports amounted to 2,895,298 Hk. Taels, and the net Chinese imports to 307,314, while exports were 1,819,189; total 5,021,801 Hk. Taels.

The interruption of the traffic with Hongkong in 1926 (owing to the boycott) led to a reduction by 50% of the total trade of Pakhoi. The population in 1926 was reckoned at 35,000.

PAKINGTON, the name of a famous English Worcestershire family, now represented by the barony of Hampton. Sir John Pakington (d. 1560) was a successful lawyer and a favourite at court, and Henry VIII. enriched him with estates, including that of Westwood in Worcestershire. His grandnephew and heir, Sir John Pakington (1549–1625), was another prominent courtier, Queen Elizabeth's "lusty Pakington," famous for his magnificence of living. His son John (1600–1624) was created a baronet in 1620. His son, Sir John, the second baronet (1620–1680), played an active part on the royalist side in the troubles of the Great Rebellion and the Commonwealth, and was taken prisoner at Worcester in 1651; Lady Dorothy, his wife (d. 1679), daughter of the lord keeper Thomas Coventry, was famous for her learning, and was long credited with the authorship of *The Whole Duty of Man* (1658), which has more recently been attributed to Richard Allestree (*q.v.*).

The baronetcy became extinct with the death of Sir John Pakington, the 8th baronet, in January 1830, but it was revived in 1846 for his maternal nephew and heir, John Somerset Pakington (1799–1880), whose name was originally Russell. In 1874 he was created Baron Hampton, and he died in London on the 9th of April 1880. From 1875 until his death Hampton was chief civil service commissioner. In 1906 his grandson Herbert Stuart (b. 1883) became 4th baron Hampton.

PAKKHTO: *see* PUSHTU LANGUAGE.

PAKOKKU, a district in the Magwe division of Burma, lying west of the Irrawaddy river and south-west of Mandalay, with the line of the Chin hills as a general boundary on the west. It has an area of 6,210 sq.m. and a population (1921) of 465,771. The part of the district along the Irrawaddy and Chindwin rivers is alluvial. Beyond this, however, the country rises gradually to the low Shinmadaung and Tangyi ridges, where it is very arid. To the westward there is a rapid drop to the well-watered valley of the Yaw river, and then a rise over broken, dry country before the valley of the Myit-tha river is reached. The principal products are millet, sesamum and sugar produced from toddy-palms in the riverain districts, which also grow rice, grain, peas and beans. Tobacco and vegetables are also produced in some quantity, and maize is grown largely for the sake of the husk, which is used for native cheroot-wrappers, under the name of *yawpet.* The Yenangyat oil-fields, which produce quantities of petroleum, are in the south of the district, and iron used to be worked in a small way. There are large areas of reserved forests in the west of the district where a good deal of teak is worked out. The cutch—a yellow dye obtained from a small tree in the drier parts of the Yaw country—is particularly esteemed. The heat in May and June is very great, rising considerably above 100° F in the shade.

The great majority of the population is Burmese, but in the Yaw valley there is a peculiar race called Taungthas, who claim to be quite distinct from both Burmese and Chins.

The headquarters town, Pakokku, stands on the right bank of the Irrawaddy, and has grown into importance since the British occupation. The population in 1921 was 19,507. It is the emporium of the trade of the Chindwin and Yaw river valleys.

Pakokku Hill Tracts, a district also in the Magwe division, lying to the west of the Pakokku district. It includes 3,100 sq.m. of the forest mountains of the Aeakan Yomas, inhabited by 28,799 people (1921), mainly Chins and allied hill tribes. It includes one of the highest peaks of the Aekan Yomas, Mt. Victoria (about 10,000 ft.). Headquarters village is Kanpeket. In the north lies the district of the Chin hills, including an administered area of 8,000 m. in addition to large unadministered tracts. Pop. (1921) 110,079 (administered areas). The headquarters town is Falam, and the whole district consists of a succession of forested ridges inhabited by Chins.

PAL, KRISTO DAS (1839–1884), Indian publicist, was born in Calcutta in 1839, of the Teli or oil-man's caste. In 1872, after twenty-two years of successful journalism, he was made a member of the Bengal legislative council, where his practical good sense and moderation were much appreciated by successive lieutenant-governors. His opposition, however, to the Calcutta Municipal Bill of 1876, which first recognized the elective system, was attributed to his prejudice in favour of the "classes" against the "masses." In 1878 he received the decoration of C.I.E. In 1883 he was appointed a member of the viceroy's legislative council. He died on July 24, 1884.

See N. N. Ghose, *Kristo Das Pal, a Study* (Calcutta, 1887).

PALACE, strictly, the residence of a sovereign or ruler; hence applied to any exceptionally large and lavish house, and also, in some cases to official buildings, as the French palais de justice. (*See* GOVERNMENT AND PUBLIC BUILDINGS; CASTLE; HOUSE; and similar articles.)

PALACIO VALDÉS, ARMANDO (1853–), Spanish novelist and critic. His early writings, pungent essays remarkable for independent judgment and refined humour, were printed in the *Revista Europea.* His first novel, *El Señorito Octavio* (1881), showed an uncommon power of observation and in *Marta y María* (1883), a portrayal of the struggle between religious vocation and earthly passion, somewhat in the manner of Valera, Palacio Valdés achieved a very popular triumph which placed him in the first rank of contemporary Spanish novelists. He followed this up by *El Idilio de un enfermo* (1883), a most interesting fragment of autobiography and by *José* (1885), a realistic picture of the manners and customs of seafaring folk, containing passages of animated description barely inferior to the finest penned by Pereda himself. The emotional imagination of the writer expressed itself anew in the charming story *Riverita* (1886), one of whose attractive characters develops into the heroine of *Maximina* (1887); and from *Maximina,* in its turn, is taken the novice who figures as a professed nun among the personages of *La Hermana San Sulpicio* (1889), in which the love-passages between Zeferino Sanjurjo and Gloria Bermúdez are set off with elaborate, romantic descriptions of Seville. *El Cuarto poder* (1888) is, as its name implies, concerned with the details, not always edifying, of journalistic life. *La Espuma* (1890) and *La Fe* (1892), were enthusiastically praised in foreign countries, but in Spain their reception was cold. Subsequently Palacio Valdés returned to his earlier and better manner in *Los Majos de Cádiz* (1896), in *La Alegria del Capitán Ribot* (1889) and in *La Aldea Perdida* (1903). In these novels, and still more in *Tristán, ó el pesimismo* (1906), he frees himself from the reproach of undue submission to French influences. His later works, *Papeles del Doctor Angélico* (1911), *La Novela de un Novelista* (1921) and *La Hija de Natalia* (1923) preserve much of the charm, if not the freshness, of his earlier novels; in any case Palacio Valdés takes a prominent place in modern Spanish literature as a keen analyst of emotion and a sympathetic, delicate, humorous observer. (J. F.-K.)

PALACKÝ, FRANTISEK [FRANCIS] (1798–1876), Czech historian and politician, was born on June 14, 1798, at Hodslavice (Hotzendorf) in Moravia, of a Protestant family. After some

years spent in private teaching Palacký settled in 1823 at Prague. Here he found a warm friend in Dobrovský, whose good relations with the Austrian authorities shielded him from the hostility shown by the government to students of Slav subjects. Dobrovský introduced him to Count Sternberg and his brother Francis, both of whom took an enthusiastic interest in Bohemian history. Count Francis was the principal founder of the Society of the Bohemian Museum, devoted to the collection of documents bearing on Bohemian history, with the object of reawakening national sentiment by the study of the national records. Public interest in the movement was stimulated in 1825 by the new *Journal of the Bohemian Museum* (*Casopis českého Musea*) of which Palacký was the first editor. The journal was at first published in Czech and German, and the Czech edition survived to become the most important literary organ of Bohemia.

Palacký had received a modest appointment as archivist to Count Sternberg and in 1829 the Bohemian estates sought to confer on him the title of historiographer of Bohemia, with a small salary, but it was ten years before the consent of the Viennese authorities was obtained. Meanwhile the estates, with the tardy assent of Vienna, had undertaken to pay the expenses of publishing Palacký's capital work, *The History of the Bohemian People* (5 vols., 1836–67). This book, which comes down to the year 1526 and the extinction of Czech independence, was founded on laborious research in the local archives of Bohemia and in the libraries of the chief cities of Europe, and remains a standard authority. The first volume was printed in German in 1836, and subsequently translated into Czech. The publication of the work was hindered by the police-censorship, which was especially active in criticizing his account of the Hussite movement.

In 1848 Palacký was deputed to the Reichstag which sat at Kroměříce (Kremsier) in the autumn of that year, and was a member of the Slav congress at Prague. He refused to take part in the preliminary parliament consisting of 500 former deputies to the diet, which met at Frankfort, on the ground that as a Czech he had no interest in German affairs. He was at this time in favour of a strong Austrian empire, which should consist of a federation of the southern German and the Slav states, allowing of the retention of their individual rights. These views met with some degree of consideration at Vienna, and Palacký was even offered a portfolio in the Pillersdorf cabinet. The collapse of the federal idea and the definite triumph of the party of reaction in 1852 led to his retirement from politics. After the liberal concessions of 1860 and 1861, however, he became a life member of the Austrian senate. His views met with small support from the assembly, and with the exception of a short period after the decree of September 1871, by which the emperor raised hopes for Bohemian self-government, he ceased to appear in the senate from 1861 onwards.

In the Bohemian Landtag he became the acknowledged leader of the nationalist-federal party. He sought the establishment of a Czech kingdom which should include Bohemia, Moravia and Silesia, and in his zeal for Czech autonomy he even entered into an alliance with the Conservative nobility and with the extreme Catholics. He attended the Panslavist congress at Moscow in 1867. He died at Prague on May 26, 1876.

Among his more important smaller historical works are: *Würdigung der alten böhmischen Geschichtschreiber* (Prague, 1830), dealing with authors many of whose works were then inaccessible to Czech students; *Archiv česky* (6 vols., Prague, 1840–72); *Urkundliche Beiträge zur Geschichte des Hussitenkriegs* (2 vols., Prague, 1872–74); *Documenta magistri Johannis Hus vitam, doctrinam, causam . . . illustrantia* (Prague, 1869). With Safarik he wrote *Anfänge der böhmischen Dichtkunst* (Pressburg, 1818) and *Die ältesten Denkmäler der böhmischen Sprache* (Prague, 1840). Three volumes of his Czech articles and essays were published as *Radhost* (3 vols., Prague, 1871–73). For accounts of Palacký *see* an article by Saint René Taillandier in the *Revue des deux mondes* (April, 1855); Count Lützow, *Lectures on the Historians of Bohemia* (London, 1905).

PALAEO-ASIATIC LANGUAGES. The languages described as "Palaeo-Asiatic" are spoken in the extreme north-east of Siberia; Yukaghir, Chukchee, Koryak, Kamchatkan, and Gilyak. They contain features characteristic of many American languages. The phonetic system is rich and is marked by a scheme of vocalic harmony by which the three classes of vowels, weak, strong, and neutral, are duly regulated. In ordinary conversation the women do not use the pronunciation of the men. The grammatical processes are numerous. Koryak has a dual and the relation between subject and predicate is conceived differently in transitive and intransitive verbs. Prefixes and suffixes are numerous. number, location, size being thus indicated. The numbers are derived from manual concepts; five being a hand and 20 being a man. Higher numbers are composed with the word for man, and numbers higher than 400 are called "limit of knowledge." Chukchee and Koryak have borrowed some words from Russian but possess the power to form new words for new ideas. Kamchatkan has been much modified by Russian.

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PALAEOBOTANY or **VEGETABLE PALAEONTOLOGY,** a branch of the science of botany, is concerned with the study of plants which lived in past ages, by means of their remains found as fossils in the rocks. Fossil plants may be regarded as the documents on which the history of the plant-world is founded. A surprising amount is known about the form of fossil plants from rocks as ancient as those of the Ordovician (*see* GEOLOGY), and, according to the latest estimates of geological time, about 500,000,000 years have since elapsed. During that time the constitution of the flora of the earth has been changing continuously. Starting with the fossils found in the older sedimentary rocks and reviewing those of successively later formations, it becomes apparent that each species, genus, or larger systematic grouping has three phases in its history: its first appearance and development, its period of maximum abundance, and its dying out and final extinction. As one would expect, the fossils found in the more recently formed rocks are most like the plants living at the present day. While on the one hand the evolution of some families of plants appears to be an exceedingly slow process, for even as far back as the Ordovician there are found algae very similar in form to some of the living ones, there are on the other hand examples illustrating comparatively rapid evolution. Although the Angiosperms (plants with flowers) appear late in geological time they have already become the dominant plants of to-day. A reference to the diagram below will show that there is evidence that the more highly specialised groups such as the Cycadales, Bennettitales and Angiosperms have been evolved later than the comparatively simple types represented by the Algae and

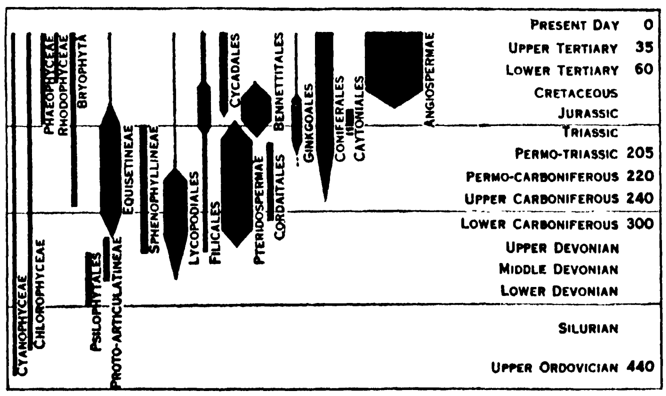


DIAGRAM REPRESENTING DURATION AND RELATIVE ABUNDANCE OF THE VARIOUS GROUPS OF PLANTS AT DIFFERENT GEOLOGICAL PERIODS, WITH THE AGES IN MILLIONS OF YEARS CALCULATED FROM RADIO-ACTIVE MINERALS

Bryophyta and that simplicity in structure is in general an index of primitiveness. This agrees in a general way with the theory that the more specialised and complex plants have been evolved from simpler forerunners. It must be remembered, however, that although Lycopods, Cycads and Ginkgoales are represented in the present day flora the chances are that an investigator at a future period would find no trace of them among the fossil debris of the present age since they form such a small part of the vegetation. There is no reason to believe that the present day flora of the world has attained a permanent constitution; on the contrary, it

is probably changing as rapidly, if not more rapidly, than at any part of its developmental history.

Earliest Land Plants.—About the close of the Silurian period and the beginning of the Devonian, land-plants appear for the first time; and all plant-fossils found in earlier rocks than these have so far proved to be Algae. It has been suggested that land-plants may have arisen from sea-weed ancestors which became established on the land and in the process of migration underwent considerable changes—a theory which is not disproved by the fossil-evidence. By the Upper Devonian period land-plants were in existence which in complexity of organization were little inferior to the plants of to-day; there were forests of tall trees, so that then the face of the earth with its mountains and forests must have appeared much as it does now. It is from fossil-plants that information has been gained of the enormous fluctuations in climate and changes in the distribution of land and sea that have succeeded one another in the history of the earth's surface. It is a striking fact that rich, perhaps tropical, floras are found in the rocks of countries now in the frigid grip of polar conditions, *e.g.*, Greenland and Spitsbergen. In the latter country the fact that coal is found in large quantities in Devonian, Carboniferous, Jurassic and Tertiary rocks, is clear proof of vigorous vegetation in lands which at the present moment have a scanty mantle of small herbs in their more favoured valleys.

Conditions of Fossilization.—Before the history of the various groups of the Plant World is considered the nature of plant-fossils and the technique of palaeobotanical investigation may be briefly explained. Fossil-plants are to be found in two forms, incrustations and petrifactions. The incrustations are the commonest type found and have been formed by plant-fragments becoming embedded in the mud or silt of a lake or estuary. As the sediment was changed in the course of ages into shale or sandstone rocks the plants became compressed by the vertical stress of the overlying sediment and are finally found, when the rock is split open, in the form of a thin layer of black carbonaceous matter which gives silhouettes of the plants. In many fossils this carbonaceous matter is similar to coal (*q.v.*) in composition and retains to a varying extent the outward form of the plant (Plate I., fig. 7) while the internal structure has mostly disappeared. It is possible to remove such a fossil from the rock and then the film may be translucent and some structure visible (Plate I., fig. 6). It may happen that in an incrustation the original cuticle of the plant and sometimes the spores are preserved and may be isolated by chemical treatment. The petrifaction is the most valuable type of fossil for investigation of the internal structure but is comparatively rare. In the petrifaction the entire plant fragment has been converted into solid rock, mainly by a gradual substitution of mineral matter for the water which forms such a large proportion of most plant tissues, before the plant was subjected to any considerable pressure by the sand and mud subsequently deposited over it. The mineral substances reach the plant by a process of diffusion from the water contained in the sediment in which the plant is embedded. The most perfectly preserved plants are those petrified in silica. The Middle Devonian chert found in Aberdeenshire contains embedded in its siliceous matrix fossil-plants in which every cell-wall is so clearly defined (Plate I., fig. 2) that the knowledge of their internal structure is practically complete. The beds of silica of Permian age at Autun in France have also furnished some very perfectly preserved plants. Silicified wood is common in many geological formations and a considerable number of silicified Mesozoic plants is known.

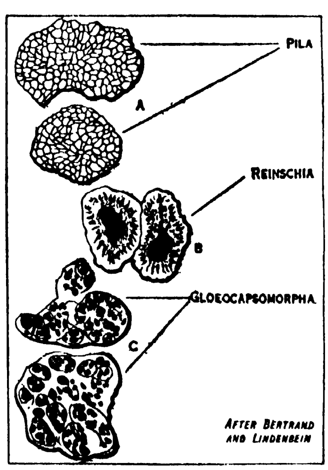
Concretionary masses known as "coal-balls" or "bullions" are found embedded in the coal of certain seams in Lancashire and Yorkshire, sometimes in such abundance that further working of the seam is unprofitable. These coal-balls consist largely of calcium and magnesium carbonates and contain well preserved plant fragments; they represent part of the vegetable matter of the seam which became petrified before the rest became compressed to form the coal. Similar concretions are found in the Belgian, Dutch, Westphalian and Silesian coal-fields. It is from the study of the plants in the coal-balls from Lancashire and Yorkshire that Binney, Williamson and recently Scott, have been able to reveal so much about the structure of fossil-plants of the Carboniferous period. The coal-ball or other petrified mass may be cut into thin slices which are ground so thin and translucent that the cellular structure of the contained plants is made visible when viewed by transmitted light.

Form Genera.—Specimens of fossil-plants which are sufficiently complete to show the connection between the different parts of the same plant, for example between the leaves and stem or the cones and stem, are very rare. It is therefore usually convenient to constitute form-genera to include the corresponding parts of a group of closely allied species. Thus in the genus of fossil-trees *Lepidodendron* the stems are included in the form-genus *Lepidodendron*, detached leaves in *Lepidophyllum* and the cones in *Lepidostrobus*, while the root-bearing parts which are indistinguishable from those of an allied genus *Sigillaria* are grouped with those of the latter genus in the form-genus *Stigmaria*.

PLANTS OF THE PALAEOZOIC PERIOD

In this great division of Geological time the oldest rocks which contain evidence of contemporary plant life were laid down. The various groups of plants present in the Palaeozoic will be treated in systematic order while the distribution and succession of the floras will be briefly dealt with at the end of this section. The Glossopteris or Southern type of Carboniferous and Permian flora will be considered in the section on the Mesozoic Period.

Thallophyta. *Algae* (Seaweeds, etc.).—As a class the Algae are difficult subjects to investigate in the form of fossils. Except in the case of a few of the groups of this large division of the plant kingdom the plant body is soft, consisting of a very large proportion of water, and therefore offering a very small amount of solid matter for the making of a fossil. In external form so many Algae are alike; they are often undifferentiated into stem and leaves, *i.e.*, thalloid, and unless there is information available about their method of reproduction external form alone is of little value in determining their systematic position. A great many supposed fossil-algae have been described and named but it can often only be said about them that the outline of the mark they make on the rock suggests the outline of the frond of a sea-weed. If none of the carbonaceous constituent of the plant is left and no cellular structure preserved such a fossil is of no scientific value. Some purely physical causes such as the flow of a small trickle of water over a mud surface can produce shapes like branching fronds and it has been shown fairly conclusively that certain marks which at one time were supposed to represent Algae in some early rocks are no more or less than the tracks of worms or some other animals in the mud which was finally consolidated to form the rock. Where organic residue is present and there is evidence that the structure is really of vegetable origin further information cannot be got without cellular structure as a guide as there are other plants beside algae which have a thalloid form, *e.g.*, some Liverworts.



FROM (A, B) BULLETIN DE LA SOCIETE BELGE DE GÉOLOGIE, (C) BULLETIN DE LA SOCIÉTÉ BOTANIQUE DE GENÈVE

FIG. 1.—SOME ALGAL CONSTITUENTS OF COAL AND BITUMINOUS SHALES

The *Schizophyceae* were present in all probability as early as the Cambrian. *Marpolia spissa*, one of several thalloid and filamentous types found in Middle Cambrian rocks in British Columbia shows structure which indicates that what appear to be branching filaments are really compound, consisting of several cellular filaments united in a sheath. The cells of the filaments are exceedingly small. These features are also exhibited by the living genus *Schizothrix* of the Schizophyceae. *Archaeothrix oscillatori-*

formis discovered by Kidston and Lang in the Middle Devonian chert of Aberdeenshire is an Alga consisting of cellular filaments which are so like those of some living Schizophyceae that there is no doubt of its systematic position in that group. *Pachytheca,* a small spherical algal colony built up of filaments of a similar type is a characteristic fossil of the Silurian and Devonian and appears to be related to the Schizophyceae.

The *Chlorophyceae* (Green Algae) are not certainly known as fossils but it seems probable that they may have existed in the Palaeozoic. A considerable deposit of a combustible material is known in Silurian rocks to the east of the Baltic. This deposit (Kuckersite) consists of a fossil-alga *Gloeocapsomorpha* (fig. 1 C). The affinities of this plant are doubtful but it may well be a green Alga. It has been shown that many bituminous shales and cannel coals are mainly formed of a deposit of small algal colonies. *Pila* and *Reinschia* (fig. 1, A and B) form the main algal constituent of many shales and coals of Carboniferous and Permian age. The building up of combustible deposits of a similar nature is taking place at the present day: a green alga, *Botryococcus coorongiana,* almost identical in the form of its cell-colonies with *Reinschia,* forms masses of tough bituminous matter on the shores of certain South Australian lagoons. While alive these algae store up oil in their cells and it is this oil which on the death of the organism permeates the whole mass and gives the bituminous properties to this "coorongite" and presumably also to the fossil deposits built up of algae with a similar cellular structure such as *Reinschia.* The existing families of the Codiaceae and Dasycladaceae are represented as far back as the Ordovician and provide us with the longest and perhaps most complete historical record of any living group of plants. In several of the genera of both families a thick calcareous deposit accumulates on the outside of the cell-wall and it is in virtue of this deposit that they have been preserved and that some are important constitutents of limestones formed during various geological periods. *Dimorphosiphon, Palaeoporella* and *Cyclocrinus* are some of the Ordovician genera. *Dimorphosiphon* is remarkably like the living genus *Codium* but differs in having a secretion of lime on its surface.

Charophyta (Stoneworts).—There is evidence of the presence of plants allied to the stoneworts in the Devonian; *Palaeonitella,* from the Aberdeenshire chert, with its whorled branch segments, is very like a small *Nitella.*

Fungi (Moulds, etc.).—Abundant remains of fungal filaments and resting spores have been found in the Aberdeenshire chert and establish the presence of Phycomycetous fungi in the Middle Devonian. Some of the filaments have numerous septations which as Kidston and Lang have suggested may indicate the presence of higher fungi (*Eumycetes*) as well. There are several records of Phycomycetes from the Carboniferous and Permian while F. E. Weiss has demonstrated the presence, in a coal-ball, of roots belonging to some gymnosperm infected with fungal hyphae. The distribution of the fungus in the tissues suggests that here is an example of the symbiotic relationship of fungus to higher plants which is known as mycorrhiza.

Bacteria.—A number of supposed fossil bacteria have been described from Palaeozoic rocks but they are of practically no scientific value. It is however practically certain that bacteria existed because petrified plant remains are found which show clear evidence of decay and no traces of fungi are visible.

Thallophyta of Uncertain Systematic Position. Nematophyton. In the Silurian and Devonian, in several parts of the world, fragments of a large plant are found the whole bulk of which was built up of loosely packed tubes, the larger running parallel to the axis while finer ones are found forming an inter-lacing system between them. In one specimen in which the outer surface is preserved there is a narrow zone where the tubes turn outwards and meet the surface at right angles. This type of construction is typically algal but the size of the fossils, some of which reach a thickness of three feet, show that they are quite unlike any living alga. In *Sporocarpon* from the Upper Devonian of America only the tips of the branches of what must have been a thalloid plant have been found. These tips are forked and rows of isolated tetrads of spores are found embedded in the tissue in each branch. The resistant nature of the spores suggests that they may have been cutinised like those of the Pteridophyta. Cutinised spores are also found in the lower Devonian plant *Parka,* the "puddock spawn" of the Forfarshire quarrymen, which consists of small circular thalli with small rounded masses of spores embedded in them.

Bryophyta.—Mosses and liverworts are found in almost every type of vegetation at the present day and it is surprising that they are so rare in the fossil state. On structural grounds they must be considered a relatively primitive and simple type of plant. Several fossil liverworts are known from the Upper Carboniferous of England. *Hepaticites Kidstoni* is a very small plant (fig. 2, B) with two parallel rows of leaves one on either side of a relatively stout axis and two rows of smaller scale-like leaves along the surface of the axis. In *H. Willsii* (fig. 2, A) and *H. Langii* the plant is thalloid consisting of a ribbon-shaped body which forked repeatedly. In *H. metzgerioides* a strand of conducting cells is present along the middle of the thalloid body of the plant. All these liverworts appear to be most closely related to the anacrogynous liverworts and compare very closely with some of the living ones in their vegetative structure. There is no evidence of the presence of acrogynous liverworts. Small shoots have spirally arranged leaves preserved as incrustations. *Muscites polytrichaceus,* and a very small petrified stem, which has absorptive hairs with oblique cross walls, *M. Bertrandi,* have been found in Upper Carboniferous rocks in France, demonstrating fairly conclusively the existence of mosses at that period.

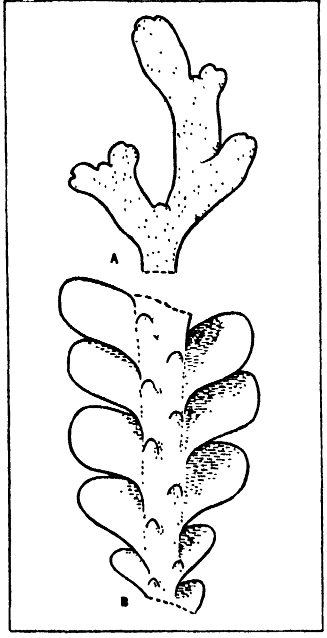
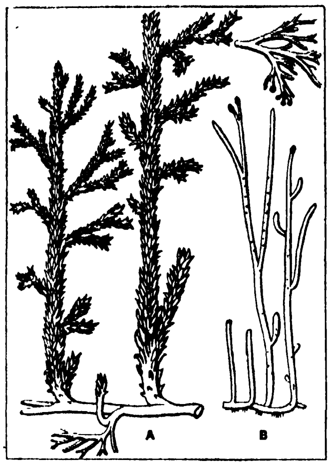


FIG. 2.—CARBONIFEROUS LIVERWORTS
A. Thallose type. B. Leafy type

Pteridophyta. *Psilophytales.*—Among the several very incompletely known plants of the Lower Devonian, *Psilophyton princeps* may be cited as representing one of an important group of plants which have certain primitive attributes. The name was given to some specimens from Canada by Sir J. W. Dawson more than half a century ago. Owing to the discovery of large masses of silica containing petrified plants in beds of Middle Devonian age in Aberdeenshire Kidston and Lang have been able to reconstruct, almost in their entirety, some plants which are closely related to Dawson's *Psilophyton princeps.* The plants are found petrified in their position of growth and five species grouped in three genera have been distinguished which with *Psilophyton* constitute the Psilophytales. One of them, *Rhynia Gwynne-Vaughani* (fig. 3, B) a small plant with cylindrical shoots, about 8 in. in height, is remarkable for having no leaves or roots. The lower parts of the shoots were horizontal and were furnished with small tufts of absorptive hairs on the under surface; while the presence of stomata on the vertical parts bears witness to their having been aerial and green. Another species, *Rhynia major,* was a slightly larger plant but both species of *Rhynia* must have been much alike in appearance. Sporangia are found on the tips of some of the aerial branches containing numerous spores (Pl. I., fig. 2) which were produced in tetrads as in other Pteridophyta. The internal structure of the shoot is simple (Pl. I., fig. 1); a single strand of xylem (wood) in the centre surrounded by a sheath of phloem (bast) constituted the vascular cylinder or stele. The cortex is wide in relation to the vascular tissue and consists of an inner zone of thin walled cells with large intercellular air spaces and an outer zone, two or three layers deep, of large cells which are elongated at right angles to the surface. The epidermis con-

sists of a single layer of smaller, slightly thicker-walled cells and had a well developed cuticle. The stomata are infrequent and each consists of two simple guard cells surrounding a pore. Small adventitious branches are found attached to some of the shoots and as there is no vascular connection between the adventitious branch and the shoot it is probable that these branches were easily detached and served to propagate the plant vegetatively.



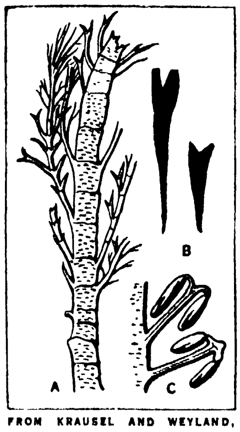
AFTER KIDSTON AND LANG

FIG. 3.—ANCIENT TYPES OF LAND-PLANT FROM THE DEVONIAN OF SCOTLAND. A. ASTEROXYLON. B. RHYNIA

Hornea Lignieri, a plant of similar dimensions and habit, has tuberous swellings at the base of the shoots. The differentiation of vascular tissue, which forms a cylindrical strand in the stem, only extends for a short distance into the swollen base, whose under surface bore absorptive hairs. The sporangia differ from those of *Rhynia* in having a sterile column of tissue extending from the base up into the midst of the sporangium. This column has been compared with the columella found in the capsules of the Liverworts and Mosses. In both *Rhynia* and *Hornea* the sporangia look something like swollen branch-tips and in *Hornea* branched sporangia are known.

Asteroxylon Mackei (fig. 3, A) a more complex plant, had smooth horizontal stems with small root-like branches; true roots are absent just as in *Rhynia* and *Hornea;* the aerial shoots are erect and densely clothed with small scale-like leaves. The stele contains a fluted column of xylem which appears in section like a multi-rayed star. Small strands of tracheids connected with the stele pass out towards each leaf but stop short before entering the base of the leaf which had no vascular tissue. In *Thursophyton* a probably closely allied plant from the Middle Devonian the leaves are small and spine-like and vary considerably in size. These facts suggest that in plants of the small-leaved type such as the lycopods the leaves may be the homologues of spines or in other words the small leaf of the lycopod may have evolved from a small spine or emergence of the shoot by a gradual process of vascularisation, an early stage in the process being represented by the condition found in *Asteroxylon* where the vascularisation has not yet extended from the shoot into the leaf itself. The sporangia of *Asteroxylon* were borne, in all probability, on small smooth branches. Another species of *Asteroxylon* has been found in Germany which has leafless upper branches, comparing therefore with the supposed fertile branches of the Scottish plant. Nothing is known about the sexual generation of these Devonian plants. A consideration of the Psilophytales as a group suggests that they may represent, in the *Asteroxylon-type* with its small leaves, the fore-runners of the Lycopods. The branching shoot of *Rhynia* with its terminal sporangia suggests that the large megaphyllous fern frond with sporangia on its edges may have originated from such a branching shoot. The column of tissue in the sporangium of *Hornea* suggests comparison with the columella of the moss or liverwort. The living group, the Psilotales, which compare with *Rhynia* in being rootless and sometimes almost leafless but which differ considerably in the position of the sporangia on the plant, may also be related. Finally, in the absence of differentiation into stem and leaves, the plant body of *Rhynia* with its simple thalloid form calls attention to the suggestion put forward by more than one writer that land-plants are descended from algal ancestors. It has been remarked that the sporangia in the vascular plants correspond morphologically to the branches of the algal thallus which bear the reproductive organs (*e.g.,* the stichidia in the red sea-weeds). This is interesting in view of the resemblance between sporangia and branch tips already referred to in *Hornea* and to the structure of the fertile branches in *Sporocarpon* the Upper Devonian thallophyte in which the tips bear isolated tetrads of spores. There was clearly in Devonian times a group of plants in existence in which there was a combination of thallophyte and pteridophyte characters and, as Kidston and Lang point out, "the facts are . . . consistent with the Rhyniaceae finding their place near the beginning of a current of change from an Alga-like type of plant to the type of the simpler Vascular Cryptogams."

Articulatales.—This large group of the Pteridophyta includes the Proto-articulatineae, Sphenophyllineae, and the Equisetineae.



FROM KRAUSEL AND WEYLAND, "DEVONFLORA" (SENCKENBERGISCHE NATURFORSCHENDE GESELLSCHAFT)

FIG. 4.—ARTICULATE PLANT OF MIDDLE DEVONIAN AGE (CALAMOPHYTON PRIMAEVUM)
A. Small branch. B. Leaves. C. Two sporangiophores; each with two sporangia

The first is represented in the Middle Devonian of Germany by *Calamophyton primaevum* (fig. 4) a plant recently described by Kraüsel and Weyland. The stems are jointed and have small bifid leaves attached at the nodes. The sporangia are borne in pairs on modified leaves which compare closely therefore with the sporangiophores of the Equisetineae. *Hyenia* of the same age has small deeply cleft leaves and in vegetative features resemble the Sphenophyllineae. The fertile leaves are forked and two or three sporangia are borne on the ends of each division.

Sphenophyllineae. — *Sphenophyllum,* a genus common in the Carboniferous, ranges from the Upper Devonian to the Triassic. The plant grew in the form of a slender shrub which may have supported its branches by scrambling over other plants. The stems are jointed with whorls of small wedge-shaped leaves, which are often deeply dissected (Pl. I., fig. 8). The leaves of one whorl lie immediately above those of the whorl below and are usually in multiples of three. This arrangement is related to the structure of the stele which is triangular in section and has a central column of xylem; at the nodes two vascular strands pass out from each corner to supply the leaves. The stems and roots have a considerable amount of secondary vascular tissue. While not much variation is shown in the vegetative parts of the known species of *Sphenophyllum* there is considerable variety in their cones. In *Sphenophyllum Dawsoni* the cones are several inches long and at least half an inch thick. They are built up of whorls of leaf-like bracts and those of each whorl are coherent laterally for half their length from the base so that each whorl forms a cup (fig. 5). The whorls of bracts overlap so that the cone is covered on the outside by their overlapping tips. The sporangia are twice as numerous as the bracts and are attached by narrow stalks (sporangiophores) to the upper surface of the sheath of bracts close to the axis of the cone. The sporangiophores are not all of the same length so that the sporangia had the appearance of being arranged in more than one whorl in each cup. In *Bowmanites* a cone belonging to some closely related plant, the sporangiophores had a bract-like expansion at the end and each bore two sporangia. This arrangement suggests that bracts and sporangiophores may be equivalent structures and that the cone of *Sphenophyllum* may be regarded as being built up of a series of bi-lobed leaves, the ventral lobes being fertile while the dorsal assumed the form of subtending bracts. In *S. fertile* this theory receives support as dorsal and ventral lobes reveal their equivalence by both being fertile. In other species there are no distinct terminal cones; nodes with fertile leaves alternate with nodes

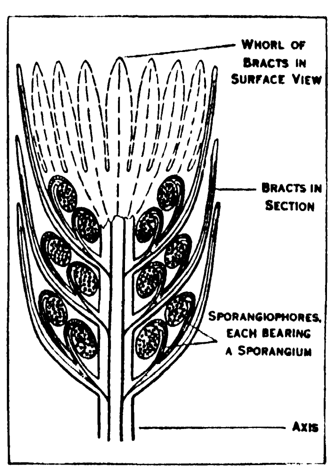
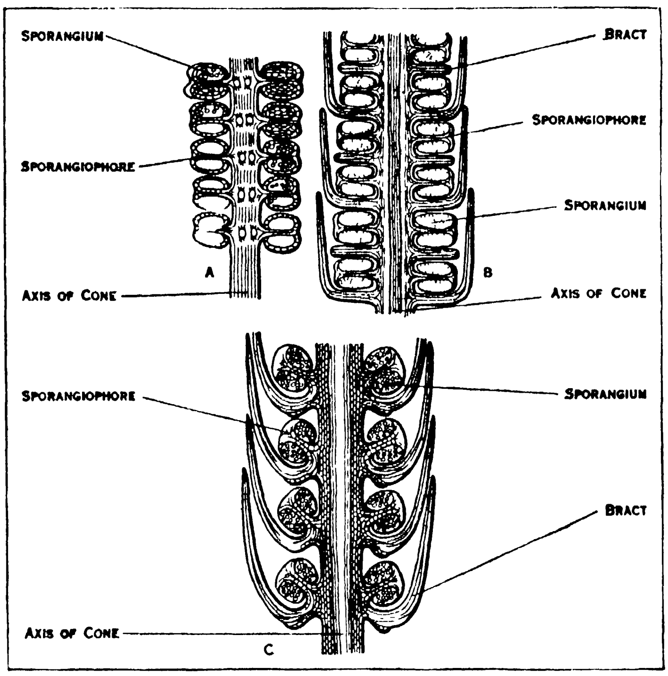


FIG. 5.—SPHENOPHYLLUM DAWSONI
Diagram showing longitudinal section of the cone

bearing sterile leaves. This hypothetical bi-lobed leaf may also be distinguished in *Cheirostrobus,* a very complicated cone of Lower Carboniferous age Here the leaf is divided into three dorsal sterile and three ventral fertile segments. Each fertile segment bears four sporangia and in construction is exceedingly like the sporangiophore of the Equisetineae and it is possible that *Cheirostrobus* is a representative of the stock from which the Sphenophyllineae and Equisetineae have both sprung.

Equisetineae —The fossil Equisetineae were at their zenith in Carboniferous times; in place of the small, herbaceous *Equisetum* (horse-tail) of to-day there were gigantic trees some with a girth of three metres and a height of 60 metres forming a conspicuous feature in some aspects of the vegetation. *Calamites* the best known genus had the same habit as the horse-tail with jointed stem and small leaves but differed in its much greater size. The internal structure of the stems, roots and leaves, is in many respects like that of *Equisetum* only there is secondary thickening in the stems and roots. The leaves, usually small, linear or lance-shaped, are often united near the base to form a sheath round the stem. Like *Equisetum* the stems are hollow with a large central cavity. Casts of these cavities in sandstone are frequently found showing longitudinal grooves representing the courses of the primary woody strands which projected into the pith cavity There is a constriction on the cast at each node and the grooves of one internode alternate with those on the internode above and below. Two main types of calamite-foliage are known: *Asterophyllites* and *Annularia;* in the former the leaves are long and awl-shaped and quite separate In *Annularia* the leaves are usually more paddle-shaped terminating in a small sharp point. The single vein which passes out into this point had, in some species, a swelling near the tip of the leaf suggesting the presence of a water gland In another type of *Annularia* the margins of the leaf were inrolled and bore a fringe of hairs which probably sheltered the stomatal surface of the leaf. The cones exhibit a considerable range in form, indicating that several families and genera may be



(A AND B) FROM RENAULT, "BASSIN HOUILLER ET PERMIEN D AUTIEN ET D ERPINAC," BY COURTESY OF THE MINISTER OF PUBLIC WORKS (FRANCE)

FIG 6 —EQUISETALEAN CONES, SHOWING LONGITUDINAL SECTIONS OF (A) ARCHAEOCALAMITES, (B) PALAEOSTACHYA, (C) CALAMOSTACHYS

included in *Calamites.* In *Calamostachys* the cones were terminal on the branches and the axis of the cone bore whorls of peltate sporangiophores similar to those of *Equisetum* but alternating with whorls of sterile bracts (fig 6, C). The sporangiophores are in superposed whorls while the bracts of one whorl alternate with those above and below. Each sporangiophore bears four sporangia in which the spores are found sometimes arranged in tetrads. In some species the spores in the cone are all of the same size but other species are heterosporous some sporangia having large numbers of small spores while others in the same cone had a smaller number of large spores. In *Palaeostachya* (fig. 6, B) the sporangiophores unlike those of *Calamostachys* are attached in the axile of the bracts which subtend them. In *Archaeocalamites,* a characteristically Lower Carboniferous plant, the leaves are long and may be twice forked while the vascular strands of the inter-

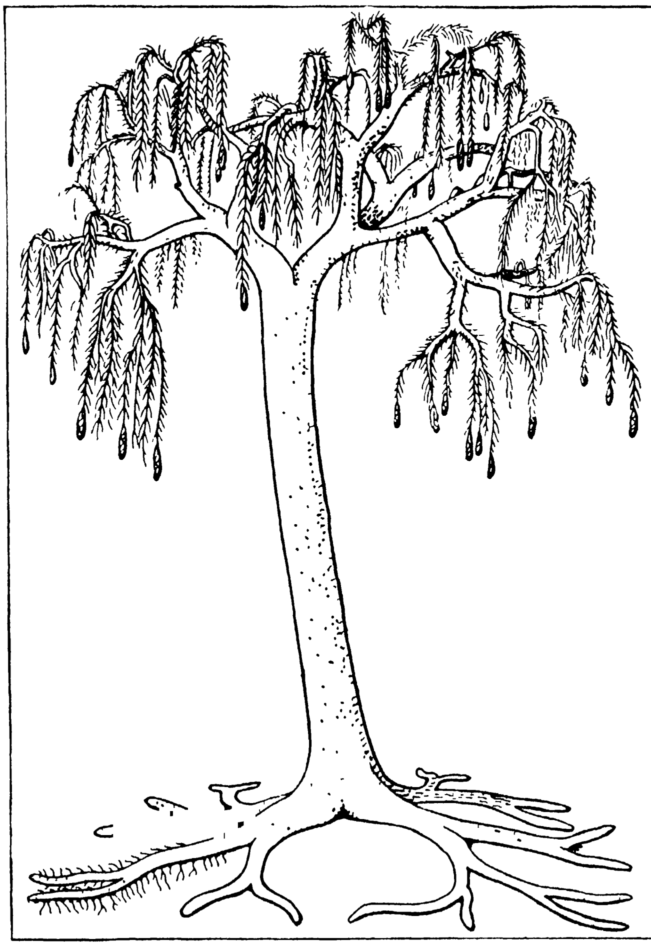


FIG 7 —RECONSTRUCTION OF A LEPIDODENDRON, SHOWING THE STIMARIAN BASE, TRUNK, LEAVES AND CONES

nodes pass straight through and do not alternate at the nodes The cones (fig 6, A) are very like those of *Equisetum* but are long and constricted at intervals where forked leaves were attached so that they resemble a branch in which the internodes are covered with sporangiophores Although the presence of heterospory and secondary thickening are probably stages in the direction of a gymnospermous type the Equisetineae must be considered as essentially Pteridophyta

Lycopodiales (Club-Moss allies)—The lycopods are typically small-leaved plants There are three living genera· *Selaginella, Isoëtes* and *Lycopodium,* interesting in view of their relation to the Palaeozoic members of the group: the first two are ligulate and the second has secondary thickening in its rootstock in these respects comparing with the majority of the fossils The living forms must be regarded as the remnant of a once important group; they are all herbs, whereas the fossils were almost all trees

(*a*) Ligulateae *Lepidodendron* (fig 7) which may be taken as the type of the group is of extended geological range; while *Protolepidodendron,* a very doubtfully related plant, is of Middle Devonian age *Lepidodendron* itself ranges from the Upper Devonian to the Permian The trunk reached a height of over 114 ft. while above that the crown of forking branches rose for a further 20 ft The lance-shaped leaves are usually from one to four inches in length but sometimes reached the length of a yard; they were shed when the part of the plant bearing them reached a certain age leaving a scar on the persistent leaf-base (Pl. I, figs

7 and 8). The ligule, a small secretory scale, is situated in a pit on the leaf-base just above the point of attachment of the leaf. The leaf-bases are diamond-shaped in outline and are very regularly arranged on the surface of the stem. The leaves have a single median vein and the ventilating tissue of the leaf was connected with that of the stem by two strips of a similar tissue termed parichnos which have left the two small marks one on each side of the vascular strand on the leaf-scar (fig. 8). There were deciduous side branches arranged in two vertical rows on each side of the trunk or main branches: when these became detached they left a characteristic scar. In other species there were numerous vertical rows of these deciduous branches and while it is possible that these branches may have borne the cones in yet other species the cones are known to have been placed on the ends of the ordinary foliage twigs (fig. 7). The stems and branches were traversed by a cylindrical column of primary xylem, in some species solid, but in others with a parenchymatous core. The protoxylems are situated on the outer surface of this column and from them the small vascular strands to the leaves passed out through the external tissues. In most species secondary wood was formed round the primary. External to the wood was a tissue corresponding to the phloem surrounded by the inner and outer cortex, the former a lacunar, ventilating tissue, while the latter had a cambial zone near its outer limit which gave rise to corky tissue. A thin layer of the cortex outside the corky tissue afforded a foundation for the attachment of the persistent leaf-bases and became fissured later by the expansion due to the secondary growth within. The cones were in general construction like those of *Selaginella* only much larger and as in the living genus each sporophyll bore a ligule on its upper surface close to the abaxial face of the sporangium. In *Lepidostrobus*, cones which belong to various species of *Lepidodendron*, each sporophyll consists of a stalk bearing on its upper surface a radially elongated sporangium with the ligule placed in a pit just beyond. The stalk terminated in an upturned blade. Some cones are heterosporous the upper sporophylls bearing micro-sporangia, while those at the base of the cone bear mega-sporangia (fig. 9).

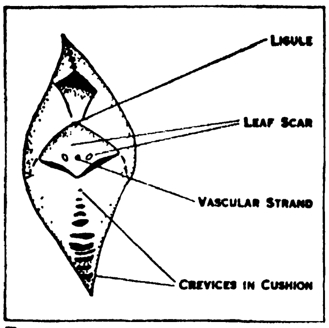


FIG. 8.—A LEAF-CUSHION FROM THE SURFACE OF A TRUNK OF A LEPIDODENDRON

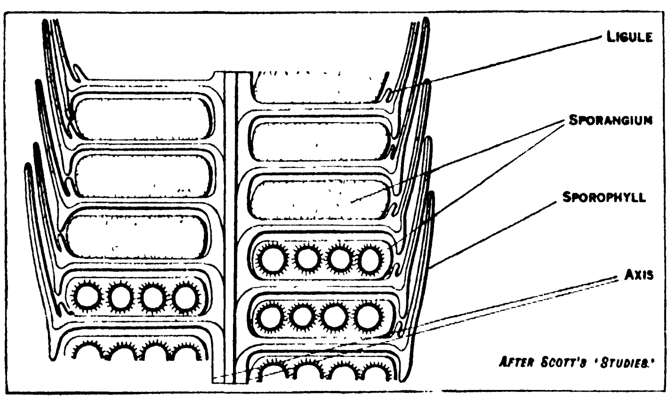


FIG. 9.—HETEROSPOROUS CONE OF LEPIDODENDRON IN LONGITUDINAL SECTION

Each megasporangium contained 8–16 megaspores. Other spores are known which bear only microsporangia or only megasporangia. It is also possible that such species bore the two kinds of cones on separate trees. Megaspores have been found with the prothallus and archegonia preserved; their reproduction must have been similar to that of *Selaginella* and it is probable that the spermatozoids which fertilised the ova in the archegonia were liberated from microspores which became entangled in the spinous processes found on the outsides of the megaspores. The chances of megaspores and microspores becoming associated in this way were largely augmented by the enormous number of microspores produced in each microsporangium. Some coals of Carboniferous age consist very largely of compressed Lycopod spores. In *Lepidocarpon* (fig. 10, B), another type of cone, only one megaspore is present in the mature sporangium and an integument, formed from an outgrowth from the sides of the sporophyll-stalk invested the sporangium except for a narrow opening along the top. In *Miadesmia* (fig. 10, A), the fructification of a herbaceous Lycopod of Carboniferous age, the integument is prolonged in the form of a sheath beyond the top of the sporangium. A fairly close comparison may be made between these two fossils and true seeds; in both fossils however, the sporophyll broke away from the parent plant with the sporangium before fertilisation took place or possibly even before microspores were deposited on it, unlike a true seed in which an embryo is usually developed before the seed is liberated from the parent plant. Among other Carboniferous lycopods *Sigillaria* occupies an important position. *Sigillaria* had a large trunk with persistent leaf bases placed either like those in *Lepidodendron* or else in vertical rows. It is probable that many *Sigillariae* were unbranched except for small, lateral, cone-bearing twigs and the tall trunks with the tufts of leaves at the tops must have presented a peculiar appearance. *Sigillaria* was heterosporous and the distribution of the two kinds of spores in the cones was probably the same as in *Lepidodendron*. In *Mazocarpon*, a sigillarian cone, the sporophylls were curiously constructed; the wall of the sporangium had a curved plate projecting from its distal end and there is no integument. A large mass of sterile tissue is present inside, and attached to, the base of the sporangium and megaspores up to the number of eight were arranged in a single layer between this sterile tissue and the wall of the sporangium. Vascular tissue is present in the centre of the sterile tissue and it connects up with the vascular strand in the sporophyll. The megaspores are concave on the side next to the sterile tissue and archegonia are present in the prothallus in each spore opposite to the place at which the spore broke open. The megaspores when dispersed broke away part of the overlying sporangium wall. *Lepidodendron* and *Sigillaria* are sometimes found attached to their root bearing parts which receive the name *Stigmaria*. The base of each *Lepidodendron* or *Sigillaria* consisted of four main downwardly directed branches which spread out and forked equally and repeatedly (fig. 7). These branching systems are often found penetrating the barren sandstone or shale underneath the seams of coal and offer certain evidence that the coal has

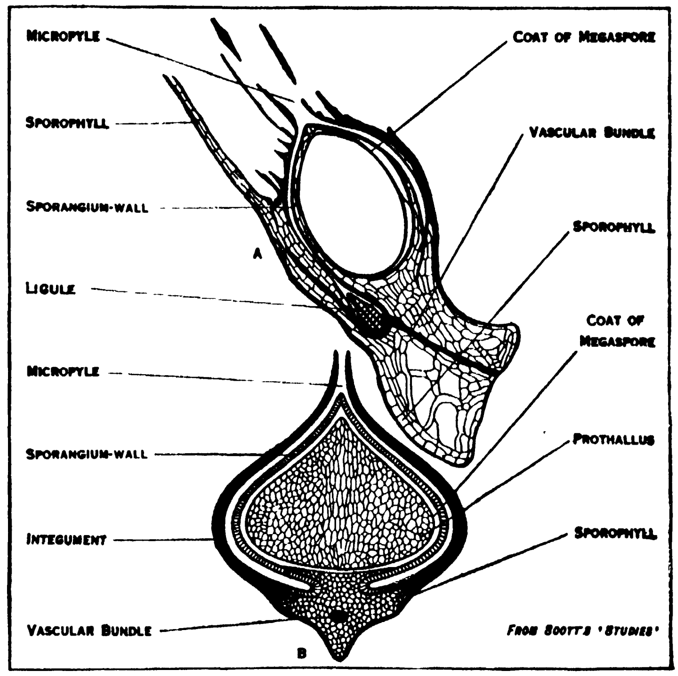
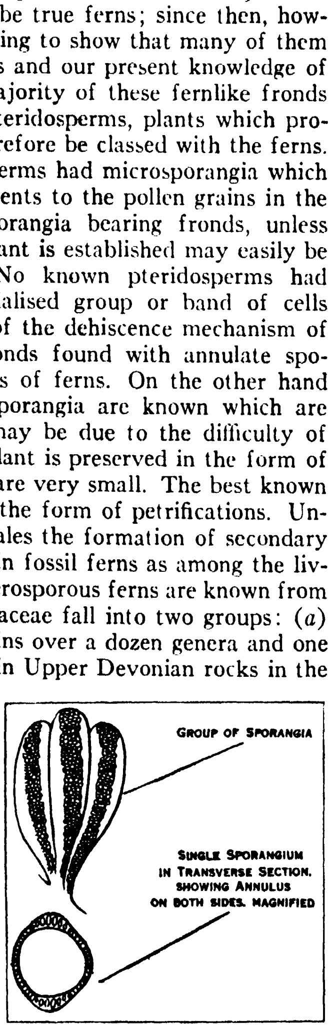


FIG. 10.—SEED-LIKE ORGANS OF SOME FOSSIL LYCOPODS
A. Miadesmia, longitudinal section of sporophyll. B. Lepidocarpon, transverse section of sporophyll

been formed in the actual place of growth of the trees from whose remains it has been formed. The surfaces of these underground branches are covered with roots which penetrated the surrounding soil. The morphology of these root-bearing structures is not yet fully elucidated; internally they are constructed more like stems than roots and the true roots which are attached to them are only very slightly endogenous. The whole branching, root-bearing system may be closely compared with the root stock of the living Isoëtes in which there is a peculiar type of secondary thickening and which bears roots very similar in structure to those of *Stigmaria.*

(*b*) Eligulatae. This group of lycopods of which *Lycopodium* is the type are not so well represented as fossils; *Spencerites*, of Carboniferous age is the only certain eligulate Lycopod known in the Palaeozoic but it is possible that *Cyclostigma*, a Devonian genus, is eligulate, for no one has yet been able to show that a ligule is present, although poor preservation might account for that.

Filicales (Ferns).—One of the striking features of the assemblage of plants found in the Carboniferous rocks is the frequency of fragments of fern-like plants. Up to the end of the 19th century these were all considered to be true ferns; since then, however, evidence has been accumulating to show that many of them belong to a higher group of plants and our present knowledge of these fossils indicates that the majority of these fernlike fronds belong to an extinct group, the pteridosperms, plants which produced seeds and which cannot therefore be classed with the ferns. In addition to seeds the pteridosperms had microsporangia which contained microspores the equivalents to the pollen grains in the flowering plants. These microsporangia bearing fronds, unless their relation to the rest of the plant is established may easily be taken for fertile fern-fronds. No known pteridosperms had microsporangia bearing the specialised group or band of cells called the annulus which is part of the dehiscence mechanism of most fern sporangia; so that fronds found with annulate sporangia are almost certainly fronds of ferns. On the other hand fertile fronds with ex-annulate sporangia are known which are also certainly ferns but here it may be due to the difficulty of detecting the annulus where the plant is preserved in the form of an incrustation and the sporangia are very small. The best known Palaeozoic ferns are preserved in the form of petrifications. Unlike the Equisetales and Lycopodiales the formation of secondary tissues was as of rare occurrence in fossil ferns as among the living and no certain examples of heterosporous ferns are known from the Palaeozoic. The Botryopteridaceae fall into two groups: (*a*) Zygopterideae. This family contains over a dozen genera and one of them, *Asteropteris,* was found in Upper Devonian rocks in the State of New York while *Ankyropteris,* the best known genus, is represented by both Carboniferous and Permian species. *Ankyropteris Grayi* from the Lower Coal Measures of England had stems about 2cm. in diameter and of considerable length; in fact it was probably a climber. Large fronds were attached at fairly wide intervals and their petioles or stalks must have nearly equalled the stem in thickness. They were arranged in spiral series on the stem and a short cylindrical branch was present in the axil of each leaf. It is possible that the axillary branch is just the smaller of the two branches of a forking of the stem effected close above the point of attachment of a leaf. The section of the coal-ball shown in Plate I., fig. 4, contains a stem cut transversely. The centre of the stele (vascular cylinder) appears as a small dark narrow-rayed star which consists of a mixture of parenchymatous tissue and tracheids; while surrounding this are the large tracheids of the periphal xylem whose outer limit retains the star-shaped outline. The annular space surrounding the xylem was produced by the decay of the phloem and the wide zone of tissue occupying the greater part of the section is the cortex. The vascular structure of the leaf-stalk is peculiar, the xylem is in the form of a doubly grooved strand which appears like a double anchor in section (hence the name of the genus). The leaflets were given off alternately on each side of the petiole. In some zygopterids these leaflets were forked at their bases so that the petiole apparently bears four rows of leaflets and has a bushy habit. The sporangia in some of the genera e.g., *Etapteris* (fig. 11) have a multiseriate annulus and are comparatively large; they were grouped in small bunches on the smaller divisions of the frond. In *Stauropteris* the stalk or rachis of the frond had four distinct rows of secondary stalks or rachises and each of these bore four rows of tertiary rachises. All the rachises are cylindrical and were presumably green as they have well developed photo-synthetic-tissue. Each frond thus consisted of a bush of small green twig-like divisions. The sporangia of *Stauropteris* had no annulus but germinating spores have been found (fig. 12) and the preliminary stages in prothallus formation is so essentially fern-like that there is no doubt that *Stauropteris* is a fern and not the pollen bearing part of a Pteridosperm, for pollen grains would behave differently on germination.



FROM ZEILLER, "BASSIN HOUILLES DE VALENCIENNES"

FIG. 11.—ETAPTERIS PINNATA

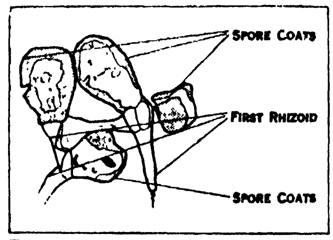


FIG. 12.—GERMINATING SPORES OF STAUROPTERIS (MAGNIFIED)

(*b*) *Botryopterideae.*—*Botryopteris cylindrica* has a long thin stem 2–5cm. in diameter bearing leaves at wide intervals and branching dichotomously but other plants belonging to the same family show considerable differences in habit. There is a simple stele consisting of a solid strand of tracheids with the smaller and first differentiated elements in the centre. The petiole is at its base very like the stem in structure. The sporangia differed from those of the Zygopterideae in being small and pear-shaped with a multiseriate annulus on one side only. The other members of the group have a more complex structure. The similarity in structure between the petiole and the stem of *Botryopteris cylindrica* is a primitive character and fits in with the suggestion that the large type of leaf or frond is derived from a subordinated lateral branch of the shoot. The Botryopterideae as a group show several points of comparison with the living Osmundaceae, representatives of which family are found in the Permian. It is also possible that the Ophioglossaceae have descended from the same stock.

Osmundaceae.—Petrified stems from the Permian are known which give satisfactory proof of the existence of plants closely agreeing in many anatomical details with *Osmunda* (royal fern). In *Thamnopteris* the woody cylinder was solid but the central part was like that in the Zygopterideae made up of parenchyma and small tracheids. There is evidence to be drawn from closely related fossils that the type of stele found in *Osmunda* has been derived in the course of descent from a solid stele such as that found in *Botryopteris, Zygopteris* and *Thamnopteris* suggesting intermediate steps in the process. Like *Osmunda* these Permian fore-runners had short stems with densely crowded fronds and adventitious roots. Fructifications of Palaeozoic Osmundaceae have not yet been recognized with certainty but *Discopteris*, an Upper Carboniferous form, has perhaps some claim to recognition

Marattiaceae.—Petrified stems have been found which in structure are so very like those of the Marattiaceae that many botanists are inclined to regard them as proof of the existence of that group in the Palaeozoic. *Psaronius,* a form-genus of tree-ferns ranges from the base of the Upper Carboniferous upwards and is quite common in the Permian. The stem has a complex vascular system, a polycylic dictyostele, except in *Psaronius Renaultii,* the Carboniferous species which has a colenostele. In these respects a close comparison is possible with the living Marattiaceae. In some species of *Psaronius* the fronds were attached alternately on opposite sides of the tree so that there were two vertical rows. In others there were several vertical series and as many as four fronds might be attached at the same

height from the ground. There was no secondary thickening but the stems were buttressed by a considerable development of adventitious roots forming a fibrous investment round them and giving them considerable rigidity. Several types of fertile fronds of Carboniferous plants are known which, though probably for the most part Pteridosperms, are fern-like and bear microsporangia grouped in synangia somewhat like those of living Marattiaceous ferns. *Asterotheca* has large multipinnate fronds which in the sterile condition would be grouped in the form-genus *Pecopteris*. The sporangia are united in synangia (fig. 13 A and A′) which are attached to small protuberances on the surface of the frond. In *Scolecopteris* the synangium has a short stalk with a central vascular strand. In the closely allied *Acitheca* the synangium has no stalk but a vascular strand is present in the central column of tissue round which the sporangia are joined and each sporangium terminates in a sharp bristle. In *Ptychocarpus* the sporangia are more intimately united and not so pointed. *Danaeites* an Upper Carboniferous type has long linear synangia, very like those of the living *Danaea*, with two rows of about 10 closely packed sporangia each of which opened by a terminal pore. In view of the fact

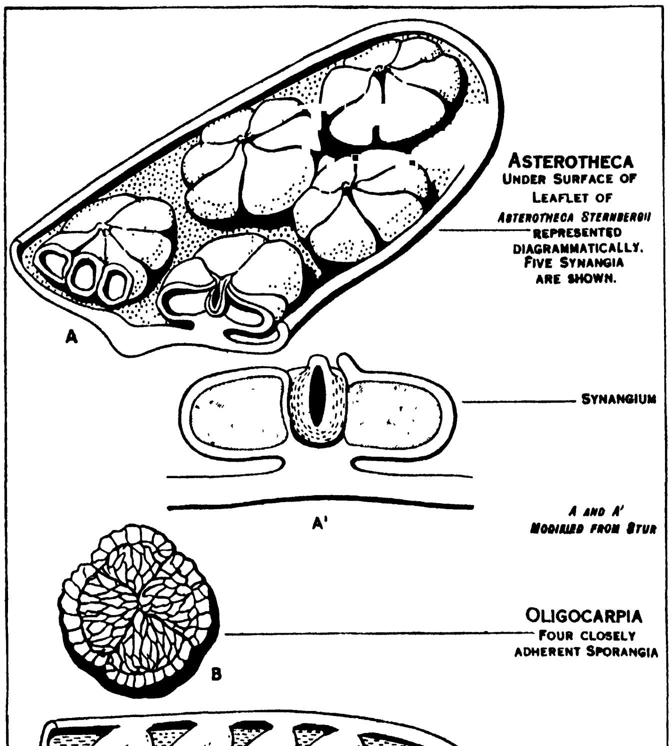
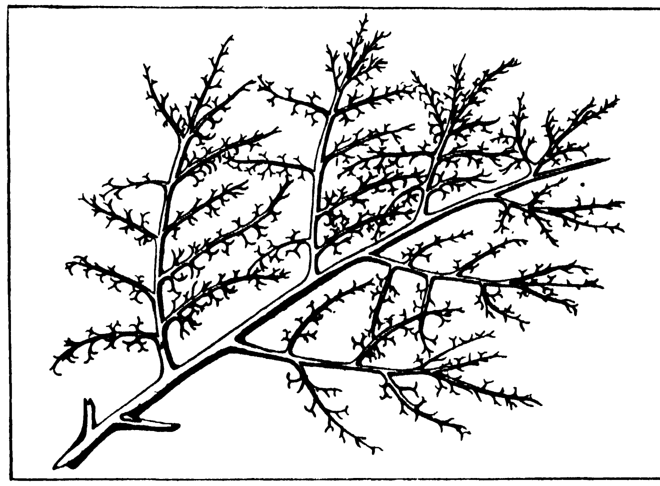


FIG. 13.—SPORANGIA OF SOME CARBONIFEROUS FERNS AND (?) PTERIDOSPERMS

that some fructifications, known to belong to Pteridosperms, were in the form of synangia it is as yet uncertain whether most of the plants included in *Asterotheca, Scolecopteris*, etc., are ferns or pteridosperms. The evidence for the existence of Marattiaceae in the Palaeozoic rests primarily on the Marattiaceous structure of the *Psaronius* stems.

Schizaeceae. The sporangia of *Senftenbergia* (fig. 13, C), an Upper Carboniferous genus, like those of the living Schizaea have an apical group of thick-walled cells constituting an annulus. An apparently closely allied genus *Klukia* of Jurassic age would seem to form a link between *Senftenbergia* and *Schizaea* as regards the sporangial structure.

Gleicheniaceae. The evidence for the presence of Gleicheniaceae in the Palaeozoic is also slight; *Oligocarpia*, an Upper Carboniferous fern, shows in the form and grouping of sporangia close resemblance to the living *Gleichenia*. The fact that the annulus is sometimes formed of more than one series of cells led Kidston to doubt its relationship to the Gleicheniaceae; but sporangia are sometimes found with more than one series in *Gleichenia* so that this objection is not completely justified. *Chansitheca* from the

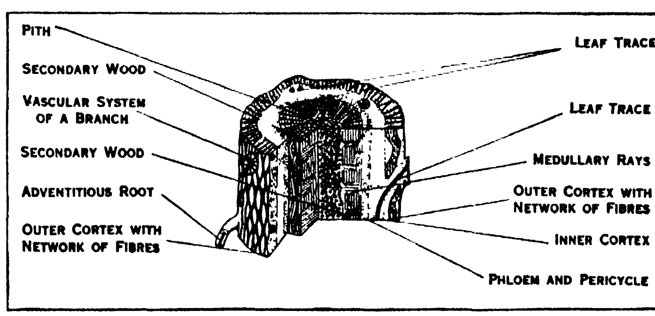


FROM KRAUSEL UND WEYLAND, "DEVONFLORA" (SENCKENBERGISCHE NATURFORSCHENDE GESELLSCHAFT)

FIG. 14.—ANEUROPHYTON, ONE OF THE MOST ANCIENT FRONDS KNOWN, FROM THE MIDDLE DEVONIAN OF GERMANY

Chansi district in China also of Upper Carboniferous age has as many as 20 sporangia in each group or sorus. It is not until the early part of the Mesozoic that undoubted Gleicheniaceae are encountered.

Pteridosperms.—A considerable number of fossils are known which have in their vegetative structure such similarity to the Ferns and indeed may well have evolved from an ancestral group of Ferns by developing in the course of their history an advanced type of heterospory in which seeds (*i.e.*, integumented megasporangia) were produced and pollination or the provision of pollen grains (microspores) to the seed took place before the seed was liberated from the parent plant. No Pteridosperms have survived to the present day, they were apparently extinct by the middle of the Jurassic period. *Eospermatopteris*, a plant rather like a tree-fern in habit with large fronds consisting of finely divided rachises and practically no lamina, has been found in the Upper Devonian rocks of New York with seed-like bodies attached to its fronds. *Hostimella racemosa* a Middle Devonian fossil from

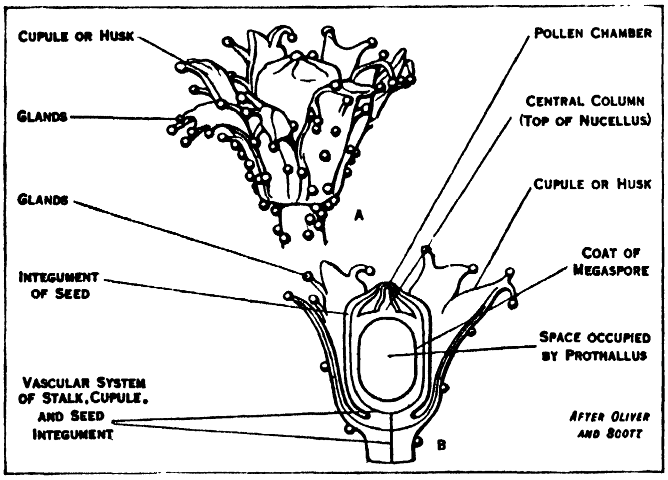


AFTER W. C. WILLIAMSON, IN "TRANSACTIONS OF THE ROYAL SOCIETY"

FIG. 15.—DIAGRAMMATIC RECONSTRUCTION OF THE STEM OF LYGINOPTERIS

Scotland consisting of branching linear stalks bore, on short lateral branches, oval-bodies which though certainly sporangia might conceivably be seeds while fronds called *Aneurophyton* (fig. 14) have been found in the Middle Devonian of Germany closely resembling the fronds of *Eospermatopteris*; so that there is a certain amount of circumstantial evidence for the presence of Pteridosperms as early as the Middle Devonian. In the Lower Carboniferous Pteridosperms form an important constituent of the vegetation and maintain that position right through the Carboniferous, Permian and Triassic; in the Jurassic they disappear. The

Pteridosperms form a large and varied group but agree in having fern-like fronds and secondary woody thickening as a normal feature in their vascular construction. *Lyginopteris Oldhamia* the most completely known Pteridosperm is of Upper Carboniferous age and is of common occurrence in the coal-measures round Oldham and other parts of Lancashire. It is found petrified in the coal-balls and also as impressions in the shales forming the

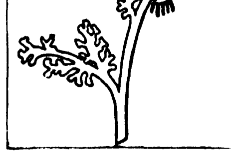


BY COURTESY OF THE COUNCIL OF THE ROYAL SOCIETY AND OF PROF. OLIVER

FIG. 16.—SEED AND HUSK OF LYGINOPTERIS

A. Reconstruction of the seed in its husk. B. Seed and husk cut longitudinally

roofs of the seams. The frond (Plate I., fig. 3) by an equal forking of the leaf-stalk is divided into two equal divisions. The stem (fig. 15) varies from 2 mm. to 4 cm. in diameter. There is a pith forming the core of the stem surrounded by a ring of scattered vascular strands which are connected with the leaf supply system. In older stems the ring of strands is surrounded by a considerable quantity of secondary wood and bast. The outer cortex contained long anastomosing bands of fibres which formed a reticulum just below the epidermis. In *Heterangium,* a closely allied genus the centre of the stem is occupied by a solid core of primary xylem and the strands of the leaf-trace system were incorporated in the outer part of the primary xylem. Oliver and Scott in 1903 were able to identify a petrified seed found in a coal-ball, as the seed of *Lyginopteris* by the presence on its husk of glandular spines exactly like those on the frond and stems of *Lyginopteris.* The seed, *Lagenostoma Lomaxi* (fig. 16 A and B), is enclosed in a lobed husk or cupule; it is barrel-shaped and its integument is furnished with a vascular system. One part of the nucellus (sporangium wall) is modified to form a complicated pollen chamber or cavity in which the pollen became lodged. In structure the seed is very similar to those of the living Cycads or Ginkgo but the pollen-chamber is rather more complicated than any of these living plants. Kidston described some tassels of microsporangia (fig. 17) attached to small pieces of fronds which bore leaflets of the same shape as those of *Lyginopteris* and there is no doubt that they represent the pollen producing organs of this plant. In most seed-bearing plants the microsporangia are borne on highly modified structures, stamens, which are quite unlike leaves in appearance; but in many Pteridosperms the fronds which bear the microsporangia are very like the sterile foliage fronds and in this respect the Pteridosperms are primitive.



FROM SCOTT, "STUDIES IN FOSSIL BOTANY" (A & C BLACK)

FIG 17.—CROSSOTHECA HOENINGHAUSI

Male fructification of *Lyginopteris*

The Medulloseae, another important group of Pteridosperms, of Carboniferous and Permian age had fern-like foliage belonging to the form-genera *Neuropteris* and *Alethopteris.* The stems, *Medullosa,* which are known to belong to the group are peculiarly complicated in structure; in place of the usual single vascular column they had several. Each vascular column was in structure like that of *Heterangium* and the stem could be briefly described as a polystelic *Heterangium.* The spirally arranged leaf stalks are of large size and contain a large number of small collateral vascular strands. The appearance of these petioles in section has given rise to the erroneous report that Monocotyledonous Angiosperms were present in the Carboniferous; they are however very like the petioles of Stangeria, one of the living Cycads. Another genus *Sutcliffia* had a large central stele with other smaller ones forming a system of meshes round it. Seeds have been found attached to fronds of *Neuropteris* (fig. 18, B) and *Alethopteris. Trigonocarpon* is a genus of seeds which were borne on some species of *Alethopteris;* it resembles the seeds of living Cycads in having a testa consisting of both soft and stony layers. The micropyle was of very considerable length. The pollen-producing organs of these plants (fig. 18, A and C) are still imperfectly known. *Potoniea* (fig. 18, C) very probably represents the pollen-bearing flower of a *Neuropteris.* The structures with toothed margins were originally cup-shaped with microsporangia placed on the inner surface of the cup. *Linopteris* an allied frond-genus had similar microsporangiate fructifications. Another fructification *Whittleseya* had large cups more than an inch deep and large pollen grains have been isolated from them. In *Telangium* the microsporangiate fructification consists of synangia of from 6 to 25 fusiform sporangia attached to small terminal expansion of the divisions of the fertile frond. In *Telangium bifidum* and *Telangium teilianum,* both from the Lower Carboniferous, the fertile part of the frond branched repeatedly at wide angles. In *T. teilianum* the fertile part was at the extremity of the frond (fig. 19) and two large pinnae branching off from the rachis on either side acted as the foliage part of the frond. Several specimens have been found in which there is a small abortive branch in place of the fructification and the frond was entirely vegetative in function. In *T. teilianum* the pollen producing synangia are known to have been carried on the frond in this manner while in *T. bifidum,* a closely related species small seed-husks have been found similarly

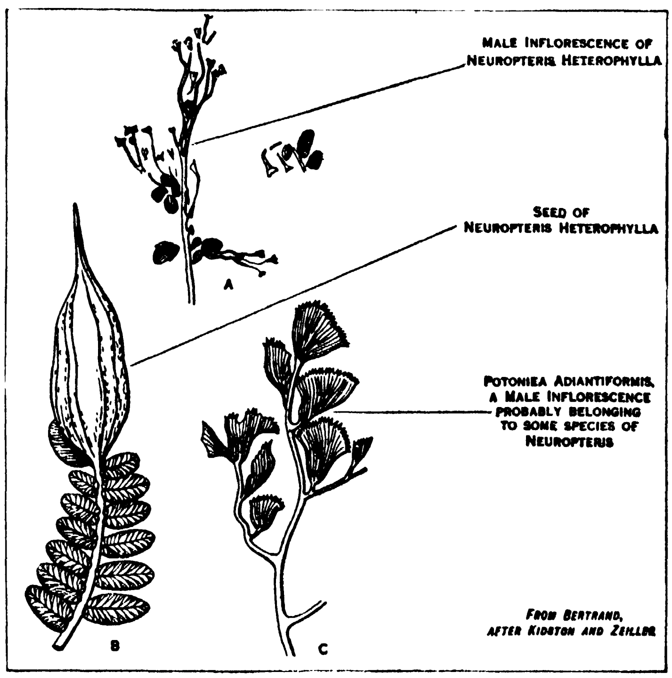


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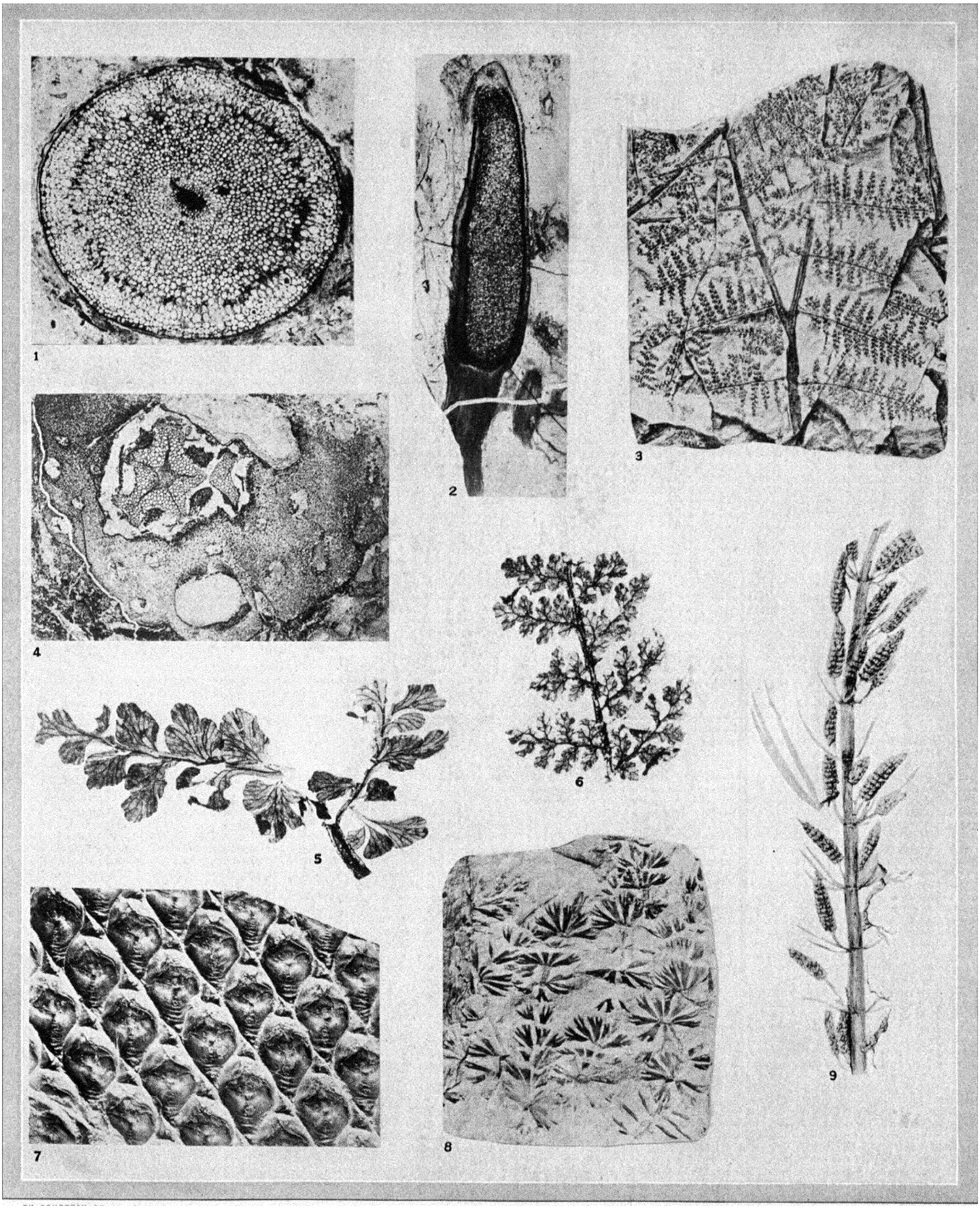
FIG. 18.—PTERIDOSPERM FRUCTIFICATIONS

placed. The nature of the stems of *Telangium* is unknown.

A large number of fossil-stems are known which, judging from their general structure, in all probability belong to the Pteridosperms. Nothing is known about their reproduction. In *Megaloxylon,* an Upper Carboniferous genus, the vascular cylinder consisted of a solid core of primary wood. The protoxylem elements are found in groups at the periphery and when followed upwards each group passes out to a leaf. On tracing them down-

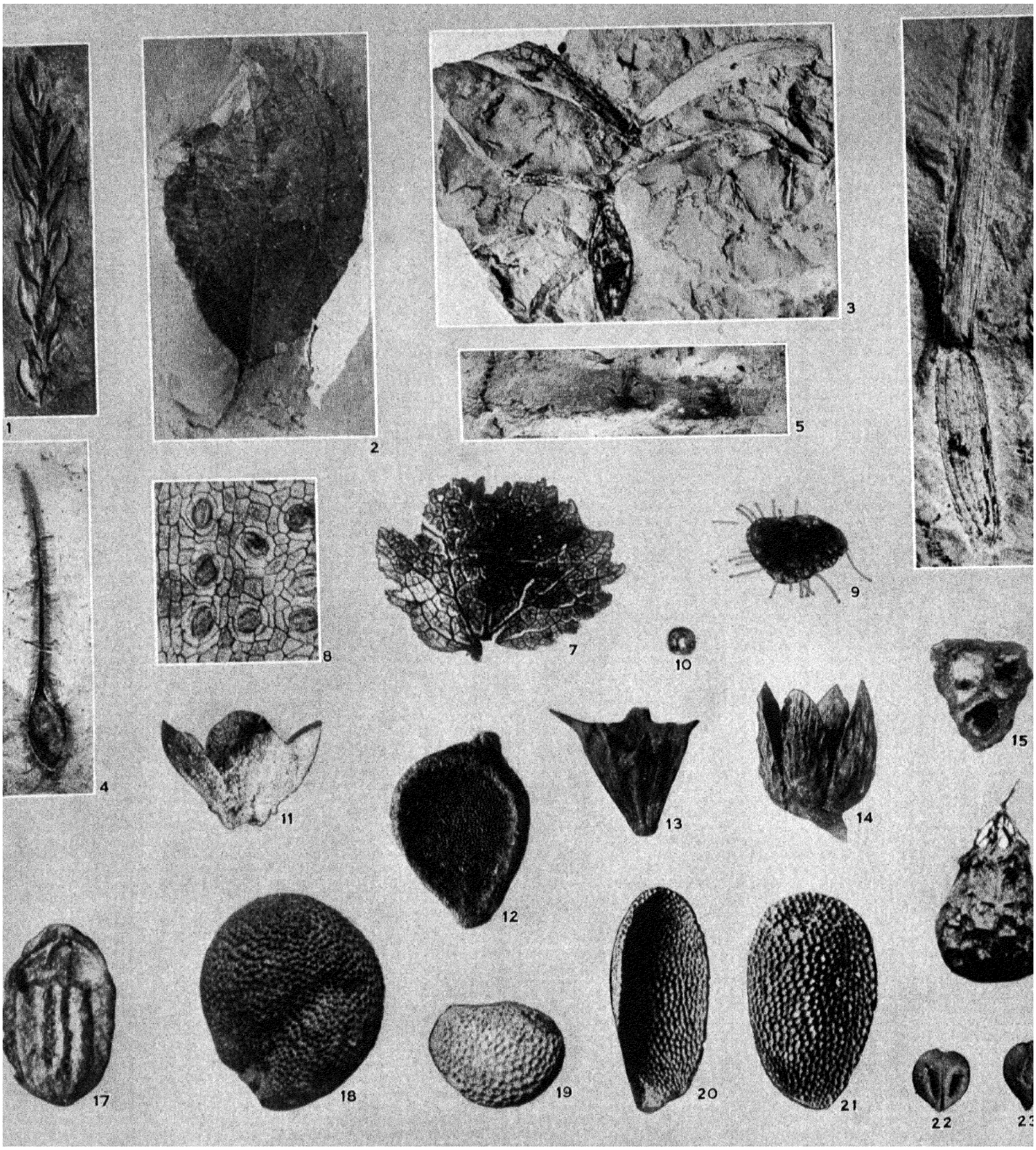


BY COURTESY OF (1, 2) THE ROYAL SOCIETY OF EDINBURGH, (9) PREUSSISCHE GEOLOGISCHE LANDESANSTALT. FROM WEISS, "STEINKOHLEN-CALMARIEN"; FROM (3, 8) SCOTT "STUDIES IN FOSSIL BOTANY" (A. AND C. BLACK, LTD.), (4) D. H. SCOTT "ON A PALAEOZOIC FERN," IN ANNALS OF BOTANY (CLARENDON PRESS)

PLANT FOSSILS OF THE PALAEOZOIC PERIOD

1. *Rhynia major*, cross section of stem (after Kidston & Lang). 2. *Rhynia major*, sporangium in longitudinal section (after Kidston & Lang). 3. *Lyginopteris Oldhamia*. Frond showing the forking of the main leaf stalk (after Potonié). 4. *Ankyropteris Grayi*, cross section of stem (after D. H. Scott). 5 *Sphenopteris obtusiloba* (after Walton). 6. *Renaultia gracilis*. 7. *Lepidodendron* sp. 8. *Sphenophyllum saxifragaefolium*. 9. *Paracalamostachys polystachya*, branch with leaves and cones (after Weiss)

PALAEOBOTANY



FOSSIL TERTIARY AND QUATERNARY PLANTS TO ILLUSTRATE MODES OF PRESERVATION AND VARIETY OF ORGANS. FIGURES 1–6, IMPRESSIONS ON ROCK. FIGURES 7–23, ORGANS FREED FROM MATRIX

Note: The name of the series in which the fossil occurs, Bembridge, etc., follows the name and description of the plant: O. signifies Oligocene; P., Pliocene; and E., Eocene; x 2, etc., indicates approximate magnification in diameters

1. *Araucarites gurnardi*, twig, Bembridge, O. x 2. 2. *Zizyphus paradisiacus* var. *paradoxus* leaf, Bembridge, O. x 2. 3. *Abelia trialata*, fruits showing two of the three wings, Bembridge, O. x 2. 4. *Clematis vectensis*, awned fruits, Bembridge, O. x 3. 5. *Radermachera pulchra*, winged seed, Bembridge, O. x 3. 6. *Apocynospermum dubium*, seed with pappus, Bembridge, O. x 12. 7. *Betula nana* (Arctic birch), leaf, Cambridge (Arctic-bed). x 6. 8. *Araucarites gurnardi*, leaf-cuticle, Bembridge, O. x 120. 9. *Azolla prisca*, male spore-mass, Bembridge, O. x 125. 10. *Azolla prisca*, male-spore, Bembridge, O. x 125. 11. *Diospyros antiqua*, calyx, Hordle, E. x 4. 12. *Ranunculus nemorosus* (buttercup), bruit, Swalmen, P. x 12. 13. *Trapa natans* (water-chestnut), nut, Brunssum, P. x 2. 14. *Fagus decurrens*, beech-mast, Reuver P. x 2. 15. *Proserpinaca reticulata*, fruit, Reuver, P. x 2. 16. *Proserpinaca reticulata*, transverse section of fruit showing 3 locules, Brunssum, P. x 12. 17. *Nyssa silvatica* (American black gum-tree), nut, Swalmen, P. x 4. 18. *Corydalis pulchrum*, seed, Hordle, E. x 15. 19. *Atropa Belladonna* (deadly-nightshade), seed, Silchester, Roman x. 20. *Actinidia faveolata*, seed (outside) Brunssum, P. x 12. 21. *Actinidia faveolata*, seed (inside) Swalmen P. x 12. 22. *Vitis vinifera* (grape), seed (ventral side), Tegelen, P. x 3. 23. *Vitis vinifera* (grape), seed (dorsal side), Tegelen, P. x 3

wards each group spreads laterally round the stele in a tangential direction and finally becomes indistinguishable from the rest of the primary wood and so disappears. There was a considerable development of secondary wood round the primary cylinder.

The Calamopityeae, from the Lower Carboniferous though possibly also represented in the Upper Devonian, have in the centre of the stem a mixture of tracheids and parenchyma surrounded by a ring of xylem strands in each of which the first differentiated tracheids are in the centre. Surrounding the ring of strands is a sheath of secondary wood. The vascular supply to the leaf separates from one of the large xylem strands as in *Lyginopteris* and then divides further out into two strands each of which is surrounded by its own zone of secondary wood This massive type of leaf supply is particularly characteristic of the Pteridosperms and is unlike the comparatively slender leaf-supply in the Gymnosperms. In the *Protopityeae,* unlike all plants known to be Pteridosperms, the leaves were arranged in two opposite series as in some species of *Psaronius.* The pith is elliptical with a sheath of primary xylem surrounding it The leaf vascular supply is given off from the ends of the ellipse Secondary xylem was present Of more particular interest are the stems included in the *Cladoxyleae. Cladoxylon scoparium* (fig 20) from the Middle Devonian of Germany is polystelic like *Medullosa* and the leaves which have been found in this species are deeply cleft and twig-like and are only $\frac{1}{4}$ inch in length The fertile leaves are not so deeply cleft and each division has a small terminal sporangium. Other *Cladoxyla* are known from the Lower Carboniferous; several have secondary thickening There still remains some doubt about the systematic position of *Cladoxylon* which may be either a Fern or a Pteridosperm.

Gymnosperms. (Cordaitales, Coniferales, etc)—*Cordaitales* The Pteridosperms although they produced seeds had some very obvious features of agreement with the ferns in the Cordaitales on the other hand there is little in common with the ferns and they may be regarded as fairly typical gymnosperms. There are three families provisionally grouped in the Cordaitales, the Poroxyleae, Pityeae and the Cordaiteae *Cordaites,* the type genus of the Cordaiteae, of Carboniferous and Permian age, was a lofty tree (fig. 21), unbranched except near the summit and bearing large leaves, linear or spatulate in shape The leaves are traversed with numerous parallel veins and must have looked somewhat like the leaves of the *Aspidistra;* they are inserted in spiral sequence on the stem and branches. The name *Noeggerathiopsis* has been given to similar leaves found in the Carboniferous and Permian of the Southern Hemisphere where the Southern type of Palaeozoic flora is found: there is no important difference between them and leaves of *Cordaites* and a separate name seems unnecessary. The inflorescences consist of small lateral branches each bearing numerous small catkins Each catkin is about a centimetre long and has a short stout axis In the staminate catkins the microsporangia are borne in bunches of from two to five at the ends of slender filaments which contained vascular tissue. These filaments bearing the sporangia arise from between the small, crowded scale leaves which formed the bulk of the catkin or were grouped together near the top. The pollen grains found in the sporangia are of large size. The ovulate or seed producing catkins like the staminate were formed of closely imbricating scales Short stalks bearing ovules arose at intervals between the scales and according to one investigator corresponded in position

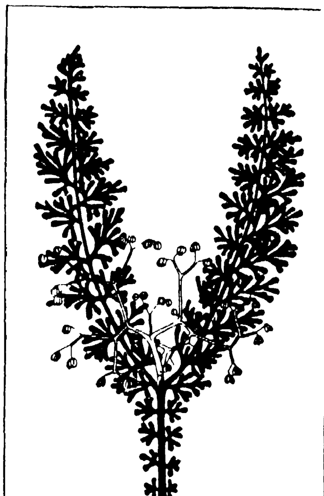
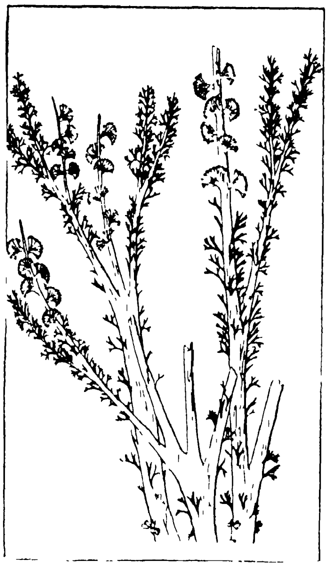


FIG 19 —FROND OF A LOWER CARBONIFEROUS PLANT, PROBABLY A PTERIDOSPERM, WITH THE TELANGIUM TYPE OF MALE FRUCTIFICATION (1/3 NATURAL SIZE)

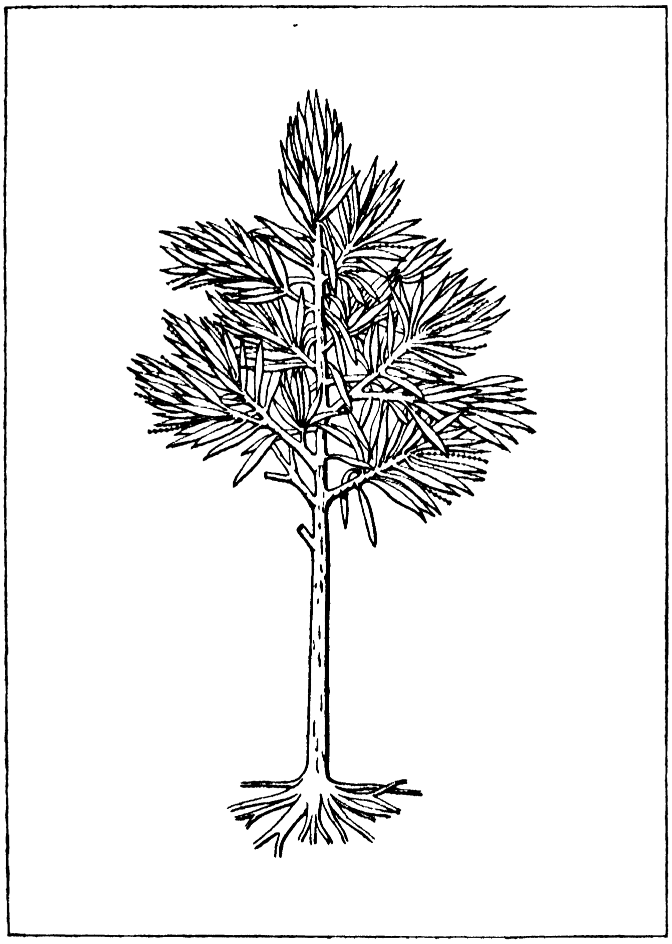
to scales In some specimens these stalks were very short but in others the seeds are found hanging out of the catkins on elongated stalks. It is possible that the stalk of the ovule lengthened as the ovule developed into a seed The ovules and seeds are flattened in a plane tangential to the catkin The integument of the ovule consisted of a hard inner layer and a fleshy outer layer while the nucellus had a well developed pollen chamber with a canal leading to it and was much like the nucellus of the living *Cycas.* In the pollen-chamber large pollen grains have been found similar to those found in the microsporangia The stem is constructed like that of a conifer except that the pith is much larger and consisted of soft tissue which split transversely into a series of diaphragms in the older condition of the stem When the stems started to decay these diaphragms broke down and internal casts in sandstone of these pith cavities exhibit transverse grooves which correspond to the remains of the diaphragms at the edge of the pith These casts receive the distinguishing name *Artisia* and it is not always possible to say whether they belong to *Cordaites* itself or to some nearly allied genus The wood is entirely centrifugal in *Cordaites* but in the closely allied genus *Mesoxylon* there was a small amount of centripetal primary wood The primary strands project into the pith. In cellular organisation the wood is very like that of the living *Araucaria* but like most other Palaeozoic woods from the Northern area there is no evidence of seasonal periodicity in the growth as indicated by the presence of "annual rings" The vascular supply to the leaf is represented by two of the primary strands surrounding the pith, which at higher level pass outwards and on reaching the base of the leaf fork repeatedly and link up with the numerous veins of the leaf lamina This double vascular connection with the axis is also found in *Ginkgo* (maiden hair tree) and is also found in the Pteridosperms In the structure of the leaf some species of *Cordaites* show close resemblance to the cycads, for in each vein the xylem is in two parts; the larger strand lying next the upper surface of the leaf consisting of centripetally developed secondary wood while the underlying strand is centrifugal with the bast lying immediately below it. In other species there is no strand of centrifugal wood Both these types of vein are found in the living cycads sometimes in the same leaf for the base of a cycad leaf centrifugal xylem may be present while higher up it may completely disappear. The veins in some species are surrounded with a sheath of cells with bordered pits just like the corresponding tissue in the leaf of the cycads. Thus in *Cordaites* we find a remarkable combination of pteridosperm, cycad and conifer characters. The fossil roots called *Amyelon radicans* though as yet they have not been found actually attached to the rest of the plant from their almost constant association and agreement in certain microscopical characters are almost certainly parts of cordaitean plants They are typical gymnosperm roots and some of the smaller ones have been found to be infested with fungal mycelium. From the position of the fungus in the roots it is almost certain that they afford an example of the association of a fungus with the higher plant which is common in living gymnosperms as well as in some of the angiosperms and is called Mycorrhiza (*q v*). The leaves of the Poroxyleae, a Permian family, attained the length of a metre and a fifth of a metre in width and show resemblance in structure to leaves of the cycads. The branches arise in the axils of the leaf as in some species of *Lyginopteris* while the vascular tissue of the branch



FROM KRAUSEL UND WEYLAND, "DEVONFLORA" (SENCKENBERGISCHE NATURFORSCHENDE GESELLSCHAFT)

FIG 20 —CLADOXYLON SCOPARIUM This is a Middle Devonian plant from Germany, with a very complex type of vascular organisation

connects up with that of the stem as in the pine. Structurally the stem is more like *Lyginopteris* than *Cordaites*. The xylem of the primary bundles surrounding the pith is entirely centripetal. Where the vascular tissue to the leaf connects with the vascular tissue of the axis it consists of two bundles similar in construction to those of cycad leaves. When traced further down the stem these two bundles appear to fuse and still lower they are only represented by a strand of secondary xylem. In the Pityeae, a Lower Carboniferous and Upper Devonian group, while there are characters indicating a relationship to the rest of the Cordaitales there are also features in their construction which mark them out as a rather distinct group. *Pitys Dayi*, a plant of arborescent habit from Lower Carboniferous rocks on the shore of the Firth of Forth, had short conical projections on its branches representing the leaves which had no flat, expanded surface. These short squat leaves must have made the tree appear like a coarse *Araucaria excelsa*. The stem had a wide pith with a ring of vascular bundles near the periphery with other smaller bundles scattered through it. The first differentiated elements are in the centre of these bundles. The relation between these strands and the rest of the vascular system is unknown. The lower part of the bundle supplying the leaf was situated in the peripheral ring and the upper part forked into three strands in the base of the leaf. A zone of secondary wood surrounded the ring of primary strands but was separated from them by a narrow zone of parenchymatous tissue. Nothing is known about the fructifications of these plants. In *Callixylon* an Upper Devonian genus there are no scattered bundles in the pith but otherwise the structure is not unlike that of *Pitys*. There is little doubt that *Callixylon* and *Pitys* are closely allied. Although an older group than the Cordaiteae and Poroxyleae the Pityeae show closer resemblance to the Araucarian conifers and less evidence of affinity to the Pteridosperms and cycads. A consideration of the comparisons that have been made between these groups leads to the belief in a common ancestral group from which they have all descended.



AFTER GRAND EURY IN SCOTT, "STUDIES OF FOSSIL BOTANY" (A & C BLACK)

FIG. 21.—RESTORATION OF A CORDAITES TREE, SHOWING ROOTS, TRUNK, AND BRANCHES BEARING LONG LANCEOLATE LEAVES AND FRUCTIFICATIONS

Coniferales.—The conifers are the most important group of living gymnosperms and there is evidence of their existence as early as the Palaeozoic. *Walchia* which appears in the Upper Carboniferous, though typically a Permian genus, had leaves and branches very like those of *Araucaria excelsa*. Casts of the pith cavity which show the course of the primary bundles show that in organisation the stem was also in substantial agreement with *Araucaria*. Cones have been found on the ends of the twigs of some species and R. Zeiller has shown that the seeds were in one species borne singly on the cone-scales, a distinctly Araucarian character. More is known about *Voltzia* a characteristic Permian and Triassic genus. The foliage shoots (fig. 22 A) of some species are much like those of *Walchia* and *Araucaria excelsa* and show the same variability in size of leaf even on closely adjoining portions of the same twig. The ovulate or seed-bearing cones (fig. 22, B) are built up of spirally arranged loosely packed scales. Each seed-bearing scale in the Permian species *V. Liebeana* (fig. 22, C, D) had three main lobes, each with a seed attached to its upper surface near its base, and two smaller lobes alternating with the three main lobes but set slightly behind them. In one specimen of a scale which has been investigated a thin pointed scale is present attached to the back of the lobed scale (fig. 22, D). The presence of this scale is of interest in considering the interrelationship of the different groups into which the living conifers are classified and in estimating their relative antiquity. In the Abietineae, the group of conifers to which the pine, cedar, larch, etc., belong, the cone is built up of two kinds of scales each with a vascular system of its own, sterile bract-scales and seed-scales which are situated in the upper angle between the bract scale and the axis of the cone and are partly coherent with the former. In the Japanese cedar (*Cryptomeria*) the two scales are coherent for a greater part of their length and only the tips are free. In others again e.g, *Sequoia* (giant tree of California) there is no outward evidence that two scales are present but the apparently single scale has a double set of vascular bundles which reveal its fundamentally double nature. In the Araucarineae the scale shows practically no indication of being double. For this reason and because the Araucarineae differ in many other ways from the rest of the Coniferae it has been suggested that they have had a separate ancestry from the others. It would appear however from a consideration of the type of double scale found in *Voltzia* which is otherwise very like an *Araucaria* that these two divisions of the Coniferae may have diverged from a common ancestral group which was represented in Permian and Triassic times by plants of the *Walchia* and *Voltzia* type.

FIG. 22.—VOLTZIA; A PALAEOZOIC CONIFER

A. Leafy twig. B. Seed-cone. C. Ventral face of seed-scale with two seeds. D. Dorsal face of seed-scale, with adherent bract-scale

The Distribution of Palaeozoic Floras.—We have seen that the Predevonian Floras consist of Thallophytes, either marine or fresh-water, and we have no evidence of a land vegetation until after the close of the Silurian Period. In the Devonian there is evidence of a rich vegetation from as far north as Ellesmere land and Spitsbergen and as far south as the Falkland islands; so that either the distribution of climatic zones fluctuated considerably or else the climate of the earth was more uniform. The former seems to be the more likely hypothesis. In the Lower

Devonian some large Thallophytes are still found, e.g., *Nematophyton,* while *Zosterophyllum, Psilophyton* and *Arthrostigma,* also characteristic of the period, may represent transition types between Thallophytes and Pteridophytes, but are distinctly nearer in their affinities to the latter. In the Middle Devonian more complicated types appear and in the Upper Devonian several groups of a more modern aspect such as the Lycopods and Ferns become distinct. In the Lower Carboniferous the important groups are the Pteridosperms, Lycopods, Equisetales and ferns and with this constitution the flora persists right through the rest of the Carboniferous and Permian. In the Upper Carboniferous there is evidence of a change of a far reaching nature in the southern hemisphere for a different flora is found there from that in the north. This difference was probably connected with the glacial period which prevailed in the south in Carboniferous times and which left unmistakable traces in contemporary rocks in South Africa and Australia. This southern flora, characterized by the fern-like plant *Glossopteris*, extended into parts of Russia and India but the greater part of the northern hemisphere had an Upper Carboniferous flora of the west European type. An outlier of the northern type of flora has been found in Carboniferous rocks in Sumatra, while in northern South America and in South Africa there is evidence in rocks of the same age of a flora of an intermediate type.

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MESOZOIC

Introductory.—The middle period of geological history, which embraces a succession of ages extending over a few hundred million years, is known as the Mesozoic era; it is divided into three periods, the oldest or TRIASSIC period, followed by the JURASSIC and CRETACEOUS periods. The term RHAETIC (from the Rhaetian Alps) is used for the stage of earth-history between the Triassic and Jurassic periods. Before considering the march of plant-life through the Mesozoic era, it is desirable to obtain a general idea of the relation of the world's vegetation as it was at the beginning of the middle period and of the broad features of the vegetation which has been reconstructed from the remains preserved in the rocks of the post-Mesozoic or Cainozoic era. We shall then be in a better position to appreciate the relation of the floras with which we are now concerned to those which preceded and followed them. In the course of the Palaeozoic era a large portion of the earth's surface had become colonized by many different kinds of plants, some of them comparatively simple, others rivalling in the complexity of form and structure forest trees of the present day. These ancient land-plants were in all probability the modified descendants of inconceivably remote ancestors which lived in the primeval seas. A botanist familiar with the vegetation of to-day, if he could wander through the forest-covered swamps of the latter part of the Carboniferous period (the Coal age), when the Palaeozoic floras reached the zenith of their luxuriance, might at the first glance think himself in a world where tree ferns, giant horsetails (*Equisetum*) and club mosses (*Lycopodium, etc.*) played a dominant part, but on closer inspection he would find that the great majority of the plants were in many respects far removed from all modern types. If he travelled across what are now Europe and North America and extended his journey into the Arctic regions, he would discover comparatively few well marked differences between the western and eastern floras in this area. He would see certain plant-associations on the drier ground and others occupying the low-lying swamps, but the vegetation as a whole would not show any well defined contrasts. Were he to travel into central China and to the Malay region he would be struck by the general resemblance of the dominant plants to those in the northern hemisphere. We know that the forests of the Coal age included many extinct members of the class Pteridophyta (ferns, horsetails, club mosses, etc.) which in their tree-like dimensions and in other characters differed widely from the corresponding diminutive plants of our own time. We know also that nearly all the fern-like shrubs and trees were not true ferns but plants for which it has been necessary to institute a new group-name, the Pteridosperma (*see* Palaeozoic section, above), because they produced seeds in place of the spore-cases (sporangia) which are characteristic of modern ferns. Some of the trees were similar in habit and in the structure of the wood to existing members of the *Araucaria* family, but they differed from all living gymnosperms in the nature of the reproductive organs. There were a few plants with leaves agreeing in form with the fronds of cycads, the surviving representatives in the vegetation of the present day of the Cycadophyta, a class which played an increasingly important rôle as the Mesozoic floras succeeded one another. Similarly a wanderer in the Palaeozoic forests would note here and there trees with relatively broad, wedge-shaped leaves resembling in form and in venation those of the maidenhair tree (*Ginkgo*). In the absence of flowering plants (Angiosperms) and in the unfamiliar features of most of the commoner trees, the forests of the Coal age formed a striking contrast to the woodlands of the modern world. The vegetation of the latter part of the Carboniferous period persisted in diminished numbers into the Permian period which is the last chapter of Palaeozoic history. At the close of the Carboniferous period changes in the earth's crust, which were sufficiently widespread and disturbing to be described as a geological revolution, created a new environment; humid swamps were transformed into relatively dry and hilly regions or into arid wastes in which inland seas like the Caspian replaced estuaries and fresh-water lakes. This shifting of the geological background is reflected in the clearly marked change in the character of the vegetation. The plants from Permian rocks are less numerous and less varied than those preserved in the coal seams and associated sediments of the latter part of the Carboniferous period. At the end of the Palaeozoic era the development of the plant world suffered a severe check; many of the Carboniferous trees failed to survive, a few new forms were evolved, but on the whole there was no marked alteration in the main botanical features of the depauperated floras.

Leaving the threshold of the Mesozoic age we may glance for a moment at the records of plant-life preserved in the rocks classed by geologists as Cainozoic or Tertiary, the rocks which chronicle the events between the Mesozoic era and the relatively short period which began with the great Ice age and shades imperceptibly into the historical age. The vegetation of the Cainozoic era was practically identical in its general composition with that of tropical and sub-tropical lands at the present day. Then as now flowering plants (Angiosperms) were the ruling dynasty and the majority of gymnosperms, ferns and other groups were essentially similar to their descendants which flourish at the present day.

The Palaeozoic forests were archaic and unfamiliar, those of the Cainozoic periods were definitely modern. This transformation was effected during the Mesozoic era; it is therefore in hopeful expectation that the student of ancient floras turns to the fragmentary samples of the vegetable world preserved in the rocks of the intervening epoch of geological history. From a study of Mesozoic floras we might expect to be able to connect the portions of the chain of life reconstructed from Cainozoic fossils with the much more ancient pieces disinterred from Palaeozoic strata. While it is true to say that palaeobotanical research has contributed much towards a knowledge of the successive floras of the Mesozoic era, it is equally true to say that we are still groping after clues which may eventually enable us to visualize the sequence of events in the course of the middle or critical stage in the history of the plant-world. The chief purpose of this article is to present in as concise a form as possible the evolutionary tendencies in the course of the long ages separating the Palaeozoic from the Cainozoic era, so far at least as they can be discovered from the meagre documents at our disposal. The imperfection of the geological record is well put by Sir Joseph Hooker: "We have not in a fossilized condition a fraction of the plants that have existed, and not a fraction of those we have are recognizable specifically."

So far no reference has been made to the Palaeozoic vegetation in the southern hemisphere. In order to obtain as complete a picture as possible of the immediate antecedents of the earliest Meso-

zoic floras it is necessary to include in our summary the greater part of the earth's surface on which we have any information. Owing to the difficulty of defining the boundary in some regions between the Carboniferous and Permian plant-beds it has been a common practice to employ the term Permo-Carboniferous as an admission of incomplete knowledge. We have already given a brief account of some of the salient features of the Permo-Carboniferous vegetation in the northern hemisphere. It is generally agreed that on the northern continents at the close of the Carboniferous period the climatic conditions were genial and favourable to the development of a luxuriant vegetation, and that in the course of the Permian period folding of the earth's crust produced changes in the physical setting which reacted disastrously on the plant-world. We cannot separate the organic from the inorganic world; evolution must be considered from a double aspect, the evolution of the plants in relation to a changing environment.

The Glossopteris Flora.—A precise correlation of beds in widely separated parts of the world is by no means easy; we cannot, for example, assert with confidence whether or not a flora revealed by a study of late Palaeozoic rocks in India and the southern hemisphere was actually contemporaneous with the forests of the northern hemisphere Coal age, or whether certain climatic conditions demonstrated by geologists in the lands south of the Equator synchronized with a strongly contrasted climate in the North. There is, however, a strong body of evidence in support of the view that before the close of the Carboniferous period, when large areas on the northern continents were covered with forests, the southern lands were in the grip of an Ice age and supported a sparse vegetation markedly different from that found on the northern swamps. In the early days of the Carboniferous period closely allied or even specifically identical plants grew in the Arctic regions, in Australia and in many other widely separated regions; the vegetation seems to have been remarkably uniform. In the later stages of the period, on the other hand, there was a well marked differentiation into two or more botanical provinces occupied by more or less sharply contrasted floras. In the latter part of the Palaeozoic era there were two large continents in the northern hemisphere, one including North America, Greenland and Europe which is sometimes spoken of as Eria; and another embracing a large part of Siberia known as Angara Land. Beyond the world-encircling Tethys sea, which washed the southern shores of these great continents, was the vast continent of Gondwanaland, formed of what are now India, Australia, Africa and South America. In geological maps Gondwanaland is usually shown as a continuous land mass parts of which are asssumed to have foundered. If we adopted the hypothesis of Wegener, Gondwanaland would have to be represented as a portion of the crust formed of the present southern continents and India fitted into one another like pieces of a jig-saw puzzle. From this compact mass, disrupted in the Mesozoic era by deep fissures, huge blocks slowly drifted away, like icebergs from a glacier, until they reached their present positions. The Permo-Carboniferous plants and sedimentary rocks of Gondwanaland indicate a state of affairs in the organic and inorganic worlds very different from that revealed by the records in the northern hemisphere. In New South Wales, for example, rocks containing remains of Lower Carboniferous plants agreeing closely with northern species are succeeded by thick masses of old boulder clays (tillites) which afford convincing evidence of a glacial period at the close of the Palaeozoic era, a reign of ice probably longer and more widespread than that which in comparatively recent times held sway over North America and Europe. Geological investigations in Australia have established the fact that before the end of the Carboniferous period the earth's crust was uplifted into mountain-ranges and conditions were produced favourable to the accumulation of ice and snow. Throughout geological history there were recurrent cycles of mountain-building and shifting of the scenes which produced new sets of factors conditioning plant-life; revolutions in the inorganic world caused transformations in the organic world. The story told by the series of plant-beds and glacial deposits in Australia, though differing in detail from that derived from a study of the corresponding strata in India, South America and Africa is broadly speaking the same for Gondwanaland as a whole. Beds of boulder clay containing innumerable erratic blocks, often many tons in weight and resting on platforms grooved and striated by slowly moving rock-studded masses of ice, occur over thousands of square miles from one end of Gondwanaland to the other, from the Falkland Islands to Tasmania, from northern Australia to Afghanistan. The approximate areas which are occupied by glacial beds are indicated in the map. The discovery of plant remains in the Argentine and in South Africa at the base of the glacial beds shows that in these regions, as probably elsewhere, the climatic conditions were not fatal to the existence of vegetation.

Gondwanaland towards the close of the Palaeozoic era may be compared with Alaska and Greenland at the present day, where glaciers and ice-sheets are bordered by an Arctic vegetation. One of the commonest Permo-Carboniferous plants on the southern continent was the genus *Glossopteris* (fig. 1), so named from the tongue-like form of the leaves, the larger of which reached a length of more than a foot. From a well-defined mid-rib are given off arching veins which by repeated unions form a fairly regular network. *Glossopteris* was formerly regarded as a fern similar in its fronds to the existing hart's tongue (*Scolopendrium*) but differing from it in the architecture of the venation; it is now believed to be a member of the Pteridosperms (*see* above) Seeds and leaves have not been found in organic union, but their frequent association in the rocks and the discovery of certain other pieces of evidence favour the conclusion that the stems which bore *Glossopteris* leaves bore also seeds. Because of the abundance of *Glossopteris* fronds and pieces of the stems (*Vertebraria*) the flora of Gondwanaland is usually spoken of as the *Glossopteris flora.* Another common genus is *Gangamopteris* with leaves on the whole larger than those of *Glossopteris* and distinguished by the feeble development or absence of a mid-rib: the two forms of leaf are not always easy to separate. Both genera are almost certainly Pteridosperms. *Schizoneura* is also a characteristic southern genus: more robust than *Equisetum* but similar to the horsetail in its jointed stems, it is distinguished from the northern hemisphere *Calamites* by its longer and broader leaves coalescent in varying degrees into a sheath which enveloped the foliage-shoots at each node. The genus *Neuropteridium* (*Gondwanidium*) (fig. 2) is represented by simple pinnate fronds superficially resembling those of some modern ferns and characterized by the large lobed leaflets; from the lack of fertile leaves one suspects that it may be a Pteridosperm. Two sets of fronds have been called *Neuropteridium,* Permo-Carboniferous and Triassic fronds. It has recently been suggested that, as there is no satisfactory evidence of generic identity, the older forms should be renamed *Gondwanidium, Neuropteridium* being reserved for Triassic fronds (fig. 11), which were probably borne on ferns and not on Pteridosperms These four genera do not occur in the later Carboniferous or in the Lower Permian floras on the continents north of the Tethys sea. The Tethys was a broad sea, stretching across the world. The Mediterranean is its diminutive modern representative. The discovery in 1912 of *Glossopteris* and thin beds of coal by the heroic members of the second Scott expedition on the Beardmore glacier, 300m. from the South Pole, points to the existence of this plant far within the Antarctic circle. It also suggests the possibility that *Glossopteris* and perhaps some of its associates had their origin in the far South.

With the more typical and more abundant members of the Glossopteris flora are associated in some regions, plants generically indistinguishable from northern forms. The long strap-like leaves originally described as *Noeggerathiopsis,* similar in size and shape to the foliage of *Yucca,* appear to be the foliage of trees closely allied to the common northern genus *Cordaites.* Similarly a few species of *Sigillaria* and *Lepidodendron* are recorded from South Africa and South America in company with *Glossopteris.* Other genera which afford points of contact between the two great botanical provinces are *Psaronius,* recorded from Brazil, a tree-fern allied to the tropical Marattiaceae in modern floras; the genus *Sphenophyllum* discovered in India, South Africa and Australia, *Psygmophyllum* with wedge-shaped, lobed leaves similar in form to those of *Ginkgo biloba* (the maidenhair tree) but not neces-

FROM (1) "CATALOGUE OF FOSSIL PLANTS OF THE GLOSSOPTERIS FLORA," (2, 4) DU TOIT, "UPPER KARROO FLORA," (3, 7) "CATALOGUE OF THE WEALDEN FLORA," (5) WALLACE, "MALAY ARCHIPELAGO" (MACMILLAN), (11) ZITTEL, "SEPARAT ABDRUCK AUS PALAEONTOGRAPHICA," IN "DIE FOSSILE FLORA DES BUNTSANDSTEINS" (SCHWEIZERBART)

FIGS. 1–11 — EXAMPLES OF MESOZOIC PLANTS AND TWO LIVING FERNS CLOSELY RELATED TO CERTAIN MESOZOIC FERNS

1. Two forms of *Glossopteris* (A ½ nat. size, B nat. size). 2. *Neuropteridium*, probably a Pteridosperm, slightly less than nat. size. 3. Branch of *Podozamites*, ⅔ nat. size. 4. Fronds of *Thinnfeldia* (A slightly reduced, B slightly enlarged). 5. *Matonia* (taller) and *Dipteris*, ferns, much reduced. 6. Cycadean frond. ½ nat. size. 7. Two leaves of *Sagenopteris* (A nat. size, B slightly enlarged). 8. Fruits believed to belong to *Sagenopteris*. 8a. Restoration of *Gristhorpia Nathorati*, nearly twice nat. size. 8b. *Caytonia Sewardi*, fruit. 8c. *Caytonia Sewardi*, longitudinal section. 9. Stem of *Cycadeoidea gigantea*, ⅛ nat. size. 10a. Restoration of an unexpanded inflorescence, nat. size. 10b. Surface-view of seed-bearing centre (conical apex in 10a). 11. Fronds of *Neuropteridium*, attached to stem. ¼ nat. size

sarily a member of the same class; also a few fern-like fronds which are probably Pteridosperms.

Apart from the abundance of *Glossopteris*, *Gangamopteris* and some other genera peculiar to the Gondwanaland flora, the most striking distinctive feature of the southern vegetation is the absence of the great majority of species and of many genera which played a prominent part in the northern forests. The important point is that the flora of Gondwanaland was relatively meagre and the commonest plants were peculiar to the southern province at least up to the time of the middle of the Permian period. Several years ago some leaves of *Glossopteris* were found in beds of Upper Permian age in northern Russia; more recently this and other members of southern flora have been recorded from several localities in Siberia, also remains of an Upper Permian flora which differed from contemporary floras in the northern hemisphere in the admixture of Gondwanaland species with plants characteristic of the northern province. This Kusnezk flora, so called from the locality in Siberia, has been traced from northern Russia through Siberia and north-west Mongolia to the coast at Vladivostock: it includes with *Glossopteris* such genera as *Neuropteris*, *Callipteridium*, and *Lepidodendron* represented by species characteristic of the northern province. With the Palaeozoic species agreeing with northern or southern forms it is of special interest to find some genera which are characteristic of Mesozoic

floras: examples of these are species of *Baiera, Phoenicopsis, Czekanowskia,* all members of the Ginkgoales, characteristic of pre-Cretaceous Mesozoic floras and more or less closely allied to the maidenhair tree; also *Podozamites* (fig. 3), a genus of uncertain affinity but a gymnosperm probably similar in habit to recent species of the conifer *Agathis* (the kauri pine, etc.) which was very widespread in the earlier Mesozoic floras; *Voltzia,* a conifer, simulating in its leaves some living Araucarias, characteristic of Permian and early Triassic floras in the northern hemisphere and recorded from the Glossopteris flora of India, also *Dioonites,* a genus founded on cycad-like fronds similar to those of the existing Mexican genus *Dioon.* The discovery of beds containing Kusnezk species on the coast of Ussuri Land overlain by strata containing the typical Lower Triassic genus *Pleuromeia* indicates a Permian age for this widespread flora despite the occurrence of several Mesozoic types. There must have been a northward migration of *Glossopteris* and some of its companions across the Tethys sea either by a chain of islands or by a land-bridge. The genus *Glossopteris* is one of several genera which probably originated in the southern hemisphere and gradually spread across the Equator; by the end of the Permian period it was firmly established in the province of the Kusnezk flora and it has recently been recognized in the Rhaetic flora of Scoresby Sound, which is in east Greenland. Similarly the occurrence of *Schizoneura* in the early Triassic flora of western Europe illustrates the penetration of members of the Glossopteris flora into the northern hemisphere in the early part of the Mesozoic era.

It has recently been shown that the Permian or Permo-Carboniferous vegetation of some regions in China was of the typical northern type. Prof. Halle of Stockholm in an exceptionally important memoir (1927) has given an account of the late Palaeozoic floras of central Shansi which are preserved in two series of sediments; the older strata known as the Yuehmenkou series and above it the Shihhotse series. Both floras included species of *Calamites, Sphenophyllum, Pecopteris, Callipteridium, Cordaites, Stigmaria* and other northern Permo-Carboniferous types As in the Kusnezk flora so also in the collections from the Shihhotse series there are species belonging to genera such as *Cladophlebis, Neuropteridium, Chiropteris* and *Dioonites* which bear a very close resemblance to members of Triassic floras in many parts of the world. *Chiropteris* is a genus represented by broad leaves with forking and anastomosing veins which in form remind one of the fronds of some species of the fern *Ophioglossum;* its systematic position is uncertain. Specimens are recorded from Triassic beds in Germany, South Africa and elsewhere. The name *Cladophlebis* is given to the branched fern fronds bearing comparatively short and often slightly curved leaflets, with a central rib and arching, forked lateral veins, attached by the whole of the base; species are characteristic of many Mesozoic floras but are seldom met with in Palaeozoic floras. The Shansi floras differ from the Kusnezk flora in the absence of *Glossopteris* and other Gondwanaland plants. The Shihhotse series is overlain by barren sedimentary beds indicative of desert conditions; it is highly probable, as Halle suggests, that in these beds we have evidence of a change from a genial and humid to a dry climate, which coincided in date with a corresponding revolution chronicled in the Permian period over a wide area in the northern hemisphere. Floras similar to those of Shansi are recorded also from Korea.

This incomplete presentation of facts may serve to illustrate some of the broad features in the distribution and composition of floras at the stage of geological history immediately antecedent to the Mesozoic era. There were at least three botanical provinces characterized by floras that were distinguished by the abundance of certain genera: (1) A very widely distributed and fairly homogeneous northern flora which probably had its origin in the lands north of the Tethys sea and spread southward into China and members of it reached the Malayan region as invaders of the realm of Gondwanaland; (2) the Glossopteris flora from which in late Permian days some of the plants wandered far to the north, and *Glossopteris* penetrated to Greenland well within the Arctic circle; (3) the Kusnezk flora of Upper Permian age, which was in part composed of plants which had found their way across the Tethys sea from the south and in part of representatives of northern Permian floras.

At the beginning of the Mesozoic era the prevalence of desert conditions over a wide area in North America and in the Old World was highly unfavourable to the further development or the continued existence of many members of the rich Permo-Carboniferous flora. By far the greater number of the Palaeozoic species failed to survive; a few new forms were evolved, and some plants such as *Schizoneura* and *Voltzia* were immigrants from Gondwanaland. A comparison of late Palaeozoic and early Mesozoic floras reveals a sharp contrast which furnishes an interesting illustration of the interdependence of organic and inorganic evolution, of the effect of changing geographical conditions on the evolution of the plant world. One of the well established conclusions of geologists is that there have been recurrent cycles of mountain-building and, as a necessary consequence, recurrent interferences with the factors conditioning plant life. One of these geological revolutions occurred at the end of the Palaeozoic era not only in the northern hemisphere but also in China and in some other regions. One of the more important aims of the student of evolution is to discover connecting links in the plant world, particularly at epochs of widespread crustal disturbances. Attention has already been called to the presence in late Permian floras of genera that are characteristic of Mesozoic floras: types, which became prominent in the latter part of the Triassic period and persisted through the several stages of the Jurassic period, were already in existence, though in a subordinate position, before the close of the Permian period The greatest contrast between the two eras is the marked difference in the general facies of the vegetation consequent on the disappearance of most of the commoner members of the older forests; but there is also a considerable difference which is due to the relative abundance in the Mesozoic floras of plants of more modern aspect, plants that are closely akin to living species as contrasted with the more archaic and much less familiar types in the Palaeozoic floras. A comparison of the rich fern vegetation of the Upper Triassic and Rhaetic floras with the comparatively small number of true ferns in the Permo-Carboniferous vegetation raises a question which has not been fully answered; whence came the more modern types of ferns which characterize the Mesozoic floras? The late Palaeozoic ferns, apart from the Marattiaceae, which can be linked with Triassic and Rhaetic forms are very few, and the evidence they afford of direct relationship to Mesozoic ferns is not convincing.

Triassic Floras.—In a general account of the Mesozoic floras it would be out of place to discuss the precise geological horizons within the Triassic period of the plant-bearing strata in different parts of the world, but it is important to consider the composition of the earlier Triassic floras in contrast to the richer plant communities which characterize the later stages of the period.

Remains of early Triassic floras have been found at a few localities in Europe, notably in the Vosges district, on the northern edge of the Eifel, and elsewhere. Characteristic genera are *Pleuromeia, Schizoneura, Voltzia, Albertia, Pelourdea, Neuropteridium, Equisetites* and a few examples of Cycadean plants. *Pleuromeia* is represented by stems, occasionally reaching a length of 2 metres or more, with spirally disposed leaf-scars similar to those on some species of the older genus *Sigillaria.* On the upper region of the stem were overlapping, short and broad scales bearing seed-like reproductive organs. The lobed and swollen base of the stem bearing numerous rootlets suggests comparison with the living quillworts (*Isoetes*). We may picture the plant as a comparatively low unbranched shrub bearing needle-like leaves and at a higher level shorter and broader fertile scales, growing probably among sand dunes in arid regions. It is one of the rare links discovered in Mesozoic floras with the tree-like lycopodiaceous plants of the Coal age. Along with species of *Schizoneura* occur large stems of *Equisetites* differing in their ampler proportions and possibly in structure from modern horsetails. *Voltzia* is a conifer resembling in its foliage-shoots and in the structure of the wood species of *Araucaria, e.g.,* the Norfolk Island pine, *Araucaria excelsa,* but in some respects differing from all recent conifers notably in the structure of the female shoots. *Albertia* with its broader

leaves recalling those of *Agathis*—the genus which includes the kauri pine of New Zealand—may also be related to the Araucarias. In Arizona over many square miles of country petrified trunks of trees, some probably 200ft. in length, have been laid bare by the denudation of early Triassic rocks; many of the stems are Araucarian or have Araucarian characters. Specimens of ribbon-like leaves have been described from Triassic beds as species of *Yuccites, Bambusium,* etc., because of their similarity to the leaves of *Yucca* and bamboos. It has been proposed to refer them to the non-committal genus *Pelourdea.* The probability is that these leaves were borne by plants descended from *Cordaites* or other Palaeozoic gymnosperms.

Reference has already been made to the fern-like fronds of *Neuropteridium* (*Gondwanidium*) as fossils characteristic of the Glossopteris flora; the name *Neuropteridium* is applied also to some Triassic leaves (fig. 11) which are probably not directly related to the southern and older examples. The occurrence of a few fronds such as *Dioonites* and *Zamites* in earlier Triassic floras prepares us for the rapid development of the Cycadophyta in the Rhaetic and Jurassic floras. It is, however, important to note that these generic names, suggested by the resemblance of the fossil leaves to those of the living Mexican and American Cycads *Zamia* and *Dioon,* should not be regarded as evidence of close affinity of the extinct to the living forms.

The much greater abundance and variety of plants in later as compared with the earlier Triassic floras affords evidence of amelioration in the physical environment. Collections made from the Richmond coal field in Virginia and from Upper Triassic beds in Austria and Switzerland enable us to follow the main lines along which the plant world was developing. Among equisetaceous types attention may be called to the genus *Neocalamites* which is not always readily distinguishable from *Schizoneura.* It is characterized by long linear leaves springing in circles from the nodal joints and free to the base instead of being united into a sheath as in *Equisetum. Neocalamites* was a very widely distributed Triassic genus; it is recorded from Tongking, from South Africa and Australia, as well as from northern localities. A notable feature of the Keuper floras is the abundance of ferns; *Macrotaeniopteris,* characterized by simple banana-like fronds reaching a length of a metre and a breadth of 17cm., is probably a fern though no sporangia have been discovered. Fronds often described as species of *Acrostichites,* an unfortunate name because of its implication of relationship to the living genus *Acrostichum,* are in some instances at least members of the Osmundaceae, a family which has been traced as far back as the Permian period. *Clathropteris platyphylla,* with its large fronds divided into spreading lobes like the segments of a horse chestnut leaf and its approximately rectangular meshes of slender veins on either side of a central rib, is one of many ferns in Mesozoic floras agreeing closely with the Indian and Malayan species of the genus *Dipteris.* The family Marattiaceae, now characteristic of the Tropics, was also represented by *Pseudodanaeopsis, Marattiopsis* and other genera closely resembling recent tropical species. These and other ferns are a few of many Triassic genera which give a modern aspect to the earlier Mesozoic floras.

Another distinguishing feature of the later Triassic floras is the abundance of the Cycadophyta as illustrated by such genera as *Sphenozamites* with its handsome fronds bearing two rows of large truncate segments, *Pterophyllum* and *Pseudoctenis* with fronds similar to those of several existing cycads in the form of the leaflets. It must be remembered that the term Cycadophyta is used in a comprehensive sense embracing not only the living cycads, represented by a comparatively small number of species and genera for the most part tropical in range, but also an extinct group, the Bennettitales. The Bennettitales reached their maximum development in the Jurassic period and in the early days of the Cretaceous period when they were represented by a large number of types: in the form and structure of the stem and in their large palm-like leaves many of them must have borne a striking resemblance to modern cycads, but in the structure of the reproductive organs they differed in many characters from all existing cycads (*see* p. 86). The point which concerns us at the moment is that the much greater wealth of cycadean plants in the later Triassic floras than in the earlier floras of the same period prepares us for their further increase in Rhaetic and Jurassic floras. Similarly the occurrence in some Triassic beds of the genus *Thinnfeldia* (fig. 4), which is probably a pteridosperm, characterized by fern-like fronds with leathery leaflets, is another example of the appearance of a new type which played a conspicuous part in Triassic, Rhaetic and Jurassic floras in almost all regions of the world.

The abundance in Upper Triassic floras of large-leaved species of the class Ginkgoales is a noteworthy character; the genus *Baiera* represented by large wedge-shaped leaves cut into linear segments and, in the more typical species, without a leaf-stalk, though already in existence in the Palaeozoic era began to play a prominent rôle in the vegetation of the Keuper stage; it persisted through the Rhaetic and Jurassic periods and survived into the Cretaceous.

Among other gymnosperms reference may be made to *Podozamites* (fig. 3), a tree with leaves similar to those of species of the living conifer *Agathis,* but distinguished from all recent genera by bearing its short, fertile, seed-bearing leaves in loose catkin-like clusters. *Podozamites* is an example of a genus which began its career in the Triassic period and became a cosmopolitan and abundant plant in Rhaetic and Jurassic floras. Our knowledge of the conifers is scanty; *Voltzia* survived from the early Triassic floras and with it some other members of the group which, through lack of material, cannot be closely compared with modern types.

In illustration of the salient features of the Triassic vegetation of Gondwanaland a brief reference is made to the plant-beds of South Africa. Sedimentary strata included in the Stormberg series have yielded a flora which shows many points of contact with the floras of the northern hemisphere. *Voltzia, Baiera, Pterophyllum, Pseudoctenis, Thinnfeldia, Schizoneura, Neocalamites,* genera of true ferns and plants with fern-like fronds occur with *Glossopteris* and other genera peculiar to southern Triassic floras. One of the most remarkable constituents of the South African vegetation is the genus *Rhexoxylon* founded on petrified wood; this was at first believed to be allied to a Palaeozoic group of gymnosperms, the Medulloseae, but an examination of additional specimens led J. Walton to compare it with certain species of *Dadoxylon,* a genus of conifers. The stem of *Rhexoxylon* reached a length of several metres and a diameter of 25cm.; it is characterized by a large pith with secretory ducts and some scattered vascular bundles, but more especially by the unusual arrangement of the wood, which was divided into wedge-shaped masses separated by bands of softer tissue and bears a very striking resemblance to the structure of some Dicotyledonous climbers in the tropical forests of the present day. *Rhexoxylon* is recorded from Triassic and probably Rhaetic beds in South Africa, and from the Antarctic continent. Nothing is known of the leaves or reproductive organs; the most interesting feature is the close agreement in the structure of the stem with that of certain living plants belonging to an entirely different section of the vegetable kingdom.

From a comparison of the fossil plants obtained from South Africa, India, Australia and South America it has been established that in its main features the Triassic vegetation of Gondwanaland was fairly uniform; many of the genera are common to both hemispheres and the distinction between the northern and southern continents was less obvious than in the latter part of the Palaeozoic era.

Rhaetic Floras.—The Rhaetic floras, richer than those of the Keuper series, are preserved in deposits formed for the most part in the estuaries of rivers and represented in many widely separated regions. Between the late Triassic plants and those furnished by the overlying Rhaetic rocks the difference is comparatively slight; there is a greater wealth of material in the Rhaetic beds and, though new forms occur, the general facies is similar to that of the Keuper vegetation. A rich Rhaetic flora has been described from Tongking; another equally rich flora has left abundant remains in southern Sweden and more recently a no less luxuriant flora has been described from Rhaetic rocks in the Scoresby

Sound district in Greenland (Harris, 1926). Collections of the same geological age have been made from central Europe and from many other regions. Though it is not easy precisely to correlate the rocks of Gondwanaland with those in the northern hemisphere, we know that in its broader features the vegetation which flourished south of the Tethys sea agreed with that of the rest of the world. This statement is not intended to give the impression of a vegetation unaffected by differences in climate; there were undoubtedly regional peculiarities, but there were many genera which appear to have had a remarkably wide geographical range. In the Rhaetic flora of Tongking *Glossopteris* is a connecting link with the Permo-Carboniferous vegetation of Gondwanaland, and the recently re-recorded occurrence of the genus as far north as Lat. 70° N. in Greenland demonstrates clearly its capacity as a traveller. In the Tongking flora we find also *Equisetites* and *Neocalamites* represented by species closely allied to northern forms. Among the ferns are many splendid examples of *Dictyophyllum* and *Clathropteris,* suggestive of the fronds of Malayan species of *Dipteris* (fig. 5, the smaller fronds); also of the *Osmunda* family. The various forms of simple *Taeniopteris* leaves recalling those of the hart's tongue (*Scolopendrium*), may be the foliage of Cycadophyta and not true ferns. *Pterophyllum* seems to have been one of the most conspicuous members of the Cycadophyta, a class represented by other genera such as *Ptilophyllum* and *Otozamites.* The fronds known as *Ptilophyllum* are characterized by two rows of linear segments giving them an appearance similar to that of the leaves of the Mexican cycad *Dioon: Otozamites* fronds are distinguished by the eared base of the segments which are occasionally relatively broad. Species of the cosmopolitan *Podozamites* also occur. It is pointed out by Dr. du Toit, in his recent account of the older Mesozoic floras of South Africa, that while the Tongking flora contained several plants specifically identical with South African and Australian forms, the absence in the Far Eastern vegetation of *Ginkgoites, Thinnfeldia* and other common Rhaetic genera is an interesting feature.

As we analyse more carefully the Triassic-Rhaetic floras of the world we shall no doubt find evidence of regional differences comparable, though less pronounced, to those in the vegetation at the present day. The close correspondence between the floras of east Greenland and the province of Scania (southern Sweden) is a remarkable fact. When we think of the enormous difference between the present north Temperate vegetation of Sweden and the treeless and stunted Arctic flora it is very difficult to understand the extraordinary resemblance presented by the two fossil floras, not only in the number and variety of the plants but also in the size of the vegetative organs. It is very unlikely, so astronomers tell us, that the earth's axis has changed its position, or at least to an extent that would make any appreciable difference to climatic conditions during that portion of geological history with which we are concerned. A possible explanation is offered by the Wegener hypothesis; in the Rhaetic period Greenland may have occupied a position relative to Europe and to the north pole different from that which it occupies to-day. There seems to be no satisfactory solution of this and other climatic problems raised by palaeobotanical researches if we reject, as we probably must, the suggestion that the axis of the earth has altered its position, and if we follow some of Wegener's critics and reject also the hypothesis which assumes changes in the relative positions of portions of the earth's crust.

There are few more attractive problems than those raised by the discovery of comparatively luxuriant floras in the Arctic regions. It is clearly impossible to make any definite statement of scientific value as to the temperature necessary for the existence of a vegetation composed of extinct species. We are apt to assume that a plant from Rhaetic or other strata, if it bears a resemblance to one which still exists, must have required for its normal development climatic or other conditions approximately the same as those prevailing in the localities of its modern representative. Such an assumption might be reasonable if based on a comparison of an assemblage of many extinct and recent forms, but it must be remembered that living plants closely related to one another are often able to exist in places with sharply contrasted temperatures. Making due allowance for the adaptability of closely allied species to widely different conditions, and admitting the danger of applying knowledge derived from observations on living plants to species which became extinct many million years ago, there remains the problem of accounting for the occurrence in southern Sweden and in eastern Greenland of floras that are in general terms identical.

What then are the salient features of the Arctic Rhaetic flora? Among the Equisetales are species of *Neocalamites* in no way inferior to those from Queensland, Tongking, South Africa and elsewhere. The discovery of a large Lycopodiaceous cone, *Lycostrobus Scotti*, in the Rhaetic flora of Sweden and the subsequent recognition of spores in the Greenland beds, which are almost certainly referable to *Lycostrobus,* affords one of the few instances of the survival into the Rhaetic period of a plant bearing a striking resemblance to the Lepidodendra of the Carboniferous forests. Ferns are represented by large fronds of the genus *Todites*, that are so named from their likeness in form and in the structure of the spore-capsules (sporangia) to the living osmundaceous fern *Todea barbara* of South Africa and New Zealand, and by species with fronds of the type designated as *Cladophlebis* a genus that was widespread also in the Jurassic period. The occurrence in Greenland of pieces of fronds hardly distinguishable from a species of *Gleichenites* described from the Lower Jurassic flora of Franconia in Germany, affords some evidence of the existence in the Arctic flora of a member of a family that is now very widely spread in the Tropics and in the Cretaceous period was particularly prominent in the vegetation of western Greenland. Among other ferns are *Matonidium*, similar in habit to the living Matonia (fig. 5), *Laccopteris, Dictyophyllum*, and *Hausmannia,* genera agreeing in habit and in the structure of the sporangia with what has been called by F. O. Bower the *Matonia-Dipteris* alliance.

One of the most clearly established facts in the history of ferns is the striking contrast between the present restricted geographical range of the two Malayan genera *Matonia* and *Dipteris* and the almost world-wide range of Mesozoic ferns, described under several generic names, which are believed on good evidence to be nearly related to one or other of these plants. The two living genera, figured by A. R. Wallace (fig. 5) side by side on Mt. Ophir in the Malay Peninsula, may be regarded as relics of a remote past, survivors of a line of ancient lineage, which after wandering over the world from Arctic lands to the far south and east persist as impressive links with a vanished world.

Reference has already been made to the genus *Thinnfeldia;* the fronds of this plant and those of a somewhat similar genus *Lepidopteris* are widely scattered Rhaetic types. *Lepidopteris,* bearing small, thick leaflets with rounded tips, is one of the Rhaetic genera which though fern-like in habit is probably a Pteridosperm: it is recorded from Greenland, Sweden, Germany, Poland and Madagascar. *Thinnfeldia* and *Lepidopteris* differ from ferns in the more leathery texture of the leaflets, which are more resistant than those of ferns to certain chemical reagents, and by the absence of any sporangia of the typical filicean type. Both may be Pteridosperms, anachronisms in the Mesozoic floras.

As we pass from Triassic to Rhaetic floras cycadean plants increase in number and diversity of habit. Our knowledge of these plants is based mainly on external form of the fronds, some simple and undivided, others with a lamina dissected into broad, equal or unequal segments (for example, *Nilssonia*) or, as in the leaves of modern cycads, with separate leaflets attached to a strong rachis (*e.g., Zamites,* fig. 6, and *Otozamites*). It has, however, been possible to supplement the distinguishing characters afforded by external differences by the more trustworthy criteria furnished by the microscopical structure of the epidermal layers. We know little of the reproductive organs of many of the Mesozoic Cycadophyta, but in a few instances it has been possible to make out the characters of both the male and female organs. One example may be quoted: Prof. Nathorst described under the name *Wielandiella* regularly forking stems bearing in the angles bud-like shoots consisting of a short and thick axis

covered with a mosaic of two kinds of appendages, the greater number sterile, slender scales (interseminal scales) with slightly expanded flat tops surrounding similar appendages which were fertile and bore each a small terminal seed. These seed-bearing and sterile scales may be regarded as modified leaves. From the base of the fertile axis "flower" were given off short modified leaves bearing sporangia containing microspores (pollen-grains). The whole fertile shoot was surrounded by linear leaves (bracts). On the forked stem were simple foliage leaves similar in shape to small fronds of a hart's tongue fern but with the blade divided into segments. The plants must have resembled a shrubby *Magnolia,* the fertile shoots being superficially comparable to the flower but differing from all existing flowers in the nature of the female organs. *Wielandiella* agrees in the general plan of its "flowers" with the genera *Cycadeoidea* and *Williamsonia,* that came into prominence in the Jurassic period and flourished in the early days of the Cretaceous period. The two latter genera agreed in form and to a large extent in structure with living cycads: *Wielandiella* on the other hand differed widely both from the two extinct genera and from all recent cycads in the much more slender and dichotomously branched stem.

Among other genera met with in Rhaetic floras in many parts of the world are *Sagenopteris* and *Podozamites. Sagenopteris* is represented by leaves with a few (three to six) narrow oval or elliptical leaflets springing like the fingers of a hand from a single stalk and resembling *Glossopteris* in the network of veins. The genus has often been compared, on account of leaf resemblance, with the water fern *Marsilia,* but Dr. Thomas has made out a good case in favour of referring to *Sagenopteris* two different kinds of fertile shoots, or catkins, bearing spherical fruits (fig. 8A) or groups of pollen-sacs. The female shoots, described by him as species of *Gristhorpia* and *Caytonia,* consist of an axis bearing two rows of short branches each of which carries an apical case containing seeds which is compared with the carpel (pistil) of a flowering plant (fig. 8A-C). These "carpels" differ from those of modern plants in being modified leaflets, and not formed from complete leaves. The male shoots, referred to the genus *Antholithus,* are of similar form and their branches bear clusters of four-lobed stamens containing winged pollen-grains. The fruits, first described from the Jurassic rocks of Yorkshire, contain closely packed seeds (fig. 8C); on the surface of the wall near the attachment of the fruit to its stalk is a stigmatic lip (fig. 8B) for reception of the pollen. Dr. Thomas instituted a new class, the Caytoniales (from a locality near Scarborough where the fossils were found) for these supposed primitive Angiosperms. Rhaetic and Jurassic floras have long been known to be rich in gymnosperms, particularly in Cycadophyta, but with the exception of a single leaf, which if it had been found in Cretaceous or Tertiary beds would have been referred to a Dicotyledonous plant, no evidence of the existence of the great class Angiospermae (flowering plants) had been furnished by the earlier Mesozoic floras. One of the attributes of angiosperms is the production of ovules, which after fertilization become seeds, in a closed vessel or ovary, a character implied in the name of the class (seeds contained in a case), in contrast to the naked seeds of conifers and cyads. It is at least certain that the Caytoniales which are represented in Rhaetic as well as in Jurassic rocks, are the most satisfactory examples so far discovered of extinct plants with a definitely angiospermous attribute. The abundance of angiosperms in some of the older Cretaceous floras and the rapidity with which they wandered over the world during the earlier stages of the Cretaceous period suggest that they must have been evolved long before they came to occupy the premier position in the vegetable kingdom. The primitive types of angiosperms probably differed widely in habit from those with which we are now familiar. *Sagenopteris* may be a pioneer of the present ruling dynasty, which having passed slowly through the earlier stages of evolution reached its full vigour in the early days of the Cretaceous period.

Conifers, though less prominent than Cycadophyta and ferns, were fairly numerous in Rhaetic floras; some were closely allied to living members of the *Araucaria* family; others such as *Stachyotaxus* with its yew-like foliage differed considerably in the fertile shoots from all recent species. Species of *Baiera, Ginkgoites* and other members of the Ginkgoales with leaves similar in form and in the structure of the epidermal layer to the "living fossil" *Ginkgo biloba,* are among the most abundant and widely distributed Rhaetic plants.

JURASSIC FLORAS

Samples of the vegetation prevalent in Jurassic times are scattered through the rocks from the far north in Franz Josef Land and Alaska to north and central Europe, Siberia, India, Japan, North America, and in Graham Land on the borders of Antarctica. One of the best known floras of the Middle Jurassic period is that preserved in the upraised sediments of estuaries which form the moors and cliffs of east Yorkshire In its main characters the Jurassic vegetation carried on the tradition which began in the latter part of the Triassic period and was further developed in the Rhaetic period. Many Rhaetic genera persisted; some new types were evolved, and a comparative study has shown that while the Rhaetic facies in its broad features was maintained there are certain characters by which Jurassic floras can usually be recognized. A brief comparison with the present vegetation of the fern-covered river-banks and the shrubs and trees on the deltas in the area that is now traversed by the Yorkshire cliffs, from north of Whitby to south of Scarborough, may enable us to realize the more striking contrasts between the present and the past. Then as now there were horsetails (*Equisetum*) forming miniature forests on the swampy ground: the plants were more robust and taller than their modern descendants, though they were smaller than their Triassic forebears. The reign of *Schizoneura* and *Neocalamites* was almost over: among the commoner plants were many which no longer occur in Europe: a botanist wandering over the deltas would be reminded of lands south of the equator: ferns such as *Dictyophyllum* and *Matonidium* would recall *Dipteris* and *Matonia;* he would also find species belonging to the Schizaeaceae, Gleicheniaceae, Marattiaceae, and Cyatheaceae, families no longer represented in the British flora and most abundant in warmer, southern lands. He would note the prevalence of species, some of them unfamiliar in the architecture of the fronds, agreeing in the structure of the spore-capsules (sporangia) with the royal fern (*Osmunda regalis*). He would also discover clumps of *Thinnfeldia* probably occupying drier ground, the fern-like fronds characterized by their stiffer leaflets without sporangia of the normal fern type. Passing to the taller shrubs and trees he would be struck by the abundance of stems bearing crowns of fronds of diverse form resembling in a greater or less degree the sago palms (cycads) of the tropics. On closer inspection he would find that the cycadean plants bore shoots similar in shape to the flower heads of the globe artichoke (*Cynara*), some of them unisexual, others with male and female organs on a single axis instead of the male and female cones of modern cycads. The great majority of these cycadean plants belonged to the Bennettitales, a group that has long been extinct, and not to the cycads in the narrow sense. Most of them were constructed on the ordinary cycad plan as regards the stem, but the type represented in the Rhaetic floras by *Wielandiella* persisted under a slightly different form into the Jurassic period. This aberrant Jurassic type was described by Dr. Thomas as *Williamsoniella;* it had a comparatively slender and forked stem bearing scattered leaves (*Taeniopteris*) more fern-like than cycadean in form, and in the angles of the forked branches bisexual "flowers" resembling those of *Wielandiella.* He would probably look in vain for oaks, elms, sycamores, the ash, alder, and other broad-leaved trees, though he might discover some plants which would puzzle him by the association of a strange type of foliage with flowers distantly related to those of some modern angiosperms. He would see cone-bearing trees reminding him of the Norfolk Island pine (*Araucaria excelsa*), trees with shoots like those of cypresses, the incense cedar of America (*Libocedrus*), and the Arbor vitae (*Thuja*); some with two-ranked leaves recalling the yews, the giant redwood of California (*Sequoia sempervirens*) and other conifers. The conifers as a whole would seem familiar, though the association in the North Temperate region of types that are now widely scattered in

warmer countries would afford an interesting topic of speculation on the vagaries of plant-dispersal. He would be surprised to find many trees exhibiting clear signs of relationship to the maidenhair tree (*Ginkgo*). From his knowledge of present-day vegetation he would have difficulty in assigning to their position in the plant-world such genera as *Sagenopteris, Thinnfeldia* and other legacies from older floras.

There were frequent though comparatively slight oscillations of the earth's crust in the course of the Jurassic period which are registered in the varying nature of the sedimentary rocks—series of beds rich in the shells of marine creatures associated with deposits formed in estuaries and lakes. The period is subdivided into stages grouped as Lower, Middle, and Upper Jurassic. A considerable interval of time separated the stages represented by the plant-bearing beds of Lower Jurassic age, such as occur in England on the coast of Dorset, from Upper Jurassic dirt beds (old surface-soils) near Lulworth cove in the same county. Beds intermediate in age are exposed on the Yorkshire coast. It is unnecessary to follow the changes in the rise and fall of individual species from the earlier to the later stages of the period; there were differences in detail, but the main features of the vegetation so far as we know remained fairly constant. Ferns, Cycadophyta, Ginkgoales and conifers continued to be the ruling dynasties from the Rhaetic through the Jurassic period.

Cretaceous Floras.—In the south of England and in some other parts of the world there is no sharp line of division between the last phase of the Jurassic period and the dawn of the Cretaceous period. In the Weald district of Kent and Sussex, in northern France, Germany and Belgium a series of fresh-water beds contains records of a time when rivers carried into a large lake logs of wood, twigs, leaves, and other samples of the vegetation which grew on the adjacent land. From the relics of this flora preserved in the cliffs at Ecclesbourne, near Hastings, on the south coast of England, and at other localities in western Europe it is possible to form a picture of the plant-world at the beginning of the Cretaceous period. The differences between this Wealden flora in northern Europe and the preceding Jurassic floras are comparatively slight: a few new forms are met with, for example a plant known as *Weichselia Mantelli* usually regarded as a fern with spreading fronds bearing small and thick leaflets; another fern *Onychiopsis psilotoides*, probably allied to the living genus *Onychium*, a member of the Polypodiaceae which is represented in the Far East and in other regions; also a fern of peculiar habit referred to the genus *Tempskya*, which may be a member of the Schizaeaceae, recorded from several European localities and from Montana; species of conifers agreeing in the needle-like leaves and in the cones with members of the family Abietineae which includes pines, firs, cedars, larches and other genera. The genus *Sagenopteris*, though not yet extinct, was much less in evidence in early Cretaceous than in Jurassic floras. In the Wealden vegetation of northern Europe there were no trees, so far as is known, other than conifers. The vegetation had still the Jurassic facies at least in the main. Reference has already been made to the structure of the fertile shoots of the Rhaetic genus *Wielandiella* and the Jurassic *Williamsoniella*, two examples of the extinct Bennettitales which in their comparatively slender, forked stems differ widely from all existing cycads.

One of the outstanding features of the early Cretaceous floras is the abundance of cycadean plants, a feature also of Jurassic vegetation. Most of the stems are of the type known as *Cycadeoidea;* the splendid specimen (fig. 9) from Upper Jurassic rocks of southern England, *Cycadeoidea gigantea*, agrees closely with stems of some modern cycads in its bulky form and in the closely packed persistent bases of old leaf-stalks which give a characteristic appearance to the plant. This species differs from most examples in the absence of fertile branches. The first typical representative of the genus is one described by Carruthers from Lower Cretaceous beds in the Isle of Wight named *Bennettites Gibsonianus* and now included in *Cycadeoidea*. Embedded among the leaf-bases are several lateral branches bearing a terminal "flower" and numerous short, linear leaves. In this species the flowers appear to be unisexual and female. The discovery in Dakota and in other districts in North America of hundreds of stems preserved in wonderful perfection supplied material which was described by Dr. Wieland in two well-illustrated volumes. Some of the stems are unbranched; others consist of several tuberous branches. A remarkable feature is the extraordinary abundance of fertile shoots on a single stem. The flowers are usually bisexual, some bearing male and female organs which were apparently functional; others with female organs only and with scars showing the former presence of male organs. A fertile branch ends in a depressed dome or in a tapered cone (fig. 10A) covered with two kinds of appendages, fertile ovule-bearing or seed-scales, each surrounded by a rosette of sterile inter-seminal scales with swollen, flat tips (fig. 10B) forming a protective layer over the whole "fruit." Below the female portion was a circle of 10–20 pinnately branched stamens bearing rows of compound sporangia (pollen-sacs) with numerous pollen-grains. The stamens were at first infolded round the flower-axis; after expanding and shedding the pollen they fell off. The fertile branch bore numerous hairy bracts, which surrounded a conical axis, bearing short female organs (ovuliferous scales) and interseminal scales enclosed by a series of infolded leaves (stamens) bearing rows of compound sporangia (pollen-sacs). The seeds contained an embryo with two cotyledons. The male organs may be compared on a small scale with the fertile leaves of modern ferns of the family Marattiaceae; while the female organs are of a type that is peculiar to the Bennettitales (*e.g., Wielandiella, Williamsoniella, Williamsonia, Cycadeoidea*). The largest example of a flower so far recorded is one described by Dr. Marie Stopes from Lower Cretaceous beds in the Isle of Wight which produced thousands of small seeds on a single "fruit." *Cycadeoidea* in its reproductive apparatus differs fundamentally from existing cycads though in the form and structure of the stem it is similar to them. It has been suggested that the general resemblance of the bisexual flowers to those of a magnolia may be an expression of actual affinity and that the angiosperms, which replaced the Cycadophyta as the ruling dynasty in the early days of the Cretaceous period may be connected with them by descent. The chief difficulty in the way of accepting this view is the lack in the flowers of the Bennettitales of any structure definitely comparable with an ovary. A few leaves discovered in strata on the Atlantic border of the United States of America, in the so-called Potomac series the lowest members of which are approximately equivalent to the English Wealden series, bear some resemblance to those of certain modern flowering plants; but their precise nature is uncertain. On the other hand Lower Cretaceous beds along a strip of the west Greenland coast on Disko island, on the coast of the adjacent mainland and on Upernivik island (Lat. 71° N.) have yielded several Wealden species. A species of *Ginkgoites*, ferns allied to *Matonia* and *Dipteris*, several forms of *Gleichenites*, closely allied to tropical and sub-tropical Gleichenias and to fossil members of the family recorded from Jurassic rocks, also some Wealden species of gymnosperms, associated with many leaves practically identical in form and venation with those of living flowering plants. Plane trees, magnolias, oaks, also leaves described as *Dalbergites* because of their striking resemblance to the foliage of the tropical genus *Dalbergia*, a member of the Leguminoseae It is significant that in no other part of the world do we find a greater abundance and variety of angiosperms preserved side by side with ferns and gymnosperms, which appear to be specifically indistinguishable from Wealden species from northern Europe, North America and many other parts of the world. It would seem, therefore, that many of the broad-leaved trees may have had their origin in the early days of the Cretaceous period on an Arctic continent whence in later times they spread farther and farther towards the south.

It is worth while to consider in rather more detail the nature of the vegetation which flourished in Greenland in the earlier stage of the Cretaceous period. We have already commented on the luxuriance of the Rhaetic flora of Scoresby Sound in east Greenland; the Lower Cretaceous flora has been partially reconstructed from specimens obtained from beds on approximately the same latitude (Lat. 70–71° N.) on the opposite coast. Another question

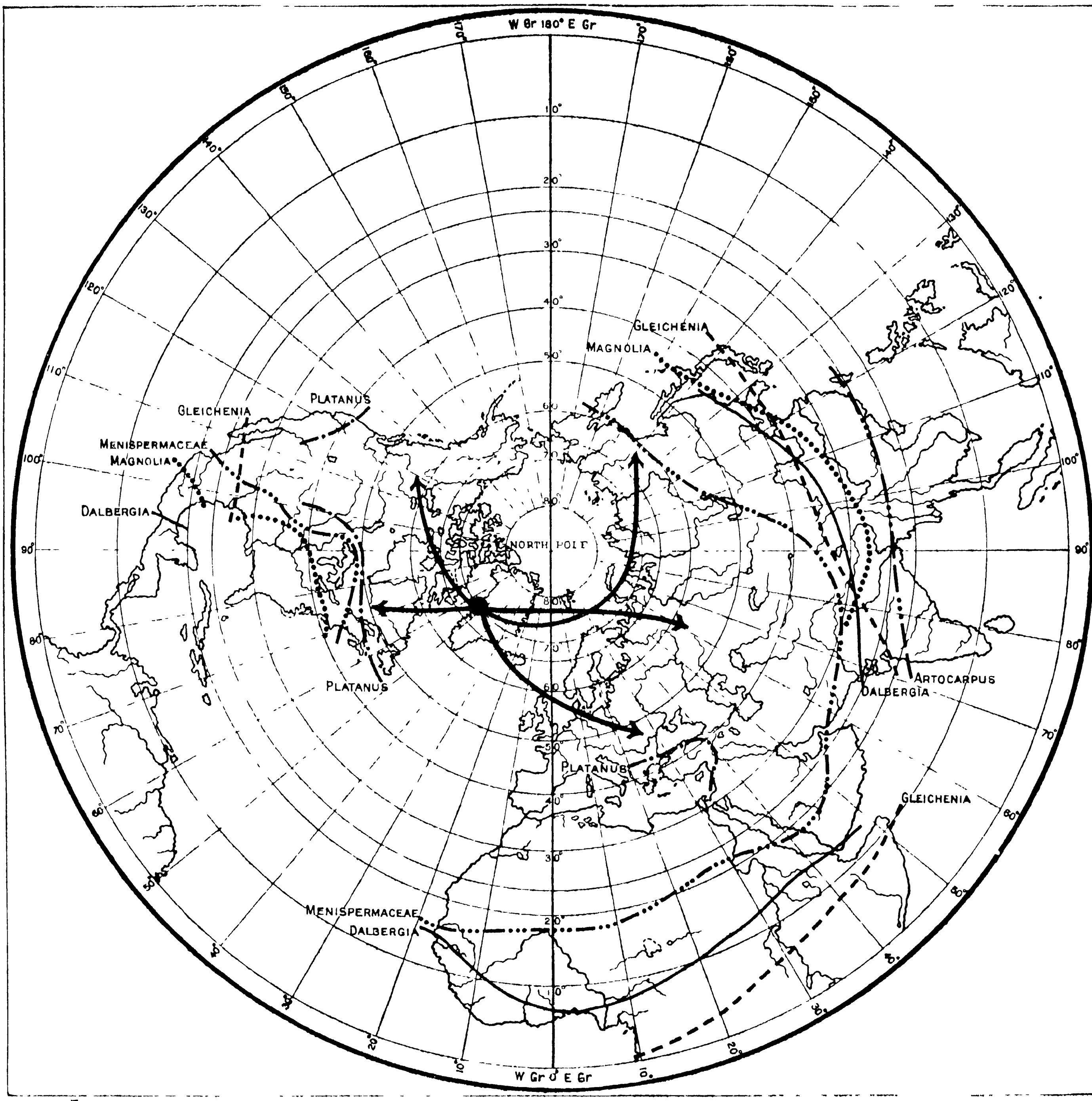

FIG 12 - MAP OF THE NORTHERN HEMISPHERE SHOWING ON THE WEST COAST OF GREENLAND THE DISTRICT WHERE A RICH LOWER CRETACEOUS FLORA HAS BEEN FOUND
The arrows indicate a Southern Migration of Arctic Cretaceous plants The present northern limits of families and genera represented in the Greenland Cretaceous flora are shown by the various lines

of great importance and of no little difficulty is the apparently sudden transformation of the older Mesozoic vegetation, in which flowering plants played little or no part, into what we may call a vegetation that is entirely modern in its dominant characters. The only indication in Rhaetic and Jurassic floras of plants foreshadowing angiosperms in the nature of their reproductive organs is furnished by the Caytoniales From Lower Cretaceous rocks in England above the Wealden series Dr Marie Stopes described some highly specialized types of dicotyledonous wood which cannot be regarded as primitive. It is therefore certain that angiosperms had reached an advanced state of development at a comparatively early stage in the Cretaceous period.

The salient features of the west Greenland flora may be briefly summarised as follows: Species of *Gleichenites* were the chief representatives of the ferns; they agree closely in the forking of the frond axis, in the structure of the spore-capsules, and in the anatomy of the leaf-stalk with existing species of *Gleichenia* Among other ferns are *Laccopteris*, a genus that in the form of the fronds and in the structure of the sporangia bears a striking likeness to *Matonia; Hausmannia* closely allied to *Dipteris;* species of *Sphenopteris* and *Cladophlebis* which have not as yet been assigned to a definite position in relation to living species The Cycadophyta are represented by plants bearing leaves having the characters of *Pseudocycas, Ptilophyllum* and *Otozamites* genera which played a prominent part in Jurassic floras The fronds known as *Ptilophyllum* are characterized by two rows of linear segments giving them an appearance similar to that of the Mexican cycad *Dioon; Otozamites* fronds are distinguished by the eared base of the segments which are occasionally relatively broad. Trees with leaves like those of *Ginkgo* were abundant in the Arctic forests and with them were other members of the Ginkgoales Conifers were represented by species believed to be akin

to *Araucaria* and *Agathis* of the southern hemisphere, by members of the cypress family, relatives of the sequoias of California, at least one species of Abietineae, and by several conifers with leaves resembling in structure those of the umbrella pine (*Sciadopitys*) of Japan. With these were associated several species of dicotyledons surprisingly modern in the pattern of the foliage: in addition to the genera previously mentioned special attention is drawn to *Artocarpus,* the tropical bread-fruit tree. The occurrence of leaves agreeing closely in venation with those of the cinnamon tree (*Cinnamomum*) and of members of the Menispermaceae, a family of flowering plants that is now characteristic of tropical and warm temperate countries, affords further evidence of unusual climatic conditions in the Arctic regions (Map, fig. 12). We cannot believe that the evolution of the flowering plants was a sudden event. The oldest known angiosperms so far discovered must be the descendants of a line of ancestors stretching far back into the earlier stages of the Mesozoic era.

Conclusion.—A comparative study of the records of plant-life shows that the character of the vegetation was fundamentally changed during the later stages of the Palaeozoic era; a few of the older types survived, but most of the plants which flourished in the Coal age disappeared. By degrees as the Triassic period advanced, ferns of modern aspect increased rapidly in number and displaced the Pteridosperms from their position of dominance. The seed-bearing fern-like plants were by no means extinguished but they were overshadowed by the gradual rise to power of the Cycadophyta, the Ginkgoales, and other groups. The next great change in the plant-world was at the end of the Jurassic period and at the beginning of the Cretaceous period when the present dominant class, the angiosperms, began to assert its ascendancy and the floras became modified "as by a new creation." It is impossible to follow in detail the progress of evolution during the Cretaceous period as a whole. The important point is that at the beginning of the period flowering plants were small in number or entirely absent; this is the conclusion based on the very incomplete data at present available. In the Lower Cretaceous floras of Greenland, North America, Bohemia and Sakhalin Island in which dicotyledons first appear in quantity there were also several representatives of gymnosperms and ferns which had survived from the Jurassic period. As we ascend to the higher divisions of the Cretaceous period the floras become more modern and the chief differences between them and those of our own day are geographical rather than botanical. The floras of North America and Europe, for example, agree much more closely with present-day floras in sub-tropical or even tropical lands than with the plant associations which now occupy the territory where the fossils have been found. The problem of climatic change raised by the Cretaceous vegetation of Greenland has still to be solved. On the accompanying map (fig. 12) the northern limit of distribution of some of the families and genera is roughly shown. If we assume that the Greenland Cretaceous species grew under conditions similar to those which govern the life of their present-day relatives, it follows that the climate must have been at least as warm as that in the Mediterranean region at the present time. It is certain that the Cretaceous vegetation could not have endured the hardships imposed on the present Arctic floras; but it is by no means certain that extinct species of living genera could not have existed under conditions which would be fatal to their modern descendants. The past is in many respects the key to the present; but it is dangerous to carry this principle too far.

From the broken fragments of plants preserved in the sedimentary rocks of the Mesozoic periods we have been able to reconstruct a few of the links in the middle portion of the chain of life and to follow the varying fortunes of certain groups and families through successive ages. The history of the plant-world may be compared with that of human races; for a time one race holds sway over a widening territory unchecked by serious competitors until, with apparent suddenness, a more efficient stock asserts itself and the balance of power is disturbed. In the contrast between the vegetation of the Cretaceous period and that characteristic of the earlier stages of the Mesozoic era we have one of the most impressive illustrations of the revolutionary aspect of evolution presented by the records of the rocks.

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TERTIARY PLANTS

Introduction.—The great geological divisions into Primary, Secondary and Tertiary eras are based chiefly upon the observations of marine strata and marine organisms. The reason for this classification lies in the fact that oceans are more continuous than land, and sea organisms therefore present a more universal basis for classification than land organisms. But changes in land life do not always coincide with changes in marine life, and for this reason a different grouping of geological periods is better for the study of plants. The last great phase in the development of plant life is the coming in of flowering plants. Tertiary botany is chiefly concerned with the history of these; but for their origin we must go back to the Cretaceous.

With the advent of flowering plants the age of world-wide floras is left behind. From this time onwards plants are grouped into localized floras comparable with those of the present day.

Mode of Occurrence of the Plants.—Hardly ever has a whole fossil plant been found with its parts in association. Not uncommonly fruits containing seeds, and leaves attached to stems occur. Thus material available for the study of Tertiary plants is fragmentary. Most of the determinations are based on leaves, fruits and seeds, but there are notable exceptions. In the Baltic amber various delicate organs are preserved. Pollen has chiefly been studied from the Quaternary peat of northern Europe.

Tertiary and Quaternary plant deposits are formed in various ways. Sometimes the portions of the plants are embedded in the silts of ancient lakes, as in central France, Switzerland, and the

Rocky mountains; sometimes in the silts of rivers, as in the beds formed by the old Rhine; or sometimes in the brackish water silts of estuaries, as in the beds of the Hampshire (England) coast. Again plant deposits may be the accumulations of swamps, *e.g.*, the brown coal of Germany; or of successive layers of vegetation occupying the same spot, like the peat of northern Europe. Yet again plants may be buried by volcanic ejecta, as has happened in Scotland, Ireland and central France. Or they may have become entangled in resin, as has happened in the case of the Baltic amber. It is from such scattered information, overlapping now in one place, now in another, that the history of Tertiary plant life in Europe is pieced together. Whatever the mode of origin, there are corresponding differences in the kind of matrix, in the parts of the plant preserved, and, generally, in the components of the floras.

Leaves usually occur in fine clay or tufa, and most frequently as mere impressions showing more or less clearly the form and nervation; but, in the case of coniferous and evergreen leaves, not infrequently part of the carbonized leaf itself is preserved covered by its tough cuticle. Delicate winged and pappus-bearing fruits and seeds also occur in fine clays. Other fruits and seeds, also wood, are found embedded in coarse material such as sandy clays, sands and loam, and in peat. Usually if carbonaceous substance is present, it is impregnated with mineral matter. If, as is common, this is iron pyrites, the close intermixture of hard pyrites with rotten carbonaceous matter makes it difficult to examine the objects by sectioning. Sometimes the carbonaceous substance is entirely replaced by silica or calcite, when sectioning becomes possible.

Methods of Study.—Different organs being differently preserved, each part of the plant requires a special method of study. Leaf impressions require no preliminary treatment beyond exposing any part concealed. When the leaf-blade is preserved, a fragment must be chipped off with a knife and, by treatment with nitric acid and chlorate of potash followed by ammonia, the cuticle can be isolated, mounted on a microscope slide, studied and photographed. Winged and pappus-bearing fruits and seeds must be studied in the same way. Other fruits and seeds are isolated by disintegrating the matrix. This may be done by boiling the seed-bearing material in a strong soda solution, or warming in a 10% solution of nitric acid over a water bath. The dissolved matrix is then strained off through sieves, leaving the fossils behind. These can be examined as free entities. In the investigation of pollen grains the material is boiled with a 10% solution of caustic potash. Wood, being large, is usually picked out of the matrix with a knife or other instrument, and, if possible, sectioned and studied microscopically.

The number of living species is so great, and the required knowledge so detailed, that rarely does a worker attempt more than one branch of the study. All workers have one initial need in common—as complete a collection as possible of those parts of the living plant they wish to study. Ideally, all living species should find place in the collection, and the material should be arranged so as best to suit the particular branch of study. The arrangement of public herbaria is usually not very suitable for palaeobotany. The reason lies in the method of classification of living plants. This is based principally on the arrangement of the floral organs, although other organs play a subsidiary part. In consequence all collections of dried plants, and all books dealing with classification, are arranged on this basis, and afford no ready key to the palaeobotanist, as they do to the botanist. For the former the organs he studies have always to be re-classified. All great herbaria provide abundant material for the study of leaves, but not for that of other organs. Fruits and seeds are badly represented, and there is great need for better collecting of these organs.

Either from collections or illustrations, the student must gather all possible material for comparison. But the living material is the most important. He must examine the fossil and living part in detail, using the microscope. Stress is laid on the comparison with living material, for sometimes palaeobotanists have been content to follow the easier course of comparing with previous determinations only. But on the exact comparison with living plants depends our knowledge of the relation of fossil species to living ones.

Scope of the Study of Tertiary Plants.—Tertiary plants furnish some of the later chapters in the history of living plants, and of the world; the latest of all being found in the Quaternary. They give the most reliable information obtainable about the ancestors of the living forms; where they lived and what their various organs were like. That is to say, what changes in distribution and structure they have undergone, or, on the other hand, what stability they may show. They give also the best information obtainable as to past climate.

In the early stages of the period we can trace no living species, but some species are sufficiently close to living ones to be placed in living genera. Others which cannot be placed in living genera may yet be placed in living families. Nevertheless, until the close of the Tertiary period, plants constantly occur whose living relations have not been discovered. Whether this is because the plants have become extinct and left no link with the present, or because our knowledge of living plants is inadequate to trace their relations is difficult to tell. Probably both causes operate. It is certain, however, that old forms more remote from the living have yielded place to newer forms closer to the living; so that by the end of the Tertiary period (latest Pliocene) all known fossil floras are composed, almost exclusively, of living species, although the geographical distribution of these may have changed in the interval.

The study of a succession of floras in a given region, say western Europe, shows clearly that changes occur in their components from age to age. Further, that the components of the successive floras are related to those of living localized floras; now to a tropical, now to a warm-temperate flora, and so on.

But living plants are grouped into localized floras largely under the influence of climate. Adverse climatic conditions will kill developed, *i.e.*, rooted, plants. Whole species, or even genera would be killed out, were it not that plants have an inherent power of movement in their embryo stage—the seeding stage. If the members of a species can cast their seed beyond the range of the adverse conditions, that species may survive. If not, it must die. But for survival, the change of climate must not overtake its rate of travel, and there must be a suitable habitat within reach. That plants continually try to occupy fresh ground is shown by the rapidity with which they spring up on waste land (Krakatoa after the earthquake, Flanders during the war). That they fail to establish themselves, if the ground is already occupied by a healthy population, is shown by the rarity with which introduced plants are able to establish themselves among a native flora. It is largely by movement under changing climate that in process of time plants have been grouped into the existing local floras. Under a change from heat to cold the movement will be from higher to lower latitudes and from higher to lower altitudes. Under a change from cold to heat it will be in the reverse directions.

In considering the results which have accrued from the study of Tertiary plants, we propose to divide the subject under three heads belonging to the three great geographical regions in connection with which most of the work on Tertiary plants has been carried out. These regions are Europe, North America and the Arctic. The work on the Tertiary plants of all other parts of the world is, as yet, too scattered and too scanty to admit of treatment in a short article. Space does not permit of more than a general indication of the characters of the floras which succeeded one another in the three regions during the long Tertiary ages—probably some tens of millions of years. For fuller knowledge readers must consult the bibliography. Much of the older work needs revision, chiefly because the knowledge of the plants of the Far East—just those with which Tertiary plants are most closely allied—has increased so greatly during this century. In view of this increase in knowledge we illustrate the fossil floras of the various periods, where we can, by the latest work, provided the floras are large and their age well established. There is an additional advantage in so doing because the later works give references to the more important older works.

Typical Plant Deposits

Era	Age	Europe	America, *Am.;* Arctic, *A*
Quaternary	Historic	Roman, Celtic, etc.	
	Neolithic	Peat of north Europe Dogger Bank peat, "Submerged Forests"	
	Palaeolithic	Post-glacial, arctic Interglacial, warm Preglacial, arctic	Eastern Canada and eastern U.S.A.
Tertiary	Pliocene	Cromer Forest bed Mougoudo, Reuver	Citronelle, *Am.*
	Miocene	Brown Coal, Oeningen	Florissant, *Am.*
	Oligocene	Aix Bembridge, Baltic amber	Catahoula, *Am.;* Alum Bluff, *Am.*
	Eocene	Hordle Bournemouth, London clay Sezanne, Gelinden	Green River, *Am.* Wilcox, *Am.;* Spitzbergen, Greenland, *A.*
Secondary	Cretaceous	Plant beds of Saxony, Bohemia, Portugal	Laramie, *Am.* Dakota, *Am.;* Potomac, *Am.;* Kome, *A.*

CRETACEOUS AND TERTIARY PLANTS OF EUROPE

The plant deposits of Europe, though numerous, are usually of limited extent and confined to small areas. When intercalated with marine beds the geological age may be clear; but frequently this does not happen, and then the age is doubtful, unless the deposits contain the remains of land animals, which sometimes help in correlation.

Cretaceous.—Flowering plants when they appear in Lower Cretaceous rocks, are represented, in Europe, by a few scattered specimens of very doubtful affinity; a few species represented by leaves, from Portugal, or wood, from England and so forth. As time progresses the remains become more frequent, but floras still retain their predominant Secondary character.

By the Upper Cretaceous, flowering plants begin to dominate, and from various parts of central Europe a considerable number of species have been recorded. In Bohemia, besides conifers and ferns, there occur many dicotyledons. *Credneria* is a genus of unknown affinity, but other plants have been referred to living genera. Such are *Myrica, Ficus, Quercus, Eucalyptus, Pisonia, Phillyrea, Rhus, Prunus, Bignonia, Laurus, Salix, Benthamia.* But without the evidence of fruits or flowers in support, it is difficult to believe that so many living genera existed.

After the Cretaceous there was an interval of unknown duration not represented by deposits in Europe. The Tertiary period which followed witnessed great changes in the physical geography of the continent. The great mountain-chains which span Eurasia were uplifted. As we shall see later this has had an enormous influence on the plant life of these regions ever since. In addition to mountain-building, there was also great volcanic activity in various parts. It is customary to divide the Tertiary into four periods: Eocene, Oligocene, Miocene, Pliocene.

Eocene.—The earliest Eocene, the Paleocene, is not represented in Britain, but is found on the Continent in the north-east of France, and in Belgium. The flora is still close to that of the Upper Cretaceous, and indicates similar warm-temperate or subtropical conditions. Count G. de Saporta recorded from Gelinden, near Liége, species of oak, chestnut, laurel, cinnamon, camphor, *Litsea* and *Persea;* also members of the *Araliaceae, Menispermaceae, Celastraceae* and *Myrtaceae* families. From tufa formed by an ancient waterfall at Sezanne he recorded, besides a profusion of ferns, genera of *Lauraceae, Tiliaceae, Meliaceae, Sterculiaceae;* also *Symplocos, Artocarpus* (the bread-fruit), *Magnolia,* hazel, alder, willow, viburnum, cornel, fig, ivy and vine; but nearly all the European genera show an exotic character. From the Paleocene near Paris, Watelet recorded *Araucaria,* bamboo and palms.

Later in age are the Woolwich and Reading series of England from which a small but interesting flora suggests a rather more temperate climate than that which preceded or followed it. Leaves of plane are abundant, and among the plants recorded are *Robinia,* a palm, two figs and a laurel. C. von Ettingshausen and J. Starkie Gardner who worked on the beds, recorded two ferns, *Aneimia* and *Pteris;* and two gymnosperms, *Libocedrus,* related to the American *L. decurrens,* and a species of swamp cypress, *Taxodium europaeum.*

The Oldhaven beds which follow have yielded fig and cinnamon. None of these beds have as yet been fully investigated, and the evidence is too scanty for a correct inference as to climate.

The deposit next in age in England to which we must refer is the London Clay. It is the most important plant bed of Lower Eocene age in Europe. The fruits and seeds are very abundant and beautifully preserved. For more than two centuries they have attracted attention. In 1840 Dr. James Scott Bowerbank published an admirable study of some of them, but the work was never finished. His botanical knowledge was inadequate to allow him to determine the species. In 1879 Ettingshausen made a very hurried study of Bowerbank's material, and published a list of plants, but without any evidence to support his determinations Critical examination of the same material by the writers, who are now engaged upon its study, proves that his work was faulty in the extreme and valueless. The work of revision is not completed, but it may be stated that, with the exception of a few representatives of sub-tropical genera, the affinity of all is tropical. Scarcely any of the genera have living representatives in Europe. The Nipa palm was one of the commonest species. In the present era it abounds on the margins of estuaries and lagoons in the tropics of east Asia. Other palms are common, and families wholly tropical find representation. It can scarcely be doubted that the climate of Britain was tropical, or nearly so, when the London Clay was deposited.

Similar evidence of tropical conditions comes from the Paris basin where, amongst other plants, numerous palms occur, including *Nipa; Ottelia,* a tropical water-plant of the Old World is also found. Saporta pointed out the further evidence for tropical conditions shown by the scarcity of caducous leaves, an absence which indicates the non-occurrence of seasonal changes. The middle Eocene of the Bournemouth beds (Hampshire) still shows something of a tropical character. The flora is as yet incompletely known, but Dr. Helena Bandulska has begun in connection with it, one of the few systematic studies of leaf-cuticles that has been made. Isolated cuticles have frequently been studied, but the systematic examination of living species is but begun. It may prove of great value. The Nipa palm (determined from fruits) flourished, also such tropical genera as *Aniba, Litsea* and *Neolitsea;* but somewhat cooler conditions may be evidenced by *Lindera* and *Nothofagus.* Gardner and Ettingshausen had previously recorded many ferns, also conifers including *Araucarites.*

We must draw attention to a curious and important fact. It has been noted that the flora of the London clay was exotic. All Tertiary floras continued to be so in a large degree until towards the end of the period. At first even the families were mainly exotic. Gradually European families came in, but the relationship of the genera was exotic. Then European genera began to appear, but the relationship of the species was exotic. Lastly, at the end of the Pliocene the whole flora was transformed to one of European species. Stated in another way: A flora of European relationship gradually replaced one of exotic relationship, which died out.

The relationship of the dying flora is very remarkable. In the Eocene it was more or less world-wide, but with a marked leaning to plants of the Far East. In floras later than the Eocene the relationship contracts. African affinities nearly disappear. Plants with relations in the Far East predominate. Next in order come North American and Mediterranean plants; then Australian, in spite of the fact that the Far East and America are so far, and the Mediterranean so near. Yet another way of stating the same fact is, that a type of flora which was gradually killed out in Europe, survived largely in the Far East and in America, and only in a very small degree in the Mediterranean. The parts of the Far East in which the living allies are found are Japan, China, Burma, further India, the Malay Peninsula, Malay Islands, Formosa, the Philippines; also Australia. In a general way as time passed the relationship passed northward from Malaya to Japan and China, and from the West Indies through the United States to Canada.

The upper Eocene of Hordle (Hampshire), the flora of which was described by M. E. J. Chandler, has yielded the conifers *Sequoia* (related to the red-wood) and pine. In addition there occur among flowering plants such tropical or sub-tropical genera as *Broussonetia, Chlorophora, Gordonia, Iodes, Meninspermum, Natsiatum, Nipa, Orites, Phellodendron, Symplocos, Zanthoxylon,* and various vines. Among genera which now range into Europe are *Corydalis, Liquidambar, Styrax,* as well as the blackberry, elder and persimmon.

Oligocene.—In the succeeding Oligocene the change of flora is comparatively slow. The flora of the Bembridge beds (Hampshire) of Early Oligocene age, has lately been studied by E. M. Reid and M. E. J. Chandler. It contains a few tropical and subtropical genera such as *Epipremnum, Neolitsea, Phyllanthera, Radermachera, Tylophora,* but plants of a cooler range are also common; *Araucarites, Catalpa, Cinnamomum* (the cinnamon), *Engelhardtia, Incarvillea, Libocedrus, Sabal* (the palmetto), and numbers of genera which now have representation in Europe: Bulrush, bur-reed, pond-weeds, water-soldier, sedge, beech, oak, hornbeam, clematis, buttercup, poppy and *Acanthus.*

A flora of somewhat the same age is preserved in the Baltic amber. Reference has already been made to its mode of preservation. The plants include the amber-pine itself, from which the resin dripped, enclosing insects, leaves, twigs, wood, flowers, seeds and hairs. Many of the flowers closely resemble living forms. Among exotic genera are two palms *Phoenix* (the date-palm) and *Sabal, Clethra, Dalbergia, Deutzia, Ephedra, Hammamalis, Hibbertia, Magnolia, Stuartia, Trianthera* and *Ximenia.* Among European genera are *Daphne, Erodium, Geranium, Loranthus, Amarantus, Myrica, Smilax* and *Thesium,* besides oak, chestnut, beech, willow, polygonum, flax, maple, holly, buckthorn and wild-parsley. Probably this list needs revision. It will be noticed that a great number of these genera have not appeared in previous lists, and will not appear in later ones. The amber flora offers a good example of the selective process which accompanies different kinds of preservation.

One of the largest known fossil floras belongs to the Oligocene, that of Aix in Provence. It was determined by Saporta. It comes from the bed of an old lake The lake itself long continued in existence, and the life around and within it suffered many vicissitudes whilst the region was convulsed by the earth movements and volcanic activity of the time, although no very great change took place in the flora from beginning to end. Some of the exotic families represented are *Bignoniaceae, Proteaceae* and *Sapotaceae* Among exotic genera are *Aralia, Ailanthus, Bombax, Leucothoë, Magnolia, Sapindus, Sterculia, Zanthoxylon.* Several conifers and palms occur. *Lauraceae* are represented by cinnamons and camphors. Among European genera are *Arundo, Daphne, Smilax* and *Styrax,* bur-reed, bulrush, pond-weeds, alders, birch, oak, fig, poplar, willow, laurel, jasmine, olive, oleander and persimmon.

Miocene.—One of the earliest described and most famous of Tertiary floras was obtained from the silted up lake of Oeningen in Switzerland. From this Oswald Heer recorded hundreds of species. As his work needs revision, it will be better to take as a type of a Miocene flora the almost equally famous brown-coal of central Europe. Much recent work has been done on brown-coal material derived from various localities by the late Dr. P. Menzel and Dr. R. Kräusel. Numerous conifers are found—*Sequoia, Taxodium,* and *Glyptostrobus.* The walnut family is strongly represented by American and Asiatic forms. Catkin-bearing trees are abundant. Among exotic genera are *Ampelopsis, Acanthopanax, Aralia, Cinnamomum, Elaeodendron, Lindera, Liquidambar, Magnolia, Persea, Symplocos.* Among European genera are *Cotoneaster, Paliurus, Sorbus, Spiraea, Trapa, Zizyphus,* plane, plum, hawthorn, blackberry, maple, *Euonymus,* holly buckthorn, lime and ash. In this flora are found forms so near the living as to be named as mere varieties. It must be remarked, however, that genera found in Europe are still often represented by species of exotic relationship.

The transition from Miocene to Pliocene is well represented in the old volcanic region of central France. E. M. Reid has described from fruits and seeds a late Miocene (or Mio-Pliocene) flora from Pont-de-Gail. Among alien genera are *Actinidia, Amethystia, Cleomella, Clerodendron, Ehretia, Epipremnum, Magnolia, Meliosma, Menispermum, Phellodendron, Polanisia, Symplocos, Trichosanthes.* All are of east Asian or American affinity. There are besides numbers of European genera which cannot here be named.

Pliocene.—The Lower Pliocene flora of Mougoudo (Cantal) is a little newer. It was examined by Prof. L. Laurent who recorded exotic *Lauraceae, Rhamnaceae* and *Malvaceae,* also *Zelkova, Abronia, Cissus, Grewia, Sterculia* and *Paulownia.*

The largest known Lower Pliocene flora is the Reuverian from the Dutch-Prussian border. It was studied by Prof. Laurent and by C. and E. M. Reid. Among exotics are *Actinidia, Araucaria, Aralia, Brasenia, Carya, Epipremnum, Euryale, Glyptostrobus, Karwinskia, Magnolia, Meliosma, Menispermum, Myrsine, Nelumbium, Nyssa, Phellodendron, Proserpinaca, Pseudolarix, Pterocarya, Sequoia* and *Zelkova,* besides many others. European genera are now numerous. Many living species occur, some of them European.

Similar evidence comes from the Rhone valley where M. l'abbé Georges Depape has recorded *Buettneria, Carya, Cinnamomum, Diospyros, Ginkgo, Glyptostrobus, Laurus, Liquidambar, Liriodendron, Oreodaphne, Persea, Pterocarya, Sapindus, Sassafras, Torreya, Zanthoxylon* and *Zelkova,* amongst exotic genera.

In the Middle Pliocene a great change occurred in the European flora. Very rapidly the old exotic plants disappeared and European plants took their places, almost with a rush. In the flora of Tegelen (Holland) but a few stragglers of the exotic genera remain: *Actinidia, Dulichium, Euryale, Magnolia, Phellodendron, Pilea* and *Pterocarya.* 84% of genera were European and 82% were represented by allies of European species. By the close of the Pliocene, *i.e.*, the end of the Tertiary period, the Cromer forest-bed flora shows an almost exclusive European alliance The old flora had gone.

CRETACEOUS AND TERTIARY PLANTS OF NORTH AMERICA

As distinguished from the European, the Tertiary flora of North America is characterized by the continuity of the great bulk of its elements from past to present, with only such changes as have attended evolution and plant migration within the continent; some of the more tropical forms having sought refuge in South America When alien elements occur they show alliance with the Tertiary plants of Europe, or with the living plants of the Far East, and in a lesser degree with those of Africa and the Mediterranean. The alliance with the Far East continues to the present day, as Asa Gray and the late Prof. C. S. Sargent have pointed out. Hence the living flora of America is linked with the extinct Tertiary flora of Europe, and with the living flora of the Far East.

The Cretaceous and Tertiary plant deposits of North America present a magnificent series, often covering extensive areas They may be divided into three chief groups: (1) The deposits of the southern and south-eastern coastal plains, a series studied by Prof. E. W. Berry. These show an ordered succession of strand floras of very similar character which lived under similar conditions, and are therefore closely comparable from age to age. They are dated by intercalated marine strata. (2) The deposits of the

eastern coastal plain; those of Cretaceous age being the most important. (3) The Rocky mountain group where a scattered series of continental deposits occurs, some of them having been formed, as were many in Europe, under the influence of mountain-building and volcanic action. The beds, like similarly isolated beds in Europe, are of somewhat doubtful age, but Cretaceous, Eocene and Miocene strata appear to be represented. The flora is of an inland type.

Cretaceous.—The Cretaceous witnessed in America, as in Europe, the passing of the flora of secondary type and the incoming of flowering plants. Conifers, cycads and ferns were still largely represented, but they diminished in number, and the older forms died out. The flowering plants of the Lower Cretaceous were markedly different from those of the present day. They are referable to living families, but only a few, such as fig and sassafras, to living genera. In the Upper Cretaceous, the flora became richer and more varied. It indicates a mild climate without seasonal changes. In the coastal beds of the south and from beds of similar age, which extend through Alabama and New Jersey and are found in West Greenland, a rich flora is found in which figs, willows and magnolias are predominant. From the Dakota Sandstone Leo Lesquereux described a considerable number of genera, among which may be mentioned *Aralia, Cinnamomum, Eucalyptus, Ficus, Ilex, Inga, Juglans, Laurus, Magnolia, Nyssa, Paliurus, Pinus, Populus, Quercus, Sassafras, Sequoia, Sterculia, Zizyphus.* These also indicate mild conditions.

The latest Cretaceous is found in the Laramie formation of the Rocky mountain group. The strata were laid down in a great inland sea which was gradually drained by the elevation and silting up of its bed. Coal seams indicate long persistent swamps and lagoons. In his study of the flora, the late Dr. F. H. Knowlton named ferns, the conifers *Dammara* and *Sequoia,* and, among flowering plants, *Anona, Ceanothus, Cercis, Hicoria, Magnolia, Nelumbium, Pistacia, Sabal, Zizyphus,* as well as species of walnut, willow, poplar, oak, bread-fruit, fig, ivy, holly; but many of the plants can only be referred to families; their more exact relationship being uncertain.

Eocene.—The Eocene saw a sudden development of modern types. Almost all the plants are closely allied to those which inhabit the warm regions of the earth. Even when genera range into cooler regions they are, in almost every case, represented in the tropics also. The largest Lower Eocene flora is the Wilcox flora described by Berry. Most of the plants are tropical or subtropical, a few are allied to temperate forms. Among genera are *Acacia, Anona, Aralia, Artocarpus, Avicennia, Banisteria, Bumelia, Canavalia, Canna, Carapa, Cassia, Cedrela, Celastrus, Chrysobalanus, Cinnamomum, Coccolobis, Combretum, Dalbergia, Dodonaea, Drypetes, Engelhardtia, Fagara, Ficus, Fraxinus, Glyptostrobus, Guettarda, Ilex, Inga, Juglans, Laurus, Magnolia, Maytenus, Myrica, Nectandra, Nyssa, Oreodaphne, Oreopanax, Osmanthus, Paliurus, Persea, Pisonia, Pistia, Pithecolobium, Planera, Porana, Prunus, Quercus, Reynosia, Rhamnus, Sapindus, Sideroxylon, Simaruba, Sophora, Sterculia, Taxodium, Trapa, Zamia, Zizyphus.* It is to be noted that some of these genera such as *Glyptostrobus, Laurus, Oreodaphne, Paliurus, Porana, Sideroxylon* and *Trapa,* are now confined to the Old World.

The Green river beds of the Rocky mountain group belong to a later Eocene age. Knowlton, who revised the flora in 1924, stated that there is an overwhelming preponderance of species with living allies in tropical and sub-tropical regions. He tentatively divided the species into lowland and upland forms. The flora is not a large one. Among the lowland forms he named species of palm, a relation of the banana, and *Brasenia* (a species of water-lily), besides other genera which are the same as some recorded from the Wilcox beds.

Oligocene.—The Oligocene is not well known from America. From the coastal region Berry has described several small floras. Among them are those of the Alum Bluff beds and the Catahoula Sandstone. Like so many Oligocene floras in Europe the constituents show mixed relationships. Some, such as palms, show alliance with tropical forms. Others, like *Ulmus, Rhamnus* and *Paliurus,* with cooler forms. Berry concludes that the Oligocene period in America was warmer than the Eocene, although this is open to doubt, for the Oligocene floras are too small to be representative; while the Eocene floras also show a large preponderance of tropical forms. In Europe the Eocene was undoubtedly the warmer period.

Miocene.—The Miocene in the south is known only from small floras. Temperate forms mingle with those of a more tropical type, as they do in Europe, indicating a cooler flora supplanting a warmer one, under the influence of a changing climate. The climatic conditions appear to have been very similar to those of the same regions to-day.

In the Rocky mountain region more is known of Miocene floras. The Florissant beds of Colorado, studied by Prof. T. D. A. Cockerell, show beautiful leaf impressions, and recall the Oeningen beds of Switzerland. *Ailanthus, Anona, Liquidamber, Persea, Robinia, Sequoia,* also persimmon, fig, oak and pine are typical plants. The climate was probably similar to, but damper than, that of the present day.

Pliocene.—The Pliocene is not well represented. Its flora is essentially modern, and includes existing species, although a few, like *Trapa* (the water-chestnut), are now extinct in America.

CRETACEOUS AND TERTIARY PLANTS OF THE ARCTIC REGIONS

Our knowledge of Arctic plants comes, in the first instance, from the studies made by Heer between 1868 and 1883. He recognized two periods for flowering plants. The older is referred to the Cretaceous. The newer, by him called Miocene, is now generally referred to the Eocene. He described about 335 species from the Cretaceous, and 282 from the Tertiary, but the numbers are certainly far too large, as indicated by Prof. A. C. Seward's work in 1926. The plants come from various localities within the Arctic Circle ranging as far north as Grinnell Land, lat. 81, and Spitzbergen, lat. 79. That the plants are *in situ* is shown by the fact that some are rooted.

Cretaceous.—In the lower beds of the Greenland Cretaceous, from Kome, occurs one of the earliest known flowering plants, called by Heer a poplar. From later beds at Atane, besides ferns, some of which are referred to genera now tropical, come many conifers such as *Araucaria, Cupressus, Sciadopitys* and *Sequoia,* palms, *Artocarpus, Liriodendron, Magnolia, Sapindus, Sassafras, Rhus;* species referred to Proteaceae and Menispermaceae; also species of oak, poplar and fig. Still higher beds at Patoot contain *Acer, Acerates, Aralia, Zizyphus,* also species of fig, walnut, plane and buckthorn, among flowering plants; and *Dammara* among conifers.

Eocene.—The late Prof. Nathorst stated that the Eocene beds of Spitzbergen yield *Taxodium, Sequoia, Libocedrus,* grass, sedges, pines, willows and pond-weed. From Cape Lyell he recorded *Sequoia, Grewia, Magnolia,* water-plantain, maple, poplar, willow, alder, birch, hornbeam, hazel, beech, oak, elm, plane and lime.

From Greenland Heer recorded *Gingko, Libocedrus, Glyptostrobus, Taxodium, Sequoia, Pinus* among conifers; *Sassafras, Acerates, Nyssa, Vitis, Acer, Koelreuteria, Juglans, Rhus,* and many catkin-bearing trees among flowering plants. The climate was temperate.

Most of these genera reappeared in the Tertiary of Europe and America. They are related to plants now living in Asia and America. Some also live in Europe. The occurrence of these plants within the Arctic Circle has a most important bearing upon the interpretation of plant-history in the Northern Hemisphere.

TERTIARY PLANTS IN RELATION TO WORLD HISTORY

Summary.—The Tertiary floras of Europe, America and the Arctic, and the living floras of the Far East and North America, are all intimately related. What little is known of the Tertiary floras of Russia and Asia indicates that they, too, were related. It follows that Tertiary floras of an east Asian-American alliance lived on to form the source of much of the living floras of east Asia and America, but were killed in Eurasia. In those regions where they lived, there are no transcontinental mountain-chains forming barriers between the Pole and the Equator, whereas in

the regions where they died, there are. Further, the mountain-chains were being formed whilst the extermination was in progress, and the extermination was greatest after they were formed. Hence it may be inferred that the mountain-chains helped to kill. There is another set of facts which points to the same conclusion. In the early Tertiary, the European flora showed considerable alliance with Indian and African plants, indicating passage between these regions. Later, at the time when the barrier was in existence, the alliance died out. Again, therefore, the barrier would seem to have helped to kill. Alliances must indicate either linkages through some common source, or direct linkage. Also, if the allies are far removed, they must indicate migration. The interruption of the alliances by east-west barriers must indicate that the migration was north-south. Finally the presence of ever cooler and cooler forms must indicate that it was from north to south.

Explanation.—The phenomena involved are of world-wide significance, not localized. The best explanation is that originally suggested by Saporta. It meets all the facts, and is based on the assumption that whilst the temperature of, at least, the northern portion of the Northern Hemisphere underwent change, no change, or but very slight, took place in the position of the Poles. As the full measure of the relationship with plants of the Far East has become better known, the evidence supporting this explanation has become more full and definite. The explanation is that in Cretaceous and early Tertiary times the North Polar regions supported a warm type of vegetation, allied to living plants. In the Cretaceous these were of a sub-tropical or warm-temperate type; in the Eocene of a cooler type, at which time the flora of Britain and France was tropical. Slowly the climate cooled, and as it did so, plants migrated southward throughout Europe, Asia and North America, their places being taken by others of a cooler type. These new forms must have been evolved in the north since the linkage of floras continued throughout the Tertiary. The migrants must have suffered loss by the way and undergone evolutionary changes even in America and east Asia, for, although allied to one another, the living floras of these regions differ. Some elements were lost here, others there. In Europe and western Asia the whole were ultimately destroyed. With the ever increasing cold behind, and the impassable mountains in front, they perished, leaving scarcely a trace.

Space will not permit us to enter into any full discussion of the recurrence of Glacial and inter-Glacial periods and the influence they may have had on the flora. It is evident, however, that if climatic alterations, such as those just described, are part of the normal routine that has gone on through all geological periods, and are not merely confined to the latest, then such changes must evidently have had great influence on the evolution and geographical distribution both of species and of floras. Whether this was so is a question still to be decided, for in dealing with extinct floras it is difficult to decide, except in the most general way, to what climatic conditions they point. We seem to find indications of long-period climatic oscillations in Tertiary times, but none of the sudden invasion of an Arctic flora, like that which occurred during more recent times.

It might appear from the above that the Eurasian continent was gradually depleted of plants. But this was not so. The flora was greatly impoverished, and has remained so, in marked contrast to that of America, and especially to that of the Far East. But new plants came in to form the living flora of Eurasia. Where they came from is not certain. Some may have come from the north, but many, possibly most, appear to have come from the vast highlands of central Asia. Their history has yet to be discovered.

QUATERNARY PLANTS

The latest chapters in the history of our planet belong to the Quaternary period, and to these chapters plants contribute a very important share. We confine our attention to the Quaternary of Europe, because from it comes almost the whole of our information. The most important feature so far disclosed in the Quaternary of America is the presence of a few east Asian or European plants—*Xanthium, Pterocarya,* cinnamon and laurel, which died out later.

Compared with the Tertiary, the Quaternary period was short —a few hundred thousand years. The important facts regarding it are: (1) In north Europe a series of rapid and marked climatic changes took place. (2) Throughout the period man is known to have lived.

With the Quaternary ice age, the cooling of the northern regions, which had been going on since the Eocene, reached a climax. The ice age was not a period of unbroken Arctic cold. This is shown clearly by beds of temperate plants intercalated between others showing cold conditions. Such temperate, interglacial beds have been found throughout north Europe, including Britain. Most of the plants now live in these regions; a few are extinct; and others survive elsewhere. The British plants indicate a climate about as warm as, but drier than, that of the present day.

In beds of preceding and succeeding age colder types of plants occur. Dwarf arctic willow and the arctic birch flourished on the plains of Germany and in the south of England. The ground was gay with arctic and alpine flowers—*Primula farinosa, Saxifraga oppositifolia, Dryas octopetala, Polygonum viviparum,* the alpine poppy, flax, potentilla, geranium, scabious, campanula, gentian and the bearberry. *Ranunculus hyperboreus,* one of the most arctic of buttercups, grew in the Isle of Wight. It now lives no further south than the Dovrefjeld mountains, Lapland, Alaska and Labrador. These changes were going on whilst palaeolithic man lived in Europe.

Subsequently the climate ameliorated. The snow and ice retreated, although slight alternations of climate still occurred. Some of these have been traced by the statistical study of pollen in peat Using this study for the investigation of peat dredged from the floor of the Dogger Bank, 60 ft. beneath the sea, Dr. G. Erdtman, of Stockholm, discovered that it belonged to the "boreal" period, when the climate was cold but not arctic. The peat had previously been studied by the Reids who found evidence of a great fenland stretching from England to the Continent. The "boreal" period which saw this fenland in existence belongs to the age of early Neolithic man. In Neolithic deposits various cultivated plants are found: wheat, barley, millet, apples, pears, the opium poppy and flax.

As prehistory passes into history we glean interesting scraps of information. Tutankhamun was buried with a string of seeds from the magic mandrake around his neck; the Celts grew wheat, barley and beans at Glastonbury; and the Romans brought coriander, fig, grape and mulberry to Silchester, also many vegetables and wild fruits.

BIBLIOGRAPHY.—The literature dealing with Tertiary plants is usually technical and is mainly embodied in papers published in scientific periodicals. Text-books on the subject are few, and treat it from the point of view of the botanist, without giving any account of the composition of successive floras. The most useful text-books are: H. Potonie, *Lehrbuch der Palaobotanik* (revised by W. Gothan, 1921); K. A. Zittel, *Handbook of Palaeontology,* vol. ii., trans. by C. R. Eastmann (London, 1925). Full references to all palaeobotanical papers published before 1889 will be found in Lester Ward, "The Geographical Distribution of Fossil Plants," *8th Report U.S. Geological Survey* (Washington, D.C., 1889). References to all American literature up to 1919 will be found in F. H. Knowlton, "A Catalogue of the Cenozoic Plants of North America," *Bull. 696, U.S. Geol. Survey* (Washington, D.C., 1919). E. W. Berry, *Tree Ancestors* (Baltimore, 1923), is an interesting popular work. Two important and interesting early works are O. Heer, *The Primaeval World of Switzerland* (trans. and edit. by James Heywood, 2 vols., London, 1876), and G. de Saporta, *Le Monde des Plantes* (Paris, 1879). Recent large European publications which give very full references to more recent literature are C. and E. M. Reid, "The Pliocene Floras of the Dutch-Prussian Border," *Med. Rijksops. Delfstoffen,* No. 6 (The Hague, 1915); R. Kraüsel, "Nachtrage zur Tertiarflora Schlesiens," *Jahrb. Geol. Landersanst*, vol. xxxix.-xl. (Berlin, 1920–21); G. Depape "La Flore Pliocène de la vallée du Rhône," *Ann. des Sc. nat. bot*, vol. iv, 10th series (Paris, 1922); E. M. Reid and M. E. J. Chandler, *Catalogue of the Cainozoic Plants,* vol. i., British Museum, Nat. Hist. (1926). Literature on Quaternary plants is even more scattered and often appears in a supplementary form to other work The only text-books dealing with the subject are C. Reid, *The Origin of the British Flora* (London, 1899), which contains references to work prior to 1899, and C. Reid, *Submerged Forests* (Cambridge, 1913). J. R. Matthews, "The Distribution of Certain Portions of the

British Flora," part 1, *Ann. Bot.*, vol. xxxvii. (London, 1923), contains references to several papers dealing with British deposits. G. Erdtman, "Literature on Pollen-Statistics Published before 1927," *Geolog. Forens.* (Stockholm, March-April, 1927), contains full references to all literature on pollen work. (E. M. R.; M. E. J. C.)

PALAEOGNATHAE, the term used in ornithology (*q.v.*) to denote the more primitive modern birds, replacing the older term Ratitae (*q.v.*).

PALAEOGRAPHY, the name given to the science of ancient handwriting acquired from a study of surviving examples. The word is sometimes erroneously used where epigraphy would be better (for inscriptions, *q.v.*, on stone or metal). It is difficult, indeed, to define the boundary between the two sciences; many of the ancient inscriptions of the Far East, Cambodia, India, Ceylon, etc., may quite legitimately be dealt with as part of the study of palaeography, although they are usually treated by epigraphists as purely confined to their realm of activity. The different implements used from the beginning in the making of marks or outline characters, whereby man made a permanent record of his thoughts and experiences, have had their influence on the classification of writings as adopted by later scholars.

For a discussion of the palaeography of Far Eastern peoples the article INSCRIPTIONS should be consulted. In the present article only Greek and Latin palaeography will be discussed. In the articles EGYPT and HIEROGLYPHICS will be found details of the Egyptian records. (X.)

GREEK

A history of Greek handwriting must be incomplete owing to the fragmentary nature of the evidence. If we rule out the inscriptions on stone or metal, which belong to the science of epigraphy, we are practically dependent for the period preceding the 4th or 5th century of the Christian era on the papyri from Egypt (*see* PAPYROLOGY) the earliest of which take back our knowledge only to the end of the 4th century B.C. This limitation is less serious than it might appear, since the few mss. not of Egyptian origin which have survived from this period, like the parchments from Avroman (E. H. Minns, *Journ. of Hell. Stud.*, xxxv., 22 *seq.*) or Dura (*New Pal. Soc.*, ii., 156), the Herculaneum papyri, and a few documents found in Egypt but written elsewhere, reveal a surprising uniformity of style in the various portions of the Greek world; but some differences can be discerned, and it is probable that, had we more material, distinct local styles could be traced.

Further, at any given period several types of hand may exist together. There was a marked difference between the hand used for literary works (generally called "uncials" but, in the papyrus period, better styled "book-hand") and that of documents ("cursive") and within each of these classes several distinct styles were employed side by side; and the various types are not equally well represented in the surviving papyri.

The development of any hand is largely influenced by the materials used. To this general rule the Greek script is no exception. Whatever may have been the period at which the use of papyrus or leather as a writing material began in Greece (and papyrus was employed in the 5th century B.C.), it is highly probable that for some time after the introduction of the alphabet the characters were incised with a sharp tool on stone or metal far oftener than they were written with a pen. In cutting a hard surface it is easier to form angles than curves; in writing the reverse is the case; hence the development of writing was from the angular letters ("capitals") inherited from the epigraphic style to rounded ones ("uncials"). But only certain letters were affected by this development, in particular E (uncial ϵ), Σ (c), Ω (ω), and to a less extent A (α).

The Ptolemaic Period.—The earliest Greek papyrus yet discovered is probably that containing the *Persae* of Timotheus, which dates from the second half of the 4th century B.C. and its script has a curiously archaic appearance. E, Σ, and Ω have the capital form, and apart from these test letters the general effect is one of stiffness and angularity. More striking is the hand of the earliest dated papyrus, a contract of 311 B.C. Written with more ease and elegance, it shows little trace of any development towards a truly cursive style; the letters are not linked, and though the uncial c is used throughout, E and Ω have the capital forms. A similar impression is made by the few other papyri, chiefly literary, dating from about 300 B.C.; E may be slightly rounded, Ω approach the uncial form, and the angular Σ occurs as a letter only in the Timotheus papyrus, though it survived longer as a numeral (=200), but the hands hardly suggest that for at least a century and a half the art of writing on papyrus had been well established. Yet before the middle of the 3rd century B.C. we find both a practised book-hand and a developed and often remarkably handsome cursive.

These facts may be due to accident, the few early papyri happening to represent an archaic style which had survived along with a more advanced one; but it is likely that there was a rapid development at this period, due partly to the opening of Egypt, with its supplies of papyri, and still more to the establishment of the great Alexandrian library, which systematically copied literary and scientific works, and to the multifarious activities of Hellenistic bureaucracy. Henceforward the two types of script were sufficiently distinct (though each influenced the other) to require separate treatment. Some literary papyri, like the roll containing Aristotle's *Constitution of Athens*, were written in cursive hands, and, conversely, the book-hand was occasionally used for documents. Since the scribes did not date literary rolls such papyri are useful in tracing the development of the book-hand.

The documents of the mid 3rd century B.C. show a great variety of cursive hands. We have none from the chancelleries of the Hellenistic monarchs, but some letters, notably those of Apollonius, the finance minister of Ptolemy II., to his agent, Zeno, and those of the Palestinian sheikh, Toubias, are in a type of script which cannot be very unlike the Chancery hand of the time, and show the Ptolemaic cursive at its best. These hands have a noble spaciousness and strength, and though the individual letters are by no means uniform in size there is a real unity of style, the general impression being one of breadth and uprightness. H, with the cross-stroke high, Π, M, with the middle strokes reduced to a very shallow curve, sometimes approaching a horizontal line, Υ, and T, with its cross-bar extending much further to the left than to the right of the up-stroke, Γ and N, whose last stroke is prolonged upwards above the line, often curving backwards, are all broad; ϵ, c, θ, and β, which sometimes takes the form of two almost perpendicular strokes joined only at the top, are usually small; ω is rather flat, its second loop reduced to a practically straight line. Partly by the broad flat tops of the larger letters, partly by the insertion of a stroke connecting those (like H, Υ) which are not naturally adapted to linking, the scribes produced the effect of a horizontal line along the top of the writing, from which the letters seem to hang. This feature is indeed a general characteristic of the more formal Ptolemaic script, but it is specially marked in the 3rd century B.C.

Besides these hands of Chancery type, there are numerous less elaborate examples of cursive, varying according to the writer's skill and degree of education, and many of them strikingly easy and handsome. In some cursiveness is carried very far, the linking of letters reaching the point of illegibility, and the characters sloping to the right. A is reduced to a mere acute angle (∠), T has the cross-stroke only on the left, ω becomes an almost straight line, H acquires a shape somewhat like h, and the last stroke of N is extended far upwards and at times flattened out till it is little more than a diagonal stroke to the right. The attempt to secure a horizontal line along the top is here abandoned. This style was not due to inexpertness, but to the desire for speed, being used specially in accounts and drafts, and was generally the work of practised writers. How well established the cursive hand had now become is shown by some wax tablets of this period in University college, London (*Ancient Egypt*, 1927, part 3), the writing on which, despite the difference of material, closely resembles the hands of papyri.

Documents of the late 3rd and early 2nd centuries B.C. show,

perhaps partly by the accident of survival (we have nothing analogous to the Apollonius letters), a loss of breadth and spaciousness. In the more formal types the letters stand rather stiffly upright, often without the linking strokes, and are more uniform in size; in the more cursive they are apt to be packed closely together. These features are more marked in the hands of the 2nd century. The less cursive often show an approximation to the book-hand, the letters growing rounder and less angular than in the 3rd century, in the more cursive linking was carried further, both by the insertion of coupling strokes and by the writing of several letters continuously without raising the pen, so that before the end of the century an almost current hand was evolved. A characteristic letter, which survived into the early Roman period, is T, with its cross-stroke made in two portions (Ƭ). In the 1st century the hand tended, so far as can be inferred from the surviving examples, to disintegrate, we can recognize the signs which portend a change of style, irregularity, want of direction, and the loss of the feeling for style. A fortunate accident has preserved two Greek parchments written in Parthia, one dated 88 B.C., in a practically unligatured hand, the other, 22/21 B.C., in a very cursive script of Ptolemaic type, and though each has un-Egyptian features the general character indicates a uniformity of style in the Hellenistic world.

The development of the Ptolemaic book-hand is difficult to trace, as there are few examples, mostly not datable on external grounds. Only for the 3rd century B.C. have we a secure basis. The hands of that period have an angular appearance, there is little uniformity in the size of individual letters, and though sometimes, notably in the Petrie papyrus containing the *Phaedo* of Plato, a style of considerable delicacy is attained, the book-hand in general shows less mastery than the contemporary cursive. In the 2nd century the letters grew rounder and more uniform in size, but in the 1st century there is perceptible, here as in the cursive hand, a certain disintegration. Probably at no time did the Ptolemaic book-hand acquire such unity of stylistic effect as the cursive.

The Roman Period.—Papyri of the Roman period are far more numerous and show greater variety. The cursive of the 1st century has a rather broken appearance, part of one character being often made separately from the rest and linked to the next letter. A form characteristic of the 1st and 2nd centuries and surviving after that only as a fraction sign ($=\frac{1}{8}$) is η in the shape J. By the end of the 1st century there had been developed several excellent types of cursive, which, though differing considerably both in the forms of individual letters and in general appearance, bear a family likeness to one another. Qualities which are specially noticeable are roundness in the shape of letters, continuity of formation, the pen being carried on from character to character, and regularity, the letters not differing strikingly in size and projecting strokes above or below the line being avoided. Sometimes, especially in tax-receipts and in stereotyped formulae, cursiveness is carried to an extreme. In a letter of the prefect, dated in 209, we have a fine example of the Chancery hand, with tall and laterally compressed letters, *o* very narrow and α and ω often written high in the line. This style, from at least the latter part of the 2nd century, exercised considerable influence on the local hands, many of which show the same characteristics less pronounced; and its effects may be traced into the early part of the 4th century. Hands of the 3rd century uninfluenced by it show a falling off from the perfection of the 2nd century; stylistic uncertainty and a growing coarseness of execution mark a period of decline and transition.

Several different types of book-hand were used in the Roman period. Particularly handsome is a round, upright hand seen, *e.g.*, in a British Museum papyrus containing *Odyssey* III. The cross-stroke of ϵ is high, M deeply curved and A has the form α. Uniformity of size is well attained, and few strokes project, and these but slightly, above or below the line. Another type, well called by Schubart the "severe" style, has a more angular appearance and not infrequently slopes to the right; though handsome, it has not the sumptuous appearance of the former. There are various classes of a less pretentious style, in which convenience rather than beauty was the first consideration and no pains were taken to avoid irregularities in the shape and alignment of the letters. Lastly may be mentioned a hand which is of great interest as being the ancestor of the type called (from its later occurrence in vellum codices of the Bible) the biblical hand. This, which can be traced back to at least the late 2nd century, has a square, rather heavy appearance, the letters, of uniform size, stand upright, and thick and thin strokes are well distinguished. In the 3rd century the book-hand, like the cursive, appears to have deteriorated in regularity and stylistic accomplishment.

In the charred rolls found at Herculaneum and dating from about the beginning of our era we have specimens of Greek literary hands from outside Egypt, and a comparison with the Egyptian papyri reveals great similarity in style and shows that conclusions drawn from the hands of Egypt may, with caution, be applied to the development of writing in the Greek world generally.

The Byzantine Period.—The cursive hand of the 4th century shows some uncertainty of character. Side by side with the style founded on the Chancery hand, regular in formation and with tall and narrow letters, which characterized the period of Diocletian, and lasted well into the century, we find many other types mostly marked by a certain looseness and irregularity. A general progress towards a florid and sprawling hand is easily recognizable, but a consistent and deliberate style was hardly evolved before the 5th century, from which unfortunately few dated documents have survived. Byzantine cursive tends to an exuberant hand, in which the long strokes are excessively extended and individual letters often much enlarged. But not a few hands of the 5th and 6th centuries are truly handsome and show considerable technical accomplishment. Both an upright and a sloping type occur and there are many less ornamental hands, but there gradually emerged towards the 7th century two general types, one (specially used in letters and contracts) a current hand, sloping to the right, with long strokes in such characters as τ, ρ, ξ, η (which has the h shape), ι, and κ, and with much linking of letters, and another (frequent in accounts), which shows, at least in essence, most of the forms of the later minuscule. (*See* below.) This is often upright, though a slope to the right is quite common, and sometimes, especially in one or two documents of the early Arab period, it has an almost calligraphic effect.

In the Byzantine period the book-hand, which in earlier times had more than once approximated to the contemporary cursive, diverged widely from it.

VELLUM AND PAPER MSS.

The change from papyrus to vellum involved no such modification in the forms of letters as followed that from metal to papyrus. The justification for considering the two materials separately is that after the general adoption of vellum the Egyptian evidence is first supplemented and later superseded by that of mss. from elsewhere, and that during this period the hand most used was one not previously employed for literary purposes.

The Uncial Hand.—The prevailing type of book-hand during what in papyrology is called the Byzantine period, *i.e.*, roughly from A.D. 300 to 650, is known as the biblical hand. It went back to at least the end of the 2nd century and had had originally no special connection with Christian literature. In mss., whether vellum or paper, of the 4th century found in Egypt we meet other forms of script, particularly a sloping, rather inelegant hand derived from the literary hand of the 3rd century, which persisted to at least the 5th century, but the three great early codices of the Bible are all written in uncials of the biblical type. In the Vaticanus, placed in the 4th century, the characteristics of the hand are least strongly marked, the letters have the forms characteristic of the type but without the heavy appearance of later mss., and the

general impression is one of greater roundness. In the Sinaiticus, which is not much later, the letters are larger and more heavily made; and in the Alexandrinus (5th century?) a later development is seen, with emphatic distinction of thick and thin strokes. By the 6th century, alike in vellum and in papyrus mss., the heaviness had become very marked, though the hand still retained, in its best examples, a handsome appearance; but after this it steadily deteriorated, becoming ever more mechanical and artificial. The thick strokes grew heavier; the cross strokes of Τ and Θ and the base of Δ were furnished with drooping spurs. The hand, which is often singularly ugly, passed through various modifications, now sloping, now upright, though it is not certain that these variations were really successive rather than concurrent. A different type of uncials, derived from the Chancery hand and seen in two papyrus examples of the Festal letters despatched annually by the Patriarchs of Alexandria, was occasionally used, the best known example being the Codex Marchalianus (6th or 7th century?). A combination of this hand with the other type is also known.

The Minuscule Hand.—The uncial hand lingered on, mainly for liturgical mss., where a large and easily legible script was serviceable, as late as the 12th century, but in ordinary use it had long been superseded by a new type of hand, the minuscule, which originated in the 8th century, as an adaptation to literary purposes of the second of the types of Byzantine cursive mentioned above. A first attempt at a calligraphic use of this hand, seen in one or two mss. of the 8th or early 9th century (*e.g.*, *Specimina Cod. Graec. Vatican.* No. 5), in which it slopes to the right and has a narrow, angular appearance, did not find favour, but by the end of the 9th century a more ornamental type, from which modern Greek script is descended, was already established. It has been suggested (T. W. Allen, *Journ. Hell. Stud.* xl., 1–12) that it was evolved in the monastery of the Studium at Constantinople. In its earliest examples it is upright and exact but lacks flexibility; accents are small, breathings square in formation, and in general only such ligatures are used as involve no change in the shape of letters. The single forms have a general resemblance (with considerable differences in detail) both to the minuscule cursive of late papyri, and to those used in modern Greek type; uncial forms were avoided.

In the course of the 10th century the hand, without losing its beauty and exactness, gained in freedom. Its finest period was from the 9th to the 12th century, after which it rapidly declined. The development was marked by a tendency (1) to the intrusion, in growing quantity, of uncial forms, which good scribes could fit into the line without disturbing the unity of style but which, in less expert hands, had a disintegrating effect; (2) to the disproportionate enlargement of single letters, especially at the beginnings and ends of lines; (3) to ligatures, often very fantastic, which quite changed the forms of letters; (4) to the enlargement of accents, breathings at the same time acquiring the modern rounded form. But from the first there were several styles, varying from the formal, regular hands characteristic of service books to the informal style, marked by numerous abbreviations, used in mss. intended only for a scholar's private use. The more formal hands were exceedingly conservative, and there are few classes of script more difficult to date than the Greek minuscule of this class. In the 10th, 11th and 12th centuries a sloping hand, less dignified than the upright, formal type, but often very handsome, was specially used for mss. of the classics.

Hands of the 11th century are marked in general (though there are exceptions) by a certain grace and delicacy, exact but easy; those of the 12th by a broad, bold sweep and an increasing freedom, which readily admits uncial forms, ligatures and enlarged letters but has not lost the sense of style and decorative effect. In the 13th and still more the 14th centuries there was a steady decline; the less formal hands lost their beauty and exactness, becoming ever more disorderly and chaotic in their effect, while the formal style imitated the precision of an earlier period without attaining its freedom and naturalness, and often appears singularly lifeless. In the 15th century, especially in the West, where Greek scribes were in request to produce mss. of the classical authors, there was a revival, and several mss. of this period, though markedly inferior to those of the 11th and 12th centuries, are by no means without beauty.

ACCENTS, PUNCTUATION, DIVISION OF WORDS

In the book-hand of early papyri neither accents nor breathings were employed. Their use was established by the beginning of the Roman period, but was sporadic in papyri, where they were used as an aid to understanding, and therefore more frequently in poetry than in prose, and in lyrical oftener than in other verse. In the cursive of papyri they are practically unknown, as are marks of punctuation. Punctuation was effected in early papyri, literary and documentary, by spaces, reinforced in the book-hand by the paragraphus, a horizontal stroke under the beginning of the line. The coronis, a more elaborate form of this, marked the beginning of lyrics or the principal sections of a longer work. Punctuation marks, the comma, the high, low and middle points, were established in the book-hand by the Roman period; in early Ptolemaic papyri a double point (:) is found.

In vellum and paper mss. punctuation marks and accents were regularly used from at least the 8th century, though with some differences from modern practice. At no period down to the invention of printing did Greek scribes consistently separate words. The book-hand of papyri aimed at an unbroken succession of letters, except for distinction of sections; in cursive hands, especially where abbreviations were numerous, some tendency to separate words may be recognized, but in reality it was phrases or groups of letters rather than words which were divided. In the later minuscule word-division is much commoner but never became systematic, accents and breathings serving of themselves to indicate the proper division.

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LATIN

Attention should be drawn at the outset to certain fundamental definitions and principles of the science. The original characters of an alphabet are modified by the material and the implements used. When stone and chisel are discarded for papyrus and reed-pen, the hand encounters less resistance and moves more rapidly. This leads to changes in the size and position of the letters, and then to the joining of letters, and, consequently, to altered shapes. We are thus confronted at an early date with quite distinct types.

The majuscule style of writing, based on two parallel lines, ADLP. is opposed to the minuscule, based on a system of four lines, with letters of unequal height, adlp. Another classification, according to the care taken in forming the letters, distinguishes between the set book-hand and the cursive script. The difference in this case is determined by the subject matter of the text; the writing used for books (*scriptura libraria*) is in all periods quite distinct from that used for letters and documents (*epistolaris, diplomatica*). While the set book-hand, in majuscule or minuscule, shows a tendency to stabilize the forms of letters, the cursive, often carelessly written, is continually changing in the course of years and according to the preferences of the writers.

This being granted, a summary survey of the morphological history of the Latin alphabet shows the zenith of its modifications at once, for its history is divided into two very unequal periods, the first dominated by majuscule and the second by minuscule writing.

I. MAJUSCULE WRITING

Capital Writing.—The Latin alphabet first appears in the epigraphic type of majuscule writing, known as capitals. These characters form the main stem from which developed all the branches of Latin writing. On the oldest monuments (the *inscriptiones bello Hannibalico antiquiores* of the *Corpus Inscriptionum Latinarum*), it is far from showing the orderly regularity of the later period. Side by side with upright and square characters are angular and sloping forms, sometimes very distorted, which seem to indicate the existence of an early cursive writing from which they would have been borrowed. Certain literary texts clearly allude to such a hand (Van Hoesen, *Roman Cursive Writing*, pp. 1–2). Later, the characters of the cursive type were progressively eliminated from formal inscriptions, and capital writing reached its perfection in the Augustan age.

Epigraphists divide the numerous inscriptions of this period into two quite distinct classes: *tituli*, or formal inscriptions engraved on stone in elegant and regular capitals, and *acta*, or legal texts, documents, etc., generally engraved on bronze in cramped and careless capitals. Palaeography inherits both these types. Reproduced by scribes on papyrus or parchment, the elegant characters of the inscriptions become the square capitals of the manuscripts (fig. 1), and the *actuaria*, as the writing of the *acta* is called, becomes the rustic capital (fig. 2).

Of the many books written in square capitals, the *éditions de luxe* of ancient times, only a few fragments have survived, the most famous being pages from manuscripts of Virgil (Chatelain, *Pal. des classiques latins*, pl. LXI.–II., LXXV.; *Oxyrhynchus Papyri*, viii., 1,098). The finest examples of rustic capitals, the use of which is attested by papyri of the first century (Zangemeister and Wattenbach, *Exempla*, pl. I.–II.), are to be found in manuscripts of Virgil (Ehrle, *Fragm. Virgiliana*, 1899; *Pal. Soc.*, pl. 113–117; *Archivio paleogr. ital.*, i., 98) and Terence (*Pal. Soc.*, pl. 135). Neither of these forms of capital writing offers any difficulty in reading, except that no space is left between the words. Their dates are still uncertain, in spite of attempts to determine them by minute observation (Dziatzko, *Untersuchungen;* E. A. Lowe in the *Classical Quarterly*, vol. xix., p. 197).

The rustic capitals, more practical than the square forms, soon came into general use. This was the standard form of writing, so far as books are concerned, until the 5th century, when it was replaced by a new type, the uncial, which will be discussed below.

Early Cursive Writing.—While the set book-hand, in square or rustic capitals, was used for the copying of books, the writing of every-day life, letters and documents of all kinds, was in a cursive form, the oldest examples of which are provided by the graffiti on walls at Pompeii (*C.I.L.*, iv.), a series of waxen tablets, also discovered at Pompeii (*C.I.L.*, iv., supplement), a similar series found at Verespatak in Transylvania (*C. I. L.*, iii.) and a number of papyri (Wessely, *Schrifttafeln* and *Studien zur Pal.*, xiv.; *Oxyrhynchus Papyri, passim;* Federici, *Esempi di corsiva antica;* etc.). (*See* figs. 3, 4.) From a number of documents which exhibit transitional forms it appears that this cursive was originally simplified capital writing (Steffens, *Lat. Pal.*, 2nd ed., pl. 3; Wessely, *Studien*, xiv., pl. viii., etc.). The evolution was so rapid, however, that at quite an early date the *scriptura epistolaris* of the Roman world can no longer be described as capitals. By the first century, this kind of writing began to develop the principal characteristics of two new types: the uncial and the minuscule cursive. With the coming into use of writing surfaces which were smooth, or offered little resistance, the unhampered haste of the writer altered the shape, size and position of the letters. In the earliest specimens of writing on wax, plaster or papyrus, there appears a tendency to represent several straight strokes by a single curve. The cursive writing thus foreshadows the specifically uncial forms. The same specimens show great inequality in the height of the letters; the main strokes are prolonged upwards (ɔ = *b*; ƌ = *d*) or downwards (ᑫ = *q*; ↽ = *z*). In this direction, the cursive tends to become a minuscule hand.

Uncial Writing.—Although the characteristic forms of the uncial type appear to have their origin in the early cursive (Thompson, *Latin Palaeography* in Sandy's *Companion*, 2nd ed., p. 771; Van Hoesen, *The Parentage and Birthdate of the Latin Uncial* in *Transactions and Proceedings* of the American Philological Association, xlii.), the two hands are nevertheless quite distinct. The uncial is a *libraria*, closely related to the capital writing, from which it differs only in the rounding off of the angles of certain letters, principally ɑ ∂ ϵ ɱ. It represents a compromise between the beauty and legibility of the capitals and the rapidity of the cursive, and is clearly an artificial product. It was certainly in existence by the latter part of the 4th century, for a number of manuscripts of that date are written in perfect uncial hands (*Exempla*, pl. 20 fig. 5). It soon supplanted the capitals and appears in numerous manuscripts which have survived from the 5th, 6th and 7th centuries, when it was at its height. (A list is given in Traube, *Vorlesungen*, i., 171–261, and numerous reproductions in Zangemeister and Wattenbach's *Exempla*, and in Chatelain, *Uncialis scriptura*.) By this time it had become an imitative hand, in which there was generally no room for spontaneous development. It remained noticeably uniform over a long period. It is difficult therefore to date the manuscripts by palaeographical criteria alone. The most that can be done is to classify them by centuries, on the strength of tenuous data (Chatelain, *Unc. script., explanatio tabularum*). The earliest uncial writing is easily distinguished by its simple and monumental character from the later hands, which become progressively stiff and affected.

II. MINUSCULE CURSIVE WRITING

Early Minuscule Cursive.—"When writing has to be done frequently and rapidly," says the *Nouveau Traité de Diplomatique* (ii., 491), "majuscule writing is bound to turn imperceptibly into a connected or cursive minuscule." It would be easy to illustrate this generalisation by examples taken from ancient cursive writing, in which here and there from the 1st century onwards are found symptoms of transformation in the form of certain letters, the shape and proportions of which correspond more closely to the definition of minuscule writing than to that of majuscule. Rare and irregular at first, they gradually become more numerous and more constant and by degrees supplant the majuscule forms, so that in the history of the Roman cursive there is no precise boundary between the majuscule and minuscule periods.

The oldest example of minuscule cursive writing that has been discovered is a letter on papyrus, found in Egypt, dating from the fourth century (*Archiv für Urkundenforschung*, iii., pl. i.; fig. 7). This marks an important date in the history of Latin writing, for with only one known exception, not yet adequately explained—two fragments of imperial rescripts of the 5th century (Mommsen, *Fragmente zweier Kaiserrescripte* in the *Jahrbuch des gemeinen deutschen Rechts*, vi., 398; Preisigke in *Schriften der wissensch. Gesellsch. in Strassburg*, xxx.; *Pal. Soc.*, pl. 30)—the minuscule cursive was thenceforth the only *scriptura epistolaris* of the Roman world.

The ensuing succession of documents (*e.g.*, a certificate of A.D. 400 in Wessely, *Studien*, xiv., pl. xiii.; a letter of A.D. 444 in Wessely, *Schrifttafeln*, pl. xii., No. 19) show a continuous

improvement in this form of writing, characterised by the boldness of the strokes and by the elimination of the last lingering majuscule forms. The Ravenna deeds of the 5th and 6th centuries (Marini, *I papiri diplomatici;* Champollion-Figeac, *Chartes et Mss. sur papyrus;* E. A. Bond, *Facsimiles of Ancient Charters; Archivio paleogr. italiano,* i., pl. 1–5) exhibit this hand at its perfection (fig. 8).

At this period the minuscule cursive made its appearance as a book-hand, first as marginal notes, and later for the complete books themselves. The only difference between the book-hand and that used for documents is that the principal strokes are shorter and the characters thicker. This form of the hand is usually called semi-cursive.

The National Hands.—The fall of the Empire and the establishment of the barbarians within its former boundaries did not interrupt the use of the Roman minuscule cursive hand, which was adopted by the newcomers. But for gaps of over a century in the chronological series of documents which have been preserved, it would be possible to follow the evolution of the Roman cursive into the so-called national hands, forms of minuscule writing which flourished after the barbarian invasions in Italy, France, Spain, England and Ireland, and which are still known as Lombardic, Merovingian, Visigothic, Anglo-Saxon and Irish. These names came into use at a time when the various national hands were believed to have been invented by the peoples who used them, but their connotation is merely geographical.

Nevertheless, in spite of a close resemblance which betrays their common origin, these hands are specifically different, perhaps because the Roman cursive was developed by each nation in accordance with its artistic tradition. (*Cf.* Schiaparelli, *Note paleografiche* in *Archivio stor. italiano,* lxxiv. 55.)

Lombardic Writing.—In Italy, after the close of the Roman and Byzantine periods, the writing is known as Lombardic, a generic term which comprises several local varieties. These may be classified under four principal types: two for the *scriptura epistolaris,* the old Italian cursive and the papal chancery hand, or *littera romana,* and two for the *libraria,* the old Italian book-hand and Lombardic in the narrow sense, sometimes known as *Beneventana* on account of the fact that it flourished in the principality of Benevento.

The oldest preserved documents written in the old Italian cursive show all the essential characteristics of the Roman cursive of the 6th century (Bonelli, *Cod. pal. lombardo; Arch. pal. ital.,* i., iii., vii.). In northern Italy, this hand began in the 9th century to be influenced by a minuscule book-hand which developed, as will be seen later, in the time of Charlemagne; under this influence it gradually disappeared, and ceased to exist in the course of the 12th century. In southern Italy, it persisted far on into the later middle ages (Russi, *Paleogr. . . . de' docum. della prov. Napolitana*).

The papal chancery hand, a variety of Lombardic peculiar to the vicinity of Rome and principally used in papal documents, is distinguished by the shape of the letters, *a, e, q, t* (fig 9). It is formal in appearance at first, but is gradually simplified, under the influence of the Carolingian minuscule, which finally prevailed in the bulls of Honorius II. (1124–1130). The notaries public in Rome continued to use the papal chancery hand until the beginning of the 13th century.

The old Italian book-hand is simply a semi-cursive of the type already described as in use in the 6th century. The principal examples are derived from *scriptoria* in northern Italy, where it was displaced by the Carolingian minuscule during the 9th century.

In southern Italy, this hand persisted, developing into a calligraphic form of writing, and in the 10th century took on a very artistic angular appearance (Lowe, *Beneventan Script;* facsimiles in Piscicelli-Taeggi, *Paleogr. artist. di Monte Cassino*). The *Exultet* rolls provide the finest examples (fig. 10). In the 9th century, it was introduced in Dalmatia by the Benedictine monks and developed there, as in Apulia, on the basis of the archetype, culminating in a rounded *Beneventana* known as the Bari type (Novak, *Scriptura Beneventana,* Zagreb, 1920).

Merovingian—The offshoot of the Roman cursive which developed in Gaul under the first dynasty of kings is called Merovingian writing. It is represented by thirty-eight royal diplomas (Lauer and Samaran, *Les diplômes originaux des Mérovingiens*), a number of private charters (Tardif, *Facsim. de chartes et diplômes*) and the authenticating documents of relics (Prou, *Recueil de facsim.,* 1904, pl. v.).

Though less than a century intervenes between the Ravenna cursive and the oldest extant Merovingian document (A.D. 625), there is a great difference in appearance between the two writings. The facile flow of the former is replaced by a cramped style, in which the natural slope to the right gives way to an upright hand, and the letters, instead of being fully outlined, are compressed to such an extent that they modify each other's shape (fig. 11). Copyists of books used a cursive similar to that found in documents, except that the strokes are thicker, the forms more regular, and the heads and tails shorter (*Album paléogr. de la Soc. de l' Ec. des Chartes,* pl. 12).

The Merovingian cursive as used in books underwent simplification in some localities, undoubtedly through the influence of the minuscule book-hand of the period. The two principal centres of this reform were Luxeuil and Corbie (Traube, *Perrona Scottorum* in *Sitzungsberichte* of the Munich Academy, 1900; Liebart, *Corbie Scriptorium* in W. M. Lindsay's *Palaeogr. Lat.,* i.).

With the appearance, early in the 8th century, of the Carolingian minuscule, the Merovingian hand ceased to be used for books. In the Carolingian chancery, where it persisted longest, it soon discarded its characteristic forms and intricate combinations of letters under the influence of the new hand. Only a few archaic types with long slender heads and tails, vaguely reminiscent of the old script, survived in diplomatic writing until the 11th century.

Visigothic Writing.—In Spain, after the Visigothic conquest, the Roman cursive gradually developed special characteristics. Some documents attributed to the 7th century display a transitional hand with straggling and rather uncouth forms (Ewald and Loewe, *Exempla scripturae visigothicae,* pl. 3). The distinctive features of Visigothic writing, the most noticeable of which is certainly the q-shaped g, did not appear until later, in the book-hand. The book-hand became set at an early date. In the 8th century it appears as a sort of semi-cursive; the earliest example of certain date is ms. lxxxix. in the Capitular Library in Verona (Clark, *Collectanea hispanica,* 63, 129–130; Schiaparelli in *Arch. stor. ital.* lxxxii., 106). From the 9th century the calligraphic forms become broader and more rounded until the 11th century, when they become slender and angular (numerous reproductions in Ewald and Loewe, *Exempla;* Burnam, *Paleogr. iberica;* Clark, *Collectanea;* Garcia Villada, *Paleogr. espanola*).

The Visigothic minuscule appears in a cursive form in documents about the middle of the 9th century, and in the course of time grows more intricate and consequently less legible (Munoz, *Paleogr. visigoda;* Garcia Villada, *op. cit.*). It soon came into competition with the Carolingian minuscule, which supplanted it as a result of the presence in Spain of French elements such as Cluniac monks and warriors engaged in the campaign against the Moors (Hessel, *Ausbreitung der karol Minuskel* in *Archiv für Urkundenforschung,* vii., viii.).

The Irish and Anglo-Saxon hands, which were not directly derived from the Roman minuscule cursive, will be discussed later

III. SET MINUSCULE WRITING

One after another, the national minuscule cursive hands were superseded by a set minuscule hand which has already been mentioned. Its origins may now be traced from the beginning.

Half-uncial Writing.—The early cursive was the medium in which the minuscule forms were gradually evolved from the corresponding majuscule forms. Minuscule writing was thus cursive in its inception. As the minuscule letters made their appearance in the cursive writing of documents, they were adopted and given calligraphic form by the copyists of literary texts, so that the set minuscule alphabet was constituted gradually, letter by letter, following the development of the minuscule cursive. Just as some documents written in the early cursive show a mixture of

majuscule and minuscule forms, so certain literary papyri of the 3rd century (*Oxyrhynchus Papyri,* iv., pl. vi., No. 668; xi., pl. vi., No. 1,379), and inscriptions on stone of the 4th century (*Pal. Soc.,* pl. 127–8; *Arch. pal. ital.,* v., pl. 6) yield examples of a mixed set hand, with minuscule forms side by side with capital and uncial letters. The number of minuscule forms increases steadily in texts written in the mixed hand, and especially in marginal notes, until by the end of the 5th century the majuscule forms have almost entirely disappeared in some mss.

This quasi-minuscule writing, known as the Half-uncial (fig. 12; many examples in Chatelain, *Semiuncial Script.*) is thus descended from a long line of mixed hands which, in a synoptic chart of Latin scripts, would appear close to the oldest *librariae,* and between them and the *epistolaris* (cursive), from which its characteristic forms were successively derived. It had a considerable influence on the continental *scriptura libraria* of the 7th and 8th centuries.

Irish and Anglo-Saxon Writing.—The half-uncial hand was introduced in Ireland along with Latin culture in the 5th century by priests and laymen from Gaul, fleeing before the barbarian invasions. It was adopted there to the exclusion of the cursive, and soon took on a distinct character. There are two well established classes of Irish writing as early as the 7th century: a large round half-uncial hand, in which certain majuscule forms frequently appear (fig. 13), and a pointed hand, more cursive and more genuinely minuscule (fig. 14). The latter developed out of the former (Keller, *Angelsächsische Palaeogr.*). One of the distinguishing marks of mss. of Irish origin is to be found in the initial letters, which are ornamented by interlacing, animal forms, or a frame of red dots. The most certain evidence, however, is provided by the system of abbreviations and by the combined square and cuneiform appearance of the minuscule at the height of its development (fig. 15; *cf.* Schiaparelli in *Arch. stor. ital.,* lxxiv., ii., 1–126).

These two types of Irish writing were introduced in the north of Great Britain by the monks, and were soon adopted by the Anglo-Saxons, being so exactly copied that it is sometimes difficult to determine the origin of an example. Gradually, however, the Anglo-Saxon writing developed a distinct style, and even local types (Keller, *op. cit.;* Lindsay, *Early Welsh Script*), which were superseded after the Norman conquest by the Carolingian minuscule. Through St. Columba and his followers, Irish writing spread to the continent, and mss. were written in the Irish hand in the monasteries of Bobbio and St. Gall during the 7th and 8th centuries.

The Carolingian Minuscule.—In Ireland, an imported quasi-minuscule hand developed into a perfect minuscule. On the continent, where the copyists of books commonly used a cursive script, it is more difficult to trace the transition from the half-uncial to the perfect minuscule, which appeared in the time of Charlemagne and is consequently known as Carolingian. The origin of this hand is much disputed. This is due to the confusion which prevailed before the Carolingian period in the *libraria* in France, Italy and Germany as a result of the competition between the cursive and the set hands. In addition to the calligraphic uncial and half-uncial writings, which were imitative forms, little used and consequently without much vitality, and the minuscule cursive, which was the most natural hand, there were innumerable varieties of mixed writing derived from the influence of these hands on each other. In some, the uncial or half-uncial forms were preserved with little or no modification, but the influence of the cursive is shown by the freedom of the strokes; these are known as rustic, semi-cursive or cursive uncial or half-uncial hands. Conversely, the cursive was sometimes affected, in varying degrees, by the set *librariae;* the cursive of the *epistolaris* became a semi-cursive when adopted as a *libraria.* Nor is this all. Apart from these reciprocal influences affecting the movement of the hand across the page, there were morphological influences at work, letters being borrowed from one alphabet for another. This led to compromises of all sorts and of infinite variety between the uncial and half-uncial and the cursive. It will readily be understood that the origin of the Carolingian minuscule, which must be sought in this tangle of pre-Carolingian hands, involves disagreement. The new writing is admittedly much more closely related to the *epistolaris* than the primitive minuscule; this is shown by certain forms, such as the open *a* (ɑ), which recall the cursive, by the joining of certain letters, and by the clubbing of the tall letters *b d h l,* which resulted from a cursive *ductus.* All palaeographers agree in assigning the new hand the place shown in the following table:

Librariae					*Epistolaris*
Capitals Uncials	Half-uncial	Rustic uncial and half-uncial	Pre-Carolingian Carolingian	Semi cursive	Minuscule cursive

Controversy turns on the question whether the Carolingian minuscule is the primitive minuscule as modified by the influence of the cursive or a cursive based on the primitive minuscule. Its place of origin is also uncertain; Rome, the Palatine school, Tours, Metz, Reims, St. Denis and Corbie have been suggested, but no agreement has been reached. (For the latest pronouncement *cf.* Steinacker in *Miscellanea Ehrle,* iv., 126 *sq.*)

In any case, the appearance of the new hand is a turning point in the history of culture. So far as Latin writing is concerned, it marks the dawn of modern times.

IV. THE RISE OF MODERN WRITING

It is impossible here to describe in detail the transformations which the Carolingian minuscule underwent at the hands of generations of clerks through the middle ages. The course of its development may be summarized in a few words. There are undeniable points of contact between architecture and palaeography, and in both it is possible to distinguish a Romanesque and a Gothic period. The creative effort which began in the post-Carolingian period culminated at the beginning of the 12th century in a calligraphy and an architecture which, though still somewhat awkward, showed unmistakable signs of power and experience, and at the end of that century and in the first half of the 13th both arts reached their climax and made their boldest flights.

The topography of later mediaeval writing has hardly been investigated at all as yet. National varieties can, of course, be distinguished. The English Gothic cursive presents certain typical forms and a number of peculiarities of outline In Germany, efforts have been made to tabulate the distinguishing features of local hands (Steinacker, *Diplomatik und Landeskunde;* Schubert, *Eine lütticher Schriftprovinz,* etc.). The problem becomes complicated as a result of the development of international relations, and the migration of clerks from one end of Europe to the other (Hajnal, *Irrastortenet az irasbeliseg felujulasa korabol,* Budapest, 1921).

During the later centuries of the middle ages the Gothic minuscule continued to improve within the restricted circle of *de luxe* editions and ceremonial documents. In common use, it degenerated into a cursive which became more and more intricate, full of superfluous strokes and complicated by abbreviations.

In the first quarter of the 15th century an innovation took place which exercised a decisive influence on the evolution of writing in Europe. The Italian humanists were struck by the eminent legibility of the mss., written in the improved Carolingian minuscule of the 10th and 11th centuries, in which they discovered the works of ancient authors, and carefully imitated the old writing. Their example was followed by many copyists. The papal chancery adopted the new fashion for some purposes, and thus contributed to its diffusion throughout Christendom The printers played a still more significant part in establishing this form of writing by using it, from the year 1465, as the basis for their types. The humanistic minuscule soon gave rise to a sloping cursive hand, known as the Italian, which was also taken up by printers in search of novelty and thus became the italic type.

In consequence, the Italian hand became widely used, and in

the 16th century began to compete with the Gothic cursive. In the 17th century, writing masters were divided between the two schools, and there was in addition a whole series of compromises. The Gothic characters gradually disappeared. A few survived until the middle of the 18th century, but since then, except in Germany, which has shown a persistent preference for the Gothic, the Italian has been universally used. Brought to perfection in recent times by English calligraphers, it is taught in schools everywhere under the name of English cursive.

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PALAEOLITHIC: *see* ARCHAEOLOGY: *Iron Age.*

PALAEOLOGUS, a Byzantine family name which first appears in history about the middle of the 11th century. Michael Palaeologus (*q.v.*), son of Andronicus Palaeologus Comnenus, became the eighth emperor of that name in 1260, and was in turn followed by his son Andronicus II. (1282–1328). Michael, the son of Andronicus, and associated with him in the empire, died in 1320, but left a son, Andronicus III., who reigned from 1328 to 1341; John VI. (1355–91), Manuel II. (1391–1425) and John VII. (1425–48) then followed in lineal succession; Constantine XI. or XII., the last emperor of the East (1448–53), was the younger brother of John VII. Other brothers were Demetrius, prince of the Morea until 1460, and Thomas, prince of Achaia, who died at Rome in 1465. A daughter of Thomas, Zoë by name, married Ivan III. of Russia. A younger branch of the Palaeologi held the principality of Monferrat from 1305 to 1533, when it became extinct.

See ROMAN EMPIRE, LATER, and articles on the separate rulers.

PALAEONTOLOGY, the science which deals with the remains of animals and plants found buried in the rocks. For convenience it is now customary to use the term only for the study of fossil animals, and to deal with plants under the head of palaeobotany (*q.v.*). In essence however, the two form one science distinguished from zoology and botany by the fact that the organisms with which it deals are not all of the same age, but cover, incompletely it is true, the history of life in the world from a time not long after its appearance, when organisms capable of being preserved first arose.

Preservation.—In most cases only the hard parts of animals are capable of preservation as fossils, but under especially favourable circumstances the soft parts may be represented either by an impression upon the surrounding rock, or by stains, or even by a petrifaction which may preserve the microscopical structure of muscle and other tissues.

The preservation of any animal as a fossil depends on its burial in a sediment which is not subsequently destroyed by denudation. In the sea, the remains of marine animals are continually accumulating on the sea-bottom. They may lie in the place where they fall or, if exposed to the action of currents, be carried for considerable distances and when the speed of the current becomes insufficient to move them, be laid down, often in association with many other objects of the same area and weight. Thus it is common to find great accumulations of fossil shells all of approximately the same size, which are not necessarily in the place where they actually lived. On the other hand shells of burrowing molluscs may be found as they were in life. The remains of animals even if of such relatively permanent structure as shells are soon destroyed if they lie for long exposed to the action of the sea, and they can only be preserved if they are deposited at a place where mud or sand is being laid down. Such districts are comparatively rare and of local occurrence. They may be found chiefly where the sea-bottom off a coast is sinking. Certain special areas such as coral reefs provide exceptionally favourable conditions for the preservation of marine fossils.

On land the possibilities of preservation are much smaller. The remains of a land fauna are chiefly preserved either in the sediments which form on the bottom of lakes, or perhaps more commonly in arid areas where the general level of the land-surface is rising, because of the distribution of dust and sand over it by wind action. Under these circumstances the skeleton of a dead animal may become covered by a pile of blown sand, and may, if it escape the action of floods and wind, remain buried for geological periods. One exceptional method of preservation, more important in the case of plants than animals, is in the detritus of forests growing on a coastal plain at or below high-water mark, as do mangroves to-day. If this plain be situated in a sinking area, great masses of deposits (now represented by coal-fields) may be built up, and in them animals and plants will be abundantly preserved.

The nature of the preservation of an individual fossil depends greatly on its own chemical and physical composition, and on that of the surrounding sediments. The calcareous shells of molluscs and brachiopods, if buried in a mud which becomes converted into a clay, may be preserved indefinitely in their original form, because such rocks hinder the passage of water, which, when freely allowed, will either dissolve the shell completely or bring about a re-arrangement, often into crystals, of the molecules of which it is composed. In some cases such clays, especially if they become impregnated with petroleum, may preserve traces of the soft parts of the animal, in the form of a carbonaceous film made from its material exactly as coal has arisen from plant materials.

The most remarkable of such fossils are those from the Middle Cambrian of Burgess pass, British Columbia, described by C. D. Walcott. Here the external form even of slender soft processes of worms has been perfectly preserved and even something of their internal anatomy can be made out from colour differences in the carbonaceous films which represent them.

When buried in sand a shell is exposed to the action of percolating waters which if acid are capable of dissolving it. Its preservation is therefore dependent either on the sealing down of the sand by such a layer of clay as will prevent the circulation of water, or on a solidification of the sand by a cementing together of the individual grains, usually by calcium carbonate, which happens sufficiently rapidly to form a solid case round the shell, which may then persist if the percolating water be completely saturated with calcium carbonate, altered only by the laying down of further calcite in its pores. In many cases however the shell itself is entirely removed in solution, and its former presence is shown by a cavity in the sandstone, which reproduces the surfaces of the shell in negative (often with complete perfection).

When buried in a calcareous mud such as that which accumulates in the lagoon behind a coral reef, a shell often remains unaltered, and in a limestone which has been formed from such a mud, may be found in its original form, or changed only by the addition of more calcite. Under exceptional circumstances the material of an animal's skeleton may be removed and replaced by silica, sometimes as opal, by iron pyrites or other minerals.

Preparation of Fossils.—Before it can be studied, any fossil

must be freed as completely as possible from the surrounding matrix. The technique of this operation varies in each individual case; bones and shells, preserved in clays, can often be entirely cleaned by washing. The chitinous skeletons of arthropods and graptolites are sometimes preserved unaltered in shales, sandstones or limestones, and can then be prepared by removing the rock with hydrofluoric or hydrochloric acid. The resulting preparation can then in some cases be stained and mounted or cut into sections exactly as if it had formed part of a recent animal. Generally however the rock surrounding the fossil must be removed mechanically by needles or chisels and hammers. Where the fossil is represented by a cavity whose walls preserve a mould of its surfaces, it is necessary to make casts in plaster of Paris or more usually in wax, plasticene or glue. For small complex objects such as the skull of a fish, it is often preferable to remove the bone and rely on such casts, rather than to attempt to pick away the stone and preserve the actual bone substance. Sometimes however both rock and bone are too hard to be attacked by steel tools, and too similar chemically to be prepared by solution in acid. In these cases it is possible to discover the structure by a method invented by W. J. Sollas. By this technique one surface of the specimen is ground to a flat face on which the fossil is shown in section. An enlarged photograph is then made of this ground surface. A layer of rock of a definite thickness is then removed by further grinding and another photograph is taken, and the process is repeated until the whole of the fossil is ground away, but the appearance of the sections made across it at definite distances apart is preserved in the series of photographs. Each section is reproduced by being cut out of a sheet of wax of appropriate thickness and these wax-plates when piled up in correct order reproduce perfectly the shape of the original fossil at any magnification required. This method, though extremely laborious, leads to results which can be attained in no other way. In some cases it may be necessary to make a thousand sections, photographs and wax-plates of a single object.

The preparation of the skeleton of a large vertebrate is usually carried out with a hammer and chisel, the rock being carved away from the bones until these are free: they can then be mounted so as to form a skeleton exactly as are the bones of a recent animal.

History.—The fossil remains of animals have long attracted attention. In a Neolithic grave at Dunstable, Beds., a skeleton was found surrounded by fossil echinoderms from the chalk, and a famous silicified tree-trunk acted as a pedestal in an Etruscan tomb. Fossil shells were repeatedly observed during mediaeval times and are referred to in such works as *Agricola, "De Natura Fossilium,"* 1558. During the 18th century many works containing illustrations of fossils were published and some attempt was made to understand their structure and compare them with living forms. In one case a skeleton of *Megatherium* was actually set up in what was supposed to be its natural position in the museum at Madrid. The whole conception of palaeontology was, however, changed by the work of two men.

The first of these was William Smith (*q.v.*), a land-surveyor, who in 1791 when supervising the construction of the Kennet and Avon canal, observed that each of the well-marked formations represented in the Jurassic rocks in the neighbourhood of Bath, was characterized by the presence of fossils which could not be found in the beds above or below. Smith was able to show that it was possible by the aid of the contained fossils to trace the formations he had recognised near Bath, across the Midlands of England to the Yorkshire coast. These observations form the basis of stratigraphical geology and showed that there had been a succession of different faunas living in the English region during geological time.

Secondly, Georges, Baron Cuvier (*q.v.*) applied to the skeletons of fossil vertebrates the methods of study already developed for recent animals. In his great work *Recherches sur les Ossements Fossiles,* he gave most accurate and detailed accounts of the teeth and bones of fossil mammals and reptiles, endeavouring to build up by a comparison of many specimens the complete skeleton of a number of forms and to determine their systematic position in the animal kingdom by the methods of comparative anatomy. Finally, from a study of the skeleton he attempted to infer something of the habits of the animals with which he dealt. His work was of the first importance because it showed that many fossil animals were of types that no longer exist. Previously when only extinct invertebrates had been studied, it was always possible to say that they still lived and would one day be found when the seas of the world had been completely explored. When not one but very many large extinct animals had been shown to have existed in France and elsewhere, this possibility became less plausible; even in 1824 the world had been so well exploited that it was most improbable that many large animals remained unknown to zoologists. Indeed only two completely new types have since been discovered, the great panda and the okapi.

From William Smith and Georges Cuvier two different lines of palaeontological work have arisen. Until comparatively recently invertebrate fossils have chiefly been studied by men whose interests lay in stratigraphical geology and who used them purely as time-markers, just as potsherds are used by archaeologists. The type of work initiated by Cuvier has been carried on chiefly by zoologists and anatomists and has been concerned in the main with vertebrates.

GEOLOGICAL PALAEONTOLOGY

The geological use of fossils as time-markers rests primarily on a basis of observation of the actual occurrence of the remains of the species of animals in the rocks. Very extensive collections have shown, for example, that individuals of the genus *Productus* are never found except in rocks of Upper Devonian, Carboniferous and Permian age: that the species *Productus giganteus* can only be found in rocks whose deposition occupied a comparatively small part of Lower Carboniferous time, whilst the family Productidae lived from the Upper Ordovician to the end of the Permian. These facts are a mere matter of observation; their accuracy depends upon a correct identification of fossils, and on the extent of the collections which have been studied. The importance of stratigraphical geology for commercial purposes is so great that not only have all civilised countries been subjected to survey, but geological investigations have been conducted on an extensive scale all over the world even in such difficult regions as Spitsbergen, Patagonia, central Africa and Mongolia. Thus the extent of the evidence as to the distribution in time of the larger groups of fossil animals is very great, and we are entitled to lay great weight on the order of appearance and period of existence of such groups.

Classification of Stratified Rocks.—The divisions recognised by William Smith were marked primarily by lithological differences The Lower Lias in the Bath district is mostly clay, the Middle Lias contains hard bands of sandstone known as marlstone, the thin Upper Lias is predominantly limestone, the base of the Inferior Oolite is merely unconsolidated sand and so on. It was in such formations readily separable from one another by inspection that Smith collected the fossils on which he founded his generalisation that geological formations could be identified by the fossils which they contained

Later workers extended this conception and used it for the division of the stratified rocks of the world into systems originally distinguished from one another by the character of their fauna. Thus R I. Murchison separated off a great series of formations as the Silurian system, because of the occurrence in them of certain fossils, trilobites and graptolites for example, which do not occur or are rare and inconspicuous in later geological time. The character of the basis on which this system was formed was made clear by the famous long-continued discussion between Murchison and Adam Sedgwick. The latter had mapped North Wales, dividing up the rocks of which it is composed into formations and grouping the whole in the Cambrian system. When after the establishment of the Silurian system by Murchison, the fossils collected by Sedgwick came to be examined, it was discovered that the whole assemblage of Sedgwick's Cambrian fossils was that which characterised the Silurian system, and Murchison claimed that the term Cambrian was synonymous with Silurian. Thus the two conceivable methods of dividing stratified rocks into groups on the basis of their lithology and of their palae-

ontology were placed in opposition and the true nature of the differences had to be considered.

It is certain that every change in the character of sediments depends on a modification of the geography of the region in which they were being laid down, and that in those cases where successive rocks have an unconformable relationship to one another, there is an interval of time separating the two. It is now evident that the changes in the fauna which distinguish one formation from another are to a great extent the result of the evolution which has proceeded during the time separating the deposition of the sediments involved. Thus the evidence from stratigraphy and from palaeontology should lead to the same conclusions. But the changes in fauna, depending as they do on evolution which proceeds with time, should occur whether or not the geography is so altered as to cause a modification in sedimentation. It should therefore be possible on palaeontological grounds to divide the rocks of a single geological formation into smaller periods not necessarily recognisable by lithological differences but displayed by a change in fauna. The first geologist to do so was Oppel, who divided the Lias into small periods which he called zones. Technically a zone consists of the sediments which were laid down during the period of existence of a particular species of animal. In practice it is usually found that they are most readily recognised not by the presence of a single species but by the coexistence of a group of forms not one of which is necessarily present in each locality where the zone occurs.

Zones.—This process of dividing rocks into small divisions has been carried to an extreme length among Jurassic and Cretaceous sediments, but has to some extent been applied to all systems. The Cambrian system, divided into groups primarily on the lithology of the sediments of that age in north Wales, has been sub-divided into some 12 zones, chiefly on the evidence afforded by the range of different genera or species of trilobites. The succeeding Ordovician and Silurian systems were shown by Charles Lapworth to be divisible on the evidence of graptolites, and it has since been found that these graptolite zones can be recognised not only in the region of south Scotland, where they were established, but throughout western Europe, North America and even Australia. They are thus of world-wide significance.

Facies.—In the course of his work, Lapworth emphasized the fact that the Ordovician and Silurian rocks of south Scotland existed in two different forms—sandstones, shales and limestones, containing trilobites, the shells of brachiopods and molluscs, and corals; and very thin-bedded usually black shales often crowded with graptolites but usually yielding very few other fossils. He called these two rock types the "Shelly" and the "Graptolite" facies respectively. Owing to the occasional occurrence of graptolites in the shelly facies, he was able to show that the difference between the faunas of the two types did not depend on differences of time, but could be completely accounted for by the assumption that the rocks of the shelly facies were laid down near the coast in shallow water, where trilobites and shells were living. The graptolite shales on the other hand were deposited in relatively deep water and the graptolites whose remains were found in them were pelagic animals floating freely in the sea, their skeletons after the death of the colony sinking to the bottom and becoming buried in the scanty sediments which were there accumulating. The conception that two faunas of identical age may differ even completely on account of such a difference of facies, is a most important one, which has always to be kept in mind in discussing the geological age of any rock. Modern work on the distribution of animals on the floor of the Kattegat, the North Sea, and the English Channel, has shown conclusively that in very short distances, in some cases within a few hundred yards, totally different forms may be lying buried in the sea bottom; the character of the fauna being determined in part by the nature of the soil, whether gravel, sand or mud, in part by the depth of water. (*See* MARINE BIOLOGY.)

The fact that graptolites are unattached forms living floating in the surface layers of the water, explains the occurrence of their skeletons in both the shelly and graptolitic facies, and also accounts for their extraordinarily wide distribution, whilst the fact that they were undergoing a rapid evolution is the explanation of their value for recognising small periods of time. The graptolite zones of the Palaeozoic, however, probably cover long periods of time in comparison with those which are recognised in Jurassic rocks. Throughout the Mesozoic, zones have been established on the basis of the ammonites. These animals are often enormously abundant as individuals and were undergoing very rapid evolution from their first appearance at the base of the Permian to their disappearance at the top of the Cretaceous. Many of them are found in sediments of all types, individuals of the same species may be buried in sandstones, shales or limestones, a fact which suggests that like the graptolites, most of them at least did not dwell on the sea-bottom but swam freely in mid-waters or near the surface. These habits would explain the wide geographical range which some of them are known to have covered. For example, the same or closely similar species of *Mortoniceras* occur in Texas, India, South Africa and Europe.

Ammonite zones may be and have been established in all marine sediments up to the top of the Cretaceous, but when we pass to Tertiary formations we enter into conditions in which no group of marine animals can be used for a world-wide division into zones. The difficulty of subdividing the Tertiary period in all probability is to be accounted for by the absence of any group of highly developed pelagic forms undergoing a rapid evolution and capable of ready preservation as fossils. A survey of the present fauna of surface waters, especially of those not entirely coastal, suggests that the most valuable groups for zonal purposes in the Tertiary would be the whales, whose size and rarity renders them unavailable; and the copepods which are, except in very special cases, incapable of preservation. Thus the subdivision of the Tertiary period, so far as rocks of marine origin are concerned, necessarily rests on bottom-living forms from shallow seas, such as the Foraminifera, Gastropoda, Lamellibranchia and Echinoidea. It is perfectly clear from the present-day distribution that species belonging to the last three groups have in general a restricted geographical distribution, and that they are very sensitive to changes of facies. The fundamental nature of the shortcomings which such materials possess when used as time-markers is vividly illustrated by the uncertainty which still exists as to the ages of the Tertiary deposit of Australia and South America. Indeed the Foraminifera, unsatisfactory as they theoretically should be, seem on the whole the most suitable fossils for determining the correlation of Tertiary rocks, at any rate over such a part of the world's surface as experienced tropical or warm conditions.

Foraminifera and such other small fossils as Ostracoda have recently attained a new and special importance in stratigraphical geology, because they can be determined in the fragments fetched up from bore-holes made with a jumper. The exploratory bores made very extensively to prove oil-fields yield such material, the investigation of which has become a special branch of palaeontology now actively pursued because of its economic importance especially by American workers.

Establishment of Zones.—The zones so far considered rest entirely on an observational basis. They have been defined by recording the observed distribution of particular species in a series of rocks whose succession can be determined by mapping. It is clear that their validity depends entirely on the certainty with which the individuals of a species can be recognised and on the extent to which collections have been made. The business of a geologist intent on establishing zones is to collect as many fossils as possible from each bed of a well-exposed series, and then in the presence of the whole material to draw the limit of his species as finely as he can. That is, to indicate by a name (to be regarded purely as a method of handling the facts) each type of organism which can be distinguished from all others by observable and constant morphological characters. Theoretically such groupings should be made without reference to the beds in which the individual fossils have occurred, but in practice it is usually found that recognition of the more minute differences in structure is rendered much easier if the relative ages of the specimens under consideration be taken into account. Nevertheless, this practice

universally and necessarily pursued, introduces the danger that the optimism of the student may lead him into the acceptance as permanent and characteristic, of features which are not such in fact.

For full use to be made of the information acquired by the process suggested in the preceding paragraph, it is necessary to compare the species of fossils which have been thus recognised, with materials from other parts of the world. As very few museums possess collections from all over the world and as these will in any case be inadequate, such a comparison can only be made with fossils previously described. It is therefore a primary duty of a palaeontologist to publish detailed descriptions illustrated by accurate and clear figures of the forms he recognises, but he may only do so after he has compared his own specimens with the whole of the published accounts of similar creatures. This process is extraordinarily laborious and tedious but is rendered far easier if there is a modern monograph of the whole group involved. After each individual fossil of the collection has been referred to a definite species, it is easy to discover whether any of them are restricted to a definite bed or series of beds, and it is then necessary to consider whether the absence of a given species at any particular horizon is due to the age of those rocks, or can be accounted for by a change of facies, which will in most cases be indicated by a change in the lithology. Life-zones are intended to be founded on the period of existence of a definite species of animal, and hence should have a validity throughout the entire region in which the animal in question lived. Thus zones should not be established, although they may be tentatively put forward, until it can be shown that they are recognisable over some area which represents a fair sample of the probable space-range of the species.

As it is known from present-day conditions that no individual species of sedentary animal which lives in shallow seas, occurs uniformly distributed over any area even so small as the English Channel, it is clear that the non-occurrence of the zone-fossil at any place does not necessarily imply that deposits of its zone are absent there. Thus even in rocks not lithologically dissimilar, the same zone may contain different faunas in places only a few miles apart.

If the zonal fossil be a pelagic form whose remains only secure burial after they have sunk from the surface to the sea-bottom, then within wide limits its occurrence should be independent of the nature of the sediments, and its distribution, depending as it will do on currents which change from season to season, may be expected to be uniform when periods of time exceeding a few years, are considered. Thus the non-occurrence of a pelagic zonal fossil in an area within which its remains are found, assuming that the collections are adequate, is good evidence that sediments laid down during its zone, were either not deposited or have subsequently been removed. The very detailed zoning of Jurassic rocks which has been established in England by the work of S. S. Buckman and his successors has shown that such failures of sedimentation or local unconformities are exceedingly common in shallow water deposits, and that they may be entirely unrecognisable by ordinary stratigraphical methods.

Palaeogeography.—In addition to their value as time-markers, fossils may throw light on the geographical conditions under which rocks were laid down, and on the palaeogeography of the world as a whole. Certain groups of animals are now, and, so far as our knowledge extends, always have been, restricted to salt water; no echinoderm, for example, is ever found in rivers or lakes. Although a few forms (none capable of preservation as fossils) do occur in fresh water, the Coelenterata, as a group, are marine, and the occurrence of a coral is almost conclusive evidence that the rocks in which it was found were laid down under the sea. Brachiopods are equally marine, but *Lingula* and presumably some of its allies extend their range into brackish, though not into fresh water. In most cases, however, a phylum may have representatives both in the sea and in fresh water, but even in these cases it will usually be found that many of its larger divisions are restricted to one or the other habitat. Thus the Mollusca have four great groups, the Solenogastres, Polyplacophora, Scaphopoda and the Cephalopoda, all of whose members are marine, whilst the other two, the Gastropoda and the Lamellibranchia, occur both in fresh and salt water, the former group also inhabiting the land.

The actual structure of the hard parts of an animal may indicate whether it lived on land or in water, but can never present any direct evidence on the problem of the nature of the water in which it lived. Thus the whole geological use of a fossil as an indicator of the marine or fresh water origin of the rocks in which it is found depends on the accuracy of the determination of its affinities primarily with living forms whose habitat is known, and secondarily on its association with other organisms which are shown to have been marine by independent lines of evidence. But it is possible from the structure of a shell to determine something of its conditions of life. For example, those Mollusca which live between tide-marks on the sea-shore have to resist the full force of wave-action, and can only do so if they bury themselves in sand, lie concealed in cracks in rocks, or, like *Purpura*, have a shell so thick and massive as to stand hard blows. Forms like limpets, with their conical shell held down tightly to a fixed rock surface, escape displacement and destruction because of their shape. Lamellibranchs depend for the whole of their food-supplies on suspended particles in water-current which is caused to pass over their "gills" by ciliary action. Thus a lamellibranch which lives buried in sand, must maintain contact with the sea-water by a double tube long enough to stand out above the floor of the sea. The former presence of this great siphon is usually shown by a gaping hole left at the posterior end when the two valves of the shell are closed. By this means the habitat of certain forms may be discovered by their structure.

Such organisms as live in deep water are not exposed to the risk of mechanical damage by currents. Their shells need be no more massive than is necessary for the maintenance of the shape of the animal, and hence as a whole deep-sea echinoids, lamellibranchs and brachiopods are characterized by the excessive tenuity of their skeletons sometimes so thin that the animal can scarcely support its own weight in air.

Fossils and Climate.—Appeal is often made to fossils in discussions as to temperature under which certain formations have been deposited. For example, it is stated that such an extensive development of corals as occurs in the Coral Rag of Mid-Jurassic age, implies that this sea was at that time tropical. This conclusion is based entirely on the fact that at the present day coral-reefs are only found in the tropics or some few hundred miles on each side thereof. This rests on an observational basis and there is nothing in the structure of the coral individuals to explain it. The coral *Lophohelia*, which forms great branching colonies two feet in height, lives in the cold deep waters of the Norwegian fjords, and off the coasts of Scotland. This animal and others which occur with it, differ in no consistent respects from allied tropical forms. Thus the mere occurrence of corals provides very unsubstantial evidence on which to found an interpretation of the temperature of past seas. If this doubt be present in Jurassic times then it is quite clear that abundance of corals in Palaeozoic rocks affords no evidence whatsoever as to the temperature, especially as the phylogenetic relationships between Palaeozoic and Mesozoic corals are quite uncertain. In the case of rocks of Pleistocene and late-Tertiary age in which the remains of living species are found, however, it is possible to use their evidence in following the course of temperature changes during the period of their deposition.

Most living species of marine animals have a distribution which is limited by temperature. Such fish as the haddock can live and breed only in waters whose upper and lower temperature limits are strictly defined, and it is reasonable to suppose that this disability has existed from the time of their origin. Thus the discovery of such an animal as *Haliotis* (whose present northern limit is the Channel Islands) in late Tertiary rocks in England, would imply that there has since been a fall in temperature in the sea surrounding the British Isles. It is, however, clear that such evidence must be used with caution and that it becomes more fragile the further back the species be traced.

To-day, the faunas of the land, fresh waters and shallow seas are not uniformly distributed over the world. For example, each of the great land-masses has a fauna, which taken as a whole, is peculiar to it, and as the present distribution reflects the history of the individual forms, it is to be expected that similar zoogeographical regions should be recognisable at every geological period. In fact it is found from the evidence of mammals that in Oligocene times North America, Mongolia and Europe, Africa, Australia and South America formed independent provinces. Some facts of the distribution of ammonites suggest that in Cretaceous times a similar regional arrangement occurred in the seas. Owing to the difficulty of being certain that the observed faunal differences in this and similar cases do not really depend on the absence of deposits of identical age, it is rarely possible to determine the limits or indeed the real existence of palaeo-zoo-geographical regions in the sea.

It has often been stated that in past times the distinction between the climates of the tropical and temperate zones was far less pronounced than it is to-day. This statement is based on the fact that certain floras and faunas, the marine fauna of the Lower Carboniferous, and the Rhoetic flora, for example, spread uniformly over the world, and that their remains may be found indifferently in the tropics and within the Arctic circle. It is difficult to conceive of any circumstances which could have greatly modified the existing arrangement, and the wide distribution of certain faunas must be accounted for either on a basis of inadequate discrimination of species, or on a greater adaptability of the animals concerned to temperature changes. There are, in fact, certain cases where the distribution of fossil animals can only be accounted for by the existence of such temperature belts. Thus comparison of the fauna found in the Upper Marine series of Permian age in New South Wales, which from the occurrence of isolated glacial blocks on it, is known to have been formed under conditions analogous to those now existing in the Antarctic seas, with the Permian faunas of the Himalayas, which cover the same period shows conclusively that we are here dealing with the results of temperature differences. The two faunas are completely dissimilar and it is most improbable that this can be accounted for by varying facies.

THE SUCCESSION OF FAUNAS

Pre-Cambrian deposits of the age of the Algonkian and Torridonian often exhibit traces of animal life in the form of tracks and burrows similar to those made by living marine "worms," but determinable remains of animals are exceedingly rare in them. C. D. Walcott has, however, described a small fauna from North America, which is remarkable for its resemblance to that which is found in the succeeding Lower Cambrian.

Cambrian.—In the Cambrian characteristic representatives of nearly all the phyla of the animal kingdom are found. Protozoa are represented by typical radiolarian skeletons, but Foraminifera are as yet unknown. Sponges are represented by a lithistid in pre-Cambrian rocks, although not actually in the Lower Cambrian. *Protospongia* is a hexactinellid found rather abundantly in Cambrian rocks in North America and Europe. The peculiar group Archaeocyathidae, which is usually considered to belong to the Coelenterata, but appears to differ fundamentally in structure from all representatives of that phylum, is entirely restricted to Cambrian rocks and its members occur all over the world. The normal coelenterates are, however, represented by impressions of jelly-fish in the Cambrian of British Columbia and in Upper Cambrian times the first graptolites appear in the form of *Dictyonema* and its allies, together with a few representatives of the higher group, Axonolipa.

The Echinodermata are represented in Cambrian times by three classes, the Cystidea, the Crinoidea and the Holothuria. The Chaetopoda are represented by perfectly characteristic animals from the Middle Cambrian of Canada, in addition to many worm-castings, and one form from the same rocks is plausibly attributed to the Gephyrea, whilst another appears to be related to the living arrow-worm *Sagitta,* which belongs to the phylum Chaetognatha. No Cambrian representatives of the Platyhelmia, Nemertina or Nematoda are known, but these phyla are unrepresented as fossils at any period. The Brachiopoda provide perhaps the most abundant of all Cambrian fossils and certain groups are restricted to rocks of that age. During Cambrian times, however, the articulate brachiopods are rare and the Telotremata, the most advanced of these, are completely absent. Cambrian Bryozoa are unknown, and the Podaxonia are unrepresented as fossils at any time. Certain of the classes of the phylum Mollusca appear in the Cambrian. The Lamellibranchia are perhaps represented by forms belonging to the primitive division Taxodonta, but are in any case very rare. The Scaphoda, a small and inconspicuous group, are not known before Silurian times, and the Polyplacophora, always rare, are of later introduction.

Amongst the Gastropoda several forms, the primitive and purely Palaeozoic Bellerophontidae, the Euomphalidae and the still-living Pleurotomariidae occur in the Cambrian. The limpets are also represented and the group Pteropoda is abundantly present if the Hyolithidae be correctly placed amongst them. The highest division of the Mollusca, the Cephalopoda are apparently represented in Cambrian times by members of the sub-order Nautiloidea, but there is perhaps some doubt as to the correctness of the identifications on which this statement rests. The more advanced division of the cephalopods, the order Dibranchiata, is clearly of much later introduction. The group of the Arthropoda is well represented, but the majority of the forms known belong to the special Palaeozoic group of the Trilobita (*q.v.*). The Phyllopoda are represented by a few forms from the Middle Cambrian Burgess shale of British Columbia, and by other *Apus*-like creatures from other deposits, but the morphology of these animals is still so incompletely known that their relationships are uncertain. The higher group Phyllocarida is represented by many incompletely known animals widely distributed in the Cambrian, but its more advanced groups are certainly of later introduction. The group of the Arachnoidea, which includes spiders and king-crabs, has several Cambrian forms, grouped in the order Merostomata, which are clearly far more primitive in structure than the later forms. The air-breathing myriapods and insects are absent from Cambrian rocks, and the vertebrate phylum is unrepresented.

Thus the Cambrian fauna, although it includes members of all the invertebrate phyla which occur as fossils, and although certain species are represented by multitudes of individuals, is none the less a restricted one, despite the high specialisation, probably of an adaptive nature, which certain of its members exhibit. There is a marked uniformity amongst the members of each of the great divisions, the range in structure presented by them being far smaller than that which is found at any later period of the earth's history. The occurrence of so many phyla, already sharply separated from one another, and with their characteristic and typical structure fully developed, implies that the animal kingdom had had a long history in pre-Cambrian times, and the rarity of pre-Cambrian fossils can only be explained by the fact that the early members of all phyla were unprovided with hard parts capable of ready preservation as fossils. That this explanation is justified, is indicated by the fact that, taken as a whole, the Cambrian animals themselves had delicate skeletons primarily of chitin, calcareous shells being rare and when found thin, when compared with the corresponding structures of Ordovician and later forms.

Ordovician and Silurian.—In the succeeding Ordovician and Silurian periods the range of structure amongst the members of each tribe becomes much greater, a fact which is reflected in the successive appearance during this time of new divisions, classes, orders and families, whilst the majority of those already existing in Cambrian times pass onwards, exhibiting increased specialisation as they do so. Thus amongst the Protozoa, Foraminifera make their appearance. Many groups of sponges appear and amongst the Coelenterates higher orders of graptolites are predominant over the Cambrian dendroids. The Anthozoa become represented by simple and then by compound corals belonging to the Tetracoralla, and the Tabulata represent the Aleyonaria. The Echinodermata display an enormous development of cystids, crinoids and asteroids and a few blastoids, edrioasteroids and echinoids appear. The Brachiopoda branch out in a similar manner, the articulate forms

attaining a predominance both in numbers of species and in individuals. Amongst the Mollusca some 19 families of Lamellibranchia and a dozen of Gastropoda are first found, whilst the Nautiloidea are represented by about 2,000 species during the period. The Arthropoda undergo a similar expansion, new families of trilobites making their appearance, the Malacostraca becoming more abundant and varied, and the Merostomata exhibiting not only a great increase in individual size but also a marked adaptive radiation. Scorpions first appear in a form apparently not yet fully adapted for life on land. Finally perhaps at the top of the Ordovician, certainly in the Middle Silurian, the vertebrates appear in fish-like forms allied to the recent lampreys and hagfishes, and perhaps in true fishes belonging to the Acanthodi.

Devonian.—The succeeding Devonian period is rendered notable by the incoming of definite fishes. The Chondrichthyes are represented not only by acanthodians, but by forms more closely similar to the sharks, as well as by the heavily armoured Arthrodeira, whilst three distinct groups of bony fishes appear. Amongst the invertebrates, every phylum exhibits the addition of new families and higher groups, but the general character of the marine fauna remains the same, though the graptolites and trilobites, the most characteristic of all Lower Palaeozoic animals, become rarer both as individuals and as species during Devonian times, one family after another of them becoming extinct. The Nautiloidea also become less abundant and less varied in their structure, their place being taken by members of the new order Ammonoidea, which make their first appearance in the Devonian or possibly towards the end of Silurian times. In the Devonian we get the first indication of true land-forms, the most striking being perhaps the centipedes from the Old Red Sandstone of Scotland.

Carboniferous.—In the Carboniferous we have a marine fauna which, whilst in the main representing a mere continuation of that in Devonian times, is none the less characterised by the disappearance of the Receptaculida amongst the sponges, of many corals and of the graptolites amongst the Coelenterata, of some crinoids and all cistids, amongst the Echinodermata, and of many families of Brachiopoda. In their place we have a great expansion of the blastoids, asteroids and echinoids, and of both the lamellibranchs and gastropods among Mollusca, whilst the ammonoids become more abundant and more highly organised, passing up to forms which are the precursors of the great development which occurs in the Permian and Trias. Amongst the arthropods the trilobites survive only in a single family, but certain forms belonging to the Syncarida and Schizopoda represent a modern type of development of the Malacostraca. The Merostomata are reduced in numbers and variety, but true scorpions and forms which are allied to the phalangers and spiders occur, together with representatives of the extinct group Anthracomarti. Myriapods become of gigantic size and insects are represented by a very large number of forms belonging to primitive orders, many of which bridge the gaps between existing groups. The heavily armoured forms which represented the cyclostomes in Devonian times become extinct as do the arthrodeires. Elasmobranchs of many types are abundant and some of them exhibit the beginnings of structures which characterise the living Selachii. The bony fishes belonged to the three groups which appeared in Devonian times but one of them, the Palaeoniscidae has become far more abundant and varied in structure whilst the others are declining. The most important occurrence in Carboniferous times was the appearance of land-living and air-breathing vertebrates, Amphibia, and at any rate towards the end of the period, reptiles.

Permian.—The marine fauna of the Permian is in the main a mere continuation of that which existed in Carboniferous times, but it is characterised by its poverty, perhaps only because marine deposits of Permian age are rare. Most of the characteristically Palaeozoic groups of invertebrates die out either during or at the end of Permian times. Amongst such groups are the Tetracoralla, all of the then existing families of crinoids, the blastoids and edrioasteroids and all the families of brachiopods, except those still extant, and four represented by rare forms in the Trias and the lower Jura. On the other hand all the families of Mollusca which were in existence in Carboniferous times pass on through the Permian into the Mesozoic and indeed in most cases still live. During this period the great order of the ammonoids undergoes an expansion, new families being introduced, whilst the members of the earlier groups become more elaborate in structure. The trilobites are represented by one genus only and that is restricted to the lower part of the system. The most characteristic features of the Permian fauna are displayed by the vertebrates. Amongst the fish, the elasmobranchs are represented by comparatively few forms, many of the more characteristic Carboniferous families having died out. The bony fish show a definite advance in the incoming of forms derived originally from a palaeoniscid stock which are the forerunners of the abundant Mesozoic ganoids. The Amphibia include the descendants of those which lived in the Carboniferous but were in many cases much more terrestrial in habits. The reptiles on the other hand become extraordinarily abundant and varied in structure, exhibiting many evolutionary series which lead on to the mammals and to the higher reptilian orders from which the birds arose. It is probable that in late Permian times the reptiles were more varied than they have ever been since.

Triassic.—Triassic times saw the introduction of the Hexacoralla amongst the coelenterates, of special families of crinoids and the first introduction of the modern echinoids in the form of the diademoids derived from *Cidaris,* and leading on to all the other existing families. The brachiopods, although varied, belong to very few families and from this point onwards, except for the occasional abundance of individuals of a few species, play a subordinate part in the fauna. In association with this regression of the brachiopods we find an increased importance of the lamellibranchs, an increase which is paralleled and even exaggerated in the case of the gastropods; but the most characteristic Triassic molluscs are the cephalopods. During the Triassic times the ammonites became extraordinarily abundant, varied in type, and remarkably elaborate in structure. Some of them represent the culmination of families which had existed in Permian times, many originated in the Trias and did not survive that period, only one, the Phylloceratidae appearing first in the Upper Trias, lives on into the Jura to provide one of the two main stocks from which all other ammonites seem to have been derived. Concurrently the Nautiloidae exhibit a reduction in numbers and in range of structure, but the dibranchiate cephalopods, structurally the most advanced members of that group, first appear in the Trias in the form of a forerunner of the belemnites. Amongst the Crustacea the most important innovation was the introduction of the Decapoda, which have since become the leading group, whilst the single well-known Triassic insect fauna contains representatives of many families which are less archaic than those from the Carboniferous, leading up to the modern types.

The end of the Trias saw the disappearance of all the elasmobranchs except the Selachii, and the osteolepids, which do not survive the Permian, are represented only by their descendants the coelacanths. The Dipnoi are reduced to the single genus *Ceratodus,* which lived indifferently in fresh and salt water. Amongst the Actinopterygii the palaeoniscids, although still abundant, play a less and less important rôle, many families of "lepidosteoid ganoids" making their appearance and living on to become the predominant fish in the Jura. Three of the Palaeozoic orders of Amphibia had become extinct at the end of the Permian and the labyrinthodonts, although gigantic in size and world-wide in distribution, form a much less varied assemblage than their ancestors in the Permian. One family of them, however, took to the sea and provided the only known cases of Amphibia living in salt water.

During the Trias the Reptilia continue their evolution, the majority of the Permian orders living on in the form of advanced descendants, whilst new orders, the "dinosaurs" and Chelonia make their appearance on land and the seas are invaded by the unrelated groups of the ichthyosaurs, plesiosaurs and thalattosaurs. Finally there is some evidence that the pterodactyls were already flying by the end of the Trias. But the most important single event is the occurrence in the Upper Trias of mammals belonging

to the sub-class Multituberculata.

Jurassic.—The Jurassic fauna exhibits the appearance of a few families of Hexacoralla and of crinoids. In it the irregular echinoids make their appearance to undergo a rapid development in forms adapted to varied habitats, whilst the regular echinoids also branch out into new families. Amongst the brachiopods are found only the living families, together with three which died out in the Lias. Amongst the Bryozoa the now dominant group of Cheilostomata first appear. New families of lamellibranchs and gastropods were introduced, whilst the ammonites display an extraordinarily rapid evolution, the two fundamental stocks giving origin to thousands of species and hundreds of genera, abundant as individuals, sometimes wide-spread geographically but of very limited duration in time. The Dibranchiata were represented not only by the belmnites but also by forms which made a much closer approach to living *Sepia*. Amongst the arthropods, Brachyura (crabs) are added to the Macrura and amongst the insects such advanced types as the Diptera occur, together possibly with butterflies. The elasmobranchs are now entirely selachians and skate-like forms make their appearance, whilst the Holocephala become comparatively abundant and soon obtain a structure which is in all essentials identical with that of the living members of the group. Amongst the bony fishes the coelacanths live on without alteration of their structure, and the Dipnoi leave the seas of the world. Amongst the Actinopterygii the palaeoniscids are rare and little varied, whilst both salt and fresh water were occupied by abundant and very varied lepidosteoids, together with a few species, but abundant individuals, of a group Leptolepidae apparently ancestral to the Teleostei, which includes the vast majority of recent fish. Only two Jurassic Amphibia are known, a typical frog and a newt. The reptiles were still a predominant group of vertebrates, but many of the Triassic orders had become extinct, and the real range and structure which they exhibit is much smaller. The "dinosaurs" flourished on land in all parts of the world and were accompanied by tortoises, Rhynchocephalia and lizards. Pterodactyls almost as uniform in structure as the birds of to-day occupied the air and seem to have led a life similar to that of a gull. The ichthyosaurs and plesiosaurs are joined in the ocean by crocodiles and turtles. In all habitats gigantic forms appear, paralleling roughly the adaptive developments later made by mammals. The first birds are represented by two skeletons of a primitive structure from the Lithographic stone of Bavaria. The Jurassic mammals are all small, none having a skull exceeding three inches in length, but they belong to three sub-classes, one of which is possibly related to the ancestry of the living marsupials.

Cretaceous.—The marine fauna of the Cretaceous exhibits in the main a continuation of that of the Jura; but certain families of Alcyonaria make their appearance. The echinoids exhibit the incoming of some new groups of which the most important is that of the heart urchins. The brachiopods are still further reduced in variety and the Polyzoa become still more abundant, largely on account of the dominance of the Cheilostomata. Many new families of lamellibranchs and gastropods are introduced, but the ammonoides become less varied, disappearing altogether at the close of Cretaceous times. Before they do so they branch out into curious forms in which the shell comes unrolled to a varying extent, and certain other forms exhibit a return to a simplicity of structures which vividly recalls that of certain Middle Triassic ceratites.

Amongst the fish, the elasmobranchs are with few exceptions modern in type. Even such specialised forms as the goblin sharks are represented by species belonging to an existing genus. None the less, certain Tertiary selachians, the eagle rays and sawfish have not yet appeared though their ancestors are found in Upper Cretaceous rocks. The Mesozoic "ganoids" are rare and little varied, the great bulk of the bony fish being teleosts belonging to the more primitive families, although in some cases to genera which still exist. Amongst the reptiles the dinosaurs and pterodactyls reach their largest size to vanish with the end of the period, whilst the seas contained mosasaurs in addition to ichthyosaurs, plesiosaurs and Chelonia. In fresh waters in the Upper Cretaceous an aquatic rhynchocephalian *Champsosaurus* makes its appearance and the first snakes are found in the Upper Cretaceous limestones of Istria and in Patagonia. The few known Cretaceous birds belong to a super-order characterised by the possession of teeth, certain of them being adapted for powerful flight, whilst the remainder were aquatic with hind-legs modified to form paddles and the wing even more reduced than that of a penguin.

The majority of the Cretaceous mammals belong to the same groups as those which existed during the Jura, but a few forms can be shown to be closely related to the Opossums and others recently found in Mongolia are of great importance because they have every appearance of being the ancestors of the placental mammals.

Tertiary.—The Tertiary period has seen the rise and development of all the higher groups of animals. In the sea the modern corals belonging to the Hexacoralla become dominant. Amongst the Echinodermata the asteroids show extremely little change in type, and the ophiuroids pass on little altered. The echinoids are, however, of very different appearance, such animals as *Clypeaster* and the cassidulids becoming very abundant and the group of the Spatangidae branching out into a great variety of forms. The brachiopods are reduced to the still existing families and become rare both as species and as individuals. The Mollusca on the other hand become even more varied and abundant, new families of lamellibranchs and gastropods arising and few dying out. The most striking change, however, is the complete disappearance of the ammonites and belmnites; the Octopods known from the Upper Cretaceous becoming very abundant in the recent seas. Amongst the arthropods, the decapods become increasingly abundant whilst it has been demonstrated conclusively that all the orders of insects were in existence early in Tertiary times.

Tertiary fish represent a development of those present in Upper Cretaceous times, and are on the whole of little interest. The reptiles become reduced to those orders which still live. The Chelonia, lizards and snakes undergo a rapid evolution branching out to fill many different types of habitat, whilst the Rhynchocephalia and crocodiles present no new modifications. Thus the most characteristic Mesozoic reptiles, dinosaurs, pterodactyls, ichthyosaurs, plesiosaurs and mosasaurs die out during or at the end of the Cretaceous period. It is an interesting point however that the marine Chelonia and champsosaurs live on into Tertiary times.

The most important feature of the Tertiary faunas is however the "adaptive radiation" which takes place amongst the birds and mammals, leading up in the latter group to man himself. For the details of this process reference should be made to the articles MAMMALIA and ORNITHOLOGY.

EVOLUTIONARY EVIDENCE

The knowledge of the distribution of animals in time summarised above is founded on an immense material. Many millions of fossils have been examined by palaeontologists during the past century, and the conclusions resulting from their investigations cannot be seriously modified by the unexpected discovery of animals before or after the period to which we believe them to have been restricted. The whole story of the history of life may be summed up thus:—In the Lower Cambrian, representatives of all phyla of invertebrates capable of ready preservation as fossils, are present, but within each phylum they exhibit little range in structure and on morphological grounds are regarded as of low organisation. In succeeding periods the variety of structure exhibited by the members of each phylum becomes greater, a fact which is expressed by the steady increase in the number of families which are recognised. The higher families come in steadily one after the other and certain groups achieve a dominant position, vast numbers of species and of individuals being found all over the world. These dominant groups die out not by a sudden extinction but by a gradual decrease of the numbers of families, species and individuals. Amongst the vertebrates that group which from its structure has always been regarded as the most

primitive, the Cyclostomata, is the first to appear and is followed successively by the fish, Amphibia, reptiles, mammals and birds, these groups making their entrance in the order which would have been expected from their structure. The whole phenomenon of the geological occurrence of animals provides the most important single piece of evidence which exists for the truth of the theory of evolution. Darwin in the *Origin of Species* expressed his belief that it was to the evidence of fossils that we must turn for support of the evolution theory, and since his day a large part of the energies of palaeontologists have been devoted to the study of the relationships of extinct animals and to an attempt to trace the actual lines of descent which they exhibit. The phylogenies which have been drawn up by palaeontologists are of diverse types; they may merely illustrate the evolution of group from group, or they may display the mode in which one species has arisen from another, but the mode by which they have been derived is the same in all.

Phylogenies.—The first step in the construction of a phylogeny is to determine that certain animals whose remains are known from rocks of different ages are in fact related to one another. This can only be done by finding that a common plan of organisation runs through all of them and that they are held together and distinguished from associated and related forms by the possession in common of certain characters, which persist unchanged or little altered from the earlier to the later animals. Such characters, called palaeotelic, are often inconspicuous and difficult to discover. Amongst vertebrates they are to be found in such regions as the brain-case and ankle-joint, which are little exposed to adaptive changes. The certainty with which it can be shown that a series of animals of different ages are in fact related to one another, depends entirely on the number of palaeotelic characters which can be discovered in their structure. Thus far greater certainty can be attained in the case of animals with complex skeleton, such as vertebrates and echinoids, than in such creatures as Mollusca and graptolites, whose skeleton is simple.

When by this method a series of allied animals has been sorted out from amongst its contemporaries, the earliest of them should be compared with the most recent. Such a comparison will bring out differences capable of being recorded. Those members of the series which are of intermediate age must then be compared with the beginning and the end, and the nature of the differences which they display considered with respect to the changes which separate the first and last of the series. If the series has been correctly discriminated it will usually be found that all the forms fall into order, each differing from that which precedes it in the same ways as its successor differs from it.

Micraster.—The best case of such an evolutionary series, illustrating the origin of species, is that presented by the genus *Micraster*, a heart-urchin, found commonly in the Middle and Upper Chalk of England; this case was described by Dr. A. W. Rowe. Dr. Rowe collected 2,000 examples of echinoids from the chalk of the south of England, the geological horizon of every individual being accurately recorded. He then measured all these specimens and, having taken microphotographs of the details of their structure and compared the whole group of specimens from each zone with the other similar groups, decided that 18 different characters could be recognised in each test, and for each of these characters he compared the whole group of forms from each zone with that from every other zone. As a result of this comparison he was able to show that for most of the 18 characters, there was a change from the earliest to the most recent assemblages and that the *Micrasters* from each of the five zones he considered, differed from their predecessors as their successors differed from them.

For example, the character whose evolutionary change is perhaps most readily illustrated is that presented by the paired ambulacra: each one of these structures consists of a strip of the surface of the skeleton of the animal built up by two rows of small plates rigidly attached to each other by their edges and interlocking down the centre of the ambulacrum in a zig-zag line. Each plate is pierced by two small holes which are connected with the tube-feet, freely movable structures with a sucker on their outer end. Between the inner rows of pores there is an area within which great changes take place with time. In the earliest forms this interporiferous area is smooth and the whole ambulacrum forms a deep rounded valley. In the next higher zone the interporiferous area is divided up by fine incised lines along the margin of the plates and its surface is no longer quite smooth but bears a very faint granulation. In later zones the depth of the incisions between the plates increases and their inner ends become somewhat raised, the granulation is more pronounced and the whole ambulacrum, although still a deep groove, is no longer smoothly rounded. In the next stage the inner ends of the plates are so thickened as to form a V-shaped groove running continuously down the mid-line of the area. Finally the ambulacrum comes to form only a very slight depression with a deep gutter along the mid-line of the narrow interporiferous area, and the surface of each plate above and between the pores is covered with a dense granulation. These changes take place steadily with time, but all individuals living at any one period were not in the same stage of evolution. For example, the smooth type of area is found only in the two upper zones of the Middle Chalk and in the lower zone of the Upper Chalk, but whereas it is the only form found in the Middle Chalk, it occurs in 20% of *Micrasters* from the Upper Chalk zone. The next type in which the plates are marked out by incised lines occurs very rarely in the top zone of the Middle Chalk, and in 44% of *Micrasters* from the lowest zone of the Upper Chalk. In this zone 30% of the specimens are of the type in which the inner ends of the plates are thickened whilst in the succeeding zone 50% belong to this stage.

Thus for each character there is a story of an incoming of a definite evolutionary stage in a small percentage of the individuals living at a certain time. As we pass into newer rocks the percentage displaying this stage increases until the vast majority of all the specimens found conform to it, and we then have living a few individuals in an evolutionary stage which was dominant at an earlier period, and a few precocious specimens which have a structure which will later become the common form of the majority. In the case of *Micraster* the change in structure is perfectly gradual, every conceivable intermediate between the two extremes occurring in one specimen or another. Thus on the evidence of one character alone it is possible to say that a given *Micraster* must have been found in one of three zones and that there is a probability, which could be expressed as a percentage, that it was from the middle of the three zones. It is the belief of all those who have studied the distribution of *Micraster* in the field that it is possible to determine their horizon with much greater accuracy by examining not only one but all of the characters which Dr. Rowe has shown to change in a similar manner. This possibility depends on the fact that an individual *Micraster* which exhibits a slower evolution than usual of one character, will present an acceleration of development for other characters, and that regarded as a whole it will be equivalent in stage, though not identical in structure, with those that are found with it. One character, the ratio of breadth to length of the whole test, does not exhibit a parallel evolutionary change; broad and narrow forms are present in each zone in about the same proportions, so that it is clear that this character is not undergoing a steady evolution. The broad and narrow forms at any one time exhibit a similar range of variation with respect to any one character, and it is perhaps reasonable to assume that the broad forms are descendants of one another and are not mere varieties of the associated narrow species. That this is indeed so is indicated by the fact that in the stage of evolution of their ambulacra they always lag behind the narrow forms.

The general features of the evolution of *Micraster* as set out above are repeated in the evolution of all other series of animals which are well-known. In each case change of structure of any organ or character proceeds in a definite direction and appears to change gradually and not by definite steps. In every case an advanced structure is first met with in a small proportion of the individuals living at a definite time and this proportion grows larger and larger as we proceed upwards. Finally most individuals possess it but a few retain a more primitive structure, whilst the

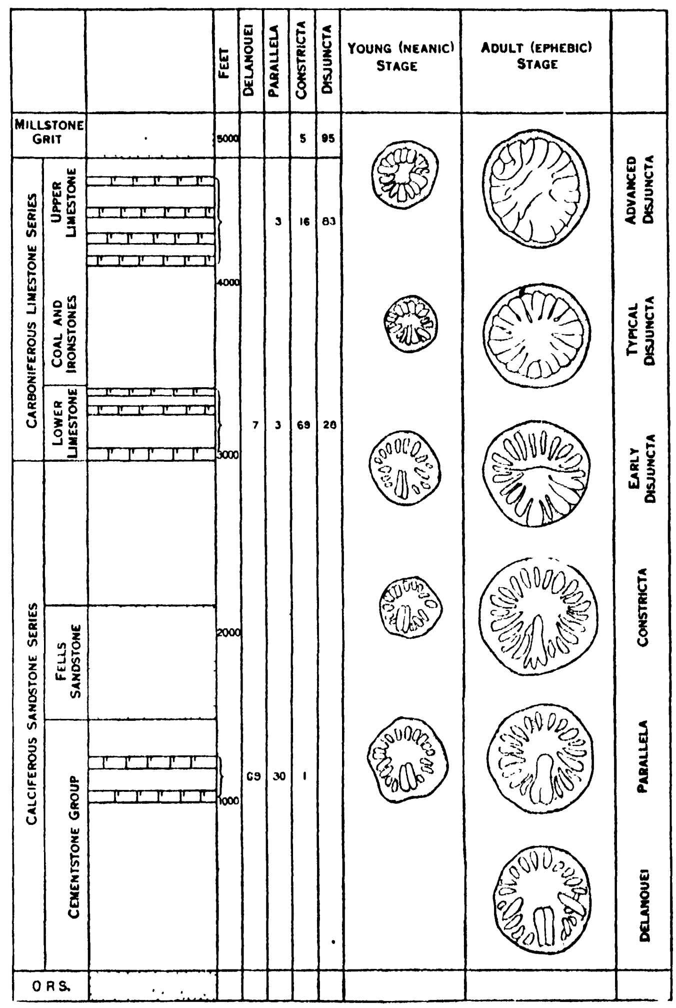
rest are more advanced foretelling the character of the majority in a succeeding period. An animal may be regarded as built up from many quasi-independent characters each exhibiting its own series of evolutionary changes; and characters of any one individual will be found to differ in the evolutionary stage which they have reached, so that by striking an average of the evolutionary stages of all the characters, it is possible to determine the date of the individual with considerable accuracy.

Members of closely allied but distinct groups such as those represented by the broad and the narrow *Micrasters*, undergo a parallel evolution, but the rate of evolutionary change may differ when one group is compared with another. A great part of modern palaeontological work consists in the attempt to sort out the members of such closely allied groups from one another and the establishment of series of forms known as phyla or lineages, which at any one time contain only a single species. This process has perhaps been carried farthest in the case of certain Cretaceous Bryozoa where W. D. Lang has distinguished a very large number of lineages each of which exhibits an evolution parallel to, though differing in detail from, that of the others. The study of lineages presents many difficulties because in the case of animals with a simple skeleton there are not many structures which, persisting unchanged throughout the history of the lineage, enable us to distinguish it from all others. Under these circumstances it is always possible to regard the members of the presumptive lineages as mere varieties which have arisen at each period from a main stock in which the whole of the evolution is taking place. Modern work on genetics has shown that identical mutants are constantly arising from normal animals and that the mutants of allied species and even genera take the same forms. This evidence lends support to the view that the alternative explanation may in many cases be preferable to the accepted distribution of allied forms amongst lineages.

Ammonites.—The ammonites, extraordinarily varied in structure, rapidly changing and very abundant as individuals, were regarded by many palaeontologists as ideal material for the investigation of phylogenies. They have been broken up into an enormous number of genera and species which have been arranged in phylogenetic lines with the aid of Haekel's biogenetic law and the additions made to that hypothesis by Alpheus Hyatt. According to this law an animal during its individual life passes through a series of stages which reproduce its ancestors. This parallel between ontogeny and phylogeny, between individual development and evolution, is not now accepted by most embryologists in its crude form. It implies that evolutionary changes in structure are added at the end of an individual's life, and that they become apparent at earlier and earlier stages in the life-history of its descendants. But we know many cases in which new characters first appear early in the life-history and may be lost when the animal grows older; under these circumstances there can be no recapitulation of phylogeny by ontogeny. An ammonite as it grew older added new material to the margin of its shell without, in most cases, interfering with the previously formed portions. Thus the shell of an adult ammonite preserves in the inner whorls of its coil the chamber of the shell which it occupied at every stage of its life-history.

Application of the biogenetic law to the stages so preserved should allow of the construction of a phylogeny which can then be compared with ammonites found in earlier beds. It is claimed that by this process the phylogeny of many ammonites can be made out, and that recapitulation can be observed in the general shape of the shell, the suture-line and the ornamentation, a true phylogeny requiring that the evidence from the development of these three independent characters shall be consistent. Furthermore it is claimed that certain types of ornament succeed one another in a definite order in all ammonites, the shell of a member of a lineage in the middle of its course beginning smooth, then developing striae, then definite ribs, which become tuberculate, then spiny, and finally repeats this series of stages in the opposite direction, or becomes smooth almost at once. In later forms ribbed and spiny stages appear earlier in the life-history until finally all of them may be skipped, the animal being smooth throughout its life. This type of evolution, which was investigated extensively by C. E. Beecher, has been supposed to occur not only in ammonites but also in gastropods, lamellibranchs and brachiopods, in all of which groups the shell preserves its early growth-stages. It has also been recognised in the development of a colony amongst coelenterates and Bryozoa.

Zaphrentis.—Out of this vast mass it is difficult to select a single case which can be regarded as conclusively established, perhaps the best are those of the development and evolution of the simple coral *Zaphrentis delanouei,* from the Lower Carboniferous of Scotland. Here we have a series of forms occurring throughout a thick series of rocks which were collected on four main horizons. It is clear that the forms from the lowest horizon ascend into those at the top by gradual change, so that no definite dividing lines could be drawn within the series. If the evolutionary series be arbitrarily divided into four stages then it is found that at the lowest horizon 69% of the specimens collected



AFTER CARRUTHER, "EVOLUTION OF ZAPHRENTIS DELANOUEI"

FIG. 1.—CHART ILLUSTRATING THE EVOLUTION OF THE SIMPLE CORAL (ZAPHRENTIS DELANOUEI)

Left three columns show the geological horizon; middle four columns, the percentage of each form of the coral at a definite horizon; and right two columns are drawings of transverse sections of a coral, when young and adult

belonged to the most primitive stage, 30% to the second, and 1% to the third evolutionary stage. At the next horizon, 2,000 feet higher, less than 1% belong to the first, 3% to the second, 69% to the third, and 28% to the fourth stage. At a still higher horizon the first stage is absent altogether. The second stage is represented by less than 1%, the third by 16% and the fourth and last by 83%. In the highest horizon studied this stage is attained by 95% of all the individuals. We have here an exact parallel to the evolution of a character in *Micraster.* But if we examine the development during life of an individual coral from one of the later horizons, we find a very complete parallel between the

evolutionary series established on quite other evidence and the individual ontogeny.

It appears that the biogenetic law, though a useful tool, must be used with caution in the construction of phylogenies, and that genealogical trees made by its aid must not be used as evidence in favour of the hypothesis itself.

Vertebrates.—The general character of the phylogenies of invertebrates which have been made by palaeontologists is repeated in the vertebrate genealogies, which rest on far more elaborate evidence. The best case is that of the horse. (*See* EQUIDAE, HORSE.) The equally complete stories of the camels, dogs and titanotheres have not yet been completely published and cannot be intelligently summarised. The rhinoceroses, as shown by the work of H. F. Osborn, have a very complex history, many different lineages arising in the Oligocene, and passing up into later geological periods. In all cases the individuals increase in size, and in many the descendants of hornless forms, long after their separation, independently develop horns which though varying in number and position in the different lineages are always of the characteristic rhinoceros pattern. The separate appearance of these horns is an example of a phenomenon abundantly seen amongst fossils. It implies that the mechanism present in the fertilised egg which determines what the structure of an adult animal will become, is such that it is capable of modification only in certain definite ways, and that in rhinoceroses this mechanism is of such a nature that when a horn arises it will be of a characteristic type, quite different from the analogous structures of giraffes, deer, oxen and titanotheres.

In certain cases the same phenomenon is presented in a somewhat different form. The whole structure of some part of an animal may exhibit a slow and gradual change in character going on throughout the whole of its history, and this change may be unaffected by modifications of the animal's habits. One of the best examples is to be found amongst the labyrinthodont Amphibia. Here all the Carboniferous forms are round-bodied, have the roof of the mouth completely supported by bone and are aquatic. Their immediate descendants are terrestrial and the head is a little flattened, while vacuities appear between the bones in the palate. In still later forms the head and whole body are extremely flat and the palatal vacuities have become enormous. These creatures must have been entirely aquatic; thus in them we have a persistence of direction of structural change so regular that the geological age of any specimen can be recognised with considerable accuracy, whilst the animal's habits change twice in different directions. Furthermore it can be shown that the evolutionary structural changes pursue the same course in different families of labyrinthodonts and in two other orders of Amphibia not closely related to them.

Thus it appears that evolutionary change in animals may be either directed towards an improvement in structure which adapts the animal for some particular mode of life, or it may take place without any apparent relationship to habits. Evolutionary change which is not adaptive in nature may be expected to take the same course in related lineages, and adaptive changes will be similar in such of their members as have the same habits and are subjected to the influence of like environments. (Further examples of this phenomenon will be found in the articles HORSE; PERISSODACTYLA; MAMMALIA; and REPTILES.)

Adaptive Radiation.—Another phenomenon first emphasised by H. F. Osborn, is that which is known as "adaptive radiation." The early members of any group, the Basal Eocene placental mammals for example, are small, and on the whole very uniform in structure; as time goes on their descendants radiate so as to fill all habitats open to them. Thus the mammals are fitted for life in forests, plains, deserts and mountains, for flight or for an aquatic life in rivers, along the sea coast or in the open oceans. They may eat animals or plants, the prey may be small or large, and it can be caught either by chase or by stalking. They may live in the Arctic or in the tropics. In consonance with these varied habits the structure of mammals has become exceedingly diverse. The limbs may be long, freely moveable and with grasping hands and feet; as in arboreal animals such as lemurs. They may become reduced to flippers in the whales; the digits may end in hoofs among cursorial animals, or may be clawed in carnivorous ones. The dentition may be fitted for gnawing, for cropping grass or for tearing flesh from bones, and it is usually possible to determine from its character what were the habits of the animal.

The "adaptive radiation" of all the higher groups of vertebrates follows similar lines. Reptiles during Mesozoic times filled the places now occupied by mammals and sometimes present striking similarities to them in general appearance.

A survey of the evolutionary history of animals as a whole shows that for each group there is a certain period at which the beginnings of an adaptive radiation appear and within a very short time lead to the establishment of the great majority of the families of which it is composed. Thus the ammonoids, although they had been in existence since Devonian times, are represented only by two families in the Carboniferous. In the Permian and Trias they branch out into most diverse forms, clearly fitted for very different modes of life. Teleost fishes existing from Upper Triassic times are represented only by a single family in the Lower Cretaceous. By the Upper Cretaceous nearly a dozen families have appeared and by Eocene times the majority of those which are known were in existence. Reptiles, beginning in the Carboniferous, experienced a wide radiation in Permian times, whilst the "radiations" of birds and mammals lie in the Tertiary, and were already fully established at the end of the Eocene. Thus in all these cases the initiation of the main types took place together and led very rapidly to the establishment of separate families, which then undergo a steady evolution without bringing about fundamental alterations in their structure. This fact implies that only at its origin and from forms of conservative structure can a group give rise to new lines whose members differ from their ancestors in fundamental features. In other words the possibility of change becomes more and more restricted the further the members of a group have carried a process of adaptive radiation. Nevertheless certain of the smaller groups of all classes may exhibit an adaptive radiation of their own long after the main development of the class is completed.

Migration.—The fact that the evolution of non-adaptive features pursues a parallel course in related lineages, and proceeds little interfered with by modifications of the environment, at a rate which does not vary widely, provides us with a means of determining approximately the age of rocks which may not contain known or even fully identifiable fossils. For example any rocks anywhere in the world which contain members of the highest grade of labyrinthodonts, will be of Triassic age and even from previously unknown forms it may be possible to determine whether they belong to the upper or lower part of that system.

The use of individual species of fossils to determine the identity of horizons in widely separated parts of the world suffers from a theoretical objection which was pointed out by T. H. Huxley, who suggested that an individual animal probably came into existence at some definite place and that in order to reach any other locality its individuals had to migrate. Nothing was known of the time taken in such migrations but it was conceivable that it might be comparable with such small divisions of geological time as those represented by zones. He stated that rocks containing identical faunas were homotaxial but not necessarily contemporaneous. We now know chiefly from the evidence of fossil mammals that all the larger groups have an evolutionary home where the important part of their evolutionary change takes place, and that from this centre there is a constant migration in all directions of such a nature that the series of forms in some neighbouring area, although they fall into a morphological family tree, are not in fact directly descended from one another. Thus all evidence shows that the main evolution of the horses took place in northern Asia and that the series which is found throughout Tertiary times in North America is really built up from the members of many overlapping migrations, each new colonist giving rise to a short evolutionary series of its own. On the other hand the camels arose in North America and the forms there found build up a true phylogenetic series.

The migrations of mammals are now well understood and an

account of them will be found in the article ZOOLOGICAL REGIONS. The time taken in migration must vary enormously for different groups and only one case in which it can be determined has been described. W. D. Matthew has pointed out that when at the end of Meiocene times, North and South America became connected, northern animals, horses and mastodons, migrated into South America, and southern forms, such as the giant ground-sloths and glyptodonts, moved into the United States. It is then possible by comparing Pleistocene North and South American faunas, to show that during the period of their migration these animals underwent little if any evolutionary change, and that in South America Pliocene forms of horses and elephants are associated with Pleistocene ground-sloths, whilst in North America ground-sloths of Pliocene type are found with Pleistocene elephants. The implication is that the migration took a period comparable in length with the interval between the Upper Pliocene and the Lower Pleistocene. If it should prove to be generally true that whilst migrating an animal exhibits little evolutionary change it should follow that at any time the members of a group at its home will be more advanced than those at the periphery of the area of distribution. This conclusion seems to be justified by the condition of affairs at the present day.

Morphological Problems.—Of recent years a new use of palaeontology has arisen. Information derived from fossil material has been applied by Robert Broom and those who have followed him, to the solution of morphological problems which have been stated by students of comparative anatomy and of embryology. In some ways one of the best examples is the proof from the mammal-like reptiles, of the truth of Reichert's theory of the derivation of the mammalian ear-ossicles. (*See* REPTILIA.) The most striking case, however, is that which arises from the work of E. A. Stensio on *Cephalaspis*. In this animal, Stensio has been able to show that complete cranial nerves associated with gill-pouches exist in the orbital region, and that the mouth is a small hole lying quite anteriorly in front of the profundus nerve. It had long ago been concluded by students of embryology that the ancestral vertebrates must have possessed these characters but the evidence on which they had relied was inconclusive and its validity had been denied by competent workers. Now in the light of Stensio's work it is quite clear that the original interpretation of the embryological data was sound. (*See* CYCLOSTOMATA.)

The study of fossils is thus seen to be of great practical utility to geologists and is capable of affording information about the course of evolution which can be obtained in no other way. Its evidence is clear that evolution provides an adequate account of past and present faunas and the facts with which it deals serve as a control of evolutionary theory. Palaeontology forms the base of a rational zoo-geography and it is capable of giving invaluable assistance in the solution of many morphological problems.

(D. M. S. W.)

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PALAEOSPONDYLUS, a small fish-like vertebrate fossil found in the Old Red Sandstone of Caithness, now referred to the Cyclostomata (*q.v.*).

PALAEOTHERIUM, a genus of primitive perissodactyls of the Upper Eocene and Lower Oligocene of Europe. The genus really includes many species, ranging in size from that of a rhinoceros down to that of a pig, and is typical of a considerable group of primitive perissodactyls nearly related to the Eocene ancestors of the horse but currently distinguished as a separate family. They are limited to the later Eocene and early Oligocene of Europe, and have not been found in Asia or North America.

The Palaeotheres have three toes on each foot, but the side toes are not so much reduced as in the earlier three-toed horses. The teeth are short-crowned without cement, the upper teeth with a pattern of two outer crescents and two transverse crests which are usually more oblique than in the early Equidae. The premolars are fully molariform as in the post-Eocene Equidae. The nasals in *Palaeotherium* are somewhat retracted, implying the possession of a short proboscis. (W. D. M.)

PALAEOZOIC ERA, in geology, term applied to the oldest strata in the earth's crust from which definite organic remains have been recorded; the base is commonly defined by an unconformity of considerable magnitude, above which occur strata containing OLENELLUS (*sensu lato*), and the fossil evidence suggests that the break varies in intensity in different parts of the world. The upper limit is harder to define, it is usually said to be taken at the top of the Permian but with increased knowledge it has in many places become increasingly difficult to separate this formation from the Trias, the basal formation of the Mesozoic, and it seems likely that it has not always been drawn at the same horizon. The Palaeozoic is divided into several periods, the Cambrian, Ordovician, Silurian (Gotlandian), Devonian or Old Red Sandstone, Carboniferous (Mississippian plus Pennsylvanian) and Permian (*qq.v.*). (G. L. E.)

PALAEPHATUS, the author of a small extant treatise, entitled Περὶ Ἀπίστων ("On Incredible Things"). It consists of a series of rationalizing explanations of Greek legends, without any attempt at arrangement or plan, and is probably an epitome, composed in the Byzantine age, of some larger work.

See edition by N. Festa, in *Mythographi graeci* (1902), in the Teubner series, with valuable prolegomena supplementary to *Intorno all' opuscolo di Palefato de incredibilibus* (1890), by the same writer.

PALAESTRA, the name apparently applied by the Greeks to two kinds of places used for gymnastic and athletic exercises. In the one case it seems confined to the places where boys and youths received a general gymnastic training, in the other to a part of a gymnasium where the *athletae*, the competitors in the public games, were trained in wrestling (παλαίειν, to wrestle) and boxing. The boys' *palaestrae* were private institutions and generally bore the name of the manager or of the founder; thus at Athens there was a *palaestra* of Taureas (Plato, *Charmides*). The Romans used the terms *gymnasium* and *palaestra* indiscriminately for any place where gymnastic exercises were carried on.

PALAFOX DE MENDOZA, JUAN DE (1600–1659), Spanish bishop, was born in Aragon. He was appointed in 1639 bishop of Angelopolis (Pueblo de los Angeles) in Mexico, and there sought to protect the natives from Spanish cruelty, forbidding any methods of conversion other than persuasion. In this he met with the uncompromising hostility of the Jesuits, whom in 1647 he laid under an interdict. He twice, in 1647 and 1649, laid a formal complaint against them at Rome. All he could obtain was a brief from Innocent X. (May 14, 1648), commanding the Jesuits to respect the episcopal jurisdiction. In 1653 the Jesuits succeeded in securing his translation to the little see of Osma in Old Castile. In 1694 Charles II. of Spain petitioned for his canonization; but this was defeated by the Jesuits.

See Antonio Gonzalez de Resende, *Vie de Palafox* (French trans., Paris, 1690).

PALAFOX Y MELZI, JOSÉ DE (1780–1847), duke of Saragossa. Brought up at the Spanish court, he accompanied Ferdinand to Bayonne in 1808 as a sub-lieutenant.. After a vain attempt to secure the king's escape, he fled to Spain. Proclaimed by the populace governor of Saragossa and captain-general of Aragon (May 25, 1808), he declared war against the French, who had already overrun Catalonia and Navarre. He defended Saragossa for a period of 61 days Palafox then attempted a campaign in the open country Forced back by Napoleon's army into Saragossa, he sustained a second siege lasting three months. Palafox himself was captured and imprisoned at Vincennes until Dec. 1813. From 1820–23 he commanded the royal guard of King Ferdinand. He took the side of the Constitution in the civil troubles and was stripped of his honours and offices by the king. Queen Maria Cristina created him duke of Saragossa and from 1836 he took part in military and political affairs as captain-general of Aragon and a senator He died in Madrid, Feb 15, 1847.

See P. de Madrago's biographical notice in the Span. trans. of Thiers, *Hist. des consulates de l'empire*, C W C Oman, *Peninsular War* (Oxford, 1902), vol. i, J Ibáñez Marín, *El defensor de Zaragoza* in *Ateneo*, v. (1908), pp. 81–89.

PALAMAS, GREGORIUS (*c* 1296–1359), Greek mystic and chief apologist of the Hesychasts (*q v.*), belonged to a distinguished Anatolian family, and his father held an important position at Constantinople Palamas at an early age retired to Mt. Athos, where he became acquainted with the mystical theories of the Hesychasts In 1326 he went to Skētē near Beroea, where he spent some years in isolation in a cell specially built for him. His health having broken down, he returned to Mt. Athos, but, finding little relief, removed to Thessalonica About this time Barlaam, the Calabrian monk, began his attacks upon the monks of Athos. Palamas championed their cause in two synods (1341 and 1351) at Constantinople, which definitively secured the victory of the Palamites. During the civil war between John Cantacuzene and the Palaeologi, Palamas was imprisoned After Cantacuzene's victory in 1347, Palamas was released and appointed archbishop of Thessalonica, being refused admittance by the inhabitants, he retired to the island of Lemnos, but subsequently obtained his see

See the historical works of John Cantacuzene and Nicephorus Gregoras, the *Vita Palamae* by Philotheus, and the encomium by Nilus (both patriarchs of Constantinople), also C Krumbacher, *Geschichte der byzantinischen Litteratur* (1897).

PALAMAS, KOSTES (1859–), Greek poet, a native of Patras, studied law at Athens, where he came under the influence of the "popular," as opposed to the "purist" school of Greek After several years of journalism, he published in 1886 his first poetical work, *The Songs of My Country*, followed in 1889 by the *Hymn to Athena*. In 1897 he was appointed secretary to the University of Athens His prose *Essay on Krystallis* (1894) contrasted philosophic with descriptive poets After the publication of *Iambs and Anapaests* and *The Grave* (1898), a series of elegies on his son's death, he became the recognized chief of the "popular" party in literature, whose organ in the press was the review, *Noumas* At that period the "language question" penetrated even politics, leading to the "Gospel Riots" of 1901 and the fall of the cabinet over the translation of the *Oresteia* in 1903 Palamas, who described himself in *The Twelve Lays of the Gipsy* as "the poet of my age and race," was considered by his admirers to be the successor of Solomos, while some critics have found in him the obscurity of Browning Later he produced the poem on Byron, recited at the Byron centenary at Athens in 1924, and *Five Syllables and the Pathetic Whispers* (1925).

See *Poems by Kostes Palamâs*, selected and rendered into English by Th. Ph. Stephanides and G. C. Katsimbalis (1925).

PALAMAU, a district of British India, in the Chota-Nagpur division of Behar and Orissa It consists of the lower spurs of the Chota-Nagpur plateau, sloping north to the valley of the Son. Area 4,916 sq.m.; pop. (1921), 733,394. Nearly three-fourths of the district is uncultivated; 300 sq m. are under forest, and about 3,000 sq.m. are covered with jungle. A small coalfield near Daltonganj was opened in 1902 Deposits of bauxite await development The administrative headquarters are at Daltonganj; pop. (1921), 9,817.

Palamau was under the rule of Chero chiefs till their conquest by the Moguls in 1660. They had their capital at the village of Palamau, where the ruins of two great forts built by them may be seen.

PALAMCOTTAH, a town of British India, in the Tinnevelly district of Madras, on the opposite bank of the Tambraparni river to Tinnevelly town, with which it shares a station on the South Indian railway, 444 m south of Madras Pop (1921), 46,643 It is the administrative headquarters of the district.

PALAMEDES, in Greek legend, son of Nauplius, king of Euboea, one of the heroes of the Trojan War, belonging to the post-Homeric cycle of legends During the siege of Troy, Agamemnon, Diomedes and Odysseus (who had been detected by Palamedes in an attempt to escape going to Troy by shamming madness) caused a letter containing money and purporting to come from Priam to be concealed in his tent They then accused Palamedes of treasonable correspondence with the enemy, and he was ordered to be stoned to death His father exacted vengeance from the Greeks on their way home, by placing false lights on the promontory of Caphareus. The story of Palamedes was first handled in the *Cypria*, afterwards by the tragedians Palamedes was regarded as the inventor of some letters of the alphabet, lighthouses, weights and measures, several games, etc.

See Roscher's *Lexikon*, art "Palamedes"

PALANPUR, a native state of India, in the Gujarat division of Bombay, on the southern border of Rajputana. Area, 1,766 sq m, pop. (1921) 236,694 The town of Palanpur is a railway junction for Deesa, 18 m distant Pop. (1921), 17,843.

Palanpur also gives its name to a political agency, or collection of native states, of which Radhanpur is the most important; total area, 6,393 sq m; pop (1921) 518,566.

PALATE, the roof of the mouth in man and vertebrate animals It consists of the anterior bony "hard palate" (*see* MOUTH), and the posterior fleshy "soft palate" (*see* PHARYNX) For the malformation consisting of a longitudinal fissure in the roof of the mouth, *see* CLEFT PALATE.

PALATINATE (Ger. *Pfalz*), a name given generally to any district formerly ruled by a count palatine, but particularly to a district of Germany, a province of the Republic of Bavaria, lying west of the Rhine (*See* BAVARIA) Excluding the Saar district, which is temporarily under the administration of the League of Nations, the Palatinate has an area of 2,124 sq m, and a population of 931,755 (1925), showing a density of 438 6 to the sq m. It is bounded on the east by the Rhine which separates it from Baden, on the south is the French department of Bas-Rhin, on the west the Saar Territory and parts of the Prussian Rhine Province and on the north Hessen

The rivers in this fertile tract of country are the Rhine, Lauter, Queich, Speirbach, Glan and Blies The Vosges, and their continuation, the Hardt, run through the land from south to north and divide it into the fertile and mild plain of the Rhine, together with the slope of the Hardt range, on the east, and the rather inclement district on the west, which, running between the Saarbruck Carboniferous mountains and the northern spurs of the Hardt range, ends in a porphyrous cluster of hills, the highest point of which is the Donnersberg (2,254 ft). The country on the east side and on the slopes of the Hardt yields a number of the most varied products, such as wine, fruit, corn, vegetables, flax and tobacco The mines yield iron, coal, quicksilver and salt. The industries are very active, especially in iron, machinery, paper, chemicals, shoes, woollen goods, beer, leather and tobacco. Spires (Speyer) is the seat of government, and among the chief industrial centres are Ludwigshafen on the Rhine, which is the principal river port, Landau, and Neustadt, the seat of the wine trade.

See *Mitteilungen des Hist. Ver. der Pfalz* (48 vols. 1870–1927).

History.—The count palatine of the Rhine was a royal official who is first mentioned in the middle of the 10th century. The first count palatine was Hermann I., who ruled from 945 until 996, and although the office was not hereditary it appears to have been held mainly by his descendants until the death of

Count Hermann III. in 1155. In 1155 the German king, Frederick I., appointed his step-brother Conrad as count palatine. In 1214, on the death of the reigning count, the Palatinate was given by the German king Frederick II. to Otto, the infant son of Louis I., duke of Bavaria. The Palatinate was ruled by Louis of Bavaria on behalf of his son until 1228, when it passed to Otto who ruled until his death in 1253.

When the possessions of the house of Wittelsbach were divided in 1255 and the branches of Bavaria and the Palatinate were founded, a dispute arose over the exercise of the electoral vote, and the question was not settled until in 1356 the Golden Bull bestowed the privilege upon the count palatine of the Rhine, who exercised it until 1623. The Palatinate was divided into four parts among the sons of the German king Rupert in 1410, but in 1559, on the extinction of the senior line, Frederick, count palatine of Simmern, succeeded to the Palatinate, becoming the elector Frederick III. Under Charles Theodore, who succeeded in 1742, with the exception of one or two small pieces the whole of the Palatinate was united under one ruler. In 1777 on the extinction of the other branch of the house of Wittelsbach, he became elector of Bavaria. The Palatinate was henceforward united with Bavaria, and has shared its political history from that time.

PALATINE. In the later Roman empire certain officials attending on the emperor, or discharging duties at his court, were called *palatini;* from the time of Constantine the Great the term was also applied to the soldiers stationed in or around the capital to distinguish them from those stationed on the frontier of the empire. In the East Roman empire the word was used to designate the administrators of the finances and the imperial lands.

This use of the word palatine was adopted by the Frankish kings of the Merovingian dynasty. They employed a high official, the *comes palatinus,* who at first assisted the king in his judicial duties and at a later date discharged many of these himself. Other counts palatine were employed on military and administrative work, and the system was maintained by the Carolingian sovereigns. The word paladin, used to describe the followers of Charlemagne, is a variant of palatine. Instead of remaining near the person of the king, some of the counts palatine were sent to various parts of his empire as judges and governors. Being in a special sense the representatives of the sovereign they were entrusted with more extended power than the ordinary counts. From this usage there naturally arose the employment of the word to denote the districts over which these powers were exercised. By Henry the Fowler, and especially by Otto the Great, counts palatine were sent into all parts of the country to support the royal authority by checking the independent tendencies of the great tribal dukes. We hear of a count palatine in Saxony, and of others in Lorraine, in Bavaria and in Swabia, their duties being to administer the royal estates in these duchies. The count palatine in Bavaria became duke of this land, the lower title being then merged in the higher one; and with one other exception the German counts palatine soon became insignificant, although, the office having become hereditary, Pfalzgrafen were in existence until the dissolution of the Holy Roman empire in 1806. The exception was the count palatine of the Rhine, who became one of the four lay electors and the most important lay official of the empire. In the empire the word count palatine was also used to designate the officials who assisted the emperor to exercise the rights which were reserved for his personal consideration. They were called *comites palatini caesarii,* or *comites sacri palatii;* in German, *Hofpfalzgrafen.*

From Germany the term passed into England and Scotland, into Hungary and Poland. In England palatine was an artificial word, applied to counties which stood outside the ordinary course of administration. In Hungary the important office of palatine owes its inception to St. Stephen. At first the head of the judicial system, the palatine became after the king the most important person in the realm. Under the later Habsburg rulers of Hungary the office was several times held by a member of this family, one of the palatines being the archduke Joseph. The office was abolished after the revolution of 1848. In Poland the governors of the provinces of the kingdom were called palatines, and the provinces were sometimes called palatinates.

In America certain districts colonized by English settlers were treated as palatine provinces. In 1632 Cecilius Calvert, 2nd Lord Baltimore, received a charter from Charles I. giving him palatine rights in Maryland. In 1639 Sir Ferdinando Gorges, the lord of Maine, obtained one granting him as large and ample prerogatives as were enjoyed by the bishop of Durham. Carolina was another instance of a palatine province.

See C. Pfaff, *Geschichte des Pfalzgrafenamtes* (Halle, 1847); G. T. Lapsley, *The County Palatine of Durham* (1900); R. Schröder, *Lehrbuch der deutschen Rechtsgeschichte* (Leipzig, 1902).

PALATKA, a city of north-eastern Florida, U.S.A., the county seat of Putnam county; on the beautiful St. John's river, 50 m. S. of Jacksonville. It is served by the Atlantic Coast Line, the Florida East Coast and the Southern Railways, and river steamers. Pop. 7,208 in 1925 (State census), of whom 3,661 were negroes; estimated locally at 10,000 in 1928. The city is a shipping point for citrus fruit and vegetables, and has large cypress lumber-mills, foundries and machine shops, turpentine stills, and other industries. Palatka was incorporated as a town in 1853, as a city in 1872. It has a commission-manager form of government.

PALAUNG, a Burmese term for a group of non-Shan tribes living in the Shan States and speaking dialects of the same Mon-Khmer language so variant that Shan is used as a *lingua franca.* The Palaung is darker than the Shan in complexion; of a timid and peaceable disposition; Buddhist and *Nat*-worshipper by religion; a cultivator of paddy and of tea for pickling. Tattooing is practised, and divining by chicken-bones. Marriage is regulated by consanguinity and the formalities entail a sort of theft of the bride, or secret elopement, and subsequent money payments to her relatives. The ordinary dead are buried with a coin for ferry-dues in the mouth or on the chest, but the corpses of priests are dried in the coffin and kept up to a year. Headmen (*kin*) are sometimes treated similarly, but the corpse is not kept so long. After cremation the bones are placed on the ground in an open pot.

See Cameron, *Palaungs of Kodaung* (Rangoon, 1912); Milne, *Home of an Eastern Clan* (1924).

PALAWAN, a small Siamese state on the west coast of the Malay peninsula. Area 900 sq.m.; pop. (latest returns) 20,000. The people are chiefly engaged in the cultivation of pepper, of which about 150 tons are annually exported. (*See* MALAY STATES: *Siamese.*)

PALAZZOLO ACREIDE, a town of Sicily, province of Syracuse, 34 m. by rail W. of it, 2,285 ft. above sea-level. Pop. 14,653 (town), 16,154 (commune). The ancient city of *Acrae,* founded by Syracuse in 664 B.C., lay on the hill above the modern town, the approach to it being defended by quarries, in which tombs of all periods have been discovered. The auditorium of the small theatre is well preserved. Close to it are ruins of other buildings, a small Odeon and some baths.

PALE, used as a historical term, is a district marked off from the surrounding country by a different system of government and law or by definite boundaries. The best known of these districts was the "English pale" in Ireland, dating from the reign of Henry II., although the word "pale" was not used in this connection until the latter part of the 14th century. The pale varied considerably according to the strength or weakness of the English authorities, and in the time of Henry VIII. was bounded by a line drawn from Dundalk to Kells, thence to Naas, and from Naas east to Dalkey, embracing, that is, part of the modern counties of Dublin, Louth, Meath, and Kildare. The pale existed until the complete subjugation of Ireland under Elizabeth; the use of the word is frequent in Tudor times. There was an "English pale" or "Calais pale" in France until 1558, extending from Gravelines to Wissant, and for a time under the Tudors an "English pale" in Scotland.

PALEARIO, AONIO (*c.* 1500–1570), Italian humanist and reformer, was born at Veroli, in the Roman Campagna. Other forms of his name are Antonio Della Paglia, A. Degli Pagliaricci. In 1520 he went to Rome, where he entered the brilliant literary circle of Leo X. When Charles of Bourbon stormed Rome in 1527 Paleario went first to Perugia and then to Siena, where he settled as a teacher. In 1536 his didactic poem in Latin hexa-

meters, *De immortalitate animarum*, was published at Lyons. In 1542 a tract by him, commonly known as *Libellus de morte Christi*, was made by the Inquisition the basis of a charge of heresy, from which, however, he successfully defended himself. In Siena he wrote his *Actio in pontifices romanos et eorum asseclas* (posthumous, Leipzig, 1606), attacking the substitution of traditional for scriptural authority, and certain doctrines, especially that of purgatory. Professor first at Lucca and then at Milan he was denounced by the inquisitor of Milan in 1567, sent to Rome for trial, condemned in Oct. 1569, and executed in July 1570.

An edition of his works (*Ant. Palearii Verulani Opera*), including four books of *Epistolae* and 12 *Orationes* besides the *De immortalitate*, was published at Lyons in 1552; this was followed by others, the fullest being that of Amsterdam, 1696. Lives by J. G. Gurlitt (in German) (Hamburg, 1805); A. Young (2 vols, 1860); J. Bonnet (Paris, 1862, Eng trans 1864). *See* also G. Morpurgo, *Un Umanista martire. Aonio Paleario* (1912).

PALEKHI, a Russian village south-east of Shuya (56° 43′ N., 41° 23′ E.), in the Ivanovo-Voznesensk province, noted for its handicraft work, dating from the time of the ikon painters of Vladimir Suzdal, and famous in the 16th and 17th centuries. In the 19th century the ikon market became limited and the 1917 revolution threatened to destroy the art. The Palekhi artel, however, began to make designs on box covers and other small articles of compressed paper and their work has found a market exceeding the supply in Nizhniy-Novgorod and New York, and has obtained medals at the Vienna and Paris exhibitions

PALEMBANG, a residency of south-east Sumatra, Dutch East Indies, facing the island of Banka, area 85,918 sq kilometres; population (1927), 844,626 It extends from the mountains which flank the west coast of Sumatra and form the dividing line between it and the residency of Bencoolen, to the Straits of Banka, and except for the mountainous country in the extreme south-west, is very flat and intersected by numerous rivers, which flow eastwards to the sea, and with their many and wide mouths form marsh lands about the coast, which has also many sandbanks. The principal of these is the Musi, which has many important tributaries, and on its banks, some 50 miles from the sea, near which it divides into two main channels, is situated Palembang, the capital of the residency, also a port, and the chief commercial town in South Sumatra, population 62,438 (1,117 Europeans and Eurasians), the largest town in Sumatra Apart from the public buildings, barracks, hotels, church, European business offices and residences, and a great mosque, which are built of stone, Palembang is a town of native houses, mostly built on piles, on account of floods, and it stretches along both sides of the river, and its inhabitants, and those of the residency are mostly Malays. The depth and width of the Musi river renders Palembang accessible to large ocean steamers, but they are able to cross the bar at its mouth only at flood tide. The port has wharves on screw piles 250 metres long, and is the terminus of the main line of the railway system of South Sumatra At Plaju, down the river from Palembang, is the petroleum centre in Sumatra of the Royal Dutch Petroleum Company, the oil, raised at Muara Enim, near the hills in the south-west, being carried to Plaju and refined there. Palembang has a considerable trade with eastern ports in the Malay Peninsula, Siam and China, and there is also important traffic by road and river with the hinterland and regular communication with other ports in Sumatra, and with Java. The value of its exports, in 1926, was 89,287,248 gulders and of its imports 41,775,831 gulders. This represented the total produce of the residency, for which Palembang is the only outlet, and the principal items of export were coffee, rubber, copra, cotton, rattans, quinine and coal, from the government-owned Bukit Asim collieries, at Tandjong, not far from Muara Enim. Coffee is the chief crop grown for export, of the *Robusta* variety, and it is a native cultivation, as, also, are rubber and cotton. Rice is the chief food crop. A *Controleur*, also an agricultural adviser, are stationed at Muara Enim, which is connected by rail and by road (with motor-car service), with Palembang, and also by motor road service with Bencoolen on the west coast, passing through Lahat, Tebingtinggi and Muaru Beliti; thus Palembang is linked up by motor with Bencoolen, and, also *via* Muara Enim, with Muaro Duop, in the extreme south, passing through Batu Raja. A road runs north-eastwards from Muaro Duop to Kaju Agung, and one from Batu Raja to Muaru Kuang, which then forks northwards, to join the Muara Enim-Palembang road: a loop of the Muara Enim-Bencoolen road runs southwards to Pagerkalam, on the border, which has a *Controleur*. The southern part of Palembang residency, mainly about the roads mentioned, is in course of development; in the northern half little has been done, communications are primitive, and, apart from Surulangun, in the north-west, Talang Betutu, north of Palembang, and Sekaju, on the Musi, in central Palembang, each of which has a *Controleur*, the nature of the lands about the coast makes extensive settlement impossible

Palembang is one of the places in the Dutch East Indies where Islam made its first appearance Arab colonies in certain Chinese ports, disturbed by Chinese civil war, diverted their commerce to the Dutch East Indies, and Palembang was one of the spots selected for the enterprise. Little, however, is heard about Palembang in history until in 1812 the Sultan, although he had recognized British suzerainty (the British occupation of the Dutch East Indies), massacred many Dutch settlers. Thereupon a British force under Colonel Gillespie was landed which drove him from the capital and installed his brother in his stead, Banka and Billiton were ceded to Great Britain, and it was during the absence of this force in Sumatra that the Sultan of Jokjakarta endeavoured to destroy European power in Java. The cession of Banka and Billiton to the Dutch, in return for Cochin in India, because of a dispute as to whether Billiton was included in the cession, brought Palembang very prominently before Dutch notice, the more so as Sir Stamford Raffles encouraged the Sultan in his attitude of independence, and in 1825 they abolished the Palembang Sultanate and brought the country under their own rule, whilst recognizing certain chiefs. (E. E L)

PALENCIA, an inland province of Spain, one of the eight into which Old Castile was divided in 1833; bounded on the north by Santander, east by Burgos, south by Valladolid, and west by Valladolid and Leon Pop (1920) 191,719; area 3,256 sq m The principal rivers are the Pisuerga and the Carrion, which unite at Dueñas and flow into the Duero at Valladolid The north is traversed by the Cantabrian mountains, the highest summit being the culminating point of the Sierra del Brezo (6,355 ft) The remainder of Palencia, the "Tierra de Campos," belongs to the great Castilian table-land. In the south is a marsh or lake, known as La Laguna de la Nava The mountainous district abounds in minerals, but only coal and small quantities of copper are worked. The province is crossed in the south-east by the trunk railway connecting Madrid with France via Irun, while the line to Santander traverses it throughout from north to south; there are also railways from the city of Palencia to Leon, and across the north from Mataporquera in Santander to La Robla in Leon A branch of the Santander line gives access to the Orbo coal-fields The Canal de Castilla, begun in 1753, and completed in 1832, connects Alar del Rey with Valladolid Wheat and other cereals, vegetables, hemp and flax are extensively grown, and there are manufactures of linen and woollen stuffs, oil, porcelain, leather, paper and rugs Palencia rugs are in great demand throughout Spain The only town with more than 5,000 inhabitants is Palencia (*q v*)

PALENCIA, an episcopal city, and the capital of the Spanish province of Palencia; on the left bank of the river Carrion, on the Canal de Castilla, at the junction of railways from Leon and Santander, and 7 m N. by W. of Venta de Baños on the Madrid-Irun line. Pop. (1920), 19,543. Palencia is built in the midst of the level plains called the Tierra de Campos, 2,690 ft. above sea-level. Palencia, the Pallantia of Strabo and Ptolemy, was the chief town of the Vaccaei. Its history during the Gothic and Moorish periods is obscure; but it was a Castilian town of some importance in the 12th and 13th centuries. The university founded here in 1208 by Alphonso IX. was removed in 1239 to Salamanca. The cathedral was begun in 1321, finished in 1504 and dedicated to St. Antolin; it is a large building in the later and florid Gothic style of Spain. The site was previously occupied by a church erected by Sancho III of Navarre and Castile (1026–

35) over the cave of St. Antolin, which is still shown. The cathedral contains El Greco's San Sebastian and other valuable paintings, old Flemish tapestry, and beautiful carved woodwork and stonework. The hospital of San Lazaro is said to date in part from the time of the Cid (*q.v.*), who here married Ximena in 1074. Manufactures are iron, rugs, alcohol, leather, soap, porcelain, linen, cotton, wool, machinery and matches.

PALENQUE, the modern name of a deserted city in Mexico, in the narrow valley of the Otolum, in the north part of the State of Chiapas, 80 m. S. of the Gulf port of Carmen. About 30 m. away, on the left bank of the Usumacinta river, stand the ruins of Men-ché or Lorillard city. The original name of Palenque has been lost, and its present name is taken from the neighbouring village, Santo Domingo del Palenque. Unlike the dead cities of the Yucatán plains, Palenque is surrounded by wooded hills and overgrown by tropical vegetation.

There is less stone carving on the exterior walls, door jambs and pillars of the buildings than on those of the Yucatán peninsula; this is due to the harder and more uneven character of the limestone. Probably owing to the same cause, there is less cut stone in the walls, the Palenque builders using plaster to obtain smooth surfaces. There is, however, considerable carving on the interior walls, the best specimens being on tablets, affixed to the walls with plaster. Modelling in stucco was extensively used. A few terra-cotta images have been found.

The so-called Great Palace consists of a group of detached buildings, apparently ten in number, standing on two platforms of different elevations. Some of the interior structures and the detached one on the lower southern terrace are in a fair state of preservation. The plan of construction shows three parallel walls enclosing two corridors covered with the peculiar pointed arches or vaults characteristic of Palenque. A square tower rises from a central part of the platform to a height of about 40 ft., divided into a solid masonry base and three storeys connected by interior stairways. The Temple of Inscriptions, one of the largest and best preserved, is distinguished chiefly for its tablets, which contain only hieroglyphics. Sculptured slabs form balustrades to the steps leading up to the temple, and its exterior is ornamented with figures in stucco, the outer faces of the four pillars in front having life-size figures of women with children in their arms. The small Temple of Beau Relief stands on a narrow ledge of rock against the steep slope of the mountain. Its most important feature is a large stucco bas-relief, occupying a central position on the back wall of the sanctuary. It consists of a single figure, seated on a throne, beautifully modelled in form, and in drapery and ornaments, with the face turned to one side and the arms outstretched. The temples on the east side of the Otolum are distinguished by tall narrow vaults, perforated by numerous square openings giving the appearance of coarse lattice work. The Temple of the Sun stands upon a comparatively low pyramidal foundation. The interior consists of the usual pair of vaulted corridors. The sacred tablet on the back wall of the sanctuary is carved in low relief in limestone, and consists of two figures, apparently a priest and his assistant making offerings. There are rows of hieroglyphics on the sides and over the central design. The Temple of the Cross is a larger structure of similar design and construction. The tablet belonging to this temple has excited controversy, because the design contains a representation of a Latin cross. The Temple of the Cerro, called that of the Cross No. 2, because its tablet is very similar to that just mentioned, stands back against the slope of the mountain, and is in great part a ruin. The ruins of Palenque have been partially investigated by a number of explorers, notably by Stephens, Charnay, Maudslay, Holmes and Blom.

See M. H. Saville, ***Bibliographic Notes on Palenque,*** Museum of the American Indian, Heye Foundation (1928).

PALÉOLOGUE, MAURICE GEORGES (1859-), French diplomat and writer, was born in Paris on Jan. 13, 1859. He entered the diplomatic service at an early age and went successively to Tangier, Rome, Germany, the East, Korea and Bulgaria. He became in 1909 deputy-director and in 1911 director of affairs in the Foreign Office. Shortly before the outbreak of the World War he was appointed ambassador to St. Petersburg (Leningrad), and retained this post until the Bolshevist revolution towards the end of 1917. He consolidated the Franco-Russian alliance, and helped to ensure effective military action on the part of Russia during the period of hostilities. In 1920 he was for a few months secretary-general of the Ministry of Foreign Affairs. Paléologue published in 1921–2, under the title of *La Russie des Tsars pendant la grande guerre* (Eng. trans., 3 vols., 1923–5) records of his diplomatic experiences in St. Petersburg. Among his other publications are literary criticisms on Vauvenargues and Alfred de Vigny (1890) and several novels. He was admitted to the French Academy in 1928.

His recent works include: *Le Roman Tragique de l'Empereur Alexandre II.* (1923, Eng. trans. 1926); *Talleyrand, Metternich, Chateaubriand* (1924, Eng. trans. 1926); and *Cavour* (1926).

PALERMO, a city of Sicily (Greek, Πάνορμος; Latin, *Panhormus, Panormus*), capital of a province of the same name, in the kingdom of Italy, and the see of an archbishop. Pop. (1921), town 361,895, commune 393,612. The city stands in the northwest of the island, on a small bay looking east, the coast forming the chord of a semicircle of mountains which hem in the *campagna* of Palermo, called the Conca d'Oro. The most striking point is Monte Pellegrino (from the grotto of Santa Rosalia, a favourite place of pilgrimage) at the north of this semicircle; at the south-east is the promontory of Zaffarano, on which stood Soluntum (*q.v.*).

A neolithic settlement and necropolis were discovered in 1897 at the foot of Monte Pellegrino, on the north-east side. Panormus certainly was Phoenician as far back as history can carry us. As the Greeks colonized the east of the island, the Phoenicians withdrew to the north-west, and concentrated themselves at Panormus, Motye, and Soluntum. Like the other Phoenician colonies in the west, Panormus came under the power of Carthage. After its conquest by Pyrrhus in 276 B.C. the city was soon recovered by Carthage, but in 254 B.C. it was taken by the Romans. (*See* PUNIC WARS.) In the First Punic War, Hamilcar Barcas was encamped for three years on Hiercte (246–243 B.C.) which should be identified, not with Monte Pellegrino, but with the next mountain to the west of it, Monte Castellaccio, south of the bay of Sferracavallo, which agrees far better with the description of Polybius. The Roman camp lay rather more than half a mile to the south, and there was continual fighting between the two forces (Kromayer, *Antike Schlachtfelder* iii. 1, Berlin, Weidmann, 1912 4 *sqq.*). Panormus received the privileges of autonomy and immunity from taxation. A colony was sent here by Augustus, and the place remained of considerable importance, though inferior to Catana. The town was taken by the Vandal Genseric in A.D. 440. It afterwards became a part of the East-Gothic dominion, and was recovered for the empire by Belisarius in 535, till it was taken by the Saracens in 835. Panormus now became the Muslim capital. After the Norman conquest the city remained for a short time in the hands of the dukes of Apulia. But in 1093 half the city was ceded to Count Roger, and in 1122 the rest was ceded to the second Roger. When he took the kingly title in 1130 it became "*Prima sedes, corona regis, et regni caput.*" During the Norman reigns Palermo was the main centre of Sicilian history, especially during the disturbances in the reign of William the Bad (1154–1166). The emperor Henry VI. entered Palermo in 1194, and it was the chief scene of his cruelties. In 1198 his son Frederick, afterwards emperor, was crowned there. It passed under the dominion of Charles of Anjou in 1266, but the famous Vespers of 1282 put an end to the Angevin dominion. From that time Palermo shared in the many changes of the Sicilian kingdom. In 1535 Charles V. landed there on his return from Tunis. The last kings crowned at Palermo were Victor Amadeus of Savoy, in 1713, and Charles III. of Bourbon, in 1735. The loss of Naples by the Bourbons in 1798, and again in 1806, made Palermo once more the seat of a separate Sicilian kingdom. The city rose against Bourbon rule in 1820 and in 1848. In 1860 came the final deliverance, at the hands of Garibaldi.

Site.—The original city was built on a tongue of land between two inlets of the sea. There is no doubt that the present main

street, the Cassaro (Roman *castrum*, Arabic *Kasr*), Via Marmorea or Via Toledo (Via Vittorio Emmanuele), represents the line of the ancient town, with water on each side of it. Another peninsula with one side to the open sea, meeting as it were the main city at right angles, formed in Polybius's time the *Neapolis*, or new town, in Saracen times Khalesa, a name which still survives in that of Calsa. But the two ancient harbours have been dried up; the two peninsulas have met; the long street has been extended to the present coast-line; a small inlet, called the Cala, alone represents the old haven. The old state of things fully explains the name Πάνορμος.

The earliest existing buildings in Palermo date from the time of the Norman kings, whose palaces and churches were built in the Saracenic and Byzantine styles prevalent in the island. The metropolitan church was built by Archbishop Walter of the Mill—an Englishman sent by Henry II. of England as tutor to William II. of Sicily—and consecrated in 1185, on the site of an older basilica (9th century or earlier), which on the Saracen conquest became a mosque, and on the Norman conquest became a church again, first of the Greek and then of the Latin rite. What remains of Walter's building is a rich example of the Christian-Saracen style, disfigured by the addition of a totally unsuitable dome by Ferdinando Fuga in 1781–1801. This church contains the tombs of the emperor Frederick II. and his parents—massive sarcophagi of red porphyry with canopies above them. But far the best example of the style is the chapel of the king's palace (Cappella Palatina), at the west end of the city. This is the work of King Roger (1132–40). The wonderful mosaics, the wooden roof in Arab style, elaborately fretted and painted, and the marble incrustation of the lower part of the walls and the floor are very fine. Other contemporary mosaics with hunting scenes are in a hall in the palace.

Alongside of the churches of this Christian-Saracen type, there is another class which follows the Byzantine type, *e.g.*, the very small church of San Cataldo, and the adjoining church of La Martorana, the work of George of Antioch, King Roger's admiral (1143). This is rich with mosaics, among them the portraits of the king and the founder. Both these and the Cappella Palatina have several small cupolas, as has the church of San Giovanni degli Eremiti, with a bell-tower, and a picturesque cloister.

The series of Christian-Saracen buildings is continued in the country houses of the kings which surround the city, La Favara and Mimnermo, the works of Roger, and the better known Ziza and Cuba, the works severally of William the Bad and William the Good. The Saracenic architecture and Arabic inscriptions of these buildings have often caused them to be taken for works of the ancient amirs; but the inscriptions of themselves prove their date. All these buildings are the genuine work of Sicilian art, the art which had grown up in the island through the presence of the two most civilized races of the age, the Greek and the Saracen. Later in the 12th century the Cistercians brought in a type of church, which, without any great change of mere style, has a very different effect, a high choir taking in some sort the place of the cupola. The greatest example of this is the neighbouring metropolitan church of Monreale (*q.v.*); more closely connected with Palermo is the church of Santo Spirito, outside the city on the south side, the scene of the Vespers.

Domestic and civil buildings from the 12th century to the 15th abound in Palermo, and they present several types of genuine national art. Of palaces the finest is perhaps the massive Palazzo Chiaramonte, now used as the courts of justice, begun in 1307. One of the halls has interesting paintings of 1377–1380 on its wooden ceiling; and in the upper storey of the court is a splendid three-light Gothic window. The later houses employ a very flat arch, the use of which goes on in the Renaissance. S. Maria della Catena may be taken as an example. The most striking point in the city is the central space at the crossing of the main streets, called the Quattro Cantoni, or four corners. Two of the four are formed by the Via Vittorio Emmanuele, but the Via Maqueda, which supplies the other two, was cut through a mass of small streets in Spanish times.

Of the city gates only two remain, the Porta Nuova and the Porta Felice; both are fine examples of the baroque style; the former was erected in 1584 to commemorate the return of Charles V. fifty years earlier, the latter in 1582. There are also numerous baroque churches, many of them adorned with stuccoes by Serpotta. Outside the walls new quarters have sprung up of recent years, especially on the north beyond the Teatro Massimo and the Politeama Garibaldi; the former (begun by G. B. Basile and completed by his son in 1897) is the largest in Italy.

The museum of Palermo is the richest in the island. Among the most important are the objects from prehistoric tombs and the architectural fragments from Selinus, including several metopes with reliefs, which are of great importance as illustrating the development of Greek sculpture. The collection of Greek vases and terra-cottas is also important. The bronzes are few, but include the famous ram from Syracuse. There are also the Casuccini collections of Etruscan sarcophagi, sepulchral urns and pottery. From Palermo itself come Latin inscriptions of the imperial period, and two large coloured mosaics with figures found in the Piazza Vittoria in front of the royal palace, belonging to a large Roman private house, the remains of which are still visible. Of greater local interest are the mediaeval and Renaissance sculptures from Palermo itself, a large picture gallery, and an extensive collection of Sicilian majolica, etc.

The university, founded in 1779, had 1,886 students in 1925–6. There is also an interesting ethnographical museum. The city wears a prosperous and busy appearance. The Marina, or esplanade at the south of the town, affords a fine sea front with a view of the bay; near it are beautiful public gardens. But as a whole, Palermo turns its back on the sea, and makes surprisingly little use of it. Near the city on the south are the oldest church in or near Palermo, S. Giovanni dei Lebbrosi (the Lepers), founded by Roger I. (1072) and the bridge over the forsaken stream of the Oreto, built by the admiral George (1113). On the other side, towards Monte Pellegrino, is the new harbour of Palermo, round which a new quarter has sprung up, including a yard capable of building ships up to 475 ft. in length, and a dry dock for vessels up to 563 ft. The harbour is in process of enlargement and improvement, and a new breakwater is being built in front of the entrance. In 1926 3,602 steamships and 5,113 sailing ships of a total tonnage of 5,911,507 entered and cleared the port, 210,775 passengers and 848,222 tons of merchandise being dealt with.

The plain of Palermo is very fertile, and well watered by springs and streams, of the latter of which the Oreto is the chief. It is planted with orange and lemon groves, the products of which are largely exported, and with many palm-trees, the fruit of which, however, does not attain maturity. It also contains many villas.

PALES, an Italian god or goddess of flocks and shepherds. The festival called Parilia (less correctly Palilia) was celebrated in her honour on April 21. In this festival Pales was invoked; the stalls were cleansed and purified with magico-religious substances, and the herdsmen leaped three times across bonfires of hay and straw (Ovid, *Fasti* iv. 731–805). The Parilia came to be regarded as the birthday celebration of Rome.

See Wissowa, *Rel. u. Kultus d. Römer* p. 199 et seq., and in ***Hermes*** lviii. 369 et seq., Rose, *Prim. Cult. in Italy,* pp. 106–108.

PALESTINE, a territory administered by the British Government under a mandate from the League of Nations, which came officially into operation in 1923. It is bounded on the north by the French sphere of Syria, as settled by the Franco-British convention of 1920, on the west by the Mediterranean, and on the south by Egyptian and Hejaz territory. On the east is Transjordan (*q.v.*) separated from Palestine roughly by the Jordan valley and the Red sea, but included in the British mandate. Palestine stretches through only about 2 degrees of latitude, being roughly 140 m. long and about 23 m. wide in the north and about 80 m. in the south. Its area (excluding Transjordan) is just over 9,000 sq m., being slightly larger than that of Wales. The total population was estimated in 1914 at 689,281; at the official census in 1922 it was 757,182, of whom 590,890 were Muslim, 83,794 Jews, 73,024 Christians, 7,028 Druses, 163 Samaritans, 265 Bahais and the remainder Sikhs, Hindus and Metawilehs. The estimated population (1926) was 852,268. Since

the promulgation of the Immigration Ordinance (1920) there has been a large immigration of Jews.

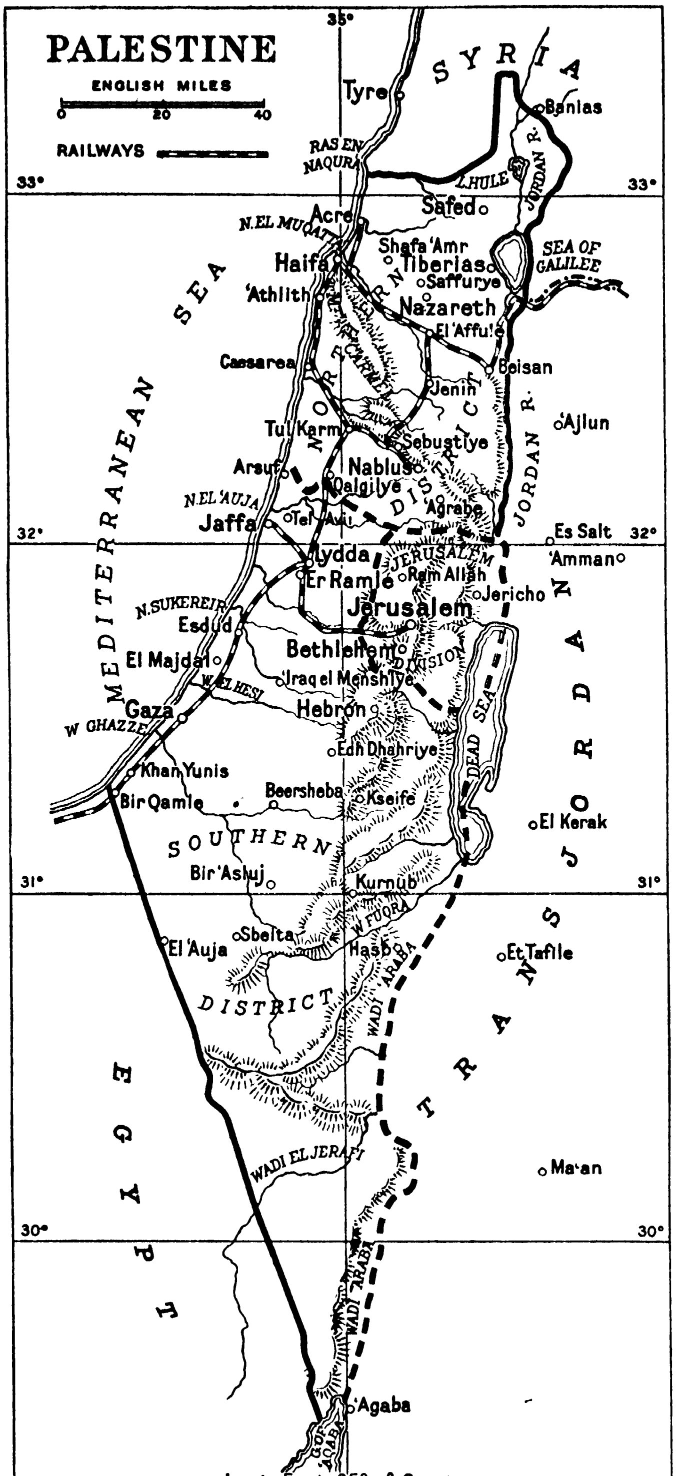
There is no ancient geographical term that covers all the area now known as Palestine. Until the period of the Roman occupation the region was subdivided into independent provinces or kingdoms, different at different times (such as Philistia, Canaan, Judah, Israel, Bashan, etc.), but never united under one collective designation. The extension of the name of Palestine beyond the limits of Philistia proper is not older than the Byzantine period. The country is at present (1929) divided into two districts: Jerusalem—southern, and Haifa—northern.

Physical Features.—Palestine forms part of an ancient plateau rising eastward from a sandy shore to an elevated tableland. A characteristic feature is that it is deeply fractured along certain lines, running from north to south. Secondary fracture lines, trending north-west to south-east, cross the main fractures, and are somewhat replaced east of Jordan by others running almost east and west. The main fractures determine the direction of the coast, with evidences of sunken land north of Carmel and of uplift along the sandy shores to the south. The steady rise of the plateau from the coast eastwards is broken by the greatest fracture line of all: that which forms the Jordan valley and the Dead sea. A belt of land has sunk deeply between a series of parallel north to south fractures, which may be followed both north and south of Palestine. The fracture is continued northwards from the Sea of Galilee between Hermon (9,383 ft.) and Lebanon (6,070 feet). The depression deepens southwards from the Sea of Galilee down to its deepest point in the Dead sea, some 2,600 ft. below the level of the Mediterranean.

Another stretch of lowland, forming the Vale of Esdraelon, passing towards the Jordan valley through the narrower Vale of Jezreel, represents one of the main secondary fracture lines with its general north-west to south-east direction. As a route from early times it has played an important part in the history of the country—at one time the highway of commerce, at another, the highway of war. These secondary fracture lines may be traced south of Esdraelon in the courses of those streams that flow, mostly in the rainy season, from the plateau's edge to the sea. East of Jordan, Arnon and Jabbok and Yarmuk are the main rivers. They tend to follow an east-to-west course, falling into Jordan. The Yarmuk was the northern limit of early Israelite life; to the north lay the Hauran cornfields under the influence of Damascus in the days of its greatness. Between Jabbok and Yarmuk was the land of Gilead that was the refuge of Israel in the days of distress (2 Sam. ii.).

The much fractured plateau of rocks of pre-carboniferous and possibly Archean age is generally concealed by later deposits, but these ancient rocks are exposed along the eastern margin of the Wadi-el-'Araba at the foot of the plateau of Edom. Similar rocks attain a greater extension towards the south, forming nearly the whole of Sinai and the hills of the east side of the Gulf of 'Aqaba. Owing to the extensive faulting in the neighbourhood of Jordan, the western (downthrow) side (forming Palestine) is made up of the newer beds (Upper Cretaceous and later) while east of Jordan the older rocks, sometimes down to the Archean floor, are exposed at the foot of the plateau. The Upper Cretaceous, represented by limestones with bands of chert, covers by far the greater part of the country, capping the plateau lands of Moab and Edom, and forming most of the high land between the Jordan and the Mediterranean. It is overlaid towards the west by similar limestones, which contain nummulites and belong to the Eocene, and are followed near the coast by the calcareous sandstones of Philistia of the same date.

Tertiary basic lavas cover extensive areas in Jalan and Hauran. These rocks are able to retain the rain and, when decomposed, form excellent soils for cereal growing and have been cornlands from early times. Small patches of volcanic material occur in Moab and also west of Jordan, especially near the Sea of Galilee. The drainage system on the plateau is peculiar. Its long and gradually rising western slope carries the main streams that eat back deep channels in the limestone before falling on the western plain. The eastern limit of the plateau falls precipitously



MAP OF PALESTINE SHOWING PLACES ASSOCIATED WITH BIBLICAL HISTORY

into Jordan, and is cut deeply by periodic torrents that rush down its slope. So sharp is this eastern edge that Bethlehem, only 14 m. from the Dead sea, stands 3,842 ft. above its waters and 5,150 ft. above its deepest point.

Palestine divides itself naturally into two longitudinal strips—the maritime plain and the mountain region.

The Maritime Plain, which, with a few interruptions, extends along the Mediterranean coast from Lebanon to Egypt, is a strip of land of remarkable fertility. It is formed of raised beaches and sea-beds, ranging from the Pliocene period downwards, and resting on Upper Eocene sandstone. It varies greatly in width. At the mouth of the Kasimiya it is some 4 m. across, and this breadth it maintains to a short distance south of Tyre,

where it suddenly narrows; until, at Ras el-Abiad, the cliffs reach the coast. South of this promontory the plain begins to widen again, being from 4 to 5 m. broad at Acre (Akka), while further south, at Haifa, it is of still greater width, and opens into the extensive Merj Ibn 'Amir (Plain of Esdraelon) which intersects the whole country. South of Haifa the promontory of Carmel effaces the plain; here the passage along the coast is barely 200 yd. in width. At 'Athlit, 9 m. to the south, it is about 2 m.; from this point it expands uniformly to about 20 m. at Ascalon. From the Kasimiya southwards the maritime plain is crossed by numerous river-beds, with a few exceptions winter torrents only.

The slopes down to the coastal plain grew fruits and corn, and were the centre of agricultural life. Here blossomed the "Roses of Sharon." Israel's hold upon the plain was usually weak, and the south-west was the centre of the Philistine power. Any settlement on this plain was essentially a station along the great route between Egypt and the Hittites, Damascus or Assyria. As the Jewish Prophets foresaw, no power could ever maintain itself in such a position, and although the Philistines at one time had control of the foothills they were driven back by David and Solomon, and in the days of the Maccabees the Philistine power was no longer a distinct unit.

The Mountain Region.—The hill country of Judaea is the nucleus of Palestine. A short distance north-north-east of Bethel stands Tell 'Asur (3,318 ft.), an outpost of the high ground which we shall consider as the Judaean hills. South of it is the long zigzag range known as Jebel el-Kuds, named from Jerusalem (el-Kuds) the chief town built upon it. The highest point is Neby Samwil (Mizpah), 2,935 ft. above the sea, north of Jerusalem. The city itself stands at an altitude of 2,593 feet. To the south of it begins the subdivision of the Judaean hills now known as Jebel el-Khalil, from Hebron (el-Khalil), which stands in an elevated basin some 450 ft. above the altitude of Jerusalem; it is here that the Judaean hills attain their greatest height. South of Hebron the limestone ridge finally breaks up and loses itself in the southern desert.

On the west side of the watershed the mountainous district extends about half-way to the sea, broken by deep valleys and passes. Among these the most important are the Wadi Selman (Valley of Aijalon), which seems to have been the principal route to Jerusalem in ancient times; the Wadi Isma'in, south of this, along which runs a road from Jaffa to Jerusalem; and the Wadi es-Surar, a higher section of the bed of the Nahr Rubin, with its railway line. It was among these hills in early times, cut off from the great trade-routes of the plain, that the shepherds treasured their nomad traditions and preserved the old rites of worship of Jehovah as well as on the high places (Hebron, Bethel, etc.). Jerusalem was a holy city before it fell to David.

Between the mountainous country of Judaea and the maritime plain is an undulating region anciently known as the Shephelah. It is composed of horizontal strata of limestone, forming groups of hills intersected by a network of small and fertile valleys. In this region, which is of great historical importance, are the remains of many ancient cities.

On the east side of the watershed the ground slopes rapidly from its height of 2,500 ft. above sea-level to a maximum depth of 1,300 ft. below sea-level, within a distance of about 20 miles. It is a waste, destitute of water and with but scanty vegetation. It has never been brought into cultivation; but in the first Christian centuries the caves in its valleys were the chosen refuge of Christian monasticism. It descends to the level of the Ghor by terraces, deeply cut through by profound ravines such as the Wadi es-Suweinit, Wadi Kelt, Wadi ed-Dabr, Wadi en-Nar (Kedron) and Wadi el 'Areijeh.

The southern district, which includes the white marl region of Beersheba, was in ancient times called the Negeb. It is a wide steppe region over which Israel's hold at first was but very slight (Simeon). The high ground in ancient Samaria includes the limestone mass of Mt. Ephraim, with the higher ground near the Jordan rift, and the western plateau merging more with the lowland than is the case in Judaea. Jebel Fuku'a (Gilboa) forms the watershed at the eastern extremity of the plain of Esdraelon, and is an outlier of Eocene rocks. The range of Carmel (highest point 1,810 ft.) runs from the small plain of Meri-el Ghuruk, though interrupted by many passes, to the end of the promontory which makes the harbour Haifa, at its foot, the best on the Palestine coast. Carmel is essentially an outpost of the hill country flanked by the maritime plain on one side and by the plain of Esdraelon on the other. The highest land in Samaria is in the neighbourhood of Nablus (Shechem)—city of refuge and regional focus. The hills include the rugged bare mass of Gerizim (Jebel-et-Turs), 2,849 ft., the smoother cactus-clad cone of Ebal (Sleimtye) 3,077 ft., and farther south Tell 'Asur, at which point begins the Judaean range. On the eastern side of the watershed the most important feature is perhaps the great valley system that connects the Mukhnah (the plain south of Nablus) with the Ghor—beginning with the Wadi Bilan and proceeding through the abundantly watered Wadi Far'a.

The Galilean Mountains and the Plain of Esdraelon.—The Galilean mountains, north of the plain of Esdraelon, fall into two regions, divided by a line joining Acre with the north end of the Sea of Galilee. The northern region (Upper Galilee) is virtually an outlier of the Lebanon mountains. At the north end is an elevated plateau, draining into the Kasimiya. The face toward the Jordan valley is lofty and steep. The highest point is Jebel Jermak, 3,934 feet. The region is fruitful, and in places well wooded. The southern region (Lower Galilee) shows somewhat different characteristics. It consists of chains of comparatively low hills, for the greater part running east and west, enclosing a number of elevated plains. The principal of these plains is El-Buttauf, a tract 400 to 500 ft. above sea-level, enclosed within hills 1,700 ft. high. It is marshy at its eastern end and very fertile. This is the plain of Zebulun or Asochis, of antiquity. The plain of Tur'an, south-east of El-Buttauf, is smaller, but equally fertile. Among the principal mountains of this district may be named Jebel Tur'an, 1,774 ft., and Jebel et-Tur (Tabor) 1,843 ft.; the latter is an isolated mass of regular shape which commands the plain of Esdraelon. Eastward the country falls to Jordan rift by a succession of steps, among which the lava-covered Sahel el-Ahma lies west of the cliffs overhanging the Sea of Galilee. The chief valleys of this region are the Nahr Na'aman with its branches, which runs into the sea south of Acre, and the Nahr-el-Muqatta', or Kishon, which joins the sea at Haifa. On the east may be mentioned the Wadi er-Rubadiya, Wadi el-Hamam and Wadi Fajjas.

The great plain of Esdraelon, as has been shown, is one of the most important natural features of western Palestine. It is a large triangle, having its corners at Jenin, Jebel et-Tur and the outlet of the Nahr-el-Muqatta', by which it communicates with the sea-coast. On the south-west it is bounded by the range of hills that terminates in the spur of Carmel. Historically it let in the invaders—merchants and soldiers—that ruined the distinctive traditions of Israel. In the winter it is swampy (Jud. v., 19–21) and in places almost impassable, though the fertility of this region is proverbial. Megiddo guards the entrance from the south. There are several small subsidiary plains extending from it both north and south into the surrounding mountain region. East of the watershed is a number of valleys running to the Ghor, the most remarkable of which are the Wadi el-Bireh and the Wadi Jalud.

Climate.—The physical structure has a definite bearing upon the many local peculiarities of climate. Palestine is open to the influences of the Mediterranean and thereby escapes the excessive drought of the interior of Arabia and Syria. The westerly winds associated with rain-bearing cyclonic storms are felt in the Mediterranean in winter, and strike the coast of Palestine, giving very heavy rains. At the same time the interactions of the moist warm air over the Mediterranean and the denser, colder, drier air in winter over Asia Minor and Arabia give an extension to the cold dry air of the interior of Asia, a feature giving a winter snowfall to the Judaean hills and the mountains of the north. Even in winter the deep Jordan valley is relatively warm, as the air is heated as it blows down from the north and west. The winter westerlies deposit their rain on the long westward-facing slopes, leaving the eastern scarp of the Jordan rift almost rain-free. The winds are warmed again in the deep valley and on cooling deposit further rain on the slopes of oak-forested Gilead.

The winter rains die away about Easter time. These are "the latter rains" of the Old Testament that foretell of heat and the ripening of crops. What rain falls in summer is mainly associated with local thunderstorms, due to the interaction of the land and sea air. In the hot dry summer, with dust-laden winds blowing from the desert over Palestine, the thermometer occasionally registers as much as 100° F in the shade, though 80°–90° is the more normal maximum. In the Jordan valley the temperature may reach 130°. The temperature may range, within 24 hours, from freezing point to 80°; this daily alternation of temperature may cause the wind to veer round the whole circle of the compass in a day (Eccl. i., 6). In October come "the former rains," which are the signal for winter ploughing. After October the winter westerlies set in again. The mean annual rainfall along the coastal area is about 28 in., although in exceptional years as much as 10 in. more are registered.

Although Palestine gets a great deal of rain, much of the water percolates through the large expanses of limestone rock and is thus wasted. Springs where the water rushes out from its subterranean channels are important, and wells were eagerly sought after in early times. They were often the cause of disputes among a shepherd group (Gen. xxvi., 17–25, and xxi.–xxv.). The countryside is fitted with ancient cisterns that tell of former works of irrigation. Besides the remains of ancient cisterns are the ruined aqueducts at Jericho, Caesarea and other places, as well as the large reservoirs known as Solomon's pools, in a valley between Jerusalem and Hebron, by which the former was supplied at one time with water. Hot springs are found at El-Hamma, about 1 m. south of Tiberias, at Zerka Mah'in (Calirrhoe), El-Hamma below Gadara, and also hot sulphur springs on the west side of the Dead sea. Irrigation and terrace cultivation are the keynote to the prosperity of Palestine.

Flora and Fauna.—The flora of Palestine has a considerable range and variety owing to the variation in local climatic conditions. In the Jordan valley the vegetation has a semi-tropical character. The coast-plain has the ordinary vegetation of the Mediterranean littoral. In the mountains the flora is, naturally, scantier than in these two more favoured regions, but even here there is a rich variety. In all parts of the country the contrast between the landscape in early spring and later, after the cessation of rains when increase of heat has burnt up the vegetation, is very remarkable.

It has been calculated that about 600 different species of vertebrate animals are recorded or still to be found in Palestine. The most important domestic animals are the sheep and the goat; the breed of oxen is small and poor. The camel, the horse and the donkey are the draught animals.

It is important to remember that the horse was a comparatively late introduction and is not mentioned until nearly the end in Genesis. In the dry regions it was somewhat of a luxury. Wild cats, cheetahs and leopards are found, but they are rare, especially the latter. The lion is extinct. The most important wild animals are the hyena, wolf (now comparatively rare), fox and jackal. Bats and rodents abound; the coney is heard of still near the Dead Sea, where the ibex also is found. Among the most characteristic birds may be mentioned eagles, vultures, owls, partridges, bee-eaters and hoopoes; singing birds are on the whole uncommon. Snakes—many of them venomous—are numerous, and there are many varieties of lizards. The crocodile is seen very rarely in the Nahr ez-Zerka. Scorpions and large spiders are universal.

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Defence.—In Palestine, as in 'Iraq (*q.v.*), responsibility for defence rests upon Great Britain as a legacy from the World War. After its conclusion British troops were kept in the country which was combined with Egypt in a military command. On their withdrawal in the interests of economy, a Palestine gendarmerie was established, but this experiment not having met with success, a British cavalry regiment was sent back in 1924–5, but this has since been withdrawn, and in 1926 a Trans-Jordan frontier force of mounted riflemen was raised with an establishment of 782, including 17 British and 23 local officers, and 15 British warrant officers, the other ranks being Muslim and Christian Arabs, Jews, Circassians, Druses, Egyptians, Sudanese and of other races. This force is administered by the Palestine Government, but, as in 'Iraq, under control of the Royal Air Force commander. British regular officers are appointed for two years, with extensions. Establishment in the ranks is for three years. The mounted riflemen carry swords and lances for ceremonial only. There is also a police force of 1,750 (245 British) armed with rifles, but not liable for military service, under a British commandant.

See also *Army List* (official). (G. G. A.)

ARCHAEOLOGY

Archaeology.—Placed on the edge of the partial desert that separates Asia from Africa, Palestine was from the beginning a halting place in the line of communication between the two. Monarchs of the old world seeking empire in Syria or in Egypt, and trade caravans passing from one country to the other, were alike bound to pause, before or after crossing the intervening wastes. Its relatively long and open coastline exposed it also towards the sea; while the desert tracks from Arabia, converging upon its frontiers to the East and South, were a further source of contact and infiltration. So that though primarily the pathway of greater nations, Palestine became from earliest times the meeting place of peoples varying in race and civilization, in religion and modes of life.

Tell el Hesy.—The complex character of the archaeological problems that awaited the investigator was made evident by the first piece of scientific excavation undertaken in the country. This was organized in 1890 by the Palestine Exploration Fund, which had already accomplished the great task of mapping and surveying the country. The site chosen under the political circumstances of the day, namely the city-mound of Tell el Hesy, lay well within the Egyptian sphere, being situated almost upon the high-road from Gaza to Jerusalem, sixteen miles only from the former and half way to Beit-Jibrin. Flinders-Petrie, who in Egypt (*see* Sequence Dating) had succeeded in grouping and classifying the Egyptian types by series corresponding to the historic epochs of that country, understood the task. He reported at the time, "A clear section of the town had been cut away by a torrent, so that any level could be worked at ease. In these circumstances a few weeks sufficed to obtain pottery of each age, from the Amorite to the Greek times." The specimens so obtained were classified according to their levels, and the recognition of Egyptian objects among them at certain depths enabled the outline of a chronological scale to be established.

Further excavation of the mound upon these lines subsequently showed that the accumulation of 65ft. of debris represented the stratified remains of eleven successive cities. The time scale was indicated in the third city by the discovery of an inscribed tablet and Egyptian objects of the 14th century B.C., and in the fourth city by further Egyptian relations of the 19th dynasty. Above this level iron replaced bronze as the characteristic metal, and finally the appearance of Attic Greek and later wares in the 7th and 8th centuries displayed the further evolution of the site with certitude. The most conspicuous building of the earliest period was a stoutly built tower, the walls of which were nearly 10ft. thick; and it was attributed, together with the foundations of the site, to the 17th century B.C., a date to which other cities of the maritime plain, including Ascalon and Dora, are found to trace their origin. The name of the city, to be inferred from indications on the inscribed tablet, was Lachish, which Egyptian records show to have had some military importance in the 18th dynasty, agreeing with later Hebrew tradition relating to the period of Joshua. Fortified by Rehoboam, Lachish was later one of the strong cities of Judah captured by Sennacherib, incidents in its history which are represented by the stratifications exposed during the excavation. The city of the Assyrian period would be that in level VI., at which time its walls were 10 to 12ft. thick. The Assyrian

king made it his headquarters and a bas-relief in the British Museum shows him receiving there the submission of Jewish prisoners. Several other city-mounds in the neighbourhood of Beit Jibrin were examined; but there was still much to be learnt. The attainment of these encouraging first results had been favoured by a rare combination of circumstances. The strata of Tell el Hesy were exceptionally uniform and free from interruption;

but in general this is not the case. In cities of increasing prosperity the larger buildings of each age were frequently given foundations which descended to and through the lower levels, disturbing the normal stratification in the process, while sometimes it is found that stout buildings survived throughout several succeeding epochs. For such reasons intrusions in the strata are the rule rather than the exception, and excavators must be prepared for such problems and to explain their cause. Only one third of the mound of Tell el Hesy had been dug, and the examination of four mounds during the two following years was only cursory and incomplete. Nevertheless at Tell el Zakarieh a large amount of pottery fragments, together with scarabs, beads and articles of bronze, gave proof of close connection with Egypt, under the new empire. At Tell el Safi it was possible to follow the line of fortifications around the hill; shafts sunk to the rock in a number of places showed the thickness of the debris to be over 40ft. and traced the origin of the city to the Bronze Age. At a depth of 20ft. there was found a series of monoliths, evidently the remains of a High Place; and at a higher level, pertaining to the early Iron age, there was a Jewish stratum containing jar handles with royal stamps assigned to the time of the kings of Judah. Higher still in the debris there were traces of the Crusaders, and near the surface sherds of modern Arab pottery. In the third mound also, Tell el Judeideh, a city wall was followed around the hill and four gateways were examined; but the date of these fortifications remains doubtful, though there were indications pointing to the origin of the city in the late bronze age. At Tell Sandahanna, identified with Mareshah, an entire town of the Seleucidan era was excavated, with towers, walls, gates, streets and houses, of which a complete plan was made, and below this were found remains of Jewish occupation. Tomb chambers of the third century B.C. discovered independently of the excavations were decorated with frescoes of hunting scenes, on which appear the lion and elephant and other fauna foreign to Palestine, together with funerary inscriptions of a Phoenician family from Sidon.

Gezer Excavation.—It became clear at this stage that the excavation of these sites involved much more than normal stratifications illustrating local arts and activities. There were evident traces of direct foreign impact and immigration which it was necessary to distinguish, and the difficulty of discrimination was greater in the deeper levels where the source and character of these intrusions were alike unknown. The Palestine Exploration Fund determined in 1902 to attack the site of Gezer on a scale hitherto unprecedented, and Dr. Macalister devoted himself to the task of obtaining and recording the whole of the information which that great and historic mound contained. This undertaking marks a definite stage of progress in archaeological research in Palestine. The work was continued during four consecutive years and was again resumed for a further three years, and a new system of classification was introduced.

The origin of the site was traced to the settlement in "Neolithic" times of a race of men, small in stature, who dwelt in caves and cremated their dead, placing the remains in the caves with provisions and foodstuffs. The culture of that age was characterized by hand-made pottery and flint implements. Domestic animals included the sheep, cow, pig and goat, and grindstones suggested that cereals were already cultivated. To the same period apparently are to be attributed some rough drawings, which however in their artistic qualities are not comparable with those of the late palaeolithic age in Europe. Eleven scarabs and other objects indicated contact with Egypt as early as in the 12th dynasty, about 2000 B.C. At that time the site was surrounded by a stone wall ten to eleven feet in thickness, provided with long narrow towers and stout gateways, and constructed of large irregular undressed stones, the open joints being packed with small stones. Two towers of rude rubble were faced with sun-baked bricks, a style more recently observed at Shechem and not unknown in the Hittite area in the north of Syria. The burials of these days were made by inhumation in caves, accompanied, as in Egypt, by objects and provisions. At a later period, beginning with 1400 B.C., there was a larger outer wall, provided with no less than 30 towers both external and internal. The whole was constructed of fairly large stones roughly dressed, but covered with mud. A great castle, the walls of which were in some places 9ft. thick, was erected at this time and it lasted with occasional restoration throughout the epochs of three subsequent cities down to 100 B.C. In religion the worship of Astarte was prevalent; more primitive cults are indicated by the "high places," analogous to that of Petra, and standing monoliths or mazzebahs, and there were traces of child burial and sacrifices. There is evidence of contact with Egypt, in the age of Amenhetep III. and IV., when (in substantiation of the records) those cities in the north of Palestine showed traces of the Hittite-Amorite invasion. A further dis-

covery of peculiar interest, as affecting foreign relations, was made in a group of masoned tombs, unlike any others of the site, which were found to contain ornaments and other objects of gold, silver, alabaster. These recalled the art of Cyprus in Sub-Mykenaean times (L.M. III. b.) and may be attributed to Aegean intruders. As elsewhere a period of Jewish habitation was indicated by a number of inscribed jar handles, and the Assyrian occupation left its traces in two inscribed tablets dating from 651 to 648 B.C.

The development of the mound at Gezer may be regarded as generally typical of its area. The evidence of Aegean intrusion, corresponding so nearly in date to the coming of the Philistines (in the age of Rameses III.) were especially significant; and the suggestion was borne out by parallel discoveries made at Ain Shems (1911 and 1912). Here also a city wall was traced, though the excavation was hampered by the remains of the monastery of Byzantine date. East of the city, outside the wall, pieces of pottery were found, some of which resembled wares of the Aegean islands and even Knossos, dating approximately to the 14th century B.C., a Mediterranean infiltration now found to characterize the special culture of the late bronze age, particularly in the northern cities. Pottery of the "Philistine" stratum, that is, the early iron age, is comparable in general style and technique with specimens from Gezer and bears out the Aegean character of that intrusion. Higher in the accumulation of debris, pottery was recognized as dating probably from the period of the kings of Judah, to whom might be attributed the construction of the city wall. There were clear indications of a siege and of the destruction of the city, which after a further interval appears to have been burnt a second time and completely destroyed. In the central portion of the city were the remains of a "high place"; and near by a cave was found which had been used as a place of burial during the earliest period of occupation. In the neighbouring tombs, which were cut in the rock, many objects of coloured pottery, scarabs, beads, seals, collars and bracelets indicated contact with Egypt at various epochs, and a number of bronze objects added to the collection of material available for study.

The examination of these six cities in the Shephelah traced, then, the origins of human settlement in Palestine to the late stone age and the beginning of village life to the early bronze age. Thereafter the occupation may be regarded as generally continuous, through successive stages of culture, influenced from various foreign sources, into historic times. The Egyptian contacts of the 12th, 18th and 19th dynasties correspond with the known activities of the Pharaohs, but it is noticeable that these Egyptian "intrusions" affected little, if at all, the local arts. The Aegean and Mediterranean relations corresponding to the 18th dynasty were widespread, and produced a marked effect here as elsewhere upon the characteristic culture of the period. The later and distinctive appearance of sub-Mykenaean products corresponds with other indications of the Philistine origins, and is traceable generally throughout the plain. The later Jewish, Hellenistic and Roman phases of the iron age culture come within history. Meanwhile the examination by Dr. Sellin and others of two famous sites in the north, Taanak and Megiddo, though on a small and preliminary scale, gave indication of parallel epochs of development upon similar lines, with, however, much variety of detail. Both shared in the high culture of the late bronze age, as was indeed to be inferred already from the Egyptian scenic records of the spoils taken by Thothmes III. at Megiddo. Yet a comparison of results made it already clear that wider and more exhaustive excavation was necessary before any general criteria of the archaeology of Palestine could be established.

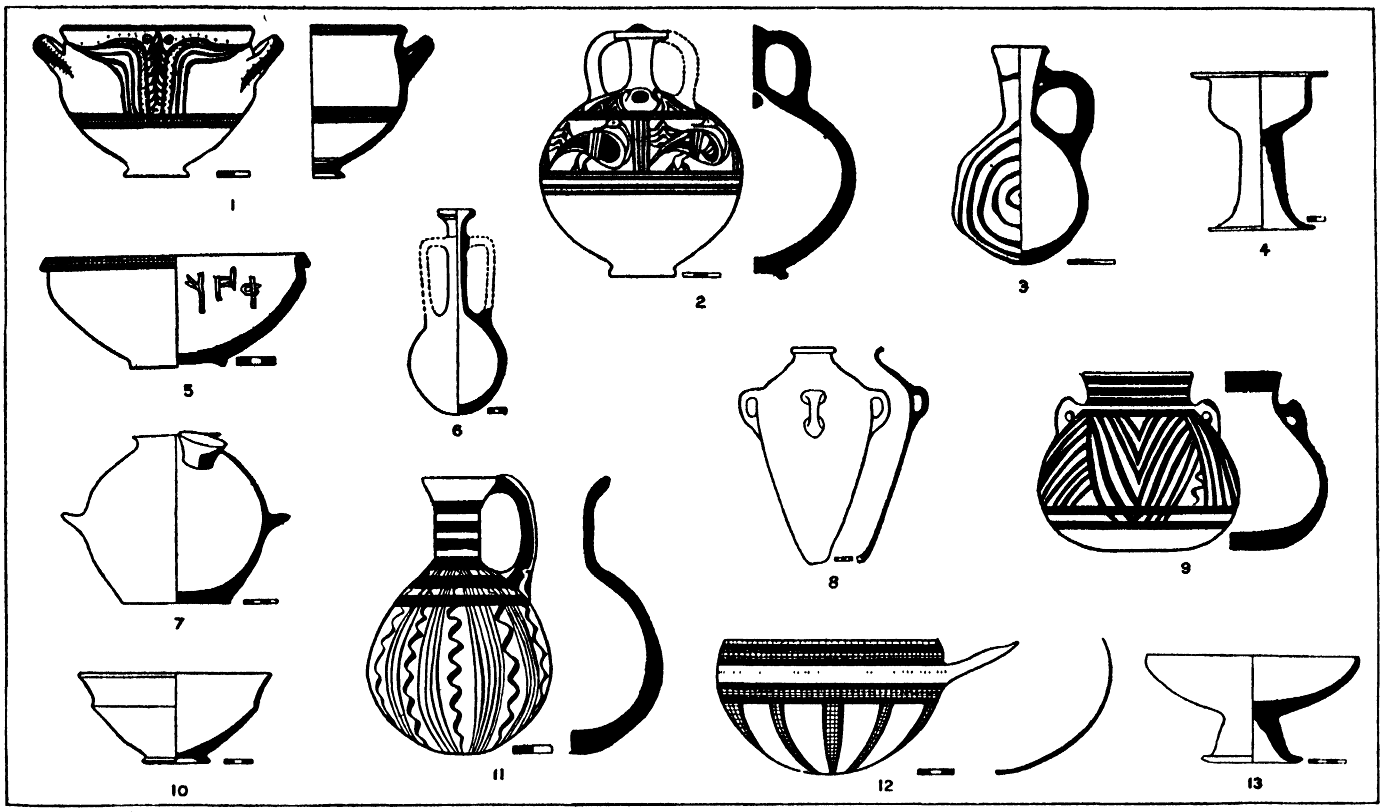
At Jericho, indeed, as might perhaps have been anticipated, the signs of Egyptian and Aegean influences were relatively meagre; and the city itself, which seems to have flourished to an exceptional degree during the middle bronze age (the Hyksos period) was destroyed and apparently remained in ruins during the great period of the cities of the north, to revive only partially in the early iron age. These conclusions, it is true, correspond in broad lines with Hebrew tradition, but they are derived from a reinterpretation of the results of the excavation, and this fact illustrates the chief difficulty of the day. Comparative data were essential at this stage to further progress and they were not available. Meanwhile Père Vincent, who had followed the progress of archaeological researches from the beginning, had rendered signal service in 1907 by the publication of his synthetic study "Canaan," in which the results of all excavations made up to that time were scrutinized and compared, and the foundations of comparative archaeology were laid down.

Post-War Work.—The acceptance by Great Britain of the mandate for Palestine at the close of the war resulted in material developments which gave great impetus to the progress of archaeological research. A British school was established in Jerusalem, and entered at once into collaboration with the *École Biblique* and the American School of Oriental Studies. In order to facilitate the co-ordination of results it was jointly agreed to adopt the now familiar divisions of the bronze age, (early, middle and late), to connote the chief phases of Canaanitish culture previous to 1200 B.C. The beginnings of this period can only be estimated at about 2500 B.C., but the end corresponds historically with the invasions of iron-using sea peoples and the Philistines, and this date is found to be generally applicable, though local variation has been observed by Sir William Flinders Petrie at Tell el Sharia on the southern frontier.

The British school was entrusted with the organization of an official Department of Antiquities, charged with the protection of the historical sites and monuments of the country, and a law was promulgated for that purpose, in which equitable facilities were offered to scientific excavation. The consequent establishment of a central museum at Jerusalem made it possible to develop and concentrate collections of specimens not only for the satisfaction of public interest but to serve as a basis for comparative study. Finally the improvement in public security enabled exploration to be extended to areas not hitherto investigated, and the British school devoted its earliest efforts to the cutting of sections in a number of sites on the plains of Akka, Esdraelon and Sharon, followed by the exploration of caves in Eastern Galilee. The American school under Dr. Albright led the way in a new era of topographical research upon scientific lines, testing the indications of Biblical and Egyptian history by the more precise archaeological evidences now becoming available. Meanwhile inspectors of the new department examined and registered no fewer than 2,000 historical sites.

Under these new conditions excavations have recommenced in unprecedented numbers throughout the country. In many cases work is still proceeding and the results are only reported as yet in summary form, so that any attempt at a general survey would be premature and might prove misleading. The sites under investigation range from the sources of the Jordan to the Egyptian frontier, from Ascalon on the coast of Philistia to Jerash and Amnan beyond the Jordan. Light is thrown by the immediate results upon every known period of cultural development, from the oldest stone age to the Crusades. A mere recital of the names and situations of the sites and the chief results will indicate the importance and comprehensive nature of this development.

Main Results.—In all some twelve or fourteen sites have been under exploration. Caves in Galilee have furnished traces and remains of primitive man of the old stone age. Upon the coastlands, mounds in the plain of Akka, Tell Harbaj and others, and caves in the neighbouring hills of Carmel and of Galilee, illustrate the local arts and foreign influences of all periods of the bronze age and early iron age, showing general parallelism with the development of culture elsewhere, but with marked traces of intrusive elements. South of Carmel, on the coast, Dora seems to have been founded in the middle bronze age, and in Hellenistic times it was a flourishing stone-built city. On the Philistine coast Ascalon traces its origin to the same epoch as Dora. The Philistine levels here were hardly explored, being reached with difficulty; they underlay the imposing remains of the prosperous Roman period, in particular the Senate house, with its elaborate cloisters, and other public buildings of that time. At Tel Mersim (possibly Kirjath Sepher) the site was defended by a stone wall already in the bronze age, and the whole plan of the city in the early iron age,



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FIGS. 1–13.—SPECIMENS OF ARCHAEOLOGICAL POTTERY VESSELS

1. Red clay vessel, from Tomb 3, Ophel, Early Bronze Age. 2. Red clay jug from Gezer, Late Bronze Age. 3. Buff clay vessel, Middle Bronze Age. 4. Vessel from Cave 2, Gezer, Early Bronze Age. 5. Buff clay bowl from High Place Grotto, Palestine, Middle Bronze Age. 6. Buff clay bowl, Late Bronze Age. 7. Orange clay bowl, Late Bronze Age. 8. Reddish clay bowl with white ash from Ascalon, Early Iron Age. 9. Orange clay jug from Tomb 1, Ain Shems, Palestine, Iron Age. 10. Buff clay vessel from Tomb 1, Ain Shems, Palestine, Iron Age. 11. Rough clay bowl from Tomb viii., Ain Shems. 12. Black clay Hellenistic vase from Tell Sandahannah. 13. So-called Philistine type jar of light yellow slip on buff clay from Gezer, Early Iron Age

with its streets, houses and gates, has been recovered. In the plain of Esdraelon the huge mound of Megiddo is now in process of complete excavation. A settlement of Neolithic date has been found at its foot, and a city-level of Israelitish period has been laid bare upon the top. There is record of the invasion of Pharaoh Shishak, hitherto unconfirmed, and trace of Hittite penetration in the 14th century, parallel with discoveries at Beisan. On the central ridge, at Balata near Nablus, the ancient walled city of Shechem is being uncovered. The stout defences of the late bronze age with a doorway of north-Syrian "Hilani" type, enclose a sanctuary and palace of that period and in its upper strata buildings of Israelitish origin. Further south the site of Seilun, thought by some to be that of Shiloh, has been examined, but though a "high place" and pottery of the late bronze and early iron age was found, the results on the whole were inconclusive. At Tel Nazbeh, north of Jerusalem, the excavation of a walled city with prodigiously strong defences is now proceeding. Here the origins of settlement are traced to the earliest phase of the bronze age, to which period also the foundations of the defensive ramparts pertain. In the late bronze age a higher wall with a stout revetment surrounded the enclosure. In places the wall still stands to a height of 27ft. with a thickness of 16 to 20ft., which is increased at the bottom by the revetment to no less than 46ft. The inscription on a jar handle suggests that this was the site of Mizpeh, but the point is not settled. Finally, at Jerusalem itself the city of the Jebusites on mount Ophel has been located and the stone wall with revetment of the late bronze age has been laid bare. The whole cultural sequence is now richly illustrated at various stages by marked styles in the ceramic wares, and it may soon be possible to distinguish the local elements and assign them to their original areas and cultural sources. The brightest period in the Canaanitish civilization was clearly that of the late bronze age, 1600 B.C. to 1200 B.C., when, by the testimony of these and earlier excavations, Palestine was a land of walled and prosperous cities sharing a high and distinctive culture which is reflected in the contemporary records of the Pharaohs. The prevailing worship at this age was that of Astarte to whom shrines are found in every site that has been sufficiently explored, together with objects of the cult, as at Beisan (the biblical Bethshan) where work was earliest begun and has now been proceeding for four or five years. Here various strata of the late bronze age have been examined to a depth of 27ft. below the surface, and tombs of the period have contributed their testimony. The temple of the goddess was renewed at successive building epochs. Direct corroboration is given to the history of Egyptian activities in the area as derived from Egyptian sources. The domination of Syria by Thothmes III. in the 15th century B.C., the penetration of the Hittites and their allies from the north in the age of Akhenaten (as indicated in the letters found at Tell el Amarna), and the subsequent efforts of Seti I. and Rameses II. in the 13th century B.C. to regain their lost Syrian possessions are definitely substantiated. Monuments of the last named Pharaohs, inscribed in Egyptian hieroglyphs, were found in strata of their period, and the texts give an account of military dispositions taken in the neighbourhood, a prelude to the conflict with the Hittite forces at Kadesh on the Orontes, *c.* 1288 B.C. A reliable historical basis, thus established, will in due time extend to every site.

Roman Age.—Relatively little archaeological material has been found pertaining to the early historical epochs of the Israelites and the Philistines, and the development of Hellenism. The prosperity of the Roman Age, already indicated by visible monuments scattered about the country, particularly by the Graeco-Roman cities of Samaria and Gerasa has already received material illustration. Before the war, excavations on the former site conducted by Dr. Reisner, had disclosed (in addition to the foundations of the royal palace of Ahab) the Senate house and forum of Herod's creation Sebaste, as well as portions of the masoned ramparts and western gateway. Since then the Palestine Explora-

tion Fund, at Ascalon, has uncovered the remains of another Senate House on a similar but larger plan, and has laid bare the foundations of the famous peristyle with which Herod the Great adorned the favoured city of his birth. The style of decoration is Corinthian, and there are indications that many elements of the building were shipped bodily from abroad. The full splendour and appearance of these columned cities is however to be seen now in the unparalleled result of uncovering the ruins of Gerasa (now Jerash), in the course of the work of consolidation which the government of Trans-Jordan has undertaken. There the whole *via principalis,* a kilometre in length, is now cleared from gate to gate, showing the original pavement and the masoned side-walks for the most part intact. The temples, theatres, nymphaeum and triumphal arch, are being steadily brought to light and put into repair; numerous inscriptions are already recovered, as well as objects of sculpture and architectural carvings. A local museum is established, so that this unique city of the Decapolis may now be visited and visualized upon the spot.

The later monuments of Graeco-Roman style, notably the Synagogues of Galilee have also received a share of active attention. That of Tell Hum (Capernaum), which had long lain in ruins as a result of earthquake has been partly reconstructed; and that of Kerazi (Chorazim) has been cleared of debris and made accessible to visitors. Mention must be made, in concluding this brief list, of the mediaeval buildings of Palestine and Trans-Jordan. The Crusaders' castles at Athlit, upon the coast, and at Ajloun, which overlooks the Jordan valley near Jerash, no less than the standing walls of Jerusalem itself, are among the most imposing antiquities of the country. But by far the best preserved and most extensive monument of the period is to be seen at Kerak near the eastern shores of the Dead sea and only to be reached by a relatively long journey by Amman. Here, crowning a hill-top, the vast stronghold of the Saracens rests upon a veritable labyrinth of earlier fortifications, the origin of which is traced at least to pre-Roman date. These buildings are all included in the programme of conservation which the governments responsible under the mandate have drawn out, and are classed among the promising sites available for investigation.

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(J. GA.)

HISTORY

I. OLD TESTAMENT PERIOD

Palestine is a land of small divisions not forming a separate entity. In the words of Sir George Adams Smith (*The Historical Geography of the Holy Land,* p. 58), it "has never belonged to one nation and probably never will." Its position gives the key to its history. Along the west coast ran the old road for traders and for the campaigns which have made the land famous. The seaports (more especially in Syria, including Phoenicia), were well known to the pirates, traders and sea-powers of the Levant. The southernmost, Gaza, was joined by a road to the mixed peoples of the Egyptian Delta, and was also the port of the Arabian caravans. Arabia, in its turn, opens out into both Babylonia and Palestine, and a familiar route skirted the desert east of the Jordan into Syria to Damascus and Hamath. Damascus is closely connected with Galilee and Gilead, and has always been in contact with Mesopotamia, Assyria, Armenia and Asia Minor. Palestine lay at the gate of Arabia and Egypt, and at the tail end of the states stretching down from Asia Minor. Encircled by famous ancient civilizations, its history cannot be isolated from that of the surrounding lands. Recent research, in bringing to light considerable portions of long-forgotten ages, is revolutionizing those impressions which were based upon the Old Testament—the sacred writings of a small fraction of this great area—and a broad survey of the vicissitudes of this area furnishes a truer perspective of the few centuries which concern the biblical student. The history of Israel is only part of the history of Palestine, and this is part of the history of a very closely interrelated portion of a world sharing many similar forms of thought and custom. The close of Old Testament history (the book of Nehemiah) in the Persian age forms a convenient division between ancient Palestine and the career of the land under non-oriental influence during the Greek and Roman ages. It also marks the culmination of a lengthy historical and religious development in the establishment of Judaism and its inveterate rival Samaritanism. The most important data bearing upon the first great period are given elsewhere in this work, and it is proposed to offer here a more general survey. *See* further JEWS.

Prehistory.—To the prehistoric ages belong the palaeolithic and neolithic flints, from the distribution of which an attempt might be made to give a synthetic sketch of early Palestinian man. (H. Vincent, *Canaan d'après l'exploration récente,* pp. 374 *sqq.*, 392–426.) The discovery (1925) in a Galilaean cave of part of a Neanderthal skull, associated with Mousterian tools, has proved the antiquity of culture in Palestine and has also shown that it was not isolated. A burial cave at Gezer revealed the existence of a race of slight build and stature, muscular, with elongated crania, and thick and heavy skull-bones. The people lived in caves or rude huts, and had domesticated animals (sheep, cow, pig, goat), the bones of which they fashioned into various implements. Physically they are quite distinct from the normal type, also found at Gezer, which was taller, of stronger build, with well-developed skulls, and is akin both to the Sinaitic and Palestinian type illustrated upon Egyptian monuments from *c.* 3000 B.C. to the modern native. At what period Palestine first became the "Semitic" land which it has always remained, is uncertain; nor can one decide whether the megalithic monuments, especially to the east of the Jordan, are due to the first wave which introduced the Semitic (Canaanite) dialect and the place-names. At all events during the last centuries of the third millennium B.C., remarkable for the high state of civilization in Babylonia, Egypt and Crete, Palestine shares in the active life and intercourse of the age; and while its ports and fertile fields are visited by Egypt, Babylonia had already claimed supremacy as far as the Mediterranean. (*See* further CANAAN.)

Egyptian Suzerainty.—A definite stage is reached in the period of the Hyksos (*c.* 1700), the invaders of Egypt, whose Asiatic origin is suggested *inter alia* by the proper-names which include "Jacob" and "Anath" as deities. After their expulsion Egypt at once enters upon a series of campaigns in Palestine and Syria as far as the Euphrates, and its successes over a district whose political fate was bound up with Assyria and Asia Minor laid the foundation of a policy which became traditional. Apart from rather disconnected details, which belong properly to the history of Babylonia and Egypt, it is not until about the 16th century B.C. that Palestine appears in the clear light of history, and henceforth its course can be traced more continuously. Of fundamental importance are the cuneiform tablets discovered at Tell el-Amarna in Egypt in 1887, containing some of the political correspondence between Western Asia and Egypt for a few years of the reigns of Amenophis III. and IV. (*c.* 1411–1360). The first Babylonian dynasty, famous for its Khammurabi, belonged to the past, but the cuneiform script and language are still used among the Hittites of Asia Minor (centring at Boghaz-keui) and the kings of Syria and Palestine. Egypt itself was now passing from its greatness, and the Hittites (*q.v.*) were its rivals for the possession of the intervening lands. Peoples apparently of Indo-Iranian connection from the powerful state of Mitanni (Northern Syria) had already left their mark as far south as Jerusalem, as may be inferred from the personal names; and in addition to the intercourse with Aegean culture (revealed by excavation), the tablets add references to mercenaries and bands from Meluḫḫa (Arabia),

Mesopotamia and the Levant.

The Amarna Age.—The small cities of this cosmopolitan Palestine were ruled by kings, not necessarily of the native stock; and the slight extent of these city-states is obvious from the references to the kings of such near-lying sites as Jerusalem, Gezer, Ashkelon and Lachish. Apart from Jerusalem and a few towns on the coast, the real weight lay to the north, and especially in Amor (*see* AMORITES). It is an age of internal disorganization and a heavy pressure by land and by sea from Northern Syria and Asia Minor. Palestine seethes with excitement, wavering between allegiance to Egypt and intrigues with the great movements at its north. The letters vividly describe the approach of the enemy, and, in appealing to Egypt, abound in protestations of loyalty, complaints of the disloyalty of other kings and excuses for the writers' suspicious conduct. Of exceptional interest are the letters from Jerusalem describing the hostility of the maritime coast and the disturbances of the Ḥabiru, a name which, though often equated with that of the Hebrews, may have no ethnological or historical significance. At all events, the hostility of the Ḥabiru cannot be isolated from that in other letters (where the enemy are otherwise described), and their steps do not agree with those of the invading Israelites in the book of Joshua. The history of the age illustrated by the Amarna letters is supplemented by the tablets found at Boghaz-keui, the capital of the old Hittite Empire. Subsequent Egyptian evidence records that Seti I. (*c.* 1321 B.C.) of the XIXth Dynasty led an expedition into Palestine, but struggles with the Hittites continued until Rameses II. concluded with them an elaborate treaty which left him little more than Palestine (1272 B.C.). Even this province was with difficulty maintained: the disturbances in the Levant and in Asia Minor (which belong to Aegean and Hittite history) and the revival of Assyria were reshaping the political history of Western Asia.

Under Rameses III. (*c.* 1200–1169) we may recognize widespread disorganization in the movements in which the Philistines (*q.v.*) participated. Nevertheless, Egypt seems to have enjoyed a fresh spell of extended supremacy, and Rameses apparently succeeded in recovering Palestine and some part of Syria. But it was the close of a lengthy period during which Egypt had endeavoured to keep Palestine detached from the rest of south-west Asia, and Palestine had hard experience of the powerful empire at its south-western border. Somewhat later Tiglath-Pileser (*c.* 1115) pushed the limits of Assyrian suzerainty westwards over the lands formerly held by the great Hittite Empire. Palestine had hitherto been bound up with Egypt, the Hittites and Mitanni, with the Amorites north of Lebanon and with the Philistine invaders. For centuries it had had a stirring history. We now reach the Israelite period.

The Hebrew Monarchy.—At an age when there were no great external empires to control Palestine Israel arose and claimed a premier place amid its neighbours (*c.* 1000). How the small rival districts with their petty kings were united into a kingdom under a single head is a disputed question; the stages to the independent Hebrew state with its national god Yahweh are still an unsolved problem. Biblical tradition itself quite plausibly represents a mighty invasion of tribes who had come from Southern Palestine and Northern Arabia (Elath, Ezion-geber)—but primarily from Egypt—and, after a series of national "judges," established the kingship. But no place can be found for this conquest, *as it is described,* either before the "Amarna" age (the date, following 1 Kings vi. 1) or about the time of Rameses II. and Merneptah (*see* Exod. i. 11); and when the latter king (*c.* 1233) records the subjugation of the people (or tribe) "Israel," it does not follow that this "Israel" was identical either with the Israelite tribes which invaded the land or with the intermixed people after this event. Whatever may have been the extent of the Israelite invasion and the sequel, the rise and persistence of an independent Palestinian kingdom depended upon its relations with the maritime coast (Philistia and Phoenicia), Edom, Moab, Ammon, Gilead and the Syrian states; and the biblical and external records for the next four centuries (to 586) frequently illustrate situations growing out of this interrelation. The evidence for these crucial years is unequal and often sadly fragmentary, and is more conveniently noticed in connection with the biblical history. A conspicuous feature is the difficulty of maintaining a single monarchy (*see* SAUL, DAVID, SOLOMON), which, however it originated, speedily became two rival states (Judah and Israel). These are separated by a very ambiguous frontier, and have their geographical and political links to the south and north respectively. The balance of power moves now to Israel and now to Judah, and tendencies to internal disintegration are illustrated by the dynastic changes in Israel and by the revolts and intrigues in both states. As the power of the surrounding empires revived, these entered again into Palestinian history. As regards Egypt, apart from a few references in biblical history (*e.g.*, to its interference in Philistia and friendliness to Solomon), the chief event was the invasion by Sheshonk (Shishak) *c.* 930 B.C.; but although it appears to be an isolated campaign, contact with Egypt never ceased. The next definite stage is the dynasty of the Israelite Omri (*q.v.*), to whom is ascribed the founding of the city of Samaria. The dynasty lasted nearly half a century, and is contemporary with the expansion of Phoenicia, and presumably therefore with some prominence of the south maritime coast. The royal houses of Phoenicia, Israel and Judah were united by intermarriage, and the last two by joint undertakings in trade and war.

Assyria and Armenia.—Meanwhile Assyria was gradually establishing itself westwards, and a powerful confederation of the heirs of the old Hittite kingdom, "kings of the land of Ḥatti" (the Assyrian term for the Hittites), was formed to oppose it. Southern Asia Minor, Phoenicia, Ammon, the Syrian Desert and Israel (under Omri's son "Ahab the Israelite") sent their troops to support Hamath and Damascus which, in spite of the repeated efforts of Shalmaneser III. (859–824), was evidently able to hold its own so long as the alliance endured. But the anti-Assyrian league was, as often in west Asia, a temporary one, and the inveterate rivalries of the small states are illustrated in a striking manner in the downfall of Omri's dynasty and the rise of that of Jehu (841); the bitter onslaughts of Damascus upon Israel, leading nearly to its annihilation; an unsuccessful attack upon the king of Hamath by Damascus, Cilicia and small states in north Syria; an Israelite expedition against Judah and Jerusalem (2 Kings xiv. 13 *seq.*); and finally the recovery and extension of Israelite power—perhaps to Damascus—under Jeroboam II. In such vicissitudes as these Palestinian history proceeds upon a much larger scale than the national biblical records relate and the external evidence is of the greatest importance for the light it throws upon the varying situations. The heirs of the old Hittite and Mitannian states stood behind the rivalries of Syrian and Palestinian kings. Assyria and Van or Urartu (Ararat, the later Armenia) were the great protagonists; and it is in the light of far-reaching moves and countermoves that one must interpret the isolated or incomplete narratives of Hebrew history. Adad-nirari III. (811–782) claims as tributary the land of the Hatti, Amor, Tyre, Sidon, "the land of Omri" (Israel), Edom and Philistia; but there followed a period of weakness for Assyria, when Urartu controlled the destinies of the petty states and Jeroboam restored the glories of Israel. But at his death Israel was rent by divided factions, whereas Judah (under Uzziah) had become a powerful kingdom, controlling both Philistia and the Edomite port of Elath on the gulf of 'Akaba. The dependence of Judah upon these districts was inevitable; the resources of Jerusalem obviously did not rely upon the small district of Judah alone. If Ammon also was tributary (2 Chron. xxvi. 8, xxvii.), political dealings with Israel and perhaps Damascus could probably be inferred. (*See* JEWS, § 9.)

Predominance of Assyria.—A new period begins with Tiglath-Pileser III. (745–727). Pro- and anti-Assyrian parties make themselves strongly felt, and when north Syria was taken in 738, Tyre, Sidon, Damascus (under Rezin), "Samaria" (under Menahem), and a queen of Aribi were among the tributaries. It is possible that Judah (under Uzziah and Jotham) had come to an understanding with Assyria; at all events Ahaz was at once encircled by fierce attacks, and was only saved by Tiglath-

Pileser's campaign against Philistia, north Israel and Damascus. With the siege and fall of Damascus (733–732) Assyria gained the north, and its supremacy was recognized by the tribes of the Syrian desert and Arabia (Aribi, Tema, Sheba). In 722 Samaria, though under an Assyrian vassal (Hoshea), joined with Philistia in revolt. In 720 it was allied with Gaza and Damascus; and the persistence of unrest is evident when Sargon in 715 found it necessary to transport into Samaria various peoples of the desert. Judah itself was next involved in an anti-Assyrian league (with Edom, Moab and Philistia), but apparently submitted in time. Nevertheless a decade later (700), after the change of dynasty in Assyria, it participated in a great but unsuccessful effort from Phoenicia to Philistia to shake off the yoke, and suffered disastrously (*see* HEZEKIAH). With the crushing blows upon Syria and Samaria the centre of interest moves southwards and the history is influenced by Assyria's rival Babylonia (under Marduk-baladan and his successors), by north Arabia and by Egypt. Henceforth the history of Samaria is ignored by the biblical writers; and of Judah, for nearly a century, few political events are recorded. Judah was under Assyrian supremacy, and, although it was involved with people of the Arabian desert in the revolt planned by Babylonia (against Assurbanipal), it appears to have been generally quiescent.

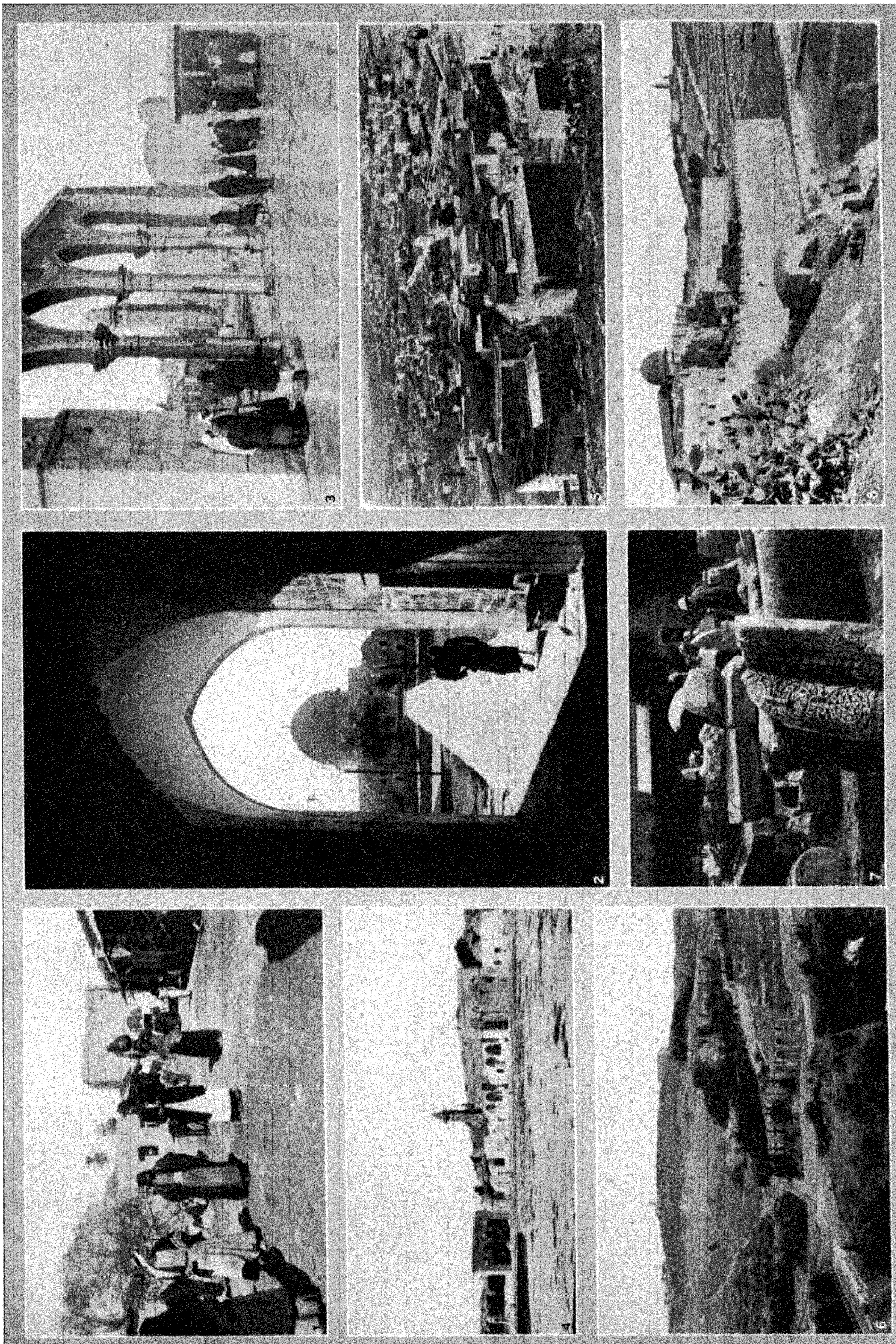
Egypt and Babylon.—At this stage disturbances, now by Aramaean tribes, now by Arabia, combine with the new rise of Egypt and the weakness of Assyria to mark a turning-point in the world's history. Psammetichus (Psamtek) I. (663–609) with his Greeks, Carians, Ionians and soldiers from Palestine and Syria, established once more an Egyptian Empire, and replaced the loose relations between Palestine and the small dynasts of the Delta by a settled policy. The effort was made to re-establish the ancient supremacy over Palestine and Syria. The precise meaning of these changes for Palestinian history and life can only incompletely be perceived, and even the significance of the great Scythian invasion and of the greater movements with which it was connected is uncertain (*see* SCYTHIA). A weak Assyria was falling before the Chaldaean Nabopolassar, the founder of the Neo-Babylonian empire. Nineveh fell in 612 and the government removed to Harran. Necho of Egypt marched into Asia to help Assyria—though not unready to take advantage of her troubles. Josiah of Judah, in turn, was perhaps not without hopes of utilizing the situation. He was overthrown at Megiddo, where about nine centuries previously the victory of Thutmosis III. had made Egypt supreme over Palestine and Syria. But Egypt was at once confronted by Nabopolassar who, as the heir of Assyria, claimed the Mediterranean coast-lands. The defeat of Necho by his son Nebuchadrezzar at Carchemish (605) is one of the world-famous battles.

Although Syria and Palestine now became Babylonian, the revival of Egypt aroused hopes in Judah of deliverance and led to revolts (under Jehoiachin and Zedekiah), in which Judah was apparently not alone. They culminated in the fall of this kingdom in 586. Henceforth the history of Palestine is disconnected and fragmentary, and the few known events of political importance are isolated and can be supplemented only by inferences from the movements of Egypt, Philistia or Phoenicia, or from the Old Testament. The Babylonian Nabonidus (553) found it necessary to quell the coastlands; and claims that all the kings from Gaza to the Euphrates assisted in his buildings. Chaldean policy generally appears to have been favourable towards faithful vassals. But a new age had now dawned in the east in the person of Cyrus the Great the leader of the Persians. After a series of successes he captured Babylonia (559), and forthwith claimed, in his famous inscription, the submission of Amor.

The Persian Empire.—The petty states of Palestine and Syria now became part of one of the largest empires of antiquity. The prophets who had marked in the past the advent of Assyrians and Chaldeans fixed their eyes upon the advance of Cyrus, confident that the fall of Babylon would bring the restoration of their fortunes. Cyrus was hailed as the divinely appointed saviour, the anointed one of Yahweh. The poetic imagery in which the prophets clothed the doom of Babylon, like the romantic account of Herodotus (i. 191), falls short of the simple contemporary account of Cyrus himself. He did not fulfil the detailed predictions; nevertheless, if Cyrus was not a worshipper of Yahweh (Isa. xli. 25), he was tolerant towards subject races and their religions, and the Jews received marked favour. Throughout the Persian age Palestine was naturally influenced by the course of events in Phoenicia and Egypt. Thus, when Cambyses, the son of Cyrus, made his great expedition against Egypt, with the fleets of Phoenicia and Cyprus, and with the camels of the Arabians, Palestine itself was doubtless involved. Also, the revolt which broke out in the Persian provinces at this juncture may have extended to Palestine; although the usurper Darius encountered his most serious opposition in the north and north-east of his empire. An outburst of Jewish religious feeling is dated in the second year of Darius (520), but whether Judah was making a bold bid for independence or had received special favour for abstaining from the above revolts, external evidence alone can decide. Towards the close of the reign of Darius there was a fresh revolt in Egypt; it was quelled by Xerxes (485–465), who did not imitate the tolerance of his predecessors.

Under Artaxerxes I. Longimanus (465–425) flourished the Jewish reformers Nehemiah and Ezra (*see* JEWS). Revolts occurred in Egypt, and for these and also for the rebellion of the Persian satrap Megabyxus, independent evidence for the position of Judah is needed, since a catastrophe apparently befell the unfortunate state before Nehemiah appears upon the scene. Little is known of the mild and indolent Artaxerxes II. Mnemon (404–359). With the growing weakness of the Persian empire Egypt reasserted its independence for a time. In the reign of Artaxerxes III. Ochus (359–338), Egypt, Phoenicia and Cyprus were in revolt; the rising was quelled without mercy, and the details of the vengeance are suggestive of the possible fate of Palestine itself. The Jewish historian Josephus (*Ant.* xi. 7) records the enslavement of the Jews, the pollution of the Temple by a certain Bagoses (*see* BAGOAS), and a seven years' punishment. Other late sources narrate the destruction of Jericho and a deportation of the Jews to Babylonia and to Hyrcania (on the Caspian Sea). The evidence for the catastrophes under Artaxerxes I. and III. (*see* ARTAXERXES), contained in biblical and in external tradition respectively, is of particular importance, since several biblical passages refer to disasters similar to those of 586 but presuppose different conditions and appear to be of later origin. The murder of Artaxerxes III. by Bagoses gave a set-back to the revival of the Persian Empire. Under Darius Codomannus (336–330) the advancing Greek power brought matters to a head, and at the battle of Issus in 333 Alexander settled its fate. The overthrow of Tyre and Gaza secured the possession of the coast and the Jewish state entered upon the Greek period. Very gradually the face of history had been undergoing a complete change. The old empires of the Near East had practically exhausted themselves. Egypt had resumed its earlier connections with the Levantine heirs of the old Aegean world. Once more the tide was to flow from the west to the east, and centuries were to pass before the oriental world reasserted itself in the rise of Christianity, the establishment of Rabbinical Judaism and the revival of oriental paganism.

Internal Changes.—In the age of the Assyrian supremacy Palestine entered upon a series of changes, lasting for about three centuries (from about 740), which were of the greatest significance for its internal development. The sweeping conquests of Assyria were "as critical for religious as for civil history" (Robertson Smith, *Rel. of the Semites*, p. 58). The brutal methods of warfare, the harsh treatment of vanquished districts or cities, and the redistribution of bodies of inhabitants, broke the old bonds uniting deities, people and land. The framework of society was shattered, communal life and religion were disorganized. As the flood poured over Syria and flowed south, Israel (Samaria) suffered grievously, and the gaps caused by war and deportation were filled up by the introduction of new settlers by Sargon, and by his successors in the 7th century. Unfortunately, there is very little evidence in the biblical history for the subsequent career of Samaria; but it is clear that the old Israel of the dynasties of



BY COURTESY OF (5, 8) CANADIAN PACIFIC STEAMSHIPS; PHOTOGRAPHS, (1, 2, 3, 4) ORIENT AND OCCIDENT. (6) ASSOCIATED SCREEN NEWS. (7) FREDERICK O. BEMM FROM ORIENT AND OCCIDENT

VIEWS IN PALESTINE

1. Street scene in the village of Jenin, Palestine
2. The Dome of the Rock seen through the doorway of the Mosque of Haram esh-Sherif, Jerusalem
3. Within the precincts of the Dome of the Rock at Jerusalem
4. Herod's Palace and the tower of Antonia, Jerusalem, c. A.D. 40
5. View of Nazareth
6. Mount of Olives outside of Jerusalem with the Garden of Gethsemane in the foreground
7. Ruins of a church at Capernaum on the Sea of Galilee, showing a richly ornamented lintel
8. On the east slope of Mount Zion looking towards the Mount of Olives; on the summit of the latter is a modern Russian church

PALESTINE

PHOTOGRAPHS, DONALD McLEISH

VIEWS IN JERUSALEM AND BETHLEHEM

1. Main façade of the church of the Holy Sepulchre, at Jerusalem, which was finished in its present form by the Crusaders in 1099. The church was first built by Constantine in 336 on the site believed by him to be that of the tomb of Christ
2. Water carriers of Jerusalem filling their goat skin bags at a well in the court of the Dome of Rock, built or adapted A.D. 691. This mosque is generally believed to occupy the site of Solomon's Temple
3. "The Garden Tomb," in the rocks outside Jerusalem, which in the opinion of General C. G. Gordon and others was the sepulchre in which Christ was buried. It is sometimes called "Gordon's Tomb of Christ"
4. Tomb of Absalom outside the city walls of Jerusalem. The monument dates from the Graeco-Roman period
5. Street scene in Bethlehem
6. The Pool of Siloam within the city walls of Jerusalem. Excavations here revealed a bath house of the period of Herod (40 B.C.–A.D. 4). The pool is 52 feet long and 19 feet wide

Omri and Jehu received crushing blows. The fact that among the new settlers were desert tribes, suggests the introduction, not merely of a simpler culture, but also of simpler groups of ideas. In the nature of the case, as time elapsed the new population must have taken root as securely as—one must conclude—the invading Israelites had done some centuries earlier. As a matter of fact the prophets Jeremiah and Ezekiel by no means regarded the population lying to the north of Judah as strangers; there is hope of a reunion of the rival districts, indeed a new Israel—in the larger sense—was growing up. The north was ready to share the Judaean distress at the fall of Jerusalem (Jer. xli. 5), and in later years offered to assist in rebuilding Yahweh's temple. In fact, since the Samaritans subsequently accepted the Pentateuch, and claimed to inherit the ancestral traditions of the Israelite tribes, it is instructive to observe how this people of singularly mixed origin so thoroughly assimilated itself to the land and at first was virtually a Jewish sect.

But Samaria was not the only land to suffer. Judah, towards the close of the 8th century, was obviously very closely bound up with Philistia, Edom and Egypt; and this and Hezekiah's dealings with the anti-Assyrian party at Ekron do not indicate any feeling of national exclusiveness, or abhorrence of the "uncircumcised Philistines." From the description of Sennacherib's invasion it is clear that social and economic conditions must have been seriously, perhaps radically disturbed, and the quiescence of Judah during the next few decades implies an internal weakness and a submission to Assyrian supremacy. During the 7th century new movements were coming from the Arabian desert; and tribes growing ever more restless made an invasion east of the Jordan through Edom, Moab and Ammon. Although they were repulsed, this awakening of a land which has so often fed Palestine and Syria, when viewed with the increasing weakness of Assyria, and subsequent vicissitudes in the history of the Edomites, Nabataeans and East Jordan tribes, forbids us to treat the invasion as an isolated raid. Later, the fall of the Judaean kingdom and the deportation of the leading classes brought a new social upheaval. The land was not denuded, and the fact that some scores of thousands of Jews remained in Judah through all the period of the exile (G. A. Smith, *Jerusalem*, ii. 269), even though they were "the poorest of the land," revolutionizes ordinary notions of this period (*see* JEWS, § 13).

In the latter part of the 6th century we find some restoration, some revival of the old monarchy in the person of Zerubbabel (520 B.C.). But not until the middle of the 5th century do the biblical records (book of Nehemiah) furnish a foundation for any reconstruction. Here Jerusalem is in sore distress and in urgent need of reorganization. Zerubbabel's age is of the past, and any attempt to revive political aspirations is considered detrimental to the interests of the surrounding peoples and of the Persian Empire. Scattered evidence suggests that Edomites had been responsible for a new catastrophe. Amid internal and external difficulties Nehemiah proceeds to repair religious and social abuses, and there is an important return of exiles from Babylonia. The ruling classes are related partly to the families of semi-Edomite origin from south Judah and partly to Samaria; but the kingship of old is replaced by a high-priest, and, under the influence of Babylonian Jews of the strictest principles, a breach was made between Judah and Samaria which was never healed. Biblical history itself recognizes in the times of Artaxerxes, Nehemiah and Ezra the commencement of a new era; and although much remains obscure we have in these centuries vicissitudes which separate the old Palestine of Egyptian, Hittite, Babylonian and Assyrian supremacy from the land which was about to enter the orbit of Greek and Roman civilization.

BIBLIOGRAPHY.—*Cambridge Ancient History*, vols. i.–iv., vi. (with bibliographies, esp. i. 635, iii. 734); *see* for the period before *c.* 1000 B.C., E. Meyer, *Geschichte des Altertums*, i. ii.; Bilabel and Grohmann, *Gesch. Vorderasiens in Ägypten* (Heidelberg, 1927–). *See* also HEBREW RELIGION, JEWS. (S. A. C.)

II. FROM ALEXANDER THE GREAT TO A.D. 70

Alexander the Great.—In the year 332 Alexander passed through Palestine to Egypt, capturing Tyre after a siege of seven months and Gaza after a siege of two. He left the Jews undisturbed in their customs and their religion. Some of them enlisted in the intelligence corps of his army (*Ant.* XI.8.5.) and Jews were among the first settlers in the new city he founded in Egypt under the name Alexandria. The high priest remained the head of the little Jewish state in Palestine and he was probably assisted by a council of elders. This *gerousia* is first mentioned as such by Josephus (*Ant.* XII.3.3.) in connection with Antiochus the Great (223–187 B.C.) but appears to go back at least as far as the Persian period (*cf.* II. Chron. xix.8, and *see* Schürer, *Geschichte* 4th ed., II.240).

Alexander died at the age of 32 on June 13, 323, and though the great empire of which he had dreamed fell to pieces at once after his death, his name remained a romantic and glorious memory throughout the nearer East.

Perhaps the most remarkable evidence of the estimation in which he was held by those who survived him is furnished by the splendid "Alexander" sarcophagus of pentelic marble now in the museum at Constantinople. This sarcophagus dates from *c.* 300 B.C., and was probably made by order of Abdalonimus, whom Alexander had appointed king of Sidon. It is one of the most beautiful examples of Greek sculpture which have come down to us, and its representations of Alexander's campaigning include the figures of the king and of his senior adviser, Parmenion.

The Ptolemies.—Palestine now fell to the portion of Ptolemy, the son of Lagus, one of the most astute of Alexander's generals and the first to settle himself in a dominion. He chose Egypt as being rich and comparatively remote, and there he ruled, first as governor in the name of Alexander's infant son, Alexander IV., and then (306 B.C.) as king. Six years before he actually took this title, he had, with the assistance of his friend, Seleucus, another of Alexander's generals, signally defeated the forces of yet another of these generals, Antigonus, at Gaza (312 B.C.) and had become master of Palestine. Seleucus himself, the same year, took Babylon and established the Seleucid dynasty in the north of the country, moving his capital after a victory over Antigonus at Ipsus (301 B.C.) to Antioch on the Orontes. In the meantime Ptolemy had subdued the cities of Coele-Syria (Diodorus XX. 113) and established the northern border of his kingdom on a line just north of Aradus and just south of Emesa. Seleucus felt himself entitled to this territory by the terms of his former agreement with his old friend, but he now found himself unable to establish his claim, and retired under protest. For practically a century Palestine remained subject to Egypt, the northern frontier receding considerably (to the south of Berytus and Damascus) about 250 B.C., and advancing again to the north of Aradus 25 years later (*see* U. Kahrstedt, *Syrische Territorien in hellenistischer Zeit*, map 1a).

The rule of the first Ptolemies was despotic but tolerant. They administered Egypt itself like a huge crown estate. Immense works of irrigation and land improvement were undertaken. Colonies of Greek settlers were planted in various places, although except Alexandria, founded by Alexander himself, and Naucratis and Ptolemais in the south, founded by Ptolemy I. (Soter), there were no large cities in the whole of Egypt which had Greek institutions and a predominantly Greek population. (*See* Rostovtzeff, *History of the Ancient World*, I. 367.) The Ptolemies themselves were men of culture, Greek culture. They took a personal interest in literature and science, founded a great library and academy (museum) and a zoological garden at Alexandria; and generally lived their own life apart. Thus they easily slipped into the traditional position of the rulers of Egypt as divine beings, and as such were accepted by the natives who did their work and paid their dues, and were not otherwise interfered with.

Similarly also, Palestine, the northern part of their dominion, the Ptolemies regarded simply as a valuable source of tribute for their treasury and timber (from the forests of Lebanon) for their shipbuilding, and as a useful buffer against their rivals, the Seleucids. The cities, especially those on the coast and on the east of the Jordan, had for some time been feeling the influence of Hellenic civilization. Not only were there new foundations like Pella and Dion in the Peraea (perhaps of the time of Alexander) and Ptolemy II.'s Philoteria on the sea of Galilee; but

older cities changed their names. Thus, probably during the reign of Ptolemy II., Akka became Ptolemais, and Amman, Philadelphia; and even where the old names were retained, as at Gaza and Ascalon, the process of Hellenization still went on.

Apparently the taxes were farmed out to the highest bidder, and it was possible for the adroit to make a fortune as a merchant-adventurer, or government agent, or both. The discovery of a large collection of papyri from Gerza (Philadelphia) in the Fayum, consisting of the records of Zeno, a Carian Greek in the employ of a high official under Ptolemy II., has recently made a considerable addition to our scanty knowledge of the general conditions of the period. An extensive and carefully regulated trade was being carried on with Egypt in Syrian cloth, for example, and especially in corn; but it is evident that the government regulations were frequently disregarded. It appears indeed as if Syrian oil and slaves, the very articles which were not allowed to be imported into Egypt, were the goods traders dealt in by preference. (Rostovtzeff, *A large Estate in Egypt in the Third century* B.C., p. 34.)

Zeno travelled a good deal in Palestine and particularly mentions a certain Tobias, the owner of a castle (*birta*) in Ammon, with whom he did business and who sent a present to Ptolemy (II.) of horses and dogs, and two white camels. Not improbably this is the building of which ruins still remain at "Arak el-Emir" where, in the entrance to some remarkable cave dwellings near by, the name Tobias may still be read clearly written in Hebrew. On the remains of the wall of this building traces of an animal frieze are to be seen which remind us of the remarkable paintings of animals round the walls of a tomb of this period, discovered about the beginning of this century, at Marissa in Judaea. It was made for a colony of settlers from Sidon (*see* Peters and Thiersch, *Painted Tombs in the Necropolis of Marissa,* 1905).

Of the family of this Tobias (very likely descended from *Tobiah the Ammonite,* Neh. iv. 3) Josephus has an entertaining story to tell (*Ant.* xii. 4). A certain Joseph, the son of Tobiah, managed to out-bid his rivals and to secure the post of chief collector of the taxes. He then showed his patriotism by exacting the whole amount due to the government from the non-Jews in the country, and allowing his own countrymen to escape scot-free. The details of the story need not be pressed, but it seems to be true that the burden of taxation was not felt very heavily and that the people as a whole were fairly content. "The inhabitants of Coele-Syria," says Polybius (V.86.9), "are somehow always more loyally disposed to this family (*i.e.,* the Ptolemies) than to any other."[1] It seems to be true also that the internal affairs of the Jews were largely in the hands of a few families of whom that of Tobias, already mentioned, and the rival family of Onias, which supplied the High Priests, were perhaps the chief.

The Seleucids.—Towards the end of the third century B.C., Antiochus (III.) the Great, who had succeeded to the Seleucid empire in 223 B.C., made a determined attempt to make himself master of Palestine. In 217 B.C. he sustained a severe check at the hands of Ptolemy (IV.) Philopator at Raphia, but Ptolemy IV. died in 205 B.C. and the son (Ptolemy V., Epiphanes) who succeeded him, was a child of five years of age. It may be that the contrast now presented between Alexandria and Antioch suggested the well-known words of Ecclesiastes x. 16, 17: "Woe to thee, O Land, when thy king is a child, and thy princes eat in the morning! Happy art thou, O Land, when thy king is the son of nobles, and thy princes eat in due season, for strength, and not for drunkenness." These words, at all events, would apply very well to the dissolute court in Egypt and the vigorous personality of Antiochus the Great; and some, undoubtedly, among the Jews, were glad when in 198 B.C. Antiochus defeated Scopas, Ptolemy's general, at Paneas and took possession of the country. The city of Gaza alone offered serious resistance, and stood a siege with a fidelity to the house of Ptolemy which provoked the admiration of Polybius (XVI.22); but at length it fell.

The Seleucids had always been much more missionary-hearted in their Hellenism than the Ptolemies. They founded large numbers of Greek cities and regarded themselves as ardent patrons and supporters of Greek city life. The immediate successors of Antiochus the Great found themselves crippled by the tremendous war-indemnity he had agreed to pay the Romans after his disastrous defeat at Magnesia (190 B.C.). The next king but one, Antiochus IV., Epiphanes (175–164 B.C.), seems to have cherished two great ambitions: one to conquer Egypt, and the other to weld together his dominion into a real cultural unity. When the Romans finally put an end to the first (Dan. xi. 30; Polybius xxix. 11) he threw himself all the more zealously into the second. His empire should have one religion, or at least it should unite in the worship of the deity manifest (Epiphanes is short for *Theos Epiphanes,* the god manifest) in himself; viz., Zeus. This was by no means a complete innovation. Antiochus II. (262–246 B.C.) had called himself *Theos.* But no king hitherto had taken the matter so seriously, and enforced a cult throughout his dominions.

Jewish Revolt.—Antiochus met with resistance nowhere but in Palestine. Here the process of Hellenization had been proceeding apace; but when an altar to Zeus was erected on the great altar in the Temple[1] and all observance of the law forbidden by the Seleucid authorities in a deliberate attempt to uproot the Jews' superstition (Tacitus) a great wave of resistance—resistance at first passive[2] and then active and intense—swept over the country. Judas, the third son of an aged priest named Mattathias, proved himself to be a very capable leader, and became known as Maccabaeus (probably *the Hammer*). He carried on a successful guerilla warfare by means of surprises, rapid marches, and night attacks; and at length managed to force his way to the Temple which he had cleansed and re-dedicated on 25 Chislev (December) 165 B.C., exactly three years (according to I. Maccabees) after the setting up of the "'abomination that maketh desolate" (Dan. xi. 31) and the first sacrifice to Zeus.

After a series of little engagements—the size of the forces involved is greatly exaggerated in both I. and II. Macc.—the Seleucid government, having its hands full nearer home, came to terms with the insurgents and granted them religious liberty (163 B.C.). Menelaus, the high priest, being now dead (II. Macc. xiii. 7), Alcimus of the true Aaronite stock, but an ardent Hellenizer, was set up in his place. The most pious section of Judas's followers accepted him at first, but were soon scandalized by his behaviour and with Judas again at their head offered him strenuous opposition. A considerable force under a general called Nicanor was sent to reinforce his dwindling supporters; but it was signally defeated by Judas, and Nicanor himself killed.

The Maccabaean Priest-Princes.—At length the Seleucid government took matters seriously in hand and Judas himself fell fighting against great odds at Elasa (161 B.C.). Again, however, domestic embarrassments at Antioch prevented the central authorities from making a final settlement of the country. This happened time after time during the rest of the century. A succession of rival claimants to the throne appeared, and by playing them off one against another, Judas's brothers and their successors gained various concessions and opportunities to proceed on razzias and small wars of conquest on their own account. Rome, meanwhile, whose influence and interest in the nearer East was steadily growing, connived, and even approved. (I. Macc. viii.). The gradual extension of Jewish territory is shown on the accompanying maps.

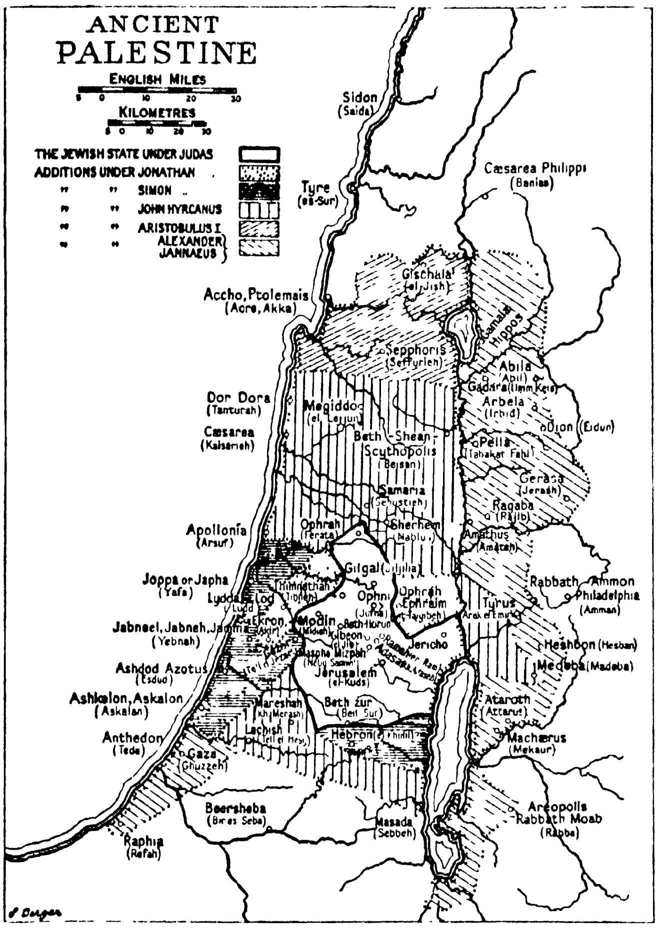
Jonathan (161–143 B.C.) put on the holy garments of the high priest in 153 B.C. (I. Macc. x. 21), and soon after the accession of his brother Simon (143–135 B.C.) the high-priesthood was

[1]On the relations between the Palestinian Jews and the Jews in Egypt (and particularly in Alexandria) see *Art.* JEWS.

[1]The sacrifice to Zeus was offered presumably by the Jewish high priest, Menelaus, who was not improbably a member of the Tobias family. Onias III. of the regular high-priestly family, a conscientious opponent of Hellenization, had been ousted from office and assassinated some time previously; and his son Onias IV., in despair, had fled to Egypt—very likely the family had all along been in league with Egypt—where he founded a new temple to Jehovah at Leontopolis (*c.* 150 B.C.).

[2]At first the pious (Hasidim) were simply butchered (I. Macc. i. 63) and rather than profane the Sabbath by striking a blow died without resistance, on one occasion "to the number of 1,000 souls" (I. Macc. ii. 38).

confirmed to him and his heirs for ever (141 B.C.) "until there should arise a faithful prophet" to determine otherwise (I. Macc. xiv. 41). Some time later (140 B.C.) Simon was granted the right of coining money (probably copper only[1]) and some specimens of "the year four" "of the redemption of Zion" (Nisan 143 being counted as the beginning of a new era Macc. xiii. 42)—still survive. His son, John Hyrcanus I. (135–104 B.C) on his coins,



MAP OF ANCIENT PALESTINE, SHOWING EXPANSION OF JEWISH TERRITORY UNDER THE MACCABEES

John the High Priest conquered and destroyed Samaria and forced the Idumeans to be circumcised He was the first of the Maccabaean princes to employ mercenaries John Hyrcanus made the mistake of quarrelling with the Pharisees and seeking the support of the Sadducees of whom we first hear as distinct parties in this reign (*Ant.* xiii. 10). His immediate successor, Aristobulus I (104–103 B.C) extended his conquests to Galilee and is said to have assumed the title of king (*Ant.* xiii 11) though it does not occur on his extant coins The long reign of his brother, Alexander Iannaeus (103–76 B.C) was full of conflict at home and abroad. He continued his father's policy of forcing outlying regions, including even the Greek cities, to accept either Judaism or annihilation His coins are the first to bear a Greek inscription (on the obverse; Hebrew still on the reverse), and he calls himself plainly King Alexander In 76 B.C. he was killed, fighting at Ragaba on the east of the Jordan His widow, Salome Alexandra, was the zealous patron of the Pharisees who (and especially a famous rabbi of the name of Simon ben Shetach) largely dictated her policy and looked back upon her reign as a foreshadowing of the golden age. At her death (67 B.C.) her two sons, Aristobulus and Hyrcanus fought one another for the succession. At first Hyrcanus, the elder and more indolent of the two, gave way to his younger and more vigorous brother; but he was persuaded by Antipater,

[1]The "thick shekels" of silver which have often been attributed to Simon, are now generally assigned to the revolt of A D. 66–70. *See* B.M. *Catalogue of the Greek Coins of Palestine,* pp. xc. ff., and P.E.F.Q.R. January 1927 pp. 47 ff.

a son of the governor of Idumea, to stir himself to obtain his birthright. At this juncture Pompey appeared on the scene. Both sides appealed to him and after some delay he decided in favour of Hyrcanus (II.), whom he set up, not as king, but as high priest of the Jews (63 B C.).

Pompey curtailed the Jewish dominions and freed a number of Greek cities, including those of the federation known as the Decapolis. During the disturbances which followed Pompey's death (48 B C.) Antipater and his family rose to greater and greater power. For some services he was able to render to Julius Caesar he was rewarded with the Roman citizenship, and the title of Procurator of Judaea[1] Some time before he died one of his sons, Phasael, had become governor of Jerusalem, and another, Herod, governor of Galilee The family of Aristobulus, however, had not given up their designs upon the throne, and in 40 B C his son Antigonus was set up as king at Jerusalem by the Parthians in a sudden invasion. In this invasion Phasael poisoned himself, but Herod escaped.

The Herods and the Procurators.—Herod escaped to Rome and got himself recognized by the senate as king of the Jews. He came back to win his kingdom In the year 37 B C., he laid siege to Jerusalem and married Mariamne, the beautiful heiress of the Maccabaean house An account of his long, and in many respects prosperous, reign (37–4 B.C) is given elsewhere.

When Herod the Great died, the country fell into a turmoil while three of his sons went to Rome to lay their several claims before Augustus. According to the emperor's decision Judaea, Samaria and Idumaea were allotted to Herod Archelaus, Galilee and Peraea to Herod Antipas; Trachonitis, Batanea and Auranitis (districts in the north) to Herod Philip. All the Herods had a strong family likeness. They were all great builders They were all of set policy, double-faced: Jews at home and Hellenists abroad Above all they were determined, at all costs, to be and remain *philoromaioi,* friends of the Romans.

Philip retained his kingdom till his death in A D. 34. Antipas, under the influence of his wife Herodias, grew too ambitious and was banished in A D. 39, but Archelaus ruled so badly that an appeal was made to the emperor against him and he was removed in less than ten years (A D 6). His place was filled by a succession of procurators a poor set of men, of low rank, puffed up with their own importance. They made Caesarea on the sea-coast their headquarters and, with the aid of a few auxiliary troops, kept such order as they could. Pontius Pilate (A D 26–36) was the fifth of them.

For a short time the whole of Palestine was reunited under King Herod Agrippa I (A D 37–44) grandson of Herod the Great, boon companion of Caligula and friend of Claudius; and, except that he was unusually good-natured, a typical Herod. When he died his kingdom was not given to his son, but it was placed under a new succession of procurators who were made responsible to the governor of Syria.

But the country was now getting out of hand, and the Roman authorities were as ill at ease as the British were in Ireland in the first quarter of the present century In fact the two situations are closely parallel the differences in temperament and religion, the assassins (*sicarii*), the stern reprisals

Rebellion.—At length under Gessius Florus rebellion broke out openly (A.D 66). An initial success against Cestius Gallus, the governor of Syria, who had tried to intervene with forces too weak to cope with the overwhelming (though ill-armed and undisciplined) numbers of the rebels, gave them undue and misleading encouragement. But when the Romans took the matter seriously and sent Vespasian and Titus with three legions and auxiliary troops numbering altogether some 60,000[2] men, the result was a foregone conclusion.

Indeed, the Jews themselves for the most part recognized it as such, and the only determined resistance the Romans met with occurred at a few strongholds like Iotapata in Galilee and above all at the capital itself. Jerusalem was captured in Sept A.D 70. In spite of Titus's express orders to the contrary, the Temple was

[1]Hyrcanus, at the same time (47 B.C.) received the title of Ethnarch
[2]Schürer [4] I. p. 611.

destroyed; and, finally, only a portion of the city wall was left standing. Its ruins became the headquarters of the Tenth Legion which for some years was kept in Palestine on garrison duty.

BIBLIOGRAPHY.—The best introduction to this period of Palestinian history for the general reader is E. R. Bevan, *Jerusalem under the High Priests* (2nd Impression, 1912); E. Meyer, *Ursprung und Anfänge des Christentums* (1921) contains a valuable survey of the period in vol. ii. with many references to recent literature. E. Schürer, *Geschichte des jüdischen Volkes im Zeitalter Jesu Christi* (4th ed. 1901–09) begins with the Maccabaean revolt, and is indispensable (with useful bibliographies). Among recent monographs of a more specialized character may be mentioned: U. Kahrstedt, *Syrische Territorien in hellenistischen Zeit* (1926) already referred to, and W. Kolbe, *Beiträge zur syrischen und jüdischen Geschichte* (1926). For the general conditions of the period *see* W. W. Tarn, *Hellenistic Civilization* (1927; with a valuable bibliography). (J. W. Hu.)

III. FROM A.D. 70 TO THE TURKISH CONQUEST

Political History from A.D. 70.—The destruction of Jerusalem was followed by the dispersal of the Jews, for whom till then it had been the religious and political centre. The first seat of the sanhedrin was at Jamnia (Yebna), where the Rabbinic system began to be formulated. The rigid code of dogmas and observances elaborated by the rabbis exercised a singularly uniting power over the scattered nation and prevented such an absorption of the Jewish people into the Roman empire as had caused the disappearance of the ten tribes of Israel in Assyria.

It would appear that at first, after the destruction of Jerusalem, no specially repressive measures were contemplated by the conquering Romans, who rather attempted to reconcile the Jews to their subject state by a leniency which had proved successful in the case of other peoples brought by conquest within the empire. But they had reckoned without the isolating influence of Rabbinism. Here and there small insurrections took place, in themselves easily suppressed, but showing the Romans that they had a turbulent and troublesome people to deal with. At last Hadrian determined to stamp out this stubborn Jewish nationalism. He issued an edict forbidding the reading of the law, the observance of the Sabbath, and the rite of circumcision; and determined to convert the still half-ruined Jerusalem into a Roman colony.

The consequence of this edict was the meteor-like outbreak of Bar-Cochba (*q.v.*) A.D. 132–135. The origin of this person and the history of his rise to power are unknown. It was his recognition as the Messiah by the celebrated Rabbi Akiba, then the most influential Jew alive, which placed him in the command of the insurrection, with 200,000 men at his command. Jerusalem was captured, as well as a large number of strongholds and villages throughout the country. Iulius Severus, sent with an immense army by Hadrian, came to quell the insurrection and recaptured Jerusalem. The rebels fled to Bethar—the modern Bittir, near Jerusalem, where the fortress garrisoned by them still remains, under the name Khurbet el-Yahud, or "Ruin of the Jews"—and were there defeated and slaughtered in a sanguinary encounter. Hadrian then turned Jerusalem into a Roman colony, changed its name to Aelia Capitolina, built a temple of Jupiter on the site of the Jewish temple and (it is alleged) a temple of Venus on Mt. Golgotha and forbade any Jew, on pain of death, to appear within sight of the city.

This disaster was the death-blow to hopes of a Jewish national independence, and the leaders of the people devoted themselves thenceforth to legal and religious study in the Rabbinical schools, which from A.D. 135 (the year of the suppression of the revolt) onwards developed in various towns in the hitherto despised province of Galilee. Seffurieh (Sepphoris) and especially Tubariya (Tiberias) became centres of this learning and the remains of synagogues of the 2nd or 3rd century which still exist in Galilee attest the strength of Judaism in that district during the years following the abortive attempt of Bar-Cochba.

Palestine continued directly under Roman rule. East of the Jordan, Cornelius Palma added Gilead and Moab to the empire under Trajan in A.D. 105. In 295 Auranitis, Batanea and Trachonitis were brought within the provincial system.

The conversion of Constantine to Christianity—or rather the profession of Christianity by Constantine—seemed likely to result in another Jewish persecution, foreshadowed by severe repressive edicts. This, however, was averted by the emperor's death.

The progress of the corrupt Christianity of the empire of Byzantium was checked for a while under Julian the Apostate, who, among other indications of his opposition to Christianity, rescinded the edicts against the Jews on his coming to the throne in 361, and gave orders for the restoration of the Jewish temple. The latter work was interrupted almost as soon as begun by an extraordinary phenomenon—the outburst of flames and loud detonations, easily explained at the time as a divine judgment on this direct attempt to falsify the prophecy of Christ.

On the partition of the empire, in A.D. 395, Palestine naturally fell to the share of the emperor of the East. From this onwards for more than 200 years there is a period of comparative quiet in Palestine; the only history it displays being that of the development of pilgrimage and of the cult of holy places and of relics, varied by occasional persecutions of the Jews. The elaborate building operations of Justinian (527–565) must not be forgotten. The "Golden Gate" of the Temple area and part of the church which is now the El-Aksa Mosque at Jerusalem, are due to him.

This interval of tranquillity came abruptly to an end in 611, when Chosroes II. (*q.v.*), king of Persia, made an inroad into Syria; joined by the Jews, anxious to revenge their misfortunes, he swept over the country, carrying plunder and destruction wherever he went. Jerusalem was taken; the Holy Sepulchre church was destroyed and its treasures carried off; the other churches were likewise razed to the ground; the patriarch was taken prisoner. Thus for a time the province of Syria with Palestine was lost to the empire of Byzantium.

The Emperor Heraclius reconquered the lost territory in 628. But his triumph was short-lived. A more formidable enemy was already on the way, and the final wresting of Syria from the feeble relics of the Roman empire was imminent. (L. St.; F. M. S.)

Rise of Islam.—The separate tribal units of Arabia, more or less impotent when divided and at war with one another, received for the first time an indissoluble bond of union from the prophet Mohammed, whose perfect knowledge of human nature (at least of Arab human nature) enabled him to formulate a religious system that was calculated to command an enthusiastic acceptance by the tribes to which it was primarily addressed. His successor, Abu Bekr, called on the tribes of Arabia to unite and to capture the fertile province of Syria from the Christians. Heraclius had not sufficient time to prepare to meet this new foe, and was defeated in his first engagement with Abu Bekr. (For the general history of this period *see* CALIPHATE.) The latter seized Bostra and proceeded to march to Damascus. He died, however, before carrying out his design (A.D. 634), and was succeeded by Omar, who, after a siege of 70 days entered the city. Other towns fell in turn, such as Caesarea, Sebusteh (Samaria), Nablus (Shechem), Lydd, Jaffa.

Meanwhile Heraclius was not idle. He collected a huge army and in 636 marched against the Arabs. The latter retreated to the Yarmuk River, where the Byzantines met them. Betrayed, it is said, by a Christian who had suffered personal wrongs at the hands of certain of the Byzantine generals, the army of Heraclius was utterly defeated, and with it fell the Byzantine empire in Syria and Palestine.

After this victory Omar's army marched against Jerusalem, which after a feeble resistance capitulated. The terms of peace, though on the whole moderate, were of a galling and humiliating nature, being ingeniously contrived to make the Christians ever conscious of their own inferiority. Restrictions in church-building, in dress, in the use of beasts of burden, in social intercourse with Muslims and in the use of bells and of the sign of the cross were enforced. When these terms were agreed upon and signed Omar, under the leadership of the Christian patriarch Sophronius, visited the Holy Rock (the prayer-place of David and the site of the Jewish temple). This he found to be defiled with filth, spread upon it by the Christians in despite of the Jews. Omar and his followers in person cleaned it, and established the place of prayer which, though later rebuilt, has borne his name ever since.

Dissensions and rivalries soon broke out among the Muslim

leaders, and in 661 Moawiya, the first caliph of the Omayyad dynasty, transferred the seat of the caliphate from Mecca to Damascus, where it remained till the Abbasids seized the sovereignty and transferred it to Baghdad (750). Rivals sprang up from time to time. In 684 Caliph Abdalmalik ('Abd el-Melek), in order to weaken the prestige of Mecca, set himself to beautify the holy shrine of Jerusalem, and built the *Kubbet es-Sakhrah*, or Dome of the Rock, which still remains one of the most beautiful buildings in the world. In 831 the Church of the Holy Sepulchre was restored; but about 100 years later it was again destroyed as a result of the revolt of the Carmathians (*q.v.*), who in 929 pillaged Mecca. This produced a Muslim exodus to Jerusalem, with the consequence mentioned. The Carmathian revolt, one of the first of the great splits in the Muslim world, was followed by others: in 936 Egypt declared its independence, under a line of caliphs which claimed descent from Fatima, daughter of the prophet (*see* FATIMITES); and in 996 Hakim Bi-amrillah mounted the Egyptian throne. This madman caused the church of the Holy Sepulchre to be entirely destroyed: and giving himself out to be the incarnation of Deity, his cult was founded by two Persians, Darazi and Hamza ibn Ali, in the Lebanon; where among the Druses it still persists (*see* DRUSES).

The contentions between the Abbasid and Fatimite caliphs continued till 1072, when Palestine suffered its next invasion. This was that of the Seljuk Turkomans from Khorasan. On behalf of their king, the Khwarizmian general Atsiz invaded Palestine and captured Jerusalem and Damascus, and then marched on Egypt to carry out his original purpose of destroying the Fatimites. The Egyptians, however, repulsed the invaders and drove them back, retaking the captured Syrian cities.

The Crusades.—The sufferings of the Christians and the desecrations of their sacred buildings during these troubled times created widespread indignation through the West. The Church responded, and a motley crowd, principally of French origin, set out in 1096 for the Holy Land. Others, under better generalship, followed; but of the 600,000 that started from their homes only about 40,000 succeeded in reaching Jerusalem, ill-discipline, famine and battles by the way having reduced their ranks. They captured Jerusalem, however, in July 1099, and the leader of the assault, Godfrey of Boulogne, was made king of Jerusalem.

So was founded the Latin kingdom of Jerusalem, whose history is one of the most painful ever penned (*see* CRUSADES). It is a record of almost unredeemed "envy, hatred and malice," and of vice with its consequent diseases, all rendered the more repulsive in that its transactions were carried on in the name of religion. For 88 turbulent years this feudal kingdom was imposed on the country, and then it disappeared as suddenly as it came, leaving no trace but ruins, a few place-names, and an undying hereditary hatred of Christianity among the native population.

The abortive second crusade (1147), led by the kings of France and Germany, came to aid the rapidly weakening Latin kingdom after their failure to hold Edessa against Nureddin, the ruler of northern Syria.

In 1173 Nureddin died, and his kingdom was seized by Saladin (Salah ed-Din), a man of Kurdish origin, who had previously distinguished himself by capturing Egypt in company with Shirkuh, the general of Nureddin. Saladin almost immediately set himself to drive the Franks from the country. The Frankish king was the boy Baldwin IV., who had paid for the errors of his fathers by being afflicted with leprosy. After being defeated by Saladin at Banias, the Franks were compelled to make a treaty with the Muslim leader. The treaty was broken, and Saladin proceeded to take action. The wretched leper king meanwhile died, his successor, Baldwin V., also a young boy, was poisoned and the kingdom passed to the worthless Guy de Lusignan, who in the following year (1187) was crushed by Saladin at the battle of Hattin, which restored Palestine to the Muslims.

The third crusade (1189) to recover Jerusalem was led by Frederick I. of Germany. Acre was captured, but quarrels among the chiefs of the expedition made the enterprise ineffective. It was in this crusade that Richard Coeur-de-lion was especially distinguished among the Frankish warriors.

Saladin died in 1193. In 1198 and 1204 took place the fourth and fifth crusades—mere expeditions, as abortive as the third. And as though it were foreordained that no element of horror should be wanting from the history of the crusades, in 1212 there took place one of the most ghastly tragedies that has ever happened in the world—the crusade of the children. Fifty thousand boys and girls were persuaded by some pestilent dreamers that their childish innocence would effect what their immoral fathers had failed to accomplish, and so left their homes on an expedition to capture the Holy Land. The vast majority never returned; the happiest of them were drowned in the Mediterranean.

The other four crusades which took place from time to time down to 1272 are of no special importance, though there is a certain amount of interest in the fact that after the sixth crusade, in 1229, Emperor Frederick II. was permitted to occupy Jerusalem for ten years. But a new element, the Mongolians of Central Asia, now bursts in on the scene. The tribes from east of the Caspian had conquered Persia in 1218. They were driven westward by pressure of the Tatars, and in 1228 had been called by the ruler of Damascus to his aid. In 1240, however, they transferred their alliance to the sultan of Egypt, and pillaged northern Syria. Driven downward through Galilee they seized Jerusalem, massacred its inhabitants and plundered its churches. They then marched on to Gaza, where the Egyptians joined them, and together inflicted a crushing defeat on the Christians and Muslims of Syria, for once compelled to unite by the common danger. The Khwarizmians and Egyptians afterwards quarrelled, and the former were compelled to retire, leaving Palestine under the rule of the Mameluke sultans of Egypt. Shortly afterwards however, another Central Asiatic invasion—that of the Tatar tribes, took place. Under their leader Hūlagū these tribes came by way of Baghdad, which they captured in 1258, and in 1260 they attacked and captured Damascus and ravaged Syria. Bibars (Beibars, Baibars), general of the Egyptian sultan Kotuz, met and drove them back; and having murdered his master, became sultan in his stead. He then proceeded to attack and destroy the relics of Christian possession in Palestine. One after another—Caesarea, Safed, Jaffa, Antioch—they fell, leaving at last Acre (Akka) only. Bibars died in 1277, and in 1291 Acre itself was captured by Khatēl, son of Kala'ūn, who put an end to Frankish rule.

During the 14th century there is little of interest in the history of Palestine. The Christians made efforts to creep back to their former possessions and churches were rebuilt in Jerusalem, Bethlehem and Nazareth; but another devastation was the result of the ferocious inroads of the Mongolian Timur (Tamerlane) in 1400. (F. M. S.)

IV. FROM THE TURKISH CONQUEST TO 1929

The penultimate stage of the history of Palestine was reached in 1516 when the war between Sultan Selim the Grim and the Mameluke rulers of Egypt resulted in the transference of the country to the victorious Turks. This change of rulers produced little change in the administration or condition of the country. Local governors were appointed from Constantinople where revenues were annually sent; various public works were undertaken such as the rebuilding of the walls of Jerusalem by Suleiman the Magnificent in 1537; but on the whole Palestine ceases from this point to have a history till the coming of the 19th century. Its annals record little save the sanguinary quarrels of local sheikhs and the oppression of the peasants by them or by the officials. The most interesting personality in a dreary period is that of the Druse prince Fakhr-ed-din (1595–1634) whose establishment of a Lebanese kingdom which included northern Palestine as far as Acre in defiance of the Turkish sultan, and his dilettante cultivation of art, a consequence of temporary exile in Italy, deserve passing notice. The order imposed by the Turks on a turbulent country did not endure. The German botanist Leonhard Rauwolf, who visited Palestine in 1575 has left a vivid description of the difficulties that beset even so simple a journey as that from Jaffa to Jerusalem. He found Jaffa in ruins. A safe-conduct had to be obtained from the governor of Ramleh before the party could proceed. At Yazur they were stopped by an

official who extorted heavy blackmail on the ground that the sultan had given him charge of the "holy places" and had forbidden him to admit anyone to them without payment Further on they had a scuffle with certain "Arabians" and at last, after accomplishing the passage of the "rough and stony" road that led to Jerusalem they were obliged to dismount before the city-gate till they should receive licence from the governor to enter.

Towards the close of the 18th century a chief named Dhahir el-Amir rose to power in Acre To him fled from Egypt an Albanian slave named Ahmad, who bore the surname of "el-Jazzar" (the butcher) on account of the obedient skill with which he had rid his Mameluke master of numerous rivals He had, however, incurred punishment for indiscipline and so took refuge with the Palestinian chief After five years his former master died and el-Jazzar returned to Egypt Soon Dhahir el-Amir revolted against the Turkish Government and el-Jazzar on account of his long residence with and full knowledge of his protector was commissioned to quell the rebellion. He succeeded and was installed as governor of Acre in Dhahir's place. He had crude aesthetic tastes and Acre owes some public buildings to him, but he was also capricious and tyrannical and lived up to his surname. Till 1791 there was a colony of French merchants with factories and offices at Acre; el-Jazzar that year summarily ordered them to quit the town. In 1798 Napoleon Bonaparte after conquering Egypt invaded Palestine in pursuit of his scheme of stirring up revolt against the Turk in Syria and conquering the Near and Middle East at the head of an adventurer army with a French core. He defeated el-Jazzar and besieged him in Acre, while a relieving column of Turks and local Arab irregulars was completely defeated by his lieutenant, General J B Kléber near Mount Tabor. But the timely arrival of British warships commanded by Admiral Sir Sidney Smith saved Acre A final attempt to storm the town was repulsed and Napoleon withdrew to Egypt

El-Jazzar died in 1806, his successor Suleiman ruled mildly but in 1814 he died and Acre became the prey of the fanatic Abdallah Pasha He caused his Jewish secretary to be murdered, but the Jew, anticipating his doom and determined that his employer should pay dearly for his crime, had secretly arranged that after his own death an inventory of Abdallah's property should fall into the hands of the Government, which had claims on the estates of el-Jazzar and of Suleiman The Government pressed its claims. Abdallah refused to pay and was besieged in Acre. He called upon Mohammed Ali Pasha the powerful governor-general of Egypt to mediate. Mohammed Ali settled the dispute but Abdallah refused to discharge his claims for the arbitration and to hand over political refugees from Egypt The Egyptian had long feared the sultan's jealousy and Abdallah's conduct gave him an excuse for taking the offensive In Nov 1831 he attacked Abdallah by land and sea. Acre was stormed next May and by the end of July all Syria was lost to the sultan The campaigns waged by the Albanian satrap of Egypt against his master and their international consequences are described elsewhere (*see* TURKEY, EGYPT, MOHAMMED ALI). Palestine, which had welcomed the new ruler, soon found it had exchanged King Log for King Stork. A rising in 1834 was ruthlessly suppressed Finally in 1840 the appearance of the British, Austrian and Russian fleets off Beirut and the advance of a Turkish army from the north led to a general revolt in which Palestine joined. Acre surrendered and the Egyptians hastily evacuated the whole country

From 1840 onwards the Turkish Government gradually strengthened its hold on Palestine. The political power of the local sheikhs was greatly reduced, to the unmixed advantage of the whole country; and the increase of European interests led to the establishment of consulates and vice-consulates of the greater powers in Jerusalem and in the ports. The rivalry of religions continued. In 1847 the dispute between Greek Orthodox and Latin ecclesiastics in the Church of the Nativity at Bethlehem, about the right to mark with a star the birthplace of Christ, became one of the prime causes of the Crimean War. On June 30, 1855, on the occasion of the visit of a European prince, the cross was for the first time since the crusades borne aloft through the streets of Jerusalem. Three years later the sacred area of the Haram esh-Sherif—the mosque on the site of the temple of Jerusalem—was for the first time thrown open to Christian visitors The last 40 years of the century were marked by a remarkable process of colonization and settlement—French and Russian monastic and other establishments, some semi-religious and semi-political; German colonies, followed after the imperial visit by more imposing official foundations; fanatical or freakish American communities; Jewish agricultural settlements—all, so to speak, nibbling at the country and each so intent upon gaining a step on its rivals as to be forgetful of the gathering storm In 1896 Dr Theodor Herzl (*q.v.*) issued his proposal for the establishment of a Jewish state in Palestine and in 1898 came to the country to investigate its possibilities (*see* ZIONISM). The same year was marked by the picturesque visit of the German emperor, William II. (R. A S M.)

1900–1918.—The first signs of danger from European rivalries and Turkish Panislamic ambitions became visible early in the 20th century, when schemes for the extension of the Turkish pilgrim railway to the Egyptian border were discussed and surveys undertaken In 1906 came the significant dispute between Great Britain and Turkey concerning the frontier of the Sinai district of Egypt After crossing the border at Rafa south of Gaza and at Akaba, the Turks recoiled before an ultimatum and the frontier was delimited In the same year the opening of a narrow-gauge railway from Deraa on the Damascus line to Haifa increased the trade and prosperity of that port. The Young Turk revolution of 1908 passed off quietly in Palestine where the officials and small garrisons declared for the new regime, and the population acclaimed it with less fervour.

Immediately before the outbreak of the World War Palestine was passably prosperous Jewish colonization, foreign philanthropy, an increasing tourist and pilgrim traffic greatly mitigated the natural poverty of the country The presence of relatively large numbers of foreigners—a few consuls, traders and professional men, many missionaries and teachers and the Jewish and German colonists—improved the amenities of the larger towns and exercised a restraining effect on Turkish officialdom In spite of the rivalry of foreign interests and the mixture of creeds and races the country was spared the crude scandals of Macedonia and Kurdistan. Education—of a sort—was fairly diffused among the townsfolk, more especially among the Jews and Christians, though the missionary schools too often made the Arab into a poor imitation of a European or American rather than into a good citizen of the Ottoman empire Below the peaceful surface there were stirrings, the example of Egyptian progress under British control helped to promote a weak but perceptible Arab nationalism only aiming in Palestine at some form of local autonomy. The Panislamic movement, supported by the Turkish authorities, was a little stronger. Arab Nationalists and Panislamists alike watched Zionist activities with increasing suspicion.

The outbreak of war between the Entente and Turkey brought this quiet period to an end For over two years Palestine was the base of large Turkish forces which occupied Sinai and made two major attacks on the Suez canal. There were allied naval demonstrations on the Palestinian coast. Ahmed Jemal Pasha, governor-general of Syria and commander of the Turkish forces, ruled the country with a rod of iron. The cessation of remittances proved fatal to large numbers of the Jews of the "Haluka" who died of sheer want. The Zionists after enjoying Jemal's favour, incurred his suspicion and suffered much minor persecution; his hand was heavy on all Arabs suspected of Nationalism; locust plagues, conscription and the extreme corruption of the Turkish officers and officials bled the peasantry white. The British counter-offensive which began in the winter of 1916 and the conquest of Palestine are described elsewhere (*see* WORLD WAR; PALESTINE, OPERATIONS IN). The fall of Jerusalem marked its first stage. The Turks and a German contingent retained most of Samaria and all Galilee until their final and complete overthrow in Sept. 1918. The victors, whose behaviour was generally admirable, were well received by the inhabitants of the country. It had suffered much in the past four years but cruelly as the war had thinned the population and wasted the resources

of Palestine, it had had one good result—the linking up of the Haifa and Jerusalem railways with the Egyptian system and the construction by both combatants of a number of wells and bridges and a network of metalled roads. (P. Gr.)

POST-WAR DEVELOPMENTS

Palestine under the Ottoman Government was an integral portion of Syria, although the Sanjaq of Jerusalem, owing to its peculiar problems and importance, was governed by a Mutasarref referring directly to Constantinople. Owing to the economic stagnation and financial strain which affected the whole Ottoman empire in consequence of the Italian (1911–12) and Balkan (1912–13) wars, Palestine was unable to develop herself in any way before the outbreak of the World War. Before 1913 autonomy in the imperial provinces extended in practice only to the right of making recommendations. The Ottoman constitution of 1908 had awakened new hopes, and in Syria and Palestine particularly so widespread a movement began in favour of decentralization that the Turkish Government thought it wise to pass the provisional vilayet laws of 1913 and 1914, granting real local government powers. It is difficult to conjecture now to what extent a naturally intelligent people, discouraged and enfeebled by four centuries of gross misgovernment, might have been helped by plans which were in fact cut short by the war and replaced by the tyranny of Jemal Pasha.

British Military Occupation.—The British occupation, established after the conquest of the country by the British forces under General Allenby in 1917, found a depleted population, the townspeople distressed, much cultivated land untilled, stocks of cattle and horses almost non-existent, orange groves ruined by lack of irrigation and commerce at a standstill. Immediately on the occupation of Jerusalem (Dec. 11, 1917), a military administration was set up, with military governors at Jerusalem and elsewhere; food was hurried up by military transport for the populace, and merchants were permitted to import goods from Egypt by the military railway. In accordance with General Allenby's proclamation, all existing rights in holy places were respected and maintained; further, the income of the Muslim Wakfs (pious foundations) was used exclusively for the Muslim beneficiaries in Palestine instead of being drained away to Constantinople. The administration was, from the outset, financially self-supporting. A local police force was built up, schools and law courts were re-opened, and, in April 1918, a water supply for Jerusalem, utilizing springs employed for the same purpose in the days of Herod and Pontius Pilate, was installed.

Zionism.—On Nov. 2, 1917, some five weeks before Lord Allenby's entry into Jerusalem, Lord (then Mr. Arthur) Balfour, at that time foreign secretary, had made on behalf of the British Government the following historic declaration:—

> His Majesty's Government view with favour the establishment in Palestine of a national home for the Jewish people, and will use their best endeavours to facilitate the achievement of that object, it being understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine, or the rights and political status enjoyed by the Jews in any other country.

The declaration was endorsed by the principal Allied Powers and embodied in the Treaty of Sèvres, where it was provided that the country should be entrusted to a mandatory Power with a mandate to be approved by the League of Nations. After the Balfour declaration the Zionist organization sent a commission, subsequently constituted as a part of the Zionist executive, to Palestine to act as a link between the British authorities and the Jewish population. This was developed so as to take charge of the larger Jewish interests, colonization, immigration, and education in Palestine. The military administration was, from its inception, assailed with demands on the one hand for an immediate and practical interpretation of the Balfour declaration, and on the other for a policy of entire negation until such time as that instrument should have been incorporated into some sort of mandate formally adopted by the Powers.

The British Government not being in a position to issue even general instructions, the administration, left in a situation without precedent more or less to its own resources, was limited by the legal necessity of governing the country under Ottoman codes amplified by enactments under military law, according to the "laws and usages of war." Even so, however, two notable and, in the circumstances, exceptional steps were taken. Hebrew was recognized with English and Arabic as the third official language, as, with Latin and Greek, it had been in the time of Christ, and considerable agricultural loans were advanced to land-owners. At the same time various oppressive small taxes were abolished. The Jerusalem chamber of commerce was established and followed by others elsewhere. The unsightly wall which had been built across Constantine's Basilica of the Nativity in Bethlehem was removed. Early in 1920 the Muslim Nebi Musa celebrations were exploited as a manifestation of Arab national sentiment against the Zionist Jews, many of whose recent immigrants had excited animosity by unwise and tactless propaganda. Riots took place on April 4 and 5 in Jerusalem and raids were made upon Beisan and the British garrison at Semakh.

On July 1, 1920, a civil Government was established with Sir Herbert Samuel as the first high commissioner of Palestine. But mutual suspicion continued, and with it further incidents; the Jerusalem riots of 1920 were succeeded next year by a serious outbreak in Jaffa and neighbourhood, and again by disturbances in the capital on the fourth anniversary of the declaration[1].

A statement, issued as a White Paper by Winston Churchill, the colonial secretary, whose policy was formally and publicly accepted by the Zionist organization, explicitly disclaimed the intention either of creating a wholly Jewish Palestine or of contemplating the disappearance or the subordination of the Arab population, language or culture.

> The nationality to be acquired by all citizens of Palestine, whether Jews or non-Jews, whether for purposes of internal law or international status would be Palestinian and nothing else. . . . But in order that the Jewish community (in Palestine) should have the best prospect of free development it is essential that it should know that it is in Palestine as of right and not on sufferance. That is the reason why it is necessary that the existence of a Jewish national home in Palestine should be internationally guaranteed. . . .

The statement was rejected by the Palestine Arab delegation, then representing the Arab cause in London, partly because they were at the time committed to demands involving almost a retractation of the mandate and partly from an instinctive reasoning that the policy even so enunciated might ultimately render Palestine Arabs of secondary interest and importance in their own country. This new definition has nevertheless considerably affected Arab opinion, and, as it has been integrally maintained by successive Labour and Conservative cabinets, in each of whom respectively high hopes had been placed by Zionist and Arab "revisionists," it has gone far to convince both of the futility of further agitation. In 1925, on the expiry of Sir Herbert Samuel's term of office, Lord Plumer was appointed high commissioner.

Constitution.—Three months after the beginning of the civil Government the high commissioner established a nominated advisory council, consisting of ten British officials and ten Palestinians—seven Arabs (four Muslim and three Christian) and three Jews. Later, on the promulgation of the mandate, it was thought advisable to confer upon Palestine a more representative constitution, and an order in council was issued in 1922, providing for the creation of a legislative council consisting of the high commissioner and 22 other members, of whom ten were to be officials and 12 elected. The elected members were to be eight Muslims, two Jews and two Christians. A boycott on the part of the Arab population rendered these and other proposals abortive. Attempts to devise an advisory council were likewise frustrated.

The present system of government is that ordinances are considered first by the high commissioner in executive council, next, after receiving the provisional approval of the colonial secretary, submitted to the advisory council consisting of ten senior officials and then published in the official gazette; but do not, save in rare cases of special urgency, become law until at least one month after publication, so that interests affected may be given the opportunity

[1]For the general atmosphere and "psychology" of these events the reader is referred to the report of the commission of enquiry (Cmd. 1540, 1921).

of expressing their views. This they often do with effect.

Religion.—Complete liberty of religion prevails in Palestine. In certain matters of internal organization, however, action has been taken to assist the communities. A purely Muslim authority has been constituted for the control of Muslim religious endowments (Wakfs) and for appointment of judges in the Muslim religious courts. To this authority, represented by an elected council, the Government has transferred certain wealthy endowments sequestrated 80 years ago by the Turks. The Orthodox patriarchate of Jerusalem, torn by dissensions both between the patriarch and his Synod and with the Orthodox Arab congregation, and crippled by debt, has seen the authority of its patriarch vindicated by a commission of inquiry, and its economic restoration begun by a financial commission, both appointed by the government. The Jewish community had possessed no recognized ecclesiastical organization. The Government assembled in 1921 a conference of leading Jews from all parts of Palestine. Two joint chief rabbis were elected; a rabbinical council was established and officially recognized. The lay community was also organized into central and local councils. Further regulations for the organization of the Jewish community, both religious and lay, and conveying powers of taxation for communal purposes have now been promulgated. In 1924 the French Protectorate of Latin Holy Places was withdrawn by the Vatican.

Justice.—The system of justice originally established by the military administration has been amended where necessary. British judges under a chief justice preside over the two sections of the court of appeal, four district courts and two land courts. All other judges and magistrates are Palestinians drawn impartially from among the qualified members of the three religious communities. Cases of religious law and personal status are still judged as under the Turkish régime by the special tribunal of the several creeds. Ottoman law, amended by ordinances of the administration, remains the foundation of the legal system.

FINANCIAL AND ECONOMIC DEVELOPMENT

In 1923 there was a budgetary deficit of £E.752,000. As a result of drastic economies, the position was retrieved in 1924, and resulted in a surplus of approximately £E.263,000.

Revenue and Expenditure

Year	Revenue	Expenditure	Surplus	Deficit
	£E	£E	£E	£E
1920–1	1,422,208	1,227,056	195,152	..
1921–2	1,997,522	1,881,108	116,414	..
1922–3	1,764,585	1,837,173	..	72,588
1923–4	1,633,893	1,633,227	666	..
1924–5	2,101,072	1,806,660	294,412	..
1925–6	2,739,091	2,040,332	698,659	..
1926–7*	1,728,131	1,875,824	..	147,693

*1927 April–December, 9 months (estimated).

The rate of the tithe has since been reduced from 12½%, the Turkish figure, to 10%, thus relieving the agriculturist at a single step of one-fifth of the weight of the tax. Legislation is now being introduced providing for the commutation of the tithe into a fixed payment over a period of years and for the substitution of the old Turkish house and land (*Werghu*) tax by an urban property tax. Palestine has hitherto had the use, free of payment, of the main line of railway, and of certain other works constructed by the British army for military purposes during the war. In 1927 the Palestine loan of £2,000,000 was approved by parliament and rapidly covered; and a Palestine currency, based on the pound sterling, with 1,000 mils to the Palestinian pound, introduced.

Communications.—There are 400 m. of metalled main roads in Palestine and 440 m. of secondary roads, serving 177 villages, of which 175 m. have been constructed or rebuilt since the establishment of the civil administration. Many hundreds of miles of tracks connecting scattered villages and settlements are used by motor and other wheeled traffic in the dry weather. In 1914 there was only one motor car in Palestine; there were in 1928 over 2,000 including over 900 within the municipal area of Jerusalem. The military railway constructed by the army across the Sinai desert has been brought under the management of the Palestine Railway Department. A train service is efficiently run from Egypt to Haifa, from Jaffa to Jerusalem and from Haifa to Syria and a through train and car service has recently been inaugurated by Constantinople to Calais. Before the war postal services were maintained largely by separate agencies of European Powers; telegraphs were restricted, telephones unknown. There are now frequent daily deliveries of letters; 34 telegraph offices, 50 public telephone exchanges, and trunk lines to all parts of the country; and Egypt answers calls in English, Arabic and Hebrew at any hour of the day and night. Imperial Airways Ltd. opened in 1927 a station at Gaza and in 1928 The Eastern Telegraph Co. laid a cable connecting Palestine with Cyprus.

Public Health.—The Department of Health with the co-operation of voluntary organizations, notably the Rockefeller Foundation, has directed intensive and successful efforts against malaria. The hospitals of the country provide 1,984 beds of which 488 are in British, 360 in French, 107 in German and 90 in Italian mission hospitals, 668 in hospitals maintained by various Jewish organizations and 271 in government and municipal hospitals. The government and municipal hospitals are intended chiefly for the treatment of infectious diseases, and in addition a mental hospital at Bethlehem is maintained by Government. Trachoma affects more than 60% of the population and preventive measures are taken in the schools where some 64,000 children are kept under early treatment or medical observation, while the ophthalmic hospital of the British Order of St. John of Jerusalem plays a chief part in treating the complications and sequelae of the disease. Leprosy is gradually disappearing and there are now only 57 known cases; 27 infant welfare centres have been established, largely by non-official bodies, in 11 towns and a number of villages; 31 nurses and 71 midwives have qualified in the department's training centres and 125 nurses and 31 midwives in voluntary institutions. Anti-rabic, cholera and smallpox vaccines are prepared in the Government laboratories, and quarantine and disinfection of pilgrims returning from Mecca, and of immigrants, is carried out. In 1927 the death rate was 28·01 while the birth rate was 50·35. The infantile mortality was 201·27 per 1,000 births.

Education.—In 1927 there were 835 schools with 67,000 pupils (42,500 boys and 24,500 girls), made up as follows: 315 Government schools (20,000 pupils: 16,500 boys, 3,500 girls), 53 Muslim non-Government schools (4,500 pupils: 3,650 boys, 850 girls), 275 Jewish schools (26,500 pupils: 13,850 boys, 12,650 girls), and 192 Christian schools (16,000 pupils: 8,500 boys, 7,500 girls). The estimated expenditure of the Department of Education for 1928 amounted to £P.143,619 of which £P.22,744 forms grants-in-aid to non-Government schools. The largest educational authority, after the Government, is the Palestine Zionist Executive, the upkeep of whose 191 schools (17,700 pupils) amounts to £P.100,000.

Assistance to Farmers.—The £E.562,000 advanced by the military administration, mostly in small loans on security of land and crops, enabled peasants to buy animals and seed, and in many ways to recover from the devastation of the war. Subsequently a Department of Agriculture and Forests was established, which gives instruction in the villages and promotes the use of improved instruments and methods; it assists the farmer in dealing with animal diseases and plant pests, fumigates his fruit trees if affected by scale, and protects his cattle from imported diseases by quarantine and veterinary control; it has also planted about 1,000,000 trees, and, through its nurseries, has facilitated plantation by others. Altogether, about 5,000,000 timber and fruit trees have been planted in these years in Palestine. A Government Stud Farm has been established at Acre.

Jewish agricultural settlements came into existence during the past half century. Many were formed on uncultivated and unpromising land which has been transformed into flourishing plantations. The settlers have drained swamps, planted eucalyptus and pines, cultivated vine and almond and developed the orange trade of Jaffa.

At the outbreak of war there were 44 settlements of 87,800 ac.; in 1928 there were about 120 covering an area of 250,000 ac. (over 10% of the cultivable area of Palestine) and supporting a

population of about 25,000. Of the older settlements most were founded or largely assisted by Baron Edmond de Rothschild or the Jewish Colonization Association acting as his agent; the later mostly by the Zionist Organization. Largely owing to the lifework of Eliezer Ben Yahuda, a practical visionary of genius, Hebrew is definitely established as the vernacular as well as the literary language of Palestinian Jewry. The revival of Hebrew culture found in 1925 concrete expression in the formal opening by the Earl of Balfour of the Hebrew University upon Mount Scopus. Hardly less remarkable is the development in 18 years of Tel-Aviv from the suburb into the rival of Jaffa with a population of over 35,000.

Natural Resources and Industry.—Before the war, industries were almost non-existent. A few soap and oil factories at Nablus and elsewhere, Baron Edmond de Rothschild's wine factories at Richon-le-Zion and Zikron Jacob, and some hand industries, such as the Bethlehem mother-of-pearl, represented the sum of local manufacture. Largely owing to Jewish enterprise, there are now factories for silicate bricks, vegetable oil, flour, salt, soap, cement, furniture, chocolates, matches and textiles, as well as smaller enterprises, and, despite difficult conditions, an export trade, especially with Egypt, is being built up. An important hydro-electric concession has been granted to Mr. Pinhas Rutenberg (the Palestine Electric Corporation Ltd.) for the utilization of the water power of the upper Jordan and its tributary the Yarmuk. Power is now being supplied by the corporation to Amman and power stations with oil engines have been erected for the supply of electricity at Tel-Aviv, Haifa and Tiberias. Though Haifa has been chosen as the site of the principal harbour, improvements are being carried out at Jaffa, the centre of orange cultivation, and thus of more than half the total export trade of the country. The potash deposits of the Dead sea constitute an important potential source of wealth and in 1927 a concession to exploit them was granted to Major Tulloch and Mr. Noremeysky (a Palestinian). The balance of trade, shown below, is increasingly adverse, equilibrium being hitherto adjusted by immigration, tourists and charity.

	Imports	*Exports*
1922	£E.5,471,667	£E.1,070,171
1923	„ 4,825,185	„ 1,143,234
1924	„ 5,266,349	„ 1,200,812
1925	„ 7,338,491	„ 1,297,559
1926	£P.6,594,098	£P.1,308,342
1927	„ 6,184,454	„ 1,899,759

In the latter half of 1926 and in 1927 Palestine experienced economic depression of steadily increasing gravity, partly due to the drought, for which loans were granted to Beersheba Bedouins, but still more to the attempt to raise prematurely the municipal and general standard of life and with it the volume of immigration, to cope with which Government was compelled to make extensive grants for unemployment relief works. The crisis was most acutely felt at Tel-Aviv, the liabilities of which township exceed £P.250,000 and in the neighbouring colony of Petach Tikveh where, owing to the objection of Jewish workers to the introduction of Arab orange pickers a clash occurred between unemployed and police. All immigration therefore, save for very carefully selected exceptions, was suspended, and there was a good deal of emigration. The fall in revenue showed itself especially in customs and railway receipts. Limited companies (103) have established themselves under the law of Palestine, and 53 foreign companies have registered themselves locally.

Administration.—The military governorships were in 1919 reduced in number from 13 to 7 and subsequently, under the civil administration, to four, later to two district commissionerships, the Jerusalem-Southern (exactly conterminous with the ancient Judea), and the Northern District. In 1926 the Jerusalem-Southern District was abolished and replaced by a Southern District, excluding the capital and its immediate neighbourhood, henceforward reduced to a deputy district commissionership. Transjordan was in 1927 declared, in closer accord with the mandate, and hereditary emirate, under H. H. the Emir Abdalla, with consequent modifications in the position there of the chief British representative. The Druses were expelled from Azrak in Transjordan, which they were using as a base for revolt in Syria. The headquarters of the R.A.F. were in 1927 transferred from Ramleh to Amman.

In 1927 the first municipal elections since the occupation were held throughout Palestine.

A severe earthquake occurred about 3 P.M. on July 11, 1927, of which the damage was principally felt at Nablus, Ramleh, Lydda and Salt. In Palestine 137 persons were killed and 160 seriously injured, and in Transjordan 64 and 102 respectively. In Jerusalem only one life was lost. Little damage was done to historic buildings: the Dome of the Rock was unaffected, but the small dome of the Holy Sepulchre was badly cracked, and is being reconstructed (1928) by Government, without prejudice to the ultimate allocation of charges, under the *status quo* of the Holy Places. The Government erected temporary hutments for the homeless at Nablus, Ramleh and Lydda and set in motion a credit scheme to assist house-owners to rebuild their premises. Further slight shocks were felt in Feb. 1928. (R. STO.)

THE HOLY PLACES

To the vast majority of Jews, Muslims and Christians, the religious associations of Palestine predominate over every other, and at all ages have attracted pilgrims to its shrines. We need allude only to the centralization of Jewish ideas and aspirations in Jerusalem, especially in the holy rock on which tradition (and probably textual corruption) have placed the scene of Abraham's sacrifice of Isaac, and over which the Most Holy Place of the Temple stood. The same associations are those of the Muslim, whose religion has absorbed so much of Judaism. The mosque of Omar which is built on the site of the Temple is one of the glories of Islam; the alleged tomb of Moses and the mosque at Hebron over the cave of Machpelah are famous centres of Muslim pilgrimage. Christianity, however, is responsible for the greatest development of the cult of holy places in Palestine.

There is no evidence that the earliest Christians were interested in the sites associated with the life and teaching of Jesus Christ. These were of no special moment to them in comparison with the all-important fact that "Christ was risen." It was not till the clear-cut impress of the events of Christ's life had faded from human recollection that there arose a desire to "seek the living among the dead." The story begins with Helena, mother of Constantine the Great, who became fired with zeal to fix definitely the spots where the great events in the birth of Christianity had taken place and in 326 visited Palestine for that purpose. Her pilgrimage, as might have been expected, was attended with complete success. The True Cross was discovered; and, by excavation conducted under Constantine's auspices, the Holy Sepulchre, "contrary to all expectation" as Eusebius naively says, was also found (*see* JERUSALEM and SEPULCHRE, THE HOLY). The stream of pilgrimage to the Holy Land began immediately, and has flowed ever since. Onwards from 333 when an anonymous pilgrim from Bordeaux visited the holy places and left a succinct account of his route and of the sights he saw, there is a continuous record of the experiences of a multitude of pilgrims. It is a pathetic record. No site, no legend, is too impossible for the unquestioning faith of these simple-minded men and women. By comparing one record with another, we can follow the multiplication of "holy places," and sometimes can even see them being shifted from one spot to another, as the centuries pass. Not one of these devout souls had any shadow of suspicion that, except natural features (such as the Mount of Olives, the Jordan, Ebal, etc.) and possibly a few individual sites (such as Jacob's well at Shechem) there was not a single spot in the whole system that could show the flimsiest evidence of authenticity.

The growth and development of "holy sites" can best be illustrated by figures. The account of the "holy places" seen in Palestine by the Bordeaux pilgrim in the 4th century of our era occupies 12 pages in the translation of the *Palestine Pilgrims' Text Society* and these 12 pages may be reduced to seven or eight as they are printed with wide margins and have many footnotes added. On the other hand the experiences and observations of Felix Fabri, a Dominican monk who visited the country about 1480, occupy in the same series two large volumes of over

600 pages each. The comparison is made in full realization of the fact that the Bordeaux record is a dry catalogue while Fabri's work is enlarged by much delightful gossip. The "invention" of sites has continued to our own times. In the so-called "Via Dolorosa" is a cave which was opened and surveyed in 1870. It became closed and forgotten; houses covered its entrance. In 1906 it was reopened, the houses were cleared away and a hospice for Greek pilgrims erected in their stead. During these works some local archaeologists attempted to penetrate the cave but were expelled with curses by the labourers. At last the hospice was finished and the cave opened for inspection. A pair of stocks was then shown cut in the rock where none appeared in the plan of 1870; a crude painting was suspended on the wall above, blasphemously representing the Messiah confined in them.

The Franciscans were nominated custodians of the Holy Places by Pope Gregory IX. in 1230. Certain sites have, however, always been held by the Oriental sects and since 1808, when the church of the Holy Sepulchre was burnt down, the number of these has greatly increased. The 19th century was disgraced, in Palestine, by a feverish "scramble" for sacred sites, in which the most dishonest means were employed and the ethics of Christianity forgotten in the struggle to oust rival orders or sects. Churches, chapels and monasteries, most of them in the worst architectural taste, sprang up like mushrooms throughout the country to perpetuate the memory of pseudo-sanctuaries which were best forgotten. The zeal and self-sacrificing devotion displayed by many of their inmates and their noble labours on behalf of the people and history of Palestine throw into yet more painful relief the actions and mental attitude of some of their co-religionists.

The authenticity of the "Holy Places" was first attacked seriously in the 18th century by Korte, a bookseller of Altona; since he led the way a steady fire of criticism has been poured upon this mass of invention. The process of manufacture continued unchecked until the World War. Even the Protestant churches are not exempt from blame; a small tomb near the Damascus Gate of Jerusalem was fixed upon by certain English enthusiasts as the true "Holy Sepulchre," an identification for which there is nothing to be said. Since the World War speculations founded on a basis of false philology and highly conjectural exegesis, such as the belief in the identity of the "Anglo-Saxons" with the ten lost tribes of Israel and in the prophetic intention of the builders of the Great Pyramid, have occupied minds that might otherwise have made further "discoveries" in the Holy Land.

FOREIGN SETTLEMENT

Down to the time of the Egyptian occupation the only foreigners permanently resident in Turkish Palestine were the members of various monastic orders and a few traders. The first Protestant missionaries settled in Jerusalem in 1823; they founded the trade in olive-wood articles for the support of their converts. In 1849 came the first of several examples that have appeared in Palestine of that curious product of American religious life—a community of dupes or visionaries led by a prophet or prophetess with claims to divine guidance The leader in this case was one Mrs. Minor, who came to prepare the land for the expected Second Advent. Her followers quarrelled and separated in 1853. This event is of importance, as it had much to do with the remarkable development of Jewish colonization of Palestine in the last 30 years of the 19th century. Mrs. Minor, who was interested in the Jewish people, was befriended by Sir Moses Montefiore; after her death her property was placed in charge of a Jew and finally passed into the hands of the *Alliance Israélite Universelle*. In 1870 this body founded an agricultural colony for Jews on the road from Jaffa to Jerusalem, and called it "Mikweh Israel." Another visionary American colony the "Adamsites" came in 1866 but lost heart and departed, after selling their property to a German community, the *Tempelgemeinde*, a Unitarian sect led by Messrs. Hoffmann and Hardegg who established themselves in Jaffa in 1868. Unlike the Americans, these hardy Württemberg peasants have flourished in Palestine and their colonies at Jerusalem, Haifa and in the Jaffa district have prospered and remain prosperous. In 1921 the return of the men of military age of the Haifa colony who had been temporarily deported as a military measure after the war, caused the greatest satisfaction among their late enemies, the British officers and officials stationed there, who congratulated themselves on the return of the "only efficient craftsmen" in the town. Another American religious colony, known after the founder as the "Spaffordites" was more successful, if less numerous than its predecessors and some of its members have played a considerable part in the social and commercial life of Jerusalem.

Jewish immigration took three forms: agricultural colonization under the auspices of Zionism (*q.v.*); the influx of needy Jews of the "haluka" (dole) who abused Hebrew charity and swelled the number of Palestinian Jews who lived or existed on remittances from Jewish congregations and philanthropists in Europe and America; the settlement by small numbers of middle-class Jews possessed of some capital who came to live out their lives in congenial surroundings. By 1914 there were over 60,000 Jews in Palestine of whom about a fifth were settled in agricultural colonies. Of the immigrants the majority came from Russia during the anti-Jewish disturbances of 1878–81.

EXPLORATION

Before the 19th century local anarchy made exploration difficult or impossible. Scientific exploration, as distinguished from the sometimes valuable narratives of early pilgrims and secular travellers, begins with Edward Robinson, an American clergyman, who made a series of journeys through the country and published his itineraries and observations under the title of *Biblical Researches in Palestine* (1841–56). Though marred by the hastiness of his visits and the consequent superficiality of his descriptions of sites and by some untenable identifications, his work is at once the standard and the foundation of all subsequent topographical work in the country. He was worthily followed by Titus Tobler, who in 1853 and later years published volumes abounding in exact observation, and by V. Guérin, whose *Description géographique, historique, et archéologique de la Palestine*, in 7 volumes (1868–80), contains a wealth of material collected in personal travel throughout Palestine.

In 1864 was founded the Palestine Exploration Fund, under the auspices of which an ordnance survey map of the country was published in 1881, accompanied by volumes dealing with the topography, orography, hydrography, archaeology, zoology and botany of the Holy Land. The same society initiated the scientific exploration of the mounds of Palestine. The example thus set was followed by French, German and American explorers. The Deutscher Palästina-Verein founded in 1878 carried out important surveys and excavations. Austrian explorers, notably Dr. E. Sellin did valuable independent work. A remarkable biblical and archaeological school under the control of the Dominican order was founded at Jerusalem, and German and American archaeological institutions, educational in their purpose, were also established there. Valuable archaeological exploration was annually carried out by the directors of these schools and their pupils. An account of some of the discoveries made by these bodies will be found under the Archaeology section of this article (*see* also ARCHAEOLOGY: *Palestine and Syria*) while the geographical and archaeological explorations of Dr. Alois Musil and Brunnow in Moab and Nabataea are referred to under TRANSJORDAN (*see* also MOAB; PETRA). Useful topographical and archaeological reconnaissances of the country on both sides of the Turco-Egyptian border were carried out by Major S. Newcombe, T. E. Lawrence (*q.v.*) and C. L. Woolley very shortly before the World War.

(R. A. S. M.)

In 1918 the military governor of Jerusalem, in order to preserve the antiquities of the district, issued and enforced certain public orders; and, to organize public opinion, established the Pro-Jerusalem Society, an international and non-sectarian body, in which all communities and most learned societies participated through their leading members. The society encouraged arts and crafts, employed a qualified architect and town planner to protect the amenities of the old and advise on the development of the new city, and collected in subscriptions some £E.15,000. It was dissolved in 1926, having distributed most of its duties and activ-

ities between the Department of Antiquities and the municipality of Jerusalem. The former was established in 1920; 2,860 historical sites have been registered by it and are being inspected, and in 1927 the Rockefeller Foundation granted to Palestine $1,000,000 for the erection and endowment of an archaeological museum.

(R. Sto.)

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PALESTINE, a city of eastern Texas, U.S.A., 120 m. S.E. of Dallas, between the Trinity and the Neches rivers; the county seat of Anderson county. It is served by the Missouri Pacific and the Southern Pacific railway systems. The population was 11,039 in 1920 (26·5% negroes) and was estimated locally at 16,000 in 1928. It is the trade centre of a very fertile region, highly cultivated along the watercourses and elsewhere heavily timbered with hardwood and pine, containing great deposits of lignite and many salt domes which are expected to yield oil. The Boggy Creek Field, with four producing wells, is 16 m. E. of the city. Seven miles W. is one of the largest salt-works in the United States, pumping brine from wells 190–220 ft. deep, and a lignite mine is in operation in the same region. The International-Great Northern railroad has its main shops at Palestine, with a total annual pay-roll of $3,000,000. Lumber, furniture, fixtures, baskets, boxes, crates, and mattresses are leading products. A settlement was made and a stockade built (Ft. Houston) 2 m. S. of Palestine in 1837. Palestine was laid out as the county seat in 1846, and was named after Palestine, Arkansas, the home of the first settler. The city was chartered in 1871. Since 1909 it has had a commission form of government.

PALESTINE, OPERATIONS IN. The British campaigns of 1914–18 in Palestine, Egypt and Syria covered an extensive stretch of territory, from the Suez Canal to Aleppo, a distance by the land route of well over 500 miles. This land route, the oldest highway in the history of the civilized world, along which the tides of thought and trade and war have flowed between Asia and Africa since time immemorial, traverses a remarkable variety of soil and scenery: the inhospitable desert of Sinai; the fertile plains of Palestine, flanked by the high rocky citadel of the Judaean hills; the deep trench of the Jordan valley; and, finally, the Syrian plateau with those cities of ancient tale, Damascus and Aleppo.

The fighting was as diversified as the terrain; it comprised battles in the desert and in fertile country, combats in steep bleak hills and in a sweltering valley below sea level, periods of close-locked siege warfare and intervals of rapid movement. The story of the successive advances of the Egyptian Expeditionary Force (as the British army in this theatre came to be called) and of the gradual extension of its objective—from the passive defence of the canal to the delivery of the *coup de grâce* to the Turkish empire—falls conveniently under four main heads: the Suez canal, Sinai, Palestine, Syria.

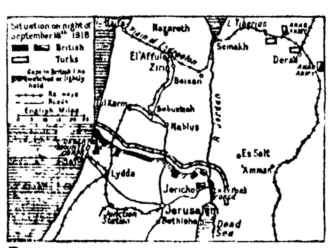
I. THE PROBLEM OF THE SUEZ CANAL

When Turkey entered the World War on the side of the Central Powers at the beginning of Nov. 1914, it was obvious that an advance from southern Palestine against the Suez canal and Egypt was likely to form part of the Turkish strategical programme, largely inspired from Berlin. Seizure of the canal would paralyse the most vital line of communication with the British Empire and seriously hamper the gathering of its armies. Even the threat must immobilize considerable numbers for passive defence. The dream of reasserting dominion over their former province of Egypt was an additional lure to the Turks.

The Turkish Advance.—Between the southern frontier of Palestine and the Suez canal lay over 100m. of almost waterless desert. It was crossed by three routes, of which the northern, near the coast, through Rafah, El 'Arish and Qatiya to El Qantara, was the easiest and best. The Turks made their main effort on the centre route, from El 'Auja by the Wadi Muksheib, which reaches the canal about Tussum, south of Ismailia; but they also sent smaller forces by the coast road and by the southern route through Nekhl to Suez, the most difficult of the three. The Turkish commander in Syria, Jemal Pasha, directed the enterprise, but its real brain was his Bavarian chief of staff, Col. Kress von Kressenstein. In spite of the difficulties, a force of some 12,000 to 15,000 Turks was brought within striking distance of the canal by the first days of Feb. 1915.

The British were not unaware of the danger—though they underestimated the Turkish effort—and were ready. The line of defence, which was held mainly by Indian troops, lay on the western bank of the canal, leaving the canal itself as an obstacle between the defenders and the enemy. A territorial division (the 42nd) and some Australian and New Zealand troops, who were completing their training near Cairo, formed the reserve. Warships in the canal provided gun support and compensated for the scarcity of land artillery. On the night of Feb. 2–3 the Turks made their effort, reached the canal, and actually succeeded in pushing three pontoons full of troops across it. These were all killed or captured. An attack next day had no better success, and the Turks withdrew, unmolested by any serious pursuit.

This first Turkish raid, though it failed, proved the desert passable to large bodies of troops and thus compelled the retention of considerable forces in Egypt for the protection of the canal. It also showed the unsuitability of the defence on the west bank, since this line could not prevent the attackers from reaching the canal and interfering with the passage of shipping. No change was made in the system of defence, however, till after Lord Kitchener's visit in Nov. 1915. For during the summer and autumn of 1915 the Gallipoli campaign was in full swing and absorbed the principal efforts of both Turk and Briton. The Senussi rising in the western desert, too, occupied the attention of the G.O.C. in Egypt, Gen. Sir John Maxwell. After the evacuation of Gallipoli at the end of 1915 and beginning of 1916 Egypt contained close on 400,000 British troops, reorganizing and recuperating after that gallant but ill-starred adventure. For a short time there existed within Egypt three separate, independent commands, but in March 1916 all three were united under Sir Archibald Murray.



PLAN OF OPERATIONS IN PALESTINE, SEPTEMBER 18TH, 1918

Meanwhile, early in 1916, a line was taken up in the desert, some 8 to 10m. to the east of the canal. Many miles of entrenchments were dug and reveted in the shifting sand, metalled roads constructed and pipe lines laid. For the Turk, freed from concern for the safety of his capital, was obviously contemplating a fresh advance on Egypt and the canal. He had in fact been busy with preparations ever since the repulse of his first effort.

This system of entrenchments, extending for some 80m. along practically the whole length of the canal, was expensive in men

as well as in material. This fact originated the first advance of the Egyptian Expeditionary Force and led to the crossing of the Sinai desert, an achievement made possible by sound and thorough organization, and by the fine quality of the mounted troops, mainly Australians and New Zealanders.

II. THE SINAI DESERT

Sir Archibald Murray's objective was to secure control of the Sinai desert, which he saw could be effected by an advance to El 'Arish near the Egyptian frontier. A position here would bar the northern route across the desert and flank the more southerly routes. It would also enable offensive operations to be undertaken against enemy forces concentrating in southern Palestine. But an invasion of Palestine was not seriously contemplated at this time; the advance was initiated to safeguard Egypt and the Suez canal. Murray estimated the force necessary at five divisions and four mounted brigades, a much smaller force than that needed adequately to garrison the defensive system along the canal. Moreover, the farther the defence was removed from Egypt the less chance there was of a sympathetic rising there.

British Advance on El 'Arish.—The first step was to occupy the Qatiya oasis, 25m. east of the canal, and thus deny to the enemy the only district within striking distance where a sufficiency of water permitted the assembly of a large force. The construction of a broad gauge railway from El Qantara towards Qatiya was begun, and large numbers of camels were collected to form the transport of the force, since in the soft sand of the desert wheeled transport was impossible. For the guns, special "pedrails" were constructed and teams doubled. Towards the end of April 1916 the Turks made a raid on the Qatiya oasis and surprised and captured some advanced posts of yeomanry. The Anzac Mounted Division, formed in March from Australian and New Zealand troops reoccupied the area next day. The object of the Turkish raid seems to have been to cause alarm and thus to prevent the further withdrawal of troops from Egypt for France, which had been going on during the spring of 1916.

By July the advance had reached Romani at the western end of a scattered group of oases extending for some 15 to 20m., when a strong Turkish force entered the eastern end. This force consisted of the 3rd Division and certain other units, totalling about 18,000 men under Kress von Kressenstein. After a pause for preparation, at dawn on Aug. 4, it attacked the British position at Romani, held by the 52nd and 42nd Divisions, the Anzac Mounted Division and some yeomanry, in all about 30,000 men, under Lt.-Gen. the Hon. H. A. Lawrence. The Turks made a determined assault but were heavily repulsed and pursued as far as Bir el Abd. Their losses, including some 4,000 prisoners, amounted to nearly half their total force. They may perhaps be accounted fortunate to have escaped at all, for intense heat and lack of water precluded the more vigorous action in pursuit, which might have made possible the annihilation of the Turkish force.

The defeated Turks retreated to El 'Arish, leaving a small detachment at Bir el Mazar till the middle of September, when it was dislodged by the Anzac Mounted Division. There was no further fighting till December. The progress of the British force (now under Lt.-Gen. Sir Charles Dobell) towards El 'Arish was governed by the rate (about 20m. a month) at which the railway and its accompanying pipe-line could be laid. The water supply available in Sinai was too brackish for constant drinking by troops; even the railway locomotives could not use it for long without loss of efficiency. The Sweetwater canal, which runs from the Nile at Cairo to the Suez canal, was the source of the pipe-line supply; from large reservoirs and a great pumping station built at El Qantara it was forced through a 12-in. pipe to railhead. In 1917 this pipe-line was extended up to Gaza.

Occupation of El 'Arish and Rafah.—Early in December the railhead was within 20m. of El 'Arish. Elaborate water and transport arrangements were now made to enable the advanced guard of the British force to capture El 'Arish. This advanced guard was known as the Desert Column, and consisted at this time of the Anzac Mounted Division and 42nd and 52nd Divisions, under Lt.-Gen. Sir Philip Chetwode. Just as all was ready the enemy withdrew and El 'Arish was occupied Dec. 20.

The nearest Turkish force (1,600 infantry with four guns) was located at Magdhaba, some 20m. south of El 'Arish. A flying column under Gen. Chauvel, consisting of the Anzac Division and Imperial Camel Corps, was at once despatched against it. After a night march Chauvel attacked the Turks in an entrenched position at dawn on Dec. 23. By late afternoon, at a cost of under 150 casualties, he had accounted for practically the whole enemy force, capturing 1,300 prisoners and burying 100 dead. Only 200 Turks survived the engagement.

The only Turkish force now remaining within the Egyptian frontier was a detachment of about 2,000 near Rafah, 25m. east of El 'Arish. This was dealt with in a similar fashion by the mounted troops under Chetwode. After a night march, he surrounded the Turkish position at dawn on Jan. 9. Some hard fighting followed, for the Turks were in a strong position and put up a stout defence. It was not till close on dark that the position was assaulted. The entire Turkish force was accounted for, while the British casualties were under 500. These two brilliant actions cleared the Egyptian province of Sinai from enemy occupation. They were striking examples of the power of boldly handled mounted troops, a power the Turk was to experience very thoroughly before the end of the World War. Murray had now obtained his original objective, since the possession of Rafah and El 'Arish secured the safety of the Suez canal and Egypt.

Towards the end of 1916 he had, however, received instructions which imposed on him a more active rôle than the mere defence of Egypt. While this defence was still to be the main consideration, it was made clear to him that the war cabinet expected some more spectacular result of the "Exodus" across the desert than the negative one of giving checkmate to Turkish designs on Egypt. At the same time they were not prepared to give Murray the additional troops he asked for. Indeed, one of his four divisions, the 42nd, was early in 1917 withdrawn to France, leaving him only three in place of the five which he held to be the minimum to fulfil the rôle demanded of him. He had the nucleus of a fourth division—the 74th—to be formed from dismounted yeomanry; and the liquidation of the western campaign enabled him to add a second mounted division to the force on the Palestine border.

The situation in the early spring of 1917 was this: railhead was close to the Egyptian frontier at Rafa, some 20m. from Gaza; the British war cabinet's policy for the Egyptian theatre had finally crystallized into instructions to Sir Archibald Murray to prepare during the summer for an offensive campaign into Palestine in the autumn; and the Turk—now definitely on the defensive—had suddenly evacuated a forward position which he had prepared at Shellal, and had sketched out a position for the defence of Palestine between Gaza and Beersheba.

The Palestine Offensive.—Gaza and Beersheba, some 25m. apart, are the two natural gates into Palestine from the south, the former by reason of its commanding position on the coast road, the latter as the last water base on the confines of the mountainous desert to east and south. Between Gaza and Beersheba, in an almost direct line, runs a series of ridges which form a natural defensive position. Murray saw that in order to carry out his instructions to prepare for an autumn offensive, it was desirable to push his railhead forward out of the desert up to the cultivated plain of south Palestine. The conditions of transport would then be entirely different and camels could be largely replaced by wheeled transport. Moreover, the capture of Gaza would make it impossible for the Turk to hold the Gaza-Beersheba line as his main defensive position.

It was decided therefore in March to attempt the capture of Gaza by a *coup de main* similar to those at Rafah and Magdhaba, but on a much larger scale. The difficulties of concentration, of supply and of secrecy were of course much increased by the necessity to employ infantry in addition to mounted troops. The Turks had at the time some 7,000 fighting troops in Gaza, another 7,000 at Tel esh Sheri'a, half-way between Gaza and Beersheba, and a small garrison in Beersheba.

The plan was, briefly, for the mounted troops to pass east of Gaza, cut the garrison's line of retreat, and hold off the arrival of

any Turkish reinforcements from the north or east. The 53rd Division was to assault the heights east and south of Gaza, while the 54th Division protected the exposed right flank from the direction of Tel esh Sheri'a.

Attacks on Gaza.—The enterprise took place on March 26. Unfortunately, a dense sea fog came up with the dawn and caused a delay of two precious hours in the deployment of the infantry. This delay, which could not have been foreseen nor prevented, was the direct cause of the loss of the battle. For the Turkish position was strong, and it was not till 5 P.M. that the 53rd Division secured the 'Ali el Muntar ridge which dominates Gaza from the east; at the same time, a part of the mounted troops were in the north-eastern outskirts of the town. The victory was to all appearances won. In fact the garrison, as was afterwards known, was on the point of surrender. But Turkish reinforcements from the north and east were already pressing on the protective screen of the mounted troops; the horses were without water, and darkness was coming on. It had been agreed beforehand that the enterprise should be abandoned if Gaza had not fallen by dark. The reports received did not indicate a successful issue; owing to a breakdown of communications, news of the success of the 53rd Division did not reach the British commander till about 11 P.M. Sir Charles Dobell hesitated to involve his infantry in the intricate network of cactus hedges which surrounds Gaza, while Chetwode was against exposing his mounted troops, exhausted by want of water, to the danger of being overwhelmed by the approaching Turkish reinforcements. The withdrawal of the mounted troops was ordered. This exposed the right of the 53rd Division, which had to be drawn back from the 'Ali el Muntar heights to gain touch with the left of the 54th. The battle was resumed next morning, but the Turkish garrison had been reinforced and had taken heart of grace at the unexpected respite of the previous evening. It was found impossible again to make good the 'Ali el Muntar ridge, the key to Gaza; and finally the whole force was withdrawn to the Wadi Ghazze.

This first battle of Gaza has been a matter of dispute and conjecture. By many of the troops who took part, it was held that the decision to withdraw threw away a victory already won. On the other hand, it is impossible to question that in the circumstances the order for retirement was justified. The two-hour delay in the morning lost the battle. Other contributory causes were the breakdown of communications (partly due to shortness of equipment) and lack of accurate maps, which made it impossible for H.Q. to obtain timely information of the progress of the fight.

Though the enterprise had failed, the force had secured a position on the Wadi Ghazze which would enable railhead to be advanced to within a short distance of Gaza in preparation for the autumn campaign. Murray now, however, received instructions to commence an offensive movement at once. A fresh assault on Gaza was therefore prepared. But the conditions were now very different; the Turk had closed the gap between Gaza and Beersheba by a series of works, and had greatly extended and strengthened the defences of Gaza. He had some five divisions in line and a considerable quantity of heavy artillery, so that Gen. Dobell's force had no easy task. Much hope was placed in some tanks, which were to be used in Eastern warfare for the first time. The attack was made in two stages, of which the first, on April 17, was designed to gain a position from which the final thrust on Gaza could be made. It was successful. But the decisive attack on April 19 failed with heavy loss; the tanks developed mechanical defects in the heavy sand or were put out of action by the well-placed Turkish guns; and the weight of artillery supporting the British attack was insufficient to demolish the formidable defences of Gaza. The British casualties were 7,000.

Operations before Gaza now settled into regular trench warfare. The Sinai campaign was at an end. It had fulfilled its object: the security of Egypt; and the careful and thorough organization which had conquered the desert had laid a solid foundation for the future British successes. For this Sir Archibald Murray deserves the greatest credit. He had never been given the number of troops necessary for more extended successes.

III. PALESTINE

A long pause in active operations followed the second battle of Gaza. The Turks, under German leadership, were now gathering their last resources at Aleppo for an attempt to recapture Baghdad. They christened this force the "Yilderim" ("lightning") group. The British General Staff decided to forestall this enterprise by an attack in Palestine which would divert this army southwards from Aleppo and remove the danger to Baghdad. The British Government also no doubt hoped by a spectacular success in the East to remove some of the disappointment caused to the public by the failure of Nivelle's offensive in France and the military collapse of Russia. Gen. Sir Edmund Allenby succeeded Sir Archibald Murray in July 1917, with instructions to report on the conditions in which offensive operations could be undertaken against the Turkish forces on the Palestine front.

Allenby's Plan Outlined.—Allenby based his plan on an appreciation made some time previously by Lt.-Gen. Sir Philip Chetwode, who now commanded on the Gaza front. The obvious line of advance was by Gaza, which would allow of naval co-operation, directly cover the lines of communication, and present comparatively small difficulties of water supply. But the defences of Gaza were too solid to be broken except by a slow and costly process of siege. The Turkish centre was also strong and the approach to it difficult. There remained the Turkish left, which rested about Abu Hureira, some 7m. west of Beersheba; the defences here were weaker and less complete, and might perhaps be rapidly overwhelmed. This would provide an opportunity for the mounted troops, the arm in which lay the chief superiority of the British force over the Turkish.

A preliminary operation was necessary to capture Beersheba, which the Turks held by a detached force; for there was not room to manoeuvre between Beersheba and the Turkish left; moreover, possession of the water supply at Beersheba was essential to further operations. The difficulties of capturing Beersheba and of placing a sufficient force within striking distance of the Turkish left were, however, serious. The three principal problems to be solved were those of transport, water supply and secrecy. Until the Gaza-Beersheba line had been passed and the cultivated plain of Palestine reached, it was not practicable to use motor lorries, and the force was dependent on horse transport and camels. This limitation greatly increased the difficulties of water supply, which was the second main problem. Its seriousness is illustrated by the fact that the striking force estimated as necessary for operations against the Turkish left required some 400,000gal. of water daily. Of the 30,000 camels available the majority would be required to carry water. The third great difficulty was to concentrate a striking force sufficient to overwhelm the garrison of Beersheba rapidly and then attack the Turkish left, without the Turks becoming aware and taking steps to counter or avoid the blow.

In spite of the difficulties to be overcome, Gen. Allenby decided to attack the Turkish left. He estimated the total force required at seven divisions and three mounted divisions with additional artillery and aeroplanes. Four divisions and two mounted divisions were to attack the Turkish left, three divisions were to make a subsidiary attack on Gaza, and one mounted division was to watch the centre between these two wings, which would be separated by some 20m. during the operations.

The number of divisions was made up to the required total by the 10th and 60th from Salonika and by the completion of the 75th, already in process of formation. Allenby formed his three mounted divisions into the Desert Mounted Corps, under Lt.-Gen. Sir H. Chauvel, an Australian, and his seven divisions into two corps, the 20th, under Lt.-Gen. Sir Philip Chetwode, and the 21st, under Lt.-Gen. Sir E. Bulfin. The elaborate preparations necessitated by the character of the forthcoming operations occupied the summer and early autumn. The railway across the desert was doubled and arrangements were made for its rapid extension during operations; ammunition and other stores were accumulated and the troops underwent special and intensive training. The development of the water supply was also a constant preoccupation.

Meanwhile, Gen. von Falkenhayn, in command of the Turkish

army at Aleppo, had realised that the security of the Palestine front was essential to the successful prosecution of the plan for the recapture of Baghdad. It was accordingly decided to drive the British back into the Sinai desert before committing the Yilderim force to the Mesopotamian adventure. All troops available at Aleppo (only three divisions) were ordered to south Palestine during September.

Both Turks and British were thus aiming to strike a blow on the Palestine front in the autumn of 1917, and each hoped to forestall the other. The poverty of the Turkish lines of communication decided this issue by the delay it imposed on the southward movement of men and stores From Haidar Pasha, the Turkish main base on the Asiatic shore of the Bosporus, to railhead in Palestine was a distance of 1,275m., with a single line of rail only, which, up to Aleppo, had also to serve the Mesopotamian front. The incomplete tunnels in the Taurus and the differences in gauge of the various lines necessitated five or six transhipments of all stores before they reached Palestine Scarcity of fuel and jealousies between the German commanders and staff and the Turkish officials who controlled the working of the communications further accentuated the difficulties. Consequently, the supply problem crippled Turkish movements throughout these campaigns. The force from Aleppo was still in process of arrival on the Palestine front when Allenby struck his blow

Disposition of the Troops.—During the days previous to Oct. 31, the date fixed by Allenby for the attack on Beersheba, the Desert Mounted Corps and the 20th Corps (10th, 53rd, 60th, 74th Divisions) were gradually and secretly moved across to the right wing from behind Gaza, where they had been in training camps by the sea. There could be no question of concealing entirely the preparations for a movement against Beersheba; but Allenby did hope to persuade the Turks that this movement was only a feint and that the real main attack was against Gaza To this end the 21st Corps (52nd, 54th and 75th Divisions), left opposite Gaza, began on Oct 26 a heavy bombardment of the Turkish defences, assisted by British and French warships from the sea The intended deception as to the real point of attack was aided by the natural nervousness of the Turk of operations by sea against his right flank. He was also aware of the great difficulties of transport and water supply in the country opposite his left flank, which he believed was sufficiently safeguarded by these natural obstacles.

The Turkish forces at the end of Oct consisted of the 8th Army (six divisions) under Kress von Kressenstein, holding Gaza and the Turkish centre, and the 7th Army (three divisions), holding Beersheba and the Turkish left The 7th Army was not yet complete, one of the divisions from Aleppo being still on the lines of communication. Falkenhayn, who was to combine the action of these two armies, only arrived at Jerusalem on Nov 1 The approximate fighting strengths of the Turkish and British forces were: Turks, 50,000 rifles, 1,500 sabres, 300 guns; British, 95,000 rifles, 20,000 sabres, 500 guns

Allenby's plan for Oct. 31 was as follows: Two divisions of the 20th Corps, the 60th and 74th, were to attack the south-western defences of Beersheba, which lay some 4m from the town itself, with the 53rd Division protecting the left flank of this attack The Anzac and Australian Mounted Divisions, which had concentrated at El Khelasa and Bir 'Aslūj, were to reach a position east of Beersheba by dawn, close the Beersheba-Hebron road, and then attack and carry the town as rapidly as possible, before the Turks could destroy the wells.

Capture of Beersheba.—During the night of Oct. 30–31 the assaulting infantry and artillery moved some 8m. to their positions of deployment, while the mounted troops undertook a ride of over 25m. to reach a position east of Beersheba These long and complicated night movements were only made possible by careful preparation and good staff work. At dawn on Oct. 31 the attack of the 20th Corps commenced. A Turkish forward work, Hill 1030, had to be taken, to allow the artillery to get within wire-cutting range of the main position. Hill 1030 was taken at 8.30 A.M.; the main assault was delivered at 12.15 P.M. and was successful; by early afternoon the British infantry were masters of the Turkish defences south-west of the town; they were still, however, some miles from the town itself. Meanwhile, the mounted troops, after closing the Hebron road, had been held up by a Turkish strong point at Tel es Saba, 3m. east of Beersheba When this was at last taken, little time remained if the town was to be captured before dark. Gen. Chauvel accordingly ordered a mounted attack at 4 P.M. The 12th Australian Light Horse Brigade charged over the Turkish trenches and rode straight into the town. This daring and well-executed charge resulted in the capture of over 1,100 prisoners and 10 guns, and saved the all-important wells from demolition. The infantry had captured another 900 prisoners, and the Turkish 27th Division had suffered practical annihilation. While the preparations for the decisive attack on the Turkish left were being made, the 21st Corps carried out a holding attack at Gaza on the night of Nov. 1–2 A considerable portion of the Gaza defences was carried and heavy losses caused to the Turks

Left to themselves, the Turkish commanders would now probably have retired to a fresh position while there was yet time But Falkenhayn, imbued with German principles of defence and ignorant of the qualities of the Turkish troops he led, ordered a counter-attack with all available reserves to the north of Beersheba. This led to three days' heavy fighting against the British 53rd Division, which had been sent into the hills to guard the right flank of the 20th Corps. The 53rd Division held its own; consequently, when at dawn on Nov. 6 the remainder of the 20th Corps (10th, 60th and 74th Divisions) attacked and broke through at Abu Hureira, the Turks had no reserves to restore the situation By nightfall Gaza was being evacuated and the whole Turkish force was in full retreat

The pursuit by Allenby's mounted troops was hampered by lack of water, and the Turkish rear-guards were well handled A gallant charge at Huj on Nov 8 by some squadrons of Worcestershire and Warwickshire Yeomanry captured three batteries of guns; but no large bodies of Turks were cut off, and the supply question limited the number of divisions which could be used in the pursuit

On Nov. 11 the Turks took up a position to cover Junction Station, where the railway to Jerusalem branches off the main line. After a short pause to organize for attack, Allenby's pursuing troops attacked on Nov 13 and soon dislodged their enemy, in an action remarkable mainly for a dashing charge by a brigade of yeomanry on a strongly held hill above the village of El Mughaiyir On the following day Junction Station was captured; Jaffa was occupied on the 16th The capture of Junction Station definitely divided the Turkish armies; the 7th was left in the hills to defend Jerusalem, while the 8th was in the plain to the north of Jaffa; there was no good communication between the two armies south of the line Tul Karm-Nablus

Before Jerusalem.—Allenby had originally intended to wait until the development of his communications allowed of his whole force being brought up before turning into the difficult hills towards Jerusalem. He now decided to oppose the Turkish 8th Army with a detachment, while with the remainder of his force he turned east and advanced on Jerusalem at once. It was a bold decision, since he had only three infantry and two mounted divisions immediately available, and the supply of these strained the resources of his transport to the utmost; the troops available had already done much hard marching and fighting; little was known of the hill country save that it was very difficult and that there was only one road fit for wheels. The Anzac Mounted Division and the 54th Division were left to hold the Turkish 8th Army in the plain, while the remaining three divisions advanced into the hills, the 75th up the main road, the 52nd on its left and the Yeomanry Mounted Division on the left of the 52nd. Both these two latter divisions were entirely dependent on pack transport. The intention was to pivot on the 75th, when that division arrived within a certain distance of Jerusalem, and to swing the left across the Jerusalem–Nablus road north of the city. It was hoped thus to compel the surrender or withdrawal of the defending Turks and to avoid fighting in vicinity of the Holy City.

There was some hard fighting on Nov. 20 and 21; the 75th Division captured the crest of the ridge at Enab in a fog on Nov.

20 and on the 21st stormed the commanding hill of En Nabi Samweil; the 52nd made similar progress; and the yeomanry were at one time within a short distance of the Nablus road. But the British effort had shot its bolt; the men were suffering much from cold and wet, and the artillery support available was insufficient against strong prepared positions. The yeomanry were counter-attacked and driven back, and the 52nd and 75th could make no headway; by Nov. 24 it was evident that without fresh troops and a period of preparation Jerusalem could not be taken. The difficult passes through the hills had, however, been secured and the boldness of the advance justified.

A pause now took place while the British army improved its communications and thus enabled the 20th Corps to be brought up from Gaza, where it had been left for convenience of supply. It took over the line opposite Jerusalem, releasing the troops which had made the first attempt to strengthen the line in the plain. Falkenhayn during this period ordered small local counter-attacks all along the line in the hope of disorganizing Allenby's plans. But these attacks had no effect and merely wasted the best remaining elements of the Turkish force

The second attack on Jerusalem was delivered at dawn on Dec. 8, in mist and rain. The brunt of the fighting fell on the 60th (London) Division, assisted on the left by the 74th Division and on the right by the 53rd Division, which had previously moved up from Beersheba along the Hebron road to within striking distance. By the evening the Turks had decided to withdraw, and the city surrendered next morning Allenby made an official entry on Dec. 11. His brilliant campaign effectively removed all danger to Baghdad from the Yilderim army, the whole of which had of necessity been used in Palestine. The last reserves of Turkish man-power were practically exhausted; and Turkey was now in a far worse plight than when Germany had, at the commencement of 1917, undertaken the re-establishment of her military prestige by driving the British out of Baghdad. Falkenhayn had completely failed to grasp either the conditions of the theatre or the idiosyncrasies of Turkish troops. He was replaced early in 1918 by Liman von Sanders.

Rising of the Arabs.—The encouragement given by the British success to the Arab revolt caused an additional drain on Turkish resources The Arab revolt had broken out a year previously, when Hussein, the Sherif of Mecca, induced the Hejaz to rise against the Turk. Jeddah and Mecca were soon captured, but the Medina garrison held out. The revolt would probably have ended in the re-establishment of the Turks, or in desultory warfare with little result, had there not appeared a young Englishman with an understanding of the Arabs and a gift for guerrilla tactics. As Col. Lawrence he became famous. He persuaded Feisal, a son of Hussein, who led the Arab forces in the field, that the true policy lay not in assaults on the Turkish garrison in Medina, which if successful would merely rid the Turks of an embarrassment, but in gradually spreading the revolt northward up to the very gates of Damascus, with propaganda as the principal weapon, and in ceaseless raiding on the long exposed Turkish communications to Medina, which would form a constant drain on the enemy's resources.

In pursuance of this policy, Feisal, with Lawrence as his adviser, moved his base of operations from opposite Medina, first to Wejh and next to Akaba, which Lawrence had captured by a dashing raid. Gen. Allenby was quick to realize the service which the Arab rising was rendering to his operations, and was always sympathetic to Lawrence's requests for equipment or other aid.

Allenby's next aim was obviously to secure sufficient room for manoeuvre in front of Jerusalem in the hills and Jaffa in the plain. On Dec. 20 and 21 the 52nd Division forced a passage of the river El 'Auja, and drove the Turks 8m. north of Jaffa, thus improving the position in the plain. In the hills, all preparations had been made for an operation to drive the Turks farther from Jerusalem, when information was received that the Turks themselves were about to attack. Reinforcements, including the 1st Division, had reached them, and Falkenhayn was determined on an attempt to recapture the Holy City. The attack was pressed with great gallantry on Dec. 26, but made no impression; on the following days the counter-attack of the British 20th Corps carried them some 5 or 6m. forward and safeguarded Jerusalem from the north. Later, the eastern flank was secured by the capture of Jericho, which took place on Feb. 21. Early in March, the line was pushed still farther north, both in the hills and in the plain, by a series of small operations Thus by the spring a strong line had been secured, which might have been held by a reduced force in the exhausted state of the Turks

Plans for 1918.—Meanwhile, the future of the Palestine campaign in the general plan of the Allies for 1918 had become the subject of considerable discussion In view of the expected great German offensive in the West, there was a considerable body of opinion amongst those who directed the Allied strategy in favour of closing down as far as possible all commitments in minor theatres and of concentrating on the vital Western Front all reinforcements that could be spared from them It was also pointed out that the maintenance of large forces on the Palestine front entailed heavy losses in shipping—which was likely to prove the Achilles' heel of the Allies—since the submarine menace was especially serious in the Mediterranean

On the other hand, it was believed by many that neither side could force an issue on the Western Front, so formidably entrenched, and that the war could be won by the elimination of Germany's weaker Allies. They held that one more blow would force exhausted Turkey to sue for peace, and consequently advocated a further offensive in Palestine This policy was eventually adopted Two divisions, the 3rd and 7th Indian, were moved from Mesopotamia to reinforce Allenby's army, and all preparations for a fresh great offensive were being made, when the storm broke on the Western Front The success of the German offensive of March 21 caused a demand on Allenby for all the troops he could spare, which of course necessitated the postponement of his operations. During April and May, two complete divisions (the 52nd and 74th), 24 additional British battalions, nine regiments of yeomanry and 5½ heavy batteries were withdrawn from the Egyptian Expeditionary Force and despatched to France. These were gradually replaced by Indian cavalry from France and Indian units from India, and the Egyptian Expeditionary Force was reorganized on an Indian basis. It required much training and organization to weld all these new, and in some cases raw, units into an effective whole; but by the end of the summer the Egyptian Expeditionary Force was again ready to strike a decisive blow.

Preliminary Operations in 1918.—Meanwhile, in March and May, Allenby had carried out two raids to the east of the Jordan. These raids were an important part of his strategical plan He had decided that his next great advance should be initiated from his left flank along the coastal plain, where his great superiority in the mounted army could be exploited Therefore, the more of the Turkish army he could draw over to the opposite flank, east of the Jordan, the easier would it be to break through on the coast when the time came The railway junction at Deraa was a vital point in the Turkish communications If the Turkish command could be persuaded by demonstrations east of the Jordan that a move in force up the Hejaz railway was a possibility, and if Feisal's Arabs could be encouraged to attack Deraa and the railway where it ran down the Yarmuk valley, the Turks would be obliged to move troops east of the Jordan With these objects the raids east of the Jordan were undertaken Neither was a complete tactical success The first raid reached the railway near Amman and cut it in several places, but failed to capture Amman before supply difficulties caused by vile weather necessitated its withdrawal. In the second raid, the mounted troops reached Es Salt; but the Turks could not be driven from their strong positions in the Shunet Nimrin pass; and the defeat of the left flank guard of the mounted troops, with the loss of nine guns, compelled their withdrawal from Es Salt.

But the two raids had the desired effect of seriously alarming the Turks for their left flank. After the second, Liman von Sanders, who was now in command, had been induced to place one-third of his total force east of the Jordan, with a corresponding weakening of his forces west of the Jordan Allenby kept

alive the opposing commander's fears for this flank by maintaining throughout the summer, in spite of the heat, a considerable force in the valley of the Jordan. In July the German units operating with the Turks made an abortive attack on part of the position of the Desert Mounted Corps

IV. SYRIA

At the end of the summer of 1918 the Turkish forces were distributed as follows, on a front of 65m.: the 8th Army (five divisions and three German battalions), in the coastal plain and the foothills, faced the British 21st Corps; the 7th Army (four divisions), in the Judaean hills astride the Nablus road, faced the British 20th Corps; while the 4th Army (two divisions, one cavalry division, and one composite division), in the Jordan valley and east of the Jordan, was opposed to the Desert Mounted Corps. The total fighting strength of the Turks amounted to 32,000 rifles, 3,500 sabres, 350 guns; and that of the British to 57,000 rifles, 12,000 sabres, 540 guns.

Gen. Allenby's plan was the reverse of that of the Gaza-Beersheba battle; then, he had struck the Turkish left while persuading them that his real effort was to be made along the coast against their right; now, he proposed to advance along the coast, while deceiving the Turks into thinking that their left flank was threatened. Steps were skilfully taken to simulate a concentration of troops in the Jordan valley, whereas in fact only a skeleton force, the Anzac Mounted Division and a few battalions, was left there. The real concentration was being secretly made in the coastal plain, to which the bulk of the Desert Mounted Corps and the 60th Division of the 20th Corps were transferred For the success with which this concentration was concealed from the Turks to the last, British superiority in the air was largely responsible

A simple statement in figures shows how well Allenby had succeeded in obtaining an overwhelming superiority of force at the decisive point. When his concentration was complete, he had on a 15m. front in the coastal plain 35,000 infantry and 400 guns against only 8,000 Turks with 130 guns; and behind that mass of infantry were three cavalry divisions waiting to exploit success On the remaining 45m. of front he left only 22,000 infantry with 150 guns, facing 24,000 Turks with 270 guns. The Turks were still unaware of his intentions or of the distribution of his force

The September Offensive.—The attack was made at 4 30 A M. on Sept. 19. The preliminary bombardment lasted only 15 min., and the infantry assault, pushed at great speed and in overwhelming strength on a broad front, was rapidly successful By 7.30 A M. the leading cavalry division was through the enemy's lines. The orders to the mounted troops were to ride straight north, disregarding any hostile troops that did not directly bar their path, cross by the passes near Megiddo into the Plain of Esdraelon, and secure El Affule and Beisan to block the Turkish lines of retreat.

The leading troops of the 5th Indian Cavalry Division reached Nazareth, Liman von Sanders' headquarters, just 24 hours after their start, having covered 52m ; they failed only by accident to capture the person of the enemy commander-in-chief. The 4th Cavalry Division, moving farther to the east, covered 70m to Beisan in 34 hours. The advance was carried out with great dash and there were several instances of successful mounted attacks. A regiment of the 5th Cavalry Division rode over a Turkish battalion in the Plain of Esdraelon; and a brigade of the Australian Mounted Division galloped into the village of Jenin, occupied by a numerous force of Turks and Germans, thus sealing one of the main exits from the trap in which the Turkish 7th and 8th Armies were now caught Meanwhile the British infantry of the 21st Corps, after breaking through the Turkish fortified system in the plain, had wheeled to the right and driven the remnants of the Turkish 8th Army into the hills The 60th London Division (Maj.-Gen. Shea) actually reached Tulkeram before dark on the 19th, having fought and marched 18m. over very heavy going.

During the two days following Sept. 19 the 21st Corps continued to press their pursuit, while the 20th Corps also pushed forward along the Judaean hills to Nablus. The infantry of these two corps thus shepherded the straggling remains of the Turkish 7th and 8th Armies into the hands of the mounted troops. The Royal Air Force, with bombs and machine-gun fire, caused havoc amongst the bewildered Turkish transport, penned in and crowded on narrow hill roads. Only a few of the most determined Turks and some of the better fed and disciplined German units managed to break out to the east and cross the Jordan. The Germans fought well throughout the retreat.

Meanwhile, the Turkish 4th Army had remained inactive, ignorant of the fate of the other armies. On the 22nd it began a hurried retreat on Amman, hoping thence to escape up the Hejaz railway to Damascus. It paused at Amman till Sept. 25, awaiting the arrival of the Maan garrison from the south. But the 4th Army was now not only too late to rescue this force, but too late to secure its own safety. Feisal's Northern Arab Army was already between it and Damascus, and the whole countryside was rising against the Turks. The Arabs under Lawrence had already contributed largely to the discomfiture of the Turks by their raids on the lines of communication near Deraa, which they cut effectively from Sept. 17 onwards. They were thus in a position to delay and harass the 4th Army in its march north

The Final Victory.—The Turkish 7th and 8th Armies having been disposed of, Allenby ordered a part of his mounted troops to occupy Haifa, which was captured on Sept. 23 by a most gallant charge of the Indian Imperial Service Brigade. The remainder were despatched east and north-east to cut off the 4th Army and to capture Damascus The 4th Cavalry Division was to cross the Jordan near Beisan and move on Deraa, while the Australian Mounted Division was to make direct for Damascus by the road which runs from Nazareth to the west of Lake Tiberias, crossing the Jordan at Jisr Benat Yakub On Sept. 25 there was a fierce fight at Tell es Semakh at the southern end of Lake Tiberias The 4th Australian Light Horse Brigade charged in the dark over unknown ground and captured the village after hand-to-hand fighting with a force composed largely of Germans.

The Turkish 4th Army passed Deraa before the 4th Cavalry Division could head it off, but under pressure from this division and from the Arabs it gradually disintegrated. The end came on Sept. 30, when the Australian Mounted Division, which on Sept 28 had overcome some determined opposition to its crossing of the Jordan, succeeded in getting astride the Damascus-Beirut road just outside the city, cutting off the remains of the 4th Army Damascus was occupied next day, Oct 1. Immediately after the capture of Damascus, malaria and influenza broke out and placed a great proportion of the British mounted forces out of action It also seriously affected the very numerous Turkish prisoners

There was now no formidable Turkish force in southern Syria To complete its occupation, two columns advanced The 7th Division left Haifa on Oct 1 and moved up the coast to Beirut, which it reached on the 8th, and then on to Tripoli, which was occupied on the 18th; the 5th Cavalry Division, which though less affected by malaria and influenza than other formations, was considerably below establishment, advanced from Damascus by Homs (Oct. 16), Hama (Oct 20) to Aleppo, which was occupied on Oct. 26. The last fighting took place north of the town on the 28th On the 31st an armistice was concluded. Between Sept 19 and Oct 26 the British army had moved its front forward a distance of 360 miles. During this period the 5th Cavalry Division had actually covered over 500 miles. The captures included 72,000 Turks and nearly 4,000 Germans and Austrians, 350 guns, 800 machine guns, and large quantities of transport and other material. History records few victories, if any, more striking and complete

Conclusions.—These campaigns of the Egyptian Expeditionary Force are of great strategical interest. For the military student they will always remain classic examples of the use of mounted troops and of the value of mobility. Conditions of war change, and it may be that some mechanical form of transport will entirely replace the horse as the means by which mobility can be secured But the power of mobility as a strategical weapon in the hands of a commander who has the knowledge and the determination to use it as did Gen. Allenby will only be enhanced. A second strategical lesson is the advantage gained by a commander who can conceal his intentions from his opponent In

both his great battles against the Turk, Allenby completely deceived his adversary as to his plans, and had thus secured a decisive superiority before the battle was joined. Only constant foresight and careful preparation can effect this. Air superiority is a factor of increasing importance in this question of concealment of plans and movements.

Finally, the dependence of all strategy on the communications may be stressed. The Turks added to the initial handicap which their long and difficult lines of communication imposed on them by their neglect to improve these and by the inefficiency of their working. Falkenhayn, during his command, entirely failed to adapt his strategy to the limitations necessitated by his means of transport. On the British side, the greatest care was devoted to developing the communications in accordance with the strategical plan, and the supply services were thus able to cope even with such problems as were presented by the rapidity of the advance to Damascus and Aleppo.

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PALESTRINA, GIOVANNI PIERLUIGI DA (1526–1594), Italian composer, was born in Palestrina (the ancient Praeneste), at the foot of the Sabine mountains, in 1526. He appears in the musical publications and other documents of his day under all manner of designations derived from his birthplace and his baptismal names. The full Latin signature is Joannes Petraloysius Praenestinus; and the most elusive designation is Gianetto, which has sometimes concealed the authorship of a first-rate Palestrina madrigal.

Palestrina seems to have been at Rome from 1540 to 1544, when he is supposed to have studied under Gaudio Mell, a person of doubtful identity, but not to be confused with Goudimel. On June 12 Palestrina married Lucrezia de' Goris. By Lucrezia Palestrina had four sons, three of whom died after showing early promise in compositions published in an earlier volume of their father's works. (Of the three, Ridolfo, Sylla and Angelo, it is thought that Sylla may be a brother or cousin.) The surviving son, Igino, is not viewed with favour by the biographers, who ascribe to him unworthy motives for the publication of certain posthumous works which his father is supposed to have wished suppressed.

Palestrina, more than any other composer, except Victoria and Morales, devoted himself whole-heartedly to the service of the Church, and aimed at the perfect harmony of musical art, not only with the spirit of Catholic devotion, but with liturgical convenience in the humblest practical matters. Palestrina's official career as a composer under papal protection began in 1551, when Julius III. had him appointed magister cappellae and magister puerorum at the Cappella Giulia, S. Pietro in Vaticano. Three years later Palestrina published, and dedicated to Pope Julius, his first book of masses. The *Missa Ecce sacerdos* is a noble, if long-winded work, and other masses in the volume show that Julius had chosen one of the greatest composers of his day as an object of his protection. (The beautiful *Missa Pro Defunctis* was added to later editions.)

In 1555, on Jan. 13, Julius appointed Palestrina a singer in the Sistine chapel. Palestrina's friend, Animuccia (*q.v.*) succeeded him at the church of S. Giulia. Palestrina enjoyed this position for only seven months. Five weeks after Palestrina's appointment Julius died; his successor, Marcellus II., reigned for 23 days, and was followed by Paul IV. who, at the end of July, began setting his house in order by pensioning off Palestrina and two other married members of the Sistine choir. A few months later Palestrina was appointed choir-master of the church of St. John Lateran, but this did not prove to be a full compensation for the loss of his position in the Sistine chapel.

During Palestrina's tenure of his post at St. John Lateran, which he gave up in 1558, he composed a book of Lamentations (*i.e.*, settings of the Holy Week lessons from the Lamentations of Jeremiah) and a book of Magnificats for all the eight Ambrosian tones or modes. Neither of these books was published till long after Palestrina's death, and the elaborate Magnificats with their numerous canonic movements in Flemish style were hardly known at all until their inclusion in the modern edition of Palestrina's complete works in score published by Breitkopf and Härtel. Palestrina's famous Lamentations, used in the Sistine chapel and known as his first book, are really his third and last book, being published in 1588. From the earlier period, however, comes an opusculum of enormous importance, closely allied to the later Lamentations in its syllabic declamation, its note-against-note harmony, and its profoundly devout pathos. This is the Improperia, sung on Good Friday. The Improperia immediately made a profound impression, and Pope Pius IV. ordered a copy to be made for the Sistine chapel. Palestrina accordingly began again to compose specially for the Papal choir; and in the *Missa Ut Re Mi Fa Sol La* we find the perfectly mature Palestrina style in a work constructed on the quaintest of Flemish formulas.

The first of Palestrina's four books of masses was republished in 1591 with the addition of a *Missa Pro Defunctis*, a very beautiful work in which no attempt is made to set the *Dies irae*, and a *Missa Nasce la gioja mia*.

The *Missa Papae Marcelli* appeared in 1567 as the last item in Palestrina's second book of masses. The volume is dedicated to the king of Spain; and in the dedication Palestrina says that, following the advice *gravissimorum, et religiosissimorum hominum*, he has given his best energies to the composition of masses *novo modorum genere*. Dr. Knud Jeppesen, in his treatise *Palestrina and the Dissonance* (Copenhagen and Oxford, 1927), has pointed out exactly where the problem lay, if Palestrina was not to reduce the whole music of the mass to note-against-note harmony or *falsobordone* like his Improperia and Tallis's Responses. Simple statistics show that, whereas in earlier masses Palestrina develops his polyphony so that the voices are hardly ever singing the same words together, in the *Missa Papae Marcelli* each clause of the text is heard in the highest voice, or in several voices simultaneously before the polyphony is allowed to make the clauses overlap, and this is a general feature of Palestrina's mature style.

Yet there was no need for Palestrina to write a work specially to meet this demand. He had already formed the style for it, and his reference to masses *novo modorum genere* applies to six other masses besides the *Missa Papae Marcelli*. The Improperia had already revealed him as the greatest master of harmonic colour in note-against-note declamation; this very mastery made him content to write most of his early madrigals in a homophonic style which rash critics might deem primitive; he was, on the other hand, a polyphonist to whom canonic devices were a child's play, the rules of which it was no trouble to follow and no sin to disregard. Any volume of Palestrina's works would have revealed to the cardinals that here was the man they needed. Every volume, except the earliest, contained works of more than one period: Palestrina published his works, not when he wrote them, but when he could afford to publish them, as the dedication of his First Book of Lamentations (really his last) plaintively shows.

The third book of masses, which appeared in 1770, shows at least three styles. It is difficult to suppose that the *Missa Repleatur os meum* can be anything but an early work; it is the heaviest and, for the most part, the dullest music Palestrina ever wrote. The materials of *Missa Brevis*, the *Missa De Feria* (a quiet work without Gloria and Credo), the *Missa L'Homme Armé*, and the above-mentioned *Missa Ut Re Mi Fa Sol La*, show how futile is any attempt to guess the quality of Palestrina's work from its theoretic or formal origins. *L'Homme Armé* is the notorious old tune on which Flemish composers based puzzles; and Palestrina bases on it an encyclopaedia of rhythmic problems. Yet his result here, and in the obviously ridiculous scheme of *Ut Re Mi Fa Sol La* is of the quality of the *Missa Brevis* and not far below the *Missa Papae Marcelli* itself.

In 1571 Palestrina was reappointed as choir-master of St. Peter's, on the death of Animuccia. In 1577 Gregory XIII. commissioned Palestrina and his colleague, Zoilo, to "purify" the musical text of the liturgical (or Gregorian) chant. It is not surpris-

ing that Palestrina, and his colleagues and successors in the task, conceived that to purify was to simplify. The Spaniards knew better, and protested. Palestrina's share in the work soon ceased; but the Palestrinian tradition of plain-chant remained official until the musical liturgiologists of Solesmes restored the ancient style at the beginning of the 20th century. (*See* MUSIC, sec. 3.)

Palestrina's fourth book of masses appeared in 1581. In this volume alone do we see traces of ecclesiastical interference.

In 1584 appeared Palestrina's wonderful setting of the Song of Solomon, in 29 motets, which he describes in his dedication as of a "genus alacrior," while he deplores that he had ever sung of a profaner love. Neither madrigals nor motets can give a complete view of Palestrina if this unique work, which is neither liturgical nor secular, is unknown. Like all Palestrina's music, it is practically difficult to know; the work cannot be appreciated in less than its entirety; and its entirety is that of a bound volume of a magazine. There is no occasion on which it can be performed as a whole in public. We must live with it, and form ourselves into groups of singers who can produce it among themselves.

The famous book of Lamentations, known as the first book, appeared in 1588, with a dedication to Pope Sixtus V. in which Palestrina complains of the poverty which compels him in his old age to publish this work in a small format and to leave many other things unpublished. The latter complaint is nobly justified by the enormous number and importance of his posthumous works. He published six books of masses. His son, Igino, published the seventh; but another seven posthumous volumes followed year by year, and late in the 19th century Haberl filled yet another volume with some of Palestrina's greatest works.

A set of hymns for the whole year appeared in 1589. They are severe and elaborate compositions, treating the themes of the plain-chant in close fugue. Only the alternate stanzas are set, the rest being left to unharmonized plain-chant.

It is possible that the *Missa Pro Defunctis,* which appears in the 1591 edition of the First Book of Masses may have been written for Sixtus V., who died in 1590. The *obiter dicta* of this pontiff, as cited by Brini, have given a bad reputation to the harmless *Missa Tu et pastor ovium,* and have not exaggerated the glories of the *Missa Assumpta est Maria.* During the two years' pontificate of Gregory XIV., Palestrina produced a double set of Magnificats in the eight tones, on the lines of his hymns, one set giving the odd verses in polyphony, and the other set the even. In 1593, in the reign of Clement VIII., Palestrina dedicated to the abbé Anton Baume another great volume of Offertories for the whole year, in his finest motet style. His last publication was a book of Madrigali Spirituali, also one of his greatest and most deeply felt works. He was preparing a seventh volume of masses when he died on Feb. 2, 1594.

It is immensely significant that the interest in an almost homophonic harmonic colour was already present in Palestrina's early madrigals, while at the same time he was capable of absorbing himself in abstruse Flemish puzzles. Facile he never was; and his weaker works are heavy. Haberl, in speaking of the *First* (really the last) *Book of Lamentations,* finely characterizes Palestrina's special power as "the capacity to remain true to a fundamental mood." The range of Palestrina's fundamental moods is wide. The despair of Job has never found deeper and truer expression than in Palestrina's *Paucitas dierum* in the Fifth Book of Motets; nor has any more glorious music than that of *Dum complerentur* in the Second Book of Motets been made to tell us of the ecstasy that came with the mighty rushing wind and fiery tongues of Pentecost. And it is all achieved in and by a style which is the quintessence of purity. The severest discipline of present-day academic counterpoint has no more to do with it than Tertullian's Latin has with the style of Virgil. R. O. Morris has shown, in *The Technique of Counterpoint* (Oxford University Press), how far our school teaching has travelled from the true Palestrina discipline; and Jeppesen, in the work above cited, shows how minutely accurate Palestrina's obedience to his own discipline is. And this is not asceticism. It denies itself nothing; for it is God-intoxicated and its peace is in the Will that inspires it.

Palestrina's works, as contained in the complete edition published by Breitkopf and Härtel, comprise 256 motets in seven volumes, the last two consisting largely of pieces hitherto unpublished, with one or two wrongly or doubtfully ascribed to Palestrina; 15 books of masses, of which only six were published in Palestrina's lifetime, the seventh being incompletely projected by him, and the 14th and 15th first collected by Haberl in 1887 and 1888; three books of magnificats, on all the customary tones; one volume of hymns; one volume (two books) of offertories for the whole year; a volume containing three books of litanies and several 12-part motets; three books of lamentations; a very large volume of madrigals containing two early books and 30 later madrigals collected from mixed publications; two books of *Madrigali spirituali,* and four volumes of miscellaneous works, newly discovered, imperfectly preserved and doubtful. The fourth volume of motets contains the Song of Solomon; and the fifth volume is a collection designed for use throughout the Church year.

(D. F. T.)

PALEY, FREDERICK APTHORP (1815–1888), English classical scholar, born at Easingwold, Yorks., was the grandson of William Paley and was educated at Shrewsbury and St. John's College, Cambridge. His conversion to Roman Catholicism forced him to leave Cambridge in 1846, but he returned in 1860 and resumed his work as a "coach," until in 1874 he was appointed professor of classical literature at the newly founded R.C. University at Kensington. This was closed in 1877 for lack of funds, and Paley removed to Boscombe, where he died on Dec. 8, 1888. His most important editions are: Aeschylus, with Latin notes (1844–47; 4th ed., 1879), Euripides (2nd ed., 1872), Hesiod (2nd ed., 1883), Homer's *Iliad* (2nd ed., 1884), Sophocles, *Philoctetes, Electra, Trachiniae, Ajax* (1880)—all with English commentary; select private orations of Demosthenes (3rd ed., 1896–98); Theocritus (2nd ed., 1869). He possessed considerable knowledge of architecture, and published manuals of *Gothic Architecture* (1846) and *Gothic Mouldings* (6th ed., 1902).

PALEY, WILLIAM (1743–1805), English divine and philosopher, was born at Peterborough. He was educated at Giggleswick school, of which his father was head master, and at Christ's College, Cambridge. He graduated in 1763 as senior wrangler, became fellow in 1766, and in 1768 tutor of his college. He lectured on Clarke, Butler and Locke, and also delivered a systematic course on moral philosophy, which subsequently formed the basis of his well-known treatise on the *Evidences of Christianity.* The subscription controversy was then agitating the university, and Paley published an anonymous *Defence* of a pamphlet in which Bishop Law had advocated the retrenchment and simplification of the 39 Articles. In 1776 he was presented to the rectory of Musgrave in Westmoreland, supplemented at the end of the year by the vicarage of Dalston, and presently exchanged for that of Appleby. In 1782 he became archdeacon of Carlisle. At the suggestion of his friend John Law (son of Edward Law, bishop of Carlisle and formerly his colleague at Cambridge), Paley published (1785) his lectures, revised and enlarged, under the title of *The Principles of Moral and Political Philosophy.* The book at once became the ethical text-book of the University of Cambridge, and passed through fifteen editions in the author's lifetime. He strenuously supported the abolition of the slave trade, and in 1789 wrote a paper on the subject. *The Principles* was followed in 1790 by his first essay in the field of Christian apologetics, *Horae Paulinae, or the Truth of the Scripture History of St. Paul evinced by a Comparison of the Epistles which bear his Name with the Acts of the Apostles and with one another,* probably the most original of its author's works. It was followed in 1794 by the celebrated *View of the Evidences of Christianity.* Paley's latitudinarian views are said to have debarred him from the highest positions in the Church, but he became a canon of St. Paul's, subdean of Lincoln, and rector of Bishopwearmouth. During the remainder of his life his time was divided between Bishopwearmouth and Lincoln. In 1802 he published *Natural Theology, or Evidences of the Existence and Attributes of the Deity collected from the Appearances of Nature,* his last, and, in some respects, his most remarkable book. He died on May 25, 1805.

The face of the world has changed so greatly since Paley's day that we are apt to do less than justice to his undoubted merits. He is nowhere original, and nowhere profound, but his strong reasoning power, his faculty of clear arrangement and forcible statement, place him in the first rank of expositors and advocates.

For his life, *see* Lives, by G. W. Meadley (1809) and his son Edmund Paley, prefixed to the 1825 edition of his works; Leslie Stephen in *Dictionary of National Biography; Quarterly Review, ii.* (Aug. 1809), ix. (July 1813). On Paley as a theologian and philosopher, *see* Leslie Stephen, *English Thought in the Eighteenth Century*, i. 405 *seq.*, ii. 121 *seq.*; R. Buddensieg, in Herzog-Hauck's *Realencyklopädie für protestantische Theologie*, xiv. (1904).

PALFREY, JOHN GORHAM (1796–1881), American historian, was born in Boston, Mass., on May 2, 1796. He graduated at Harvard, 1815, and became pastor of the Brattle Square Unitarian church, Boston, 1818–31. He was professor of sacred literature in the Harvard divinity school, 1830–39. Entering politics, he was secretary of State of Massachusetts, 1844–47; a representative in Congress, 1847–49; and postmaster of Boston, 1861–67. He was editor of the *North American Review*, 1835–43. As a writer he is best known by his *History of New England to the Revolutionary War* (1858–60). He died at Cambridge, Mass., on April 26, 1881.

PALGHAT, a town of British India, in the Malabar district of Madras on a short branch of the Madras railway from Olavakhot. Pop (1921), 45,487. As the key to Travancore and Malabar from the East, it was formerly of considerable strategic importance. The fort fell into British hands in 1768, and subsequently formed the basis of many of the operations against Tippoo. The easy ascent by the Palghat pass affords the chief route from the west coast to the interior. There is a government college.

PALGRAVE, SIR FRANCIS (1788–1861), English historian, was the son of Meyer Cohen, a Jewish stockbroker, and was born in London in July 1788. He edited several volumes for the Record Commission. In 1832 he was knighted, and he became deputy-keeper of the public records in 1838, holding this office until his death at Hampstead on July 6, 1861. Palgrave's most important work is his *History of Normandy and England* (4 vols. 1851–1864), which deals with the history of the two countries down to 1101.

He also wrote *History of England, Anglo-Saxon Period* (1831); *Rise and Progress of the English Commonwealth* (1832); *Essay upon the original Authority of the King's Council*, etc. His collected historical works were edited by his son, Sir R. H. I. Palgrave, in 1919.

PALGRAVE, FRANCIS TURNER (1824–1897), English critic and poet, eldest son of Sir Francis Palgrave (*q.v.*), was born at Great Yarmouth, on Sept. 28, 1824. He was educated at Charterhouse, and at Balliol College, Oxford. In 1846 he interrupted his university career to serve as assistant private secretary to Gladstone, but returned to Oxford the next year, and took a first class in Literae Humaniores. From 1847 to 1862 he was fellow of Exeter College, and in 1849 entered the Education Department at Whitehall. In 1850 he became vice-principal of Kneller Hall Training College at Twickenham. There he came into contact with Tennyson, and laid the foundation of a lifelong friendship. When the training college was abandoned, Palgrave returned to Whitehall in 1855, becoming examiner in the Education Department, and eventually assistant secretary. He married, in 1862, Cecil Grenville Milnes, daughter of James Milnes-Gaskell. In 1885 he succeeded John Campbell Shairp as professor of poetry at Oxford. He died in London on Oct. 24, 1897. Palgrave published some volumes of poetry, *Visions of England*, (1880–81), *Amenophis* (1892), and others; but his work as a critic was by far the more important. His *Landscape in Poetry* (1897) showed wide knowledge and critical appreciation of one of the most attractive aspects of poetic interpretation.

But Palgrave's principal contribution to the development of literary taste was contained in his *Golden Treasury of English Songs and Lyrics* (1861), an anthology of the best poetry in the language constructed upon a plan sound and spacious, and followed out with a delicacy of feeling which could scarcely be surpassed. Palgrave followed it with a *Treasury of Sacred Song* (1889), and a second series of the *Golden Treasury* (1897), including the work of later poets, but in neither of these was quite the same exquisiteness of judgment preserved.

Among his other works were *The Passionate Pilgrim* (1858), a volume of selections from Herrick entitled *Chrysomela* (1877), a memoir of Clough (1862) and a critical essay on Scott (1866). *See* Gwenllian F. Palgrave, *F. T. Palgrave* (1899).

PALGRAVE, SIR REGINALD (1829–1904), became a solicitor in 1851; but two years later was appointed a clerk in the House of Commons, becoming clerk of the House on the retirement of Sir Erskine May in 1886. He was made a K.C.B. in 1892, retired from his office in 1900, and died at Salisbury on July 13, 1904. Sir Reginald wrote *The Chairman's Handbook; The House of Commons: Illustrations of its History and Practice* (1869); and *Cromwell: an appreciation based on contemporary evidence* (1890).

PALGRAVE, SIR ROBERT HARRY INGLIS, Kt. 1909 (1827–1919), British banker and economist, was born at Westminster on June 11, 1827, the son of Sir Francis Palgrave (*q.v.*). He was educated at Charterhouse and entered Barclay's bank at Yarmouth. In 1875 he was one of three representatives of the English issuing country bankers who gave evidence before the select committee on Banks of Issue. He edited *The Economist* from 1877 to 1883, and published many works on banking, as well as *The Local Taxation of Great Britain and Ireland* (1871). He edited *Palgrave's Dictionary of Political Economy* (1894–1906; new ed. 1925). He died at Bournemouth on Jan. 25, 1919.

PALIKAO, CHARLES GUILLAUME MARIE APPOLLINAIRE ANTOINE COUSIN-MONTAUBAN, Comte de (1796–1878), French general and statesman, was born in Paris on June 24, 1796. He served as a cavalry officer in Algeria, and captured Abd-el-Kader. He was promoted general of division and commanded the province of Constantine, receiving a home command in 1858. In 1859 he led the French troops in the joint French and British expedition to China. In 1862 Napoleon III. gave him the title of comte de Palikao. In 1865 he commanded the IV. army corps at Lyons. After the first disasters of 1870 had shaken the Ollivier ministry the empress regent made him minister of war, and he became president of the council (Aug. 10). He reorganized the military resources of the nation, and claimed to have created three new army corps, 35 new regiments, and 100,000 *gardes mobiles* in 24 days. His scheme to send the army of Châlons to raise the blockade of Metz ended with the disaster of Sedan. After the capitulation of the emperor the dictatorship was offered to Palikao, but he refused to desert the empire, and proposed a council of national defence. But the chamber was invaded by the mob, and Palikao fled to Belgium. In 1871 he published *Un Ministère de la guerre de vingt-quatre jours*. He died at Versailles on Jan. 8, 1878.

PALI LANGUAGE AND LITERATURE. *Pāli* was applied to the text of the Hīnayāna Buddhist scripture (*see* Buddhism) preserved in Ceylon. Used now for the language in which those texts were written, it usually includes the language of the subsequent commentaries and other writings. By some its meaning has been extended to cover all the cognate Middle Indian dialects found in the inscriptions and other documents. The present article will be confined to the language of the Pali canon and its commentary.

Origin.—The Aryan or Indo-Aryan branch of the Indo-European family of languages was introduced into India by invading tribes during probably the latter half of the second millennium B.C. The oldest document of this language, the Ṛgveda (*see* Sanskrit), was handed down only by an oral, though exceedingly exact, tradition. The first contemporary documents, however, the Inscriptions of Asoka (*q.v.*), are written in a dialect or dialects which, although clearly later forms of that of the Vedic texts, already show marked dialectical differences according to the districts in which they were set up. Although these date only from the middle of the 3rd century B.C., it is certain that even by the latter half of the 6th century B.C. (the probable period of the Buddha's preaching) the Aryan language had spread by conquest and infiltration over very considerable areas of northern India.

There were at this period two considerable kingdoms in the north and east of the Gangetic plain, one Kosala (corresponding roughly to modern Oudh), the other Magadha (corresponding to the districts of Patna and part of Gaya). Magadha later swallowed up Kosala. The Buddha himself, a native of Kosala, passed much of his ministry in Magadha; and it has been held that the language of the Pali texts was based upon the contemporary dialect either of Kosala or of Magadha, the latter view being in particular supported by the use of the term Māgadhī or language of Magadha applied to Pali. But even if original collections of the Buddha's sayings were handed down in the current dialect of Kosala or Magadha, they may have been subsequently re-edited or re-written in some other dialect. Others see the origin of the language of the existing texts in the dialect of some later centre of Buddhist learning, such as Takṣaśilā in the north-west or Ujjēnī (modern Ujjain), capital of Avanti in the west, the influence of which has been considered by others as predominant in the formation of the language.

Pali, in its earliest texts, is a language of mixed dialectical forms, some common to both north-western and eastern dialects; others peculiarly eastern. These may be due to the influence of an original recension in an eastern dialect or to the general influence of the eastern vernaculars on the other Indo-Aryan languages, especially during the predominance of the Mauryan empire with its eastern capital. Its main characteristics are those of a western dialect. Tradition has it that the Buddhist scriptures were brought to Ceylon by Asoka's son, Mahinda, who had spent his childhood in Ujjēnī. In Ceylon the study and the use of Pali, which died out in India, was prosecuted by the Buddhists and carried thence to Burma and Siam, where it still remains to some extent the language of literature or at least of religion.

Sounds.—Pali possessed the following sounds: Vowels: *a, ā, i, ī, u, ū, ē, ō*. Consonants: stops and nasals: gutturals: *k, kh, g, gh, ṅ;* palatals: *c, ch, j, jh, ñ;* cerebrals: *ṭ, ṭh, ḍ, ḍh, ṇ;* dentals: *t, th, d, dh, n;* labials: *p, ph, b, bh, m*. Liquids: *r, l, ḷ*. Semi-vowels: *y, v*. Sibilant: *s*. Aspirate: *h*. Undefined nasal: *ṁ*. This system derived with certain modifications from that of Vedic Sanskrit. Among the vowels Skt. *ai, au* became *ē, ō,* thus confused with original *ē, ō*. Skt. *ṛ* became *a* (and in some words *i* or *u*). Thus the three members of the characteristic vowel-alternations of Sanskrit were reduced to two: *i:ē, u:ō;* while that of *ṛ:ar:ār* was upset altogether. This system was further confused by the shortening of all Sanskrit long vowels in closed syllables, which caused, for example, the loss of all distinction between such pairs as Skt. *candráḥ*, "moon" and *cāndraḥ*, "lunar," since both became *candō*.

The Sanskrit consonants, as single sounds, remained in principle unchanged, except that all sibilants: *ś, ṣ, s* were confused under one form, *s*. On the other hand consonants in contact with each other were liable to change, a stop being assimilated to a following stop (*e.g., satta, duddhaṁ* from Skt. *saptá, dugdhám*) and a continuant to a following or preceding stop (*e.g., akkō, aggi* from Skt. *arkáḥ, agníḥ*). If the assimilated consonant was a sibilant, the resultant group was aspirated (*e.g., atthi, vacchō, acchi* from Skt. *ásti, vatsáḥ, ákṣi*). Lastly, all final consonants had disappeared (*e.g., vijju* from Skt. *vidyút*).

Nouns.—Its grammatical forms are clearly derived from Vedic Sanskrit. But the process of simplification and normalization has proceeded much further. In the declension of the noun the dual has disappeared, leaving only two numbers, singular and plural. Among the cases the dative has almost lost its separate existence, its place being taken by the genitive; and in general, chiefly through the action of sound-change, the number of cases with separate terminations has been greatly reduced. The declension in the singular of a feminine stem in *-ā* illustrates this:

	Sanskrit	Pali		Sanskrit	Pali
nom.	*kanyā̀*	*kaññā*	abl.	*kanyā̀yāḥ*	*kaññāya*
acc.	*kanyā̀m*	*kaññaṁ*	gen.	*kanyā̀yāḥ*	*kaññāya*
inst.	*kanyā̀yā*	*kaññāya*	loc.	*kanyā̀yām*	*kaññāya* or *-aṁ*
dat.	*kanyā̀yai*	*kaññāya*	voc.	*kánye*	*kaññe*.

Verbs.—The changes in the verbal system are still greater. The athematic stems of Vedic (in which the termination is added directly to the root) have been mostly replaced by thematic stems, in which the insertion of the vowel *a* preserves the individuality of both root and termination (*e.g., lēḍhi, lihánti* have been replaced by *lēh-a-ti, lēh-a-nti*). The middle voice is in process of disappearance. Among the moods, traces are still found in the oldest stratum of the subjunctive, but like the imperative and optative it is confined to the present stem. Of the tenses, the perfect has ceased to play any part in regular conjugation, while the imperfect and aorist have combined into one tense. The use of participial phrases in place of finite verbal forms is increasing.

Numerals.—In general the numeral system is that of Sanskrit, alterations in form being due to sound-change, rather than to the introduction of any new principle.

Gender.—Gender is grammatical and is divided into three categories: masculine, feminine and neuter—following the system of Sanskrit. But there is already some disturbance of the system. The neuter of the numerals for "two" and "three" is used sometimes with masculine and feminine nouns. A growing confusion between masculine and neuter stems presages the loss in most of the modern languages of all distinction between these genders.

Vocabulary.—The vocabulary, though based primarily on that of Vedic Sanskrit, shows changes and developments of meaning and the admission of new words. Some words of the modern languages make their first recorded appearance in Pali, *e.g., kaḍḍhati*, "drags" (replacing Skt. *kárṣati*) appears to-day in Panjabi *kaḍḍhe*, Hindi *kāṛhe*, etc. Later the growing influence of literary Sanskrit caused the inclusion of numerous new words of that language disguised under a Pali form.

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LITERATURE

The canonical texts of the literature of Pali are divided into three collections called *Piṭakas, i.e.*, baskets. This figure of speech refers not to a crate in which things can be stored, but to the baskets, used in India in excavations as a means of handing on the earth from one worker to another, hence to a *tradition*. The first *Piṭaka* contains the *Vinaya*—that is, Rules of the Order; the second the *Suttas*, giving the doctrine, and the third the *Abhidhamma*, analytical exercises in the psychological system on which the doctrine is based. These have now all, mainly through the work of the Pali Text Society, been published in Pali.

The *Vinaya* was edited in 5 vols. by H. Oldenberg; and the more important parts of it have been translated into English by Mrs. Rhys Davids and Oldenberg in their *Vinaya Texts*.

The *Sutta Piṭaka* consists of five *Nikāyas* (collections), four principal and one supplementary. The four principal ones have been published for the Pali Text Society, and nearly all have been translated into English. These four *Nikāyas*, 16 vols. in all, are the main authorities for the doctrines of early Buddhism. The fifth *Nikāya* is a miscellaneous collection of treatises, mostly very short, on a variety of subjects. It contains lyrical and ballad poetry, specimens of early exegesis and commentary, lives of the saints, collections of edifying anecdotes and of the now well known *Jātakas* or Birth Stories. This had by 1927 been edited for the Pali Text Society in 16 vols. by various scholars.

Of the seven treatises contained in the *Abhidhamma Piṭaka* all had by 1923 been published by the Pali Text Society, and three had been translated by Mrs. Rhys Davids, Mr. S. Z. Aung and Dr. B. C. Law. A description of the contents of these books in the canon is given in Rhys Davids' *American Lectures*, pp. 44–86.

As yet but little progress has been made in the historical criticism of these books. Out of the 29 works contained in the three *Piṭakas* only one claims to have an author. That one is the *Kathā Vatthu*, ascribed to Tissa the son of Moggalī, no doubt

identical with Upagupta, the teacher of Asoka, who presided over the third council held under Asoka. It is the fifth book of the third *Piṭaka.* All the rest of the canonical works grew up in the schools of the Order, and most of them appear to contain documents, or passages, of different dates. In the introduction to his edition of the *Vinaya,* Oldenberg has shown that there are at least three strata in the existing presentation of the Rules of the Order, the oldest portions going back probably to the time of the Buddha himself It seems probable that the *Vinaya* and the four *Nikāyas* were put substantially into the shape in which we now have them before the council at Vesāli, 100 years after the Buddha's death, that alterations and additions were made in them, and most of the five *Nikāyas* and the *Abhidhamma* books completed, at various times down to the third council under Asoka; and that the canon was then considered closed No evidence has yet been found of any alterations made, after that time, in Ceylon; but there were probably before that time, in India, other books, now lost, and other recensions of some of the above

Of classical Pali in northern India subsequent to the canon there is but little evidence Three works only have survived These are the *Milinda-pañha;* the *Netti Pakarana;* and the *Peṭakopadesa* The first belongs to the north-west, the others to the centre of India, and all three may be dated vaguely in the 1st or 2nd centuries A D They are the sole survivors of what must have been a vast and varied literature Prof Takakusu has shown the possibility of several complete books belonging to it being still extant in Chinese translations and we may yet hope to recover original fragments in central Asia, Tibet, or Nepal.

At p. 66 of the *Gandha Vaṃsa,* a modern catalogue of Pali books and authors, written in Pali, there is given a list of ten authors who wrote Pali books in India, probably southern India. We may conclude that these books are still extant in Burma, where the catalogue was drawn up Three only of these ten authors are otherwise known The first is Dhammapāla, who wrote in Kāñcipura, the modern Conjevaram in south India, in the 5th century of our era His principal work is a series of commentaries on five of the lyrical anthologies included in the miscellaneous *Nikāya* Four of these have been published by the Pali Text Society, and E Hardy has discussed in the *Z D M G.* (1897) pp. 105–127, all that is known about him. Dhammapāla wrote also a commentary on the Netti mentioned above The second is Buddhadatta of the same date, author of prose and metrical comments on *Vinaya* and *Abhidhamma,* edited by A. P. Buddhadatta for the Pali Text Society The third is Buddhaghosa, who wrote the comprehensive treatise, *Visuddhi Magga,* translated as *The Path of Purity,* by P Maung Tin for the Pali Text Society, and recast in Pali much of the *Piṭaka* Commentary preserved in Ceylon in Sinhalese.

The whole of these Pali Books composed in India have been lost there They have been preserved for us by the unbroken succession of Pali scholars in Ceylon and Burma These scholars (most of them members of the Buddhist Order) not only copied and recopied the Indian Pali books, but wrote a very large number themselves We are thus beginning to know something of the history of this literature. Two departments have been subjected to critical study; the Ceylon chronicles by Prof. W. Geiger in his *Mahāvaṃsa und Dīpavaṃsa,* and the earlier grammatical works by Prof. O Franke in two articles in the *Journal of the Pali Text Society* for 1903, and in his *Geschichte und Kritik der einheimischen Pali Grammatik.* Dr. Forchhammer in his *Jardine Prize Essay,* and Dr Mabel Bode in her *Pali Literature in Burma,* have collected many details as to the Pali literature in Burma, and Dr. G. P. Malalasekera has done the same for that in Ceylon in his *Pali Literature in Ceylon.*

The result of these investigations show that in Ceylon from the 3rd century B C. onwards there has been a continuous succession of teachers and scholars. Many of them lived in the various *vihāras* or residences situate throughout the island; but the main centre of intellectual effort, down to the 8th century, was the Mahā Vihāra, the Great Minster, at Anurādhapura. This was, in fact, a great university. Authors refer, in the prefaces to their books, to the Great Minster as the source of their knowledge And to it students flocked from all parts of India The most famous of these was Buddhaghosa, from Behar in north India, who studied at the Minster in the 5th century A D., and wrote there all his well known works. Several of these, out of about 20 still extant, have been and are being edited for the Pali Text Society. About a century before this the *Dīpavaṃsa,* or Island Chronicle, had been composed in Pali verse, apparently the work of a beginner in Pali composition This was followed in about a century by Mahanāma's *Mahāvaṃsa,* a more elegant recast of the *Dīpavaṃsa.* No work written in Pali in Ceylon at a date older than the former has yet been discovered It would seem that up to the 4th century of our era the Sinhalese had written exclusively in their own tongue; that is to say that for six centuries they had studied and understood Pali as a dead language without using it as a means of literary expression In Burma, on the other hand, where Pali was probably introduced from Ceylon, no writings in Pali can be dated before the 11th century of our era Of the history of Pali in Siam very little is known There have been good Pali scholars there since late mediaeval times A very excellent edition of the 27 canonical books and the principal commentaries has been recently printed there, and there exist in our European libraries a number of Pali mss. written in Siam

It would be too early to attempt any estimate of the value of this secondary Pali literature Only a few volumes out of several hundreds known to be extant in ms. have yet been published. But the department of the chronicles, the only one so far at all adequately treated, has thrown so much light on many points of the history of India that we may reasonably expect results equally valuable from the publication and study of the remainder The works on religion and philosophy especially will be of as much service for the history of ideas in these later periods as the publication of the canonical books has already been for the earlier period to which they refer. The Pali books written in Ceylon, Burma and Siam will be our best and oldest, and in many respects our only, authorities for the sociology and politics, the literature and the religion, of their respective countries

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(T. W R D., C. A. F. R. D.)

PALIMPSEST. The custom of removing writing from an inscribed surface, and thus preparing that surface to receive another text, is an old one The term palimpsest (from Gr πάλιν, again, and ψάω, I scrape) is used by Catullus and Cicero, referring, respectively, to papyrus (?) and waxen tablets, and by Plutarch, who tells of Plato comparing Dionysius to a βιβλίον παλίμψηστον, as his tyrant nature, being δυσέκπλυτος, showed like imperfectly erased writing The reference here is clearly to washing writing off papyrus Παλίμψηστος can only at first have been applied to mss of a material strong enough to bear actual scraping or rubbing, as at first to waxen tablets and vellum books. There are still some tablets surviving with traces of earlier writing under a fresh layer of wax. Papyrus could not be scraped or rubbed; writing was sponged from it This could not be very cleanly done, so the material was only re-used for unimportant

documents Earlier writing is seldom detected in extant papyri no doubt because of the abundant supply of that material.

In the early period of palimpsests, vellum mss. were washed, not scraped. In course of time, *e.g.*, by atmospheric action, the original writing would partly reappear; thus many capital and uncial palimpsests have been successfully deciphered. In the later middle ages vellum surface was scraped away; the reading of the later examples is therefore often impossible. Besides actual rasure, there were various recipes for effacing writing, *e g*, to soften the surface with milk and meal, and then to rub with pumice. To bring out the original writing various chemical reagents have been tried. The old method of smearing with tincture of gall ultimately rendered the text illegible Of modern reagents the most harmless appears to be hydrosulphate of ammonia; but this also needs caution.

The custom of re-using vellum mss. arose primarily from dearth of material In the case of Greek mss so great was the consumption of old codices that a synodal decree (A D 691) forbade the destruction of intact mss of the Scriptures or the church Fathers The decline of the vellum trade on the introduction of paper intensified the scarcity. Vast destruction of the broad quartos of the early centuries of our era took place after the fall of the Roman empire, so the most valuable Latin palimpsests are found in volumes remade from the 7th to the 9th centuries No entire work has been found in the original text of a palimpsest, but portions of many works were used to form a volume This proves that scribes made use of any suitable material available

An enumeration of the different palimpsests of value is not here possible (*see* Wattenbach, *Schriftwesen*, 3rd ed pp. 299–317); but a few may be mentioned of which facsimiles are accessible. The ms in the Bibliothèque Nationale, Paris, known as the Codex Ephraemi, containing portions of the O. and N testaments in Gr. (? 5th century) is covered with works of Ephraem Syrus in a hand of the 12th century (ed. Tischendorf, 1843, 1845). Among the Syriac mss from the Nitrian desert in Egypt, now in the British Museum, some important texts have been recovered. A volume containing a work of Severus of Antioch of the 9th century is written on palimpsest leaves taken from mss of the *Iliad*, and the Gospel of St Luke, both of the 6th century (*Cat Anc Mss* vol i pls. 9, 10), and the *Elements* of Euclid of the 7th or 8th century. To the same collection belongs the double palimpsest, in which a text of St John Chrysostom, in Syriac, of the 9th or 10th century covers a Latin grammatical treatise of the 6th century, which in its turn has displaced the Latin annals (5th century) of Granius Licinianus For Latin palimpsests also *see* the *Exempla* of Zangemeister and Wattenbach By using skill and judgment, photography may be often made a useful agent in the decipherment of obscure palimpsest texts

PALINDROME, a verse or sentence which runs the same when read either backwards or forwards Such is the verse—

Roma tibi subito motibus ibit amor

Some have refined upon the palindrome and composed verses each word of which is the same read backwards as forwards; for instance, that of Camden:—

Odo tenet mulum, madidam mappam tenet Anna,
Anna tenet mappam madidam, mulum tenet Odo

The following is still more complicated, as it can be read in four ways—upwards and downwards as well as backwards and forwards:—

S A T O R
A R E P O
T E N E T
O P E R A
R O T A S

PALINGENESIS, a term used in philosophy, theology and biology (Gr πάλιν, again, γένεσις, becoming, birth). In philosophy it denotes in its broadest sense the theory (*e g*, of the Pythagoreans) that the human soul does not die with the body but is "born again" in new incarnations. It is thus the equivalent of metempsychosis (*q.v.*). The term has a narrower and more specific use in the system of Schopenhauer, who applies it to his doctrine that the will does not die but manifests itself afresh in new individuals. He thus repudiates the primitive metempsychosis doctrine which maintains the reincarnation of the particular soul. The word "palingenesis" or rather "palingenesia" may be traced back to the Stoics, who used the term for the continual re-creation of the universe by the Demiurgus (Creator) after its absorption into himself Similarly Philo speaks of Noah and his sons as leaders of a "renovation" or "re-birth" of the earth. Josephus uses the term of the national restoration of the Jews, Plutarch of the transmigration of souls, and Cicero of his own return from exile In the New Testament the properly theological sense of spiritual regeneration is found, though the word itself occurs only twice; and it is used by the church Fathers, *e g*, for the rite of baptism or for the state of repentance In modern biology "palingenesis" has been used for the exact reproduction of ancestral features by inheritance, as opposed to "kenogenesis" (Gr. καινός, new), in which the inherited characteristics are modified by environment

PALISSY, BERNARD (1510–1589), French potter (*see* CERAMICS), is said to have been born about 1510, either at Saintes or Agen, and died in Paris in 1589 It has been stated, on insufficient authority, that his father was a glass-painter and that he served as his father's apprentice He tells us that he was apprenticed to a glass-painter and that he also acquired the elements of land-surveying At the end of his apprenticeship he became a travelling workman; acquiring knowledge in many parts of France and the Low Countries, perhaps even in the Rhine Provinces of Germany and in Italy

About 1539 he settled at Saintes At this time he was shown a white enamelled cup which so pleased him that he determined—to use his own expressive phrase "like a man who gropes in the dark"—to discover the secrets of its manufacture Most writers have supposed that this cup was a piece of the enamelled majolica of Italy, but it is more likely that it was a specimen of Chinese porcelain, then one of the wonders of the European world First Palissy mastered the rudiments of peasant pottery. Other equipment he had none, except such information as he presumably had acquired of the manufacture of European tin-enamelled pottery

For nearly 16 years Palissy laboured on through a succession of utter failures At times he and his family were reduced to poverty, he burned his furniture and even, it is said, the floor boards of his house to feed his furnaces All these struggles and failures are recorded by Palissy in his simple and interesting autobiography The tragedy is that Palissy not only failed to discover the secret of Chinese porcelain, but that when he did succeed in making the special type of pottery that will always be associated with his name it should have been inferior technically to the contemporary productions of Spain and Italy His first successes can only have been a superior kind of "peasant pottery" decorated with modelled or applied reliefs coloured naturalistically with glazes and enamels These works had already attracted attention when, in 1548, the constable de Montmorency was sent into the Saintonge to suppress the revolution there Montmorency protected the potter and found him employment in decorating with his glazed terra-cottas the château d'Ecouen This patronage brought Palissy into fame at the French court His workshops and kilns were destroyed, but he was saved, and appointed "inventor of rustic pottery to the king and the queen-mother"; about 1563, under royal protection, he was allowed to establish a pottery works in Paris near the palace of the Louvre For about 25 years Palissy lived and worked in Paris as a personal favourite of Catherine de' Medici, and of her sons.

His productions passed through many phases He made a large number of dishes and plaques ornamented with scriptural or mythological subjects in relief, and also reproductions of the pewter dishes and ewers of François Briot and other metal workers of the period During this period he gave public lectures on natural history. His ideas of springs and underground waters were far in advance of the general knowledge of his time. He was one of the first to enunciate the correct theory of fossils

The close of Palissy's life was in keeping with his active and stormy youth. In the fanatical outburst of 1588 he was thrown into the Bastille He was condemned to death when nearly 80

years of age, but he died in one of the dungeons of the Bastille in 1589.

Palissy's Pottery.—The technique of his various wares shows their derivation from the ordinary peasant pottery of the period, though Palissy's productions are vastly superior to anything of their kind previously made in Europe. It appears almost certain that he never used the potter's wheel, as all his best known pieces have evidently been pressed into a mould and then finished by modelling or by the application of ornament moulded in relief. His most characteristic productions are the large plates, ewers, oval dishes and vases to which he applied realistic figures of reptiles, fish, shells, plants and other objects. Casts from these were fixed on to a metal dish or vase of the shape required, and a fresh cast of the whole formed a mould from which Palissy could reproduce many copies. The various parts were painted in realistic colours of various shades of blue from indigo to ultramarine, some rather vivid greens, several tints of browns and greys, and, more rarely, yellow. The authentic Palissy productions excel in the sharpness of their modelling, in a perfect neatness of manufacture and in the subdued richness of their general tone of colour. The marbled colours on the backs of the dishes in Palissy's work is soft and well fused, in the imitations it is generally dry, even harsh and uneven.

Another class of designs used by Palissy were plates, *tazze* and the like, with geometrical patterns moulded in relief and pierced through, forming open network. A few enamelled earthenware statuettes have been attributed to him; but it is doubtful whether he ever worked in the round. His productions have always been highly valued, and in the 17th century attempts were made, both at Delft and Lambeth, to adapt his "rustic" dishes with the reliefs of animals and human figures. These imitations are very blunt in modelling and coarsely painted. They are generally marked on the back in blue with initials and a date—showing them to be honest adaptations to a different medium, not attempts at forgery. Between 1840 and 1870, copies of Palissy's "Bestiole" dishes were made with great skill and success by Avisseau of Tours, and afterwards by Pull of Paris. The well-known potter, Barbizet, who set out to make "Palissys" for the million, flooded France with rude copies that should never have deceived anyone.

The best collections of Palissy's ware are those in the museums of the Louvre, the Hôtel Cluny, and Sèvres; and in England those in the Victoria and Albert museum, the British Museum and the Wallace Collection.

Palissy wrote with vigour and simplicity on a great variety of subjects, such as agriculture, natural philosophy, religion and especially in his *L'Art de terre,* where he gives an account of his processes and how he discovered them.

See Delecluze, *B. Palissy* (1838); Marryat, *Pottery* (1850, pp. 31 *seq.*); A. Dumesnil, *B. Palissy, le potier de terre* (1851); Morley, *Life of Palissy* (1855); Enjubault, *L'Art céramique de B. Palissy* (1858); H. Delange, *Monographie de l'oeuvre de B. Palissy* (1862); A. Tainturier, *Terres émaillées de Palissy* (1863); Audiat, *Étude sur la vie . . . de B. Palissy* (1868). For Palissy as a Huguenot, *see* Rossignol, *Des Protestantes illustres,* No. iv. (1861). The best English account of Palissy as a potter is that given by M. L. Solon in his *History and Description of the Old French Faïence* (1903).

PALITANA, a native state of India in the Western India States agency of the Bombay presidency. Area, 290 sq.m.; pop. (1921) 57,929. The chief is a Gohel Rajput, with the title of Thakur Sahib. Tribute jointly to the gaekwar of Baroda and the nawab of Junagarh, £700. The state is noted for its horses and horse-breeding. The chief products are grain, sugar and cotton. The capital of the state is Palitana (pop. 12,890), on the Bhaunagar railway. Above the town to the west rises the hill of Satrunja, sacred to the Jains. On this hill, all the peculiarities of Jain architecture are found in a marked degree. Some of the temples are as old as the 11th century. The hill is visited by crowds of pilgrims every year.

PALK STRAITS, the channel lying between the mainland of India and the island of Ceylon. It is named after Robert Palk, governor of Madras (1755–1763). The straits lie north of the line of reefs called Adam's Bridge, while the Gulf of Manaar lies south of it.

PALLA, PALA or IMPALA, a red South African antelope of the size of a fallow-deer, characterized by the large black lyrate horns of the bucks, and the presence in both sexes of glands on the back of the hind feet bearing a tuft of black hairs. On the east side the palla (*Aepyceros melampus*) ranges as far north as the Southern Sudan; in Angola it is replaced by a species (*Ae. petersi*) with a black "blaze" down the face. Pallas associate in large herds in the neighbourhood of water. (*See* ANTELOPE.)

PALLADIAN, a term applied to any architecture of a rather heavily classic type making a great use of the orders and generally following the grandiose manner of the work of Andrea Palladio (1518–80); especially applied to the later phase of the English Renaissance, introduced into England by Inigo Jones.

A Palladian window or Palladian motive is a combination of three openings in which the central one is crowned by an arch resting on entablatures which cap the smaller side openings and are supported on columns between the openings and pilasters at the sides. This motive is so-called because it was first used on a large scale in Palladio's basilica at Vicenza (1549–1614).

PALLADIO, ANDREA (1518–1580), Italian architect, was born in Vicenza on Nov. 30, 1518. His patron, Count Trissino, took him to study architecture in Rome. In 1547 he returned to Vicenza, where he designed many fine buildings—among the chief being the Palazzo della Ragione, and the Barbarano, Porti and Chieregati palaces. Most of these buildings which Palladio designed to be executed in stone were mainly built of brick, covered with stucco, and are now in a very dilapidated condition. Pope Paul III. called him to Rome to report upon the state of St. Peters. In Venice, Palladio built many stately churches, S. Giorgio Maggiore, the Capuchin church, and some large palaces on the Grand canal. His last great work was the Teatro Olimpico at Vicenza, finished by his pupil and fellow citizen Scamozzi.

Palladio also designed many country villas in northern Italy. The villa of Capra is perhaps the finest of these, and has frequently been imitated. Palladio was a great student of classical literature, and published in 1575 an edition of Caesar's *Commentaries* with notes. His *I quattro libri dell' architettura,* first published at Venice in 1570, has been translated into every European language. The original edition is a small folio, richly illustrated with well-executed woodcuts of plans, elevations and details of buildings. An edition with notes was published in England by Inigo Jones. The classical style adopted and partially invented by Palladio expressed a revolt against the extreme licence both of composition and ornament into which the architecture of his time had fallen. His drawings of ancient buildings are now of great value, as in many cases the buildings have ceased to exist.

See Montanari, *Vita di Andrea Palladio* (1749); Rigato, *Osservazioni sopra Andrea Palladio* (1811); Magrini, *Memorie intorno la vita di Andrea Palladio* (1845); Milizia, *Memorie degli architetti,* ii. 35–54 (1781); Symonds, *Renaissance in Italy—Fine Arts,* pp. 94–99; Zanella, *Vita di Andrea Palladio* (Milan, 1880); Barichella, *Vita di Andrea Palladio* (Lonigo, 1880); B. F. Fletcher, *A. Palladio, his life and works* (1902).

PALLADIUM, an image of Pallas (Athena), especially an archaic wooden image preserved in the citadel of Troy as a pledge of the safety of the city. It was said that Zeus threw it down from heaven when Ilus was founding the city of Ilium, and that Odysseus and Diomedes carried it off from the temple of Athena, thus making the capture of Troy possible. Many cities in Greece and Italy claimed to possess the genuine Trojan Palladium, but especially it was identified with one of the holy objects kept in the *penus* or inner shrine of Vesta at Rome. Its theft is a common subject in Greek art, especially of the early time.

PALLADIUM is a metal always present to some extent in platinum ores, which sometimes consist almost wholly of this metal; it is occasionally, but rarely, found in small amounts in osmiridium and sometimes occurs in small quantities combined with gold in the Harz Mountains. (Symbol Pd, atomic number 46, atomic weight, 106·7.) It is also present in appreciable amounts in most nickel ores, generally associated with a smaller amount of platinum, and in the Mond process of nickel extraction the residues (after removal of nickel) are worked up for platinum

metals, so that considerable quantities of both palladium and platinum are obtained from this source. Palladium was first isolated by Wollaston in 1802, who instead of publishing his discovery in the usual way placed a small amount on sale in London as a new metal, naming it palladium after the recently discovered planet Pallas. An English chemist, Chenevix, examined the substance and concluded that it was merely a platinum amalgam. The matter was cleared up when Wollaston disclosed the source of the metal in a paper in which he also announced the discovery of rhodium (*Phil. Trans.*, 1804, 428; 1805, 316).

Palladium is readily obtained in the pure state by several methods. It alone of the platinum metals forms an insoluble cyanide; in ordinary treatment, after most of the osmium, iridium and ruthenium have been removed, the solution containing platinum, palladium and rhodium is neutralized and precipitated with mercuric cyanide (alkaline cyanides are not so suitable, as soluble double cyanides are formed), palladium cyanide, $Pd(CN)_2$, being precipitated, which on simple ignition yields pure palladium. Another method of separating palladium is to add to a nearly neutral solution a large excess of ammonia. To the clear solution hydrochloric acid is added in excess when sparingly soluble palladosammine chloride, $Pd(NH_3)_2Cl_2$, is slowly precipitated, which on ignition gives pure spongy palladium. Palladium is a whitish metal very similar in appearance to platinum, it is malleable and ductile and has a specific gravity of about 11·5. It melts more readily than any other of the platinum metals, fusing at 1,549° C and being easily volatilized in an electric furnace. Palladium sponge is produced by ignition either of the cyanide or palladosammine chloride or ammonium palladium chloride $(NH_4)_2PdCl_4$; palladium black is obtained by reduction of any of its salts in solution by formic acid. A stable black colloidal solution of palladium is produced by reducing with hydrazine hydrate a solution of palladous chloride in the presence of a protective colloid, or in a less stable colloidal solution by passing an arc between palladium terminals under water containing a trace of caustic soda. Palladium differs from other platinum metals in being readily soluble in strong nitric acid, especially when this contains lower oxides of nitrogen. In the finely divided state of palladium black it is soluble even in hydrochloric acid. It is readily attacked by fusion with caustic alkalis, and when heated in a current of air or oxygen is said to form the lowest oxide, PdO. It is attacked by fluorine at the ordinary temperature and at a dull red heat by chlorine; on heating it combines directly with sulphur.

A very remarkable property of palladium is its power of absorbing hydrogen. Graham showed that a palladium wire at a dull red heat was capable of absorbing 935 times its volume of hydrogen, thereby increasing in length by 1·6% or in bulk by just over 4%. Another experiment gave an increase in bulk of nearly 10%. The maximum amount of hydrogen absorbable by palladium is roughly represented by the formula Pd_2H, and it was at one time supposed that a definite compound was formed. This, however, has now been completely disproved chiefly by the work of Silverts and his co-workers (1911), who have shown that the amount of hydrogen absorbed is a function of both temperature and pressure and that above 138° C the amount of hydrogen absorbed is a constant agreeing closely with the formula $T\times\sqrt{P}$ (T=temperature, P=pressure). Hence the composition of the substance is variable and it cannot be a true compound. This property of palladium is shared but to a much smaller extent by other allied metals, *e.g.*, the platinum group, nickel, iron, copper and tantalum, and it is on this property that the catalytic reduction by hydrogen of many substances depends, for the hydrogen molecule, H_2, appears to be dissociated into two atoms when in this condition and thus becomes enormously more reactive (*see* CATALYSIS). Owing to this property also, hydrogen is capable of diffusing through sheets of these metals at a high temperature.

Three oxides of palladium are known, Pd_2O, PdO and PdO_2; of these the first is unimportant but the others are basic and give rise to the formation of two series of salts closely analogous to the corresponding platinum compounds, but the palladic salts are less stable than the corresponding platinic ones. *Palladous chloride,* $PdCl_2$, formed by the action of chlorine at a dull red heat upon the metal or upon the sulphide PdS, or by the action of hot dilute aqua regia or a mixture of hydrochloric acid and chlorine upon the finely divided metal, crystallizes in reddish-brown crystals with two molecules of water. It combines readily with chlorides of the alkali metals giving double chlorides of the composition M_2PdCl_4. A solution of $PdCl_2$ readily absorbs carbon monoxide, yielding definite compounds. This reaction is used in analysis as a method of determining carbon monoxide in gaseous mixtures. *Palladic chloride,* $PdCl_4$, is prepared by dissolving the metal in cold strong aqua regia, when palladichloric acid, H_2PdCl_6, is formed. The simple chloride can be prepared in solution by the action of chlorine upon palladous chloride or by dissolving palladic oxide, PdO_2, in strong hydrochloric acid. The chloride combines easily with alkaline chlorides giving palladichlorides of the composition M_2PdCl_6. *Palladous iodide,* PdI_2, is formed by precipitating a solution of any palladous salt with potassium iodide, as a black flocculent precipitate soluble in excess of the reagent to a cherry-red solution.

Palladous sulphide, PdS, precipitated from solutions of palladous salts by sulphuretted hydrogen, is also formed by heating the metal in sulphur vapour; it is insoluble in yellow ammonium sulphide. *Palladic sulphide,* PdS_2, can be prepared by dry methods only, such as by fusing the lower sulphide with a mixture of sulphur and sodium carbonate. Palladium salts combine with ammonia in two different proportions forming compounds of the types $Pd(NH_3)_2X_2$ (palladosammines) and $Pd(NH_3)_4X_2$ (palladodiammines). Compounds of the former group are stable but those of the latter group easily lose ammonia and pass into the lower compounds. The ordinary salts of both series are well known and the water-soluble hydroxides of both behave as strong bases.

The uses to which palladium has been put are many and various. It is frequently used in astronomical and other instruments of precision as the basis of graduated surfaces on account of its unalterability and comparative lightness. It is also used for coating silver goods, for it is not affected by sulphuretted hydrogen as is silver, and is sometimes deposited on glass for the production of permanent mirrors. Palladium is used to a certain extent in dentistry, and during the World War considerable quantities were used for jewellery as platinum was then unobtainable. It is being used more and more in various aeroplane parts. The yellow colour of gold is destroyed by alloying it with small quantities of platinum or palladium; the product, white gold, is extensively used for jewellery. The whitening effect of palladium in gold is considerably greater than that of platinum. Palladium is sometimes used for the springs of clocks and watches, for it has the advantage over steel of not being magnetised under any conditions. During the World War, when platinum was controlled and practically unpurchasable, attempts were made to use palladium instead of platinum in the manufacture of sulphuric acid. This was only partly successful; when the exact conditions were found, palladium was just as efficient as platinum, but slight alteration from the perfect conditions caused a great falling-off in efficiency. (F. E. M.)

PALLAIN, GEORGES (1845–1923), French administrator, after practising as an advocate and occupying the position of sub-prefect, entered the Ministry of Finance and was made director of various important departments in turn, notably of the Customs department. In 1898 he was appointed governor of the Bank of France, a post which he held until his retirement in 1920.

PALLANZA, a town and summer and winter resort of the province of Novara, Piedmont, Italy, 659 ft. above sea-level. Pop. (1912) 5,122 (town); 5,638 (commune). It occupies a position of great natural beauty, on a promontory on the W. of Lago Maggiore, with a semicircle of mountains behind and the lake and Borromean Islands in front, 62 m. N. of Novara.

PALLAS, PETER SIMON (1741–1811), German naturalist and traveller, was born in Berlin on Sept. 22, 1741, the son of Simon Pallas, a surgeon. He studied medicine at Berlin, Halle, Göttingen and Leyden, and showed a leaning towards natural history. In 1761 he went to England, where he devoted himself to a geological investigation of part of the coast; and

at the age of twenty-three he was elected a foreign member of the Royal Society. In 1768 he became professor of natural history at the Imperial Academy of Science, St. Petersburg, and was appointed naturalist to a scientific expedition through Russia and Siberia, to observe the transit of Venus in 1769. Pallas went by Kazan to the Caspian, and journeyed across to China. In 1793–1794 he visited the southern provinces of Russia, and determined to settle in the Crimea. The empress gave him an estate at Simpheropol and 10,000 roubles to assist in equipping a house. He continued to live in the Crimea, devoted to research in botany, till the death of his second wife in 1810, when he moved to Berlin, where he died on Sept. 8, 1811.

His works include: *Elenchus Zoophytorum* (Hague, 1766); *Miscellanea Zoologica* (Hague, 1866); *Spicilegia Zoologica* (Berlin, 1767–1804); *Reisen durch Verschiedene Provinzen des rüssischen Reichs* (3 vols., St. Petersburg 1771–76); *Sammlungen historischer Nachrichten über die mongolischen Völkerschaften* (2 vols., 1776–1802); *Novae Species quadrupedum* (1778–79); *Icones insectorum praesertim Rossiae Siberiaeque pecularium* (1781–1806); *Zoographia rossoasiatica* (3 vols., 1831); *Bemerkungen auf einer Reise durch die sudlichen Statthalterschaften des russischen Reichs* (Leipzig, 1799–1801).

See the essay of Rudolphi in the *Transactions* of the Berlin Academy for 1812; Cuvier's Eloge in his *Recueil des éloges historiques,* vol. ii.; and the Life in Jardine's *Naturalists' Library,* vol. iv. (Edin., 1843).

PALLAVICINO, FERRANTE (1618–1644), Italian writer of pasquinades, a member of the old Italian family of the Pallavicini, was born at Piacenza in 1618. He entered the Augustinian order, residing chiefly in Venice. For a year he accompanied Ottavio Piccolomini, duke of Amalfi, in his German campaigns as field chaplain, and shortly after his return he published a number of clever but exceedingly scurrilous satires on the Roman curia and on the powerful house of the Barberini, which was so keenly resented at Rome that a price was set on his head. A Frenchman, Charles de Breche, decoyed him from Venice to the neighborhood of Avignon, and there betrayed him. After fourteen months' imprisonment he was beheaded at Avignon on March 6, 1644.

His *Opere permesse* was published at Venice in 1655, but being, as may be imagined, inferior in scurrility and grossness (Pallavicino's specialties), are much less prized by the curious than the *Opere scelte* (Geneva, 1660), which were more than once reprinted in Holland, and were translated into German in 1663.

PALLAVICINO (or Pallavicini), **PIETRO SFORZA** (1607–1667), Italian cardinal and historian, son of the Marquis Alessandro Pallavicino of Parma, born at Rome, joined the Society of Jesus in 1638. As professor of theology in the Roman College he was a member of the congregation appointed by Innocent X. to investigate the Jansenist heresy. In 1659 he was made a cardinal by Alexander VII. He died at Rome on June 5, 1667. Pallavicino is chiefly known by his history of the council of Trent, written in refutation of Paolo Sarpi (*q.v.*) in Italian, and published at Rome in two folio volumes in 1656–1657. In this he continued the task begun by Terenzio Alciati. The work was translated into Latin by a Jesuit named Giattinus (Antwerp, 1670–1673), and into German by Klitsche in 1835–1837.

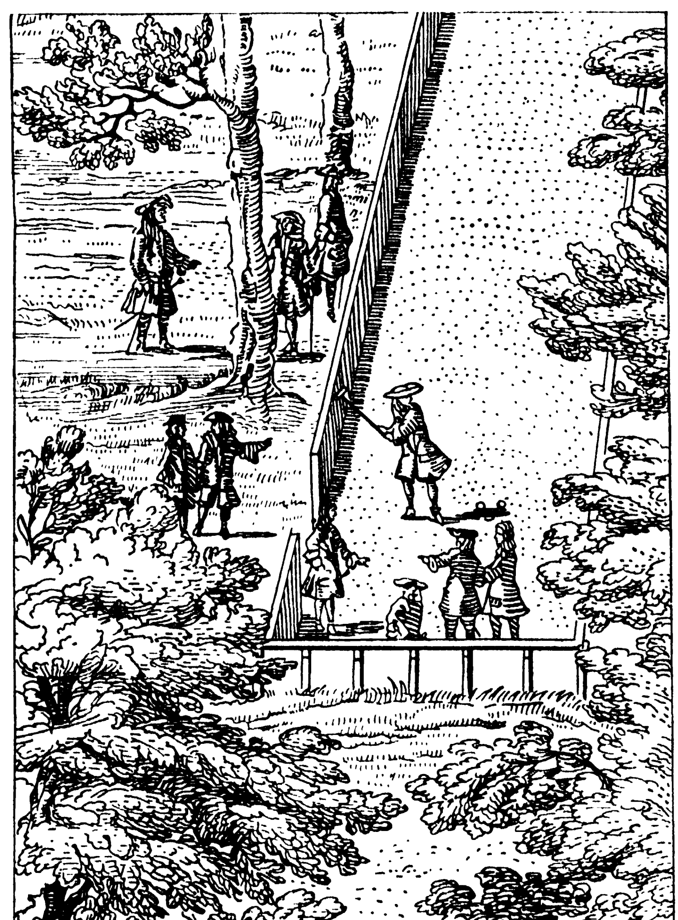
His collected *Opere* were published in Rome in 1844–1848.

PALLIUM or Pall, an ecclesiastical vestment in the Roman Catholic Church, originally peculiar to the pope, but for many centuries past bestowed by him on all metropolitans, primates and archbishops as a symbol of the jurisdiction delegated to them by the Holy See. The pallium, in its present form, is a narrow band, "three fingers broad," woven of white lamb's wool, with a loop in the centre resting on the shoulders over the chasuble, and two dependent lappets, before and behind; so that when seen from front or back the ornament resembles the letter Y. It is decorated with six purple crosses, one on each tail and four on the loop, is doubled on the left shoulder, and is garnished, back and front, with three jewelled gold pins. The two latter characteristics seem to be survivals of the time when the Roman *pallium* was a simple scarf doubled and pinned on the left shoulder.

The papal *pallia* were at one time made of white linen (*see* Johannes Diaconus, *Vita S. Gregorii M. lib. IV.* cap. 8, *pallium eius bysso candente contextum*). The right to wear the pallium seems, in the first instance, to have been conceded by the popes merely as a mark of honour. The first recorded example of the bestowal of the pallium by the popes is the grant of Pope Symmachus in 513 to Caesarius of Arles, as papal vicar. Every archbishop must apply for it, personally or by deputy, within three months after his consecration, and it is buried with him at his death (*see* Archbishop). Though the pallium is thus a vestment distinctive of bishops having metropolitan jurisdiction, it may only be worn by them within their jurisdiction, on certain solemn occasions. The pope alone has the right to wear everywhere and at all times a vestment symbolizing the fullness of ecclesiastical power.

Bibliography.—*See* P. Hinschius, *Kirchenrecht*, II. 23 *sqq.*; Gresar, "Das römische Pallium und die ältesten liturgischen Schärpen" (in *Festschrift zum elfhundertjährigen Jubiläum des campo santo in Rom,* Freiburg, 1897); Du Cange, *Glossarium s.v.* "Pallium", Joseph Braun, *Die liturgische Gewandung im Occident und Orient* (Freiburg-i.-B., 1907); *Catholic Encyclopaedia, s.v.* "Pallium."

PALL-MALL, an obsolete English game of French origin, resembling croquet, called in France *paille-maille* (from *palla,* ball, and *malleus,* mallet). Thomas Blount's *Glossographia* (ed. 1670) describes it as follows: "Pale Maille, a game wherein a round bowle is with a mallet struck through a high arch of iron (standing at either end of an alley) which he that can do at the fewest blows, or at the number agreed on, wins. This game was heretofore used in the long alley near St. James's and vulgarly



FROM "KEY'S PROSPECT"

VIEW OF PALL-MALL ALLEY, SHOWING A GAME BEING PLAYED IN THE 17TH CENTURY. TAKEN FROM AN OLD BOOK OF WOODCUTS

called Pell-Mell." The pronunciation here described as "vulgar" afterwards became classic, a famous London street having been named after a Pall Mall alley. A mallet and balls used in the game were found in 1845 and are now in the British Museum.

PALLONE (Italian for "large ball," from *palla,* ball), the national ball game of Italy. It is descended as are all other court games, such as tennis and pelota, from the two ball games played by the Romans, in one of which a large inflated ball, called *follis,* was used. The other, probably the immediate ancestor of pallone, was played with a smaller ball, the *pila.* Pallone was played in

Tuscany as early as the 14th century and is still very popular in northern and central Italy. It is played in a court (*sferisterio*), usually 100 yds. long and 17 yds. wide. A white line crosses the middle of the court, which is bounded on one side by a high wall, the spectators sitting round the other three sides, usually protected by wire screens. One end of the court is called the *battuta*, and the other the *ribattuta*. At the end of the *battuta* is placed a spring-board, upon which stands the player who receives the service. The implements of the game are the *pallone* (ball) and the *bracciale* (bat). The *pallone* is an inflated ball covered with leather, about 4⅜in. in diameter. The *bracciale* is an oak gauntlet, tubular in shape, and covered with long spike-like protuberances. It weighs between five and six pounds and is provided with a grip for the hand. The game is played by two sides—blues and reds —of three men each, the *battitore* (batter), *spalla* (back) and *terzino* (third). At the beginning of a game the *battitore* stands on the spring-board and receives the ball thrown to him on the bound by a seventh player, the *mandarino*, who does duty for both sides. The batter may ignore the ball until it comes to him to his liking, when he runs down the spring-board and strikes it with his *bracciale* over the centre line towards his opponents. The game then proceeds until a player fails to return the ball correctly, or hits it out of bounds, or it touches his person. This counts a point for the adversary. Four points make a game, counting 15, 30, 40 and 50.

See G. Franceschini, *Il Giuoco del pallone* (1903).

PALM, originally the flat of the hand, in which sense it is still used; from this sense the word was transferred as a name of the trees described below. The emblematic use of the word (=prize, honour) represents a further transference from the employment of the palm-leaves as symbols of victory.

The palms, botanically Palmae or Palmaceae, have been termed the princes of the vegetable kingdom. Neither the anatomy of their stems nor the conformation of their flowers, however, entitles them to such position, but in general character they are noble plants. Their stems are not more complicated in structure than those of the common butcher's broom (*Ruscus*); their flowers are for the most part as simple as those of a rush (*Juncus*). The family Palmaceae is characterized among monocotyledonous plants by the presence, for the most part, of an unbranched stem bearing a tuft of leaves at the extremity only, or with the leaves scattered; these leaves, often gigantic in size, are usually firm in texture and branching in a pinnate or palmate fashion. The flowers are borne on simple or branching spikes, very generally protected by a spathe or spathes, and each consists typically of a perianth of six greenish somewhat inconspicuous segments in two rows, with six stamens, or pistil of one to three carpels, each with a single ovule and a succulent or dry fruit, never dehiscent. The seed consists almost exclusively of endosperm or albumen in a cavity in which is lodged the relatively very minute embryo. Some of the more important modifications may be noticed briefly.

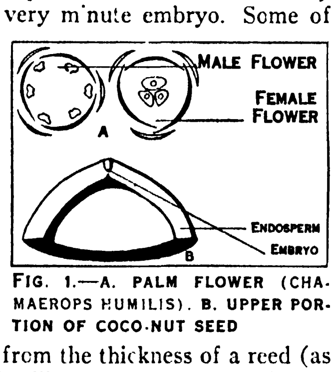


FIG. 1.—A. PALM FLOWER (CHAMAEROPS HUMILIS). B. UPPER PORTION OF COCO-NUT SEED

Taking the stem first, it is in very many palms relatively tall, erect, unbranched, regularly cylindrical, or dilated below so as to form an elongated cone, either smooth, or covered with the projecting remnants of the former leaves, or marked with circular scars indicating the position of those leaves which have now fallen away. It varies in diameter from the thickness of a reed (as in *Chamaedorea*) to a sturdy pillar-like structure as seen in the date-palm, Palmyra palm or Talipot. In other cases the very slender stem is prostrate, or scandent by means of formidable hooked prickles which, by enabling the plant to support itself on the branches of neighbouring trees, also permit the stem to grow to a very great length and so to expose the foliage to the light and air above the tree-tops of the dense forests, as in the genus *Calamus*, the rattan or cane palms (*see* LIANES). In some examples the trunk, or that portion of it above ground, is so short that the plant is in a loose way called "stemless," as in some kinds of the Sabal tribe, and as happens sometimes in the only species found in a wild state in Europe, *Chamaerops humilis*. The vegetable ivory (*Phytelephas*) of equatorial America has a very short thick stem bearing a tall cluster of leaves which appears to rise from the ground. In many species the trunk is covered with a dense network of stiff fibres, often compacted together at the free ends into spines. This material, which is so valuable for cordage, consists of the fibrous tissue of the leaf-stalk, which in these cases persists after the decay of the softer portions. It is very characteristic of some palms to produce from the base of the stem a series of adventitious roots which gradually thrust themselves into the soil and serve as buttresses to steady the tree and prevent its overthrow by the wind. The underground stem of some species, *e.g.*, of *Calamus*, is a rhizome, or root-stock, lengthening in a more or less horizontal manner by the development of the terminal bud, and sending up lateral branches like suckers from the root-stock, which form dense thickets of cane-like stems. The branching of the stem above ground is unusual; however, in the Doum palm of Egypt (*Hyphaene*), the stem forks, often repeatedly; this is due to the development of a branch to an equal strength with the main stem.

FIG. 2.—RATTAN PALM (DAEMONOROPS DRACO)
A. Young shoot (much reduced). B. Part of stem bearing male inflorescence, C. Part of female inflorescence, D. Ripe fruits

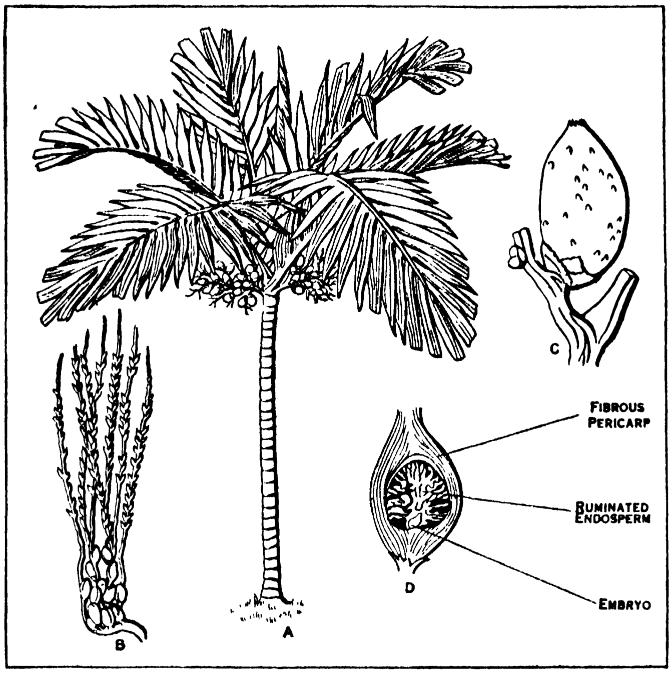
The internal structure of the stem does not differ fundamentally from that of a typical monocotyledonous stem; the taller, harder trunks owe their hardness not only to the fibrous or woody skeleton but also to the fact that, as growth goes on, the originally soft cellular tissue through which the fibres run becomes hardened by the deposit of woody matter within the cells, so that the cellular portions become as hard as the woody fibrous tissue.

The leaves of palms are arranged either at more or less distant intervals along the stem, as in the canes (*Calamus, Daemonorops*) or are approximated in tufts at the end of the stem, thus forming those noble crowns of foliage which are so closely associated with the general idea of a palm. In the young condition, while still unfolded, these leaves form "the cabbage," in some species highly esteemed for food.

The adult leaf generally presents a sheathing base tapering upwards into the stalk or petiole, and this again bears the lamina or blade. The sheath and the petiole often bear stout spines, as in the rattan palms; and when, in course of time, the upper parts of the leaf decay and fall off, the base of the leaf-stalk and sheath often remain, either entirely or in their fibrous portions only, which latter constitute the investment to the stem already mentioned. In size the leaves vary within very wide limits, some being only a few inches in extent, while those of the noble *Corypha* may be measured in tens of feet. In form the leaves of palms are rarely simple; usually they are more or less divided, sometimes, as in *Caryota*, extremely so. Usually the leaves branch regularly in a palmate fashion as in the fan-palms *Latania, Borassus, Chamaerops, Sabal*, etc., or in a pinnate fashion as in the feather-palms, *Areca, Kentia, Calamus, Daemonorops* (fig. 2), etc. The form of the segments is generally more or less linear, but a very distinct appearance is given by the broad wedge-shaped leaflets of such palms as *Caryota* and *Martinezia*. These forms run one into another by transitional gradations; and even in the same palm the form of the leaf is often very unlike at different stages of its

growth. The leaves are sometimes invested with hairs or spines; and, in some cases the under-surface is of a glaucous white or bluish colour, from a coating of wax.

The inflorescence of palms consists generally of a more or less fleshy spike, either simple or much branched, studded with numerous, sometimes extremely numerous, flowers, and enveloped by one or more sheathing bracts called "spathes." These parts



FROM KOHLER, "MEDIZINAL PFLANZEN"

FIG. 3.—A. BETEL NUT OR ARECA PALM (ARECA CATECHU), OF ASIA. B. FLOWERING BRANCH, WITH MALE FLOWERS ABOVE AND FEMALE FLOWERS BELOW. C. A RIPE FRUIT. D. VERTICAL SECTION OF FRUIT

may be small, or they may attain relatively enormous dimensions, hanging down from amid the crown of foliage, or under the crown, like huge tresses, and adding greatly to the effect of the leaves. In some cases, as in the Talipot palm, the tree flowers only once, develops a huge inflorescence, and after the fruit has ripened, dies.

The individual flowers are usually small, greenish and insignificant in appearance; their general structure has been mentioned already. Modifications from the typical structure arise from difference of texture, and specially from suppression of parts, in consequence of which the flowers are often unisexual, though the flowers of the two sexes are generally produced on the same tree (monoecious), not indeed always in the same season, for a tree in one year may produce male flowers and in the next female flowers. In a few cases they are dioecious. Sometimes the flowers are modified by an increase in the number of parts; thus the usually six stamens may be represented by 12 to 24 or even by hundreds. There are usually three carpels, more or less combined.

Owing to the arrangements already mentioned, the pollen has to be transported by the wind or insects to the female flowers. This is facilitated sometimes by the elastic movements of the stamens and anthers, which liberate the pollen so freely at certain times that travellers speak of the date-palms of Egypt (*Phoenix dactylifera*) being at daybreak hidden in a mist of pollen grains. In other cases fertilization is effected by the agency of man, who removes the male flowers and scatters the pollen over the fruit-bearing trees. This practice has been followed in the case of the date from time immemorial.

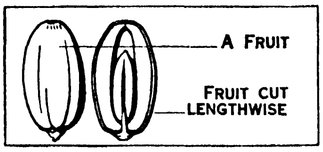


FIG. 4.—FRUIT OF DATE PALM (PHOENIX DACTYLIFERA)

The fruit is various in form, size and character; sometimes, as in the common date, it is a berry with a fleshy rind enclosing a hard stony kernel, the true seed; the fruit of *Areca* is similar; sometimes it is a kind of drupe as in *Acrocomia* (fig. 5), or the coco-nut, *Cocos nucifera,* where the fibrous central portion investing the hard shell corresponds to the fleshy portion of a plum or cherry, while the shell or nut corresponds to the stone of stone-fruits, the seed being the kernel.

The seeds show a corresponding variety in size and shape, but always consist of a mass of endosperm, in which is embedded a relatively very minute embryo. The hard stone of the date is the endosperm, the white oily flesh of the coco-nut is the same substance in a softer condition; the so-called "vegetable ivory" is derived from the endosperm of *Phytelephas.*

The family contains upwards of 170 genera with probably about 1,500 species mainly tropical, but with some representatives in warm temperate regions. *Chamaerops humilis* is a native of the Mediterranean region, and the date-palm yields fruit in southern Europe as far north as 38° N. latitude. In eastern Asia the palms, like other tropical families, extend along the coast reaching Korea and the south of Japan. In America a few small genera occur in the southern United States and California; and in South America the southern limit is reached in *Jubaea spectabile* (the Chile coco-nut) at 37° S. latitude. The great centres of distribution are tropical America and tropical Asia; tropical Africa contains only about a dozen genera, though some of the species, like the doum palm (*Hyphaene thebaica*) and the deleb or palmyra palm (*Borassus flabellifer*) have a wide distribution. With three exceptions Old and New World forms are distinct—the coco-nut (*Cocos nucifera*) is widely distributed on the coasts of tropical Africa, in India and the South Seas, the other species formerly included in the genus being confined to the western hemisphere. The oil palm (*Elaeis guineensis*) is a native of west tropical Africa. *Raphia* has species in both tropical Africa and tropical America.

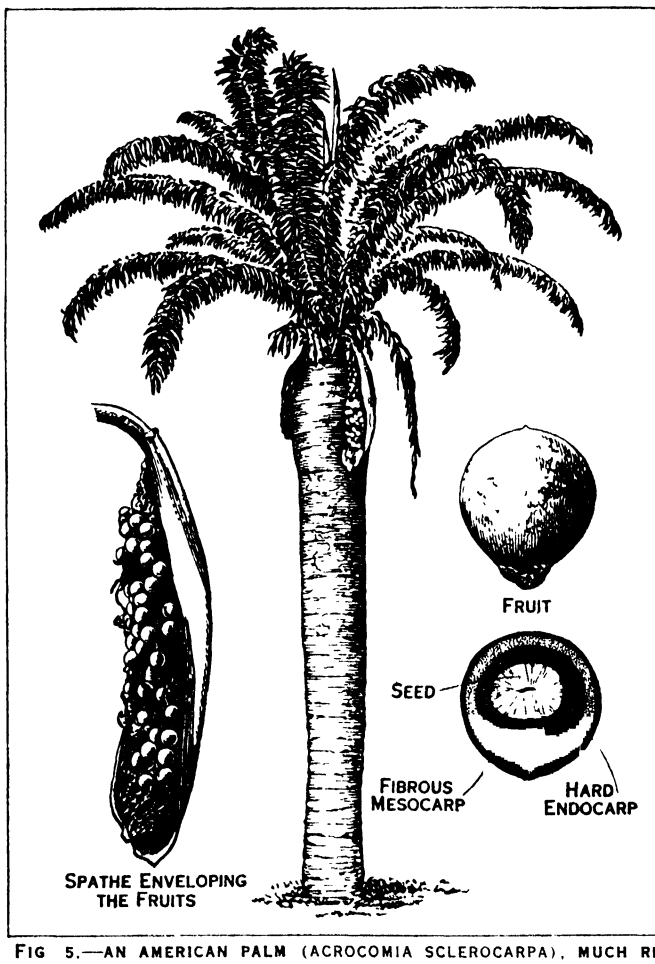
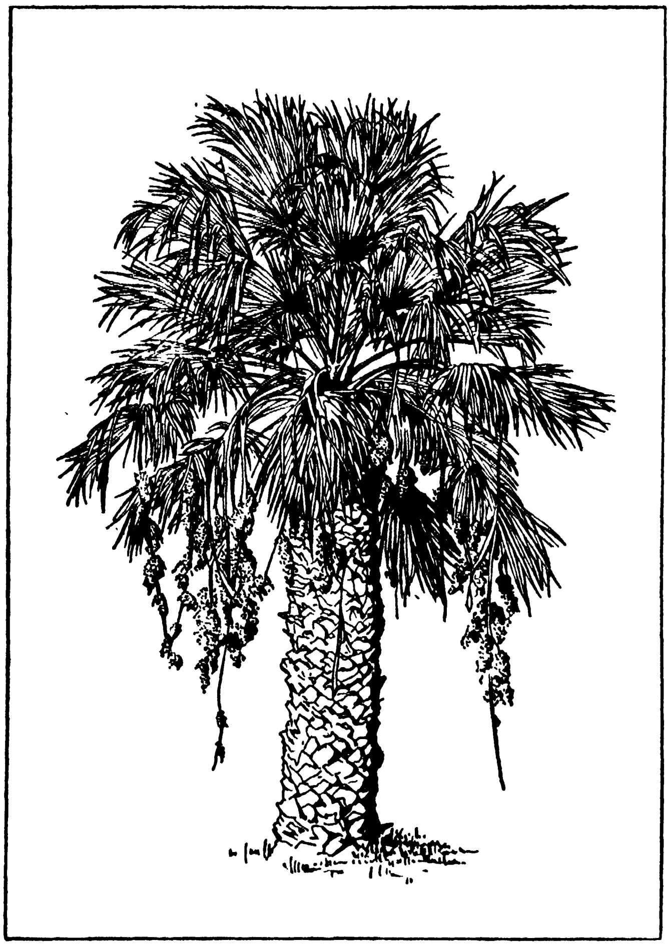


FIG 5.—AN AMERICAN PALM (ACROCOMIA SCLEROCARPA), MUCH REDUCED

The genera are arranged, according to Drude, in six tribes, distinguished by the nature of the foliage, the sexual conditions of the flower, the character of the seed, the position of the raphe, etc. Other characters serving to distinguish the minor groups are

afforded by the habit, the position of the spathes, the "aestivation" of the flower, the nature of the stigma, the ovary, fruit, etc.

Palms are of the greatest economic importance. They furnish food, shelter, clothing, timber, fuel, building materials, sticks, fibre, paper, starch, sugar, oil, wax, wine, tannin, dyeing materials, resin and a host of minor products, which render them most valuable to the natives and to tropical agriculturists. The coco-



BY COURTESY OF THE UNITED STATES BUREAU OF RECLAMATION

FIG. 6.—A DATE PALM (PHOENIX DACTYLIFERA), A NATIVE OF NORTHERN AFRICA AND SOUTH-WESTERN ASIA

nut palm, *Cocos nucifera,* and the date palm, *Phoenix dactylifera,* are treated in separate articles. Sugar and liquids capable of becoming fermented are produced by *Caryota urens, Cocos nucifera, Borassus flabellifer, Rhapis vinifera, Arenga saccharifera, Phoenix silvestris, Mauritia vinifera,* etc. Starch is procured in abundance from the stem of the sago palm, *Metroxylon,* and others. The fleshy mesocarp of the fruit of *Elaeis guineensis* of western tropical Africa yields, when crushed and boiled, "palm oil." Coco-nut oil is extracted from the oily endosperm of the coco-nut. Wax is exuded from the stem of *Ceroxylon andicolum* and *Copernicia cerifera.* Edible fruits are yielded by the date, the staple food of some districts of northern Africa, and by the pejibaye or Guilielma of tropical America. The coco-nut is a source of wealth to its possessors; and many species, e.g., *Areca sapida* (cabbage-palm and others), are valued for their "cabbage," the terminal bud, whose removal causes the destruction of the tree. The famous "coco de mer," or double coco-nut, whose floating nuts are the objects of so many legends and superstitions, is *Lodoicea malivica.* The tree is peculiar to the Seychelles. Its fruit is like a huge plum, containing a stone or nut like two coconuts (in their husks) united together. *Areca Catechu* is cultivated in tropical Asia for its seeds (reca or betel nuts).

The only species that can be cultivated in the open air in England, and then only under exceptionally favourable circumstances, are the European fan palm, *Chamaerops humilis,* the Chusan palm, *Trachycarpus Fortunei,* etc., and the Chilean *Jubaea spectabilis.* The date palm is commonly planted along the Mediterranean coast. There are several low growing palms, such as *Rhapis flabelliformis, Chamaerops humilis,* etc., which are suited for ordinary green-house culture, and many of which are enabled to resist the dry and often gas-laden atmosphere of living rooms.

For further details, *see* B. Seeman, *History of the Palms* (1856); G. Engler and A. Prantl, *Die Natürlichen Pflanzenfamilien* (Leipzig, 1887–1902); A. B. Rendle, *Classification of the Flowering Plants* (Cambridge, 1925); E. Blatter, *The Palms of British India and Ceylon;* as well as such great works as Martius, *Historia Naturalis . . . Palmarum* in 3 vols., and Barbosa Rodrigues, *Sertum Palmarum Brasiliensium* in 2 vols. (V. H. B.)

American Palms.—The palms native in the continental United States, to which reference has been made above, are 15 or more species; a number of them are as yet imperfectly understood. Most of them are fan-leaved palms. In California one palm is native, the sturdy *Washingtonia filifera;* this plant occurs about the borders of the Colorado desert, in canyons along streams or in seepage places in the open; the same or a similar species has recently been discovered in south-western Arizona. In Texas one species is native near the mouth of the Rio Grande, this being the northern limit, as far as known, of its distribution. It is a striking fan palm, *Sabal texana.* In eastern Texas the dwarf

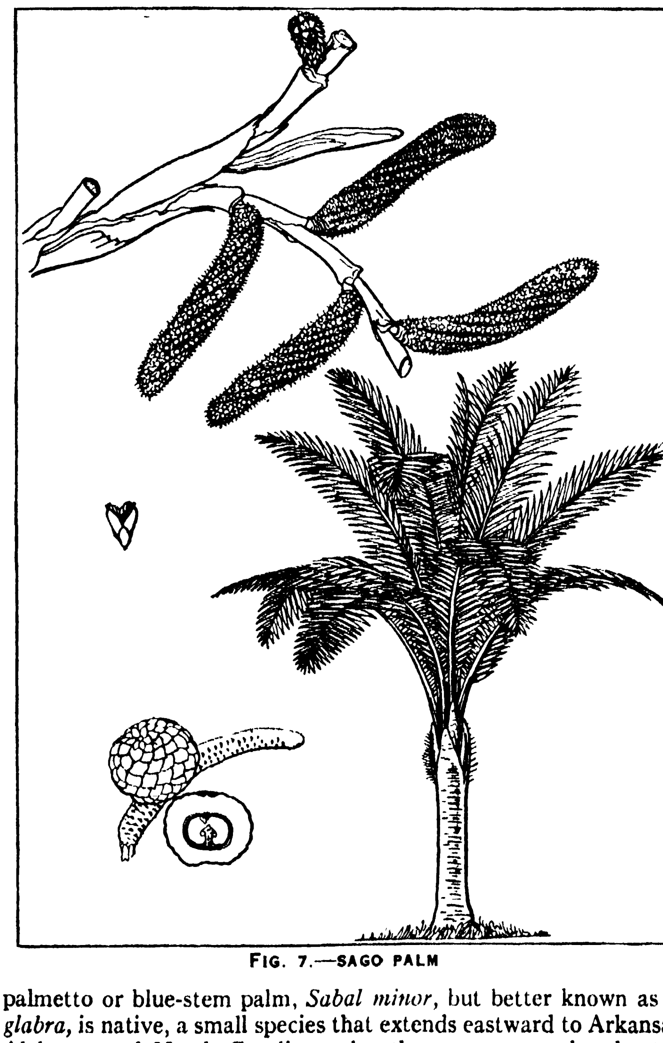


FIG. 7.—SAGO PALM

palmetto or blue-stem palm, *Sabal minor,* but better known as *S. glabra,* is native, a small species that extends eastward to Arkansas, Alabama and North Carolina; also the saw- or scrub-palmetto, *Serenoa repens* (formerly called *S. serrulata*), which covers large areas in pinelands and coastal plain to southern Florida and South Carolina. Another low or scrub palmetto, *Sabal Etonia* (or *S. megacarpa*) is native in peninsular Florida; and there are two tall or tree sabals or palmettos, the common cabbage-tree, *S. Palmetto,* a coastal plant from North Carolina to Florida, but in the peninsular part of the latter state becoming widespread,

and the recently described *S. Deeringiana* of southern Louisiana. The needle-palm, the low *Rhapidophyllum Hystrix,* ranges from Mississippi to Florida and South Carolina; this is a fan-palm known by the long needles in the sheaths at the base of the plant.

All the other palms native in the United States are confined to Florida. They are in five genera, not counting the ubiquitous coconut as native: *Thrinax, Coccothrinax* and *Acoelorraphe* (*Paurotis*), fan-palms; *Pseudophoenix* and *Roystonea* (*Oreodoxa*), feather-palms. All of these plants are confined to the warmer or semi-tropical parts of Florida, practically from the latitude of Miami southward. All may be considered as northern extensions of West Indian species. The *Pseudophoenix* is restricted, in Florida, to a few of the keys of the east coast. *Roystonea* is represented by a single species, the so-called royal palm, native on certain hammocks or islands in the Everglades.

More than 200 species of palms are recorded as planted in the continental United States. A few are known mostly as glasshouse subjects, although probably all are somewhere planted outside in the open or some of them perhaps under lath. They belong to more than 80 genera, as palm botany is now understood, and they represent many countries around the world. For the most part, the planted palms of Florida and California represent unlike sets of species, those in California having a strong Mexican character. (L. H. Ba.)

PALMA, JACOPO (*c.* 1480–1528), Italian painter of the Venetian school. He was born at Serinalta, near Bergamo, and is called Palma Vecchio (Old Palma), to distinguish him from his grandnephew, Palma Giovane, also a painter. He worked mostly in Venice. In his later years his fame spread abroad and he received commissions from Fontanelle near Oderzo, Zerman near Treviso and from Vicenza. He also painted altarpieces in three villages of his native Brembo valley, at Serinalta, Dossena and Peghera. Palma Vecchio appears to have formed his style after Titian and Giorgione; at a later period he was influenced by Lorenzo Lotto. His altarpiece in S. Maria Formosa is famous for the beautiful and majestic figure of St. Barbara on one of its six panels. A favourite subject of the master was "the Santa Conversazione" where the holy family with saints and donors are grouped against an idyllic landscape background, as in the museums of Naples, Vienna, Hampton Court, and in the Lichtenstein collection (Vienna). The fine series of female portraits in the Vienna gallery were probably painted from 1510–20. They represent fair young women of the courtesan type with hair flowing round their bare shoulders. The Berlin gallery and the National Gallery (the Mond collection) contain similar portraits, recalling the well-known Flora, by Titian. At the Dresden gallery is the famous "Three Sisters." Here, too, are "Jacob and Rachel" and "Venus" executed in the broad, blond manner in which he painted towards the end of his life (1520–25). Palma died in 1528 after a long period of illness. He left some 40 uncompleted pictures in his studio which were finished by his pupils; and this circumstance accounts for some inferior work which came into the market under his name.

See C. Ridolfi, *Le Maraviglie dell' Arte* (ed. v. Hadeln, 1914–24); G. Novelli, *Italian Masters in German Galleries* (1883); M. v. Boehn, *Giorgione und Palma Vecchio* (Bielefeld and Leipzig, 1908); J. P. Richter, *The Mond Collection* (1910). (I. A. R.)

PALMA, RICARDO (1833–1919), Peruvian man of letters, was born in Lima on Feb. 7, 1833. At the age of 20 he joined the navy, and in 1860 was forced by political exigencies to flee to Chile, where he devoted himself to journalism. Six years later, he returned to Lima, to join a revolutionary movement in favour of war with Spain, and participated in the engagement between the Spanish fleet and the batteries of Callao. In 1881, during the War of the Pacific, he took part in the battle of Miraflores in which the Peruvian forces were defeated, and during the Chilean occupation he had the courage to protest against the vandalistic destruction of the famous National Library by Chilean soldiery. After the war he was for a while director of *La Prensa* in Buenos Aires, but soon was recalled by the Peruvian Government to rebuild the National Library. In 1887 he founded the Peruvian Academy and in 1892 was sent to Spain as Peru's representative to the Fourth Centenary of the Discovery of America. His literary career began in his youth with light verses and translations from Victor Hugo. The *Anales de la inquisición de Lima,* which he had published in periodicals when he was in Chile, appeared in book form in 1863, and this was followed by poems entitled *Semblanzas* (1867) and *Pasionarias* (1870). But his fame chiefly derives from his *Tradiciones,* short prose sketches, mingled fact and fancy, of the colonial days of Peru. The first volume of the series appeared in 1872 as *Tradiciones,* and was succeeded by *Ropa vieja* (1889), *Ropa apolillada* (1891) and an *Apéndice a mis últimas tradiciones.* The best of them have been collected in a single volume, under the title *Las mejores tradiciones peruanas,* one of the most popular books in Spanish-American literature. Palma died in Miraflores, Lima, on Oct. 6, 1919.

See V. G. Calderón, *Semblanzas de América* (Madrid, 1919); W. B. Parker, *Peruvians of To-Day* (Lima, 1919). (W. B. P.)

PALMA, TOMÁS ESTRADA (1835–1908), patriot and first president of Cuba, was born near Bayamo, Santiago Province, Cuba, on July 9, 1835. He was educated at Havana and at the University of Seville in Spain. When the Ten Years' War (1868–78) was planned, he entered into the patriot plans with great zeal, freeing his slaves and giving his money to the cause of Cuban freedom. He became a general in the revolutionary army, then secretary and finally, in 1876, president of the provisional government which was instituted by the revolutionists. In 1877, however, he was captured by the Spaniards and confined first in El Morro castle and then in Spain until the revolution was suppressed. After his release he went to Honduras, where he married the daughter of the president and became postmaster-general. Later he moved to Orange county, N.Y., where he opened a boys' school, most of the children attending being from Latin-American countries. In 1895, when the Cuban revolution again broke out he went to New York city and became active in the work of the Cuban Junta. After the death of José Martí, Palma became the real head of the revolution. In New York he was active in procuring money, arms and supplies for the revolutionary forces, and was also the informally recognized diplomatic representative of Cuba at Washington. After success had come to the Cubans through the aid of the United States Palma demanded that the United States should ask for nothing less than Cuban independence in the treaty with Spain. In 1901, when the United States was ready to turn the island over to the Cubans, Palma became the first president of the republic by an almost unanimous vote. His rule was honest and intelligent and Cuba was brought to a high degree of prosperity. Palma joined no political party at first and chose a non-partisan cabinet, but he was forced more and more to ally himself with the Conservatives to get his measures through Congress. He allowed himself to become the candidate of the Conservatives for re-election in 1905, an election in which the Conservative bosses probably used fraudulent methods at the polls without Palma's previous knowledge. The Liberals charged a corrupt election and fomented the revolution of 1906, which resulted in the resignation of Palma on Sept. 6, 1906. The United States was forced to take control of the Government temporarily. Palma died in Santiago Province, Cuba, on Nov. 4, 1908.

See R. Martínez Ortiz, *Los primeros años de independencia* (1921); E. Barbarrosa, *El proceso de la república* (1911); C. E. Chapman, *History of the Cuban Republic* (1927).

PALMA or **PALMA DE MALLORCA,** the capital of the Spanish province of the Balearic islands, the residence of a captain-general, an episcopal see, and a flourishing seaport, situated 135 m. S.S.E. of Barcelona, on the south-west coast of Majorca, at the head of the fine Bay of Palma, which stretches inland for about 10 m. between Capes Cala Figuera and Regana. Pop. (1920), 77,418. Palma probably owes, if not its existence, at least its name (symbolized on the Roman coins by a palm branch), to Metellus Balearicus, who in 123 B.C. settled 3,000 Roman and Spanish colonists on the island. The bishopric dates from the 14th century. About 1 m. S.W. of Palma is the castle of Bellver, the ancient residence of the kings of Majorca. The more conspicuous buildings are the cathedral, the exchange, the royal palace, now

occupied by the captain-general, and the law courts, the episcopal palace, a late Renaissance building (1616), the general hospital (1456) and the town-house (end of the 16th century). The cathedral was founded in 1230 and finished in 1601. Palma has a seminary founded in 1700, archives dating from the 14th century, a school and museum of fine arts, a nautical school and an institute founded in 1836 to replace the old university (1503).

The harbour was formed by a mole, 387 yd. long, in the 14th century and has been considerably improved at subsequent intervals. Palma has a thriving trade in grain, wine, oil, almonds, fruit, vegetables, silk, foodstuffs and live stock. There are manufactures of alcohol, liqueurs, chocolate, sugar, flour, soap, leather, earthenware, glass, matches, paper, linen, woollen goods and rugs.

PALMA, or San Miguel de la Palma, a Spanish island in the Atlantic Ocean, forming part of the Canary Islands (*q.v.*). Pop. 52,887; area 280 sq.m. Palma is 26 m. long, with an extreme breadth of 16 m. It lies 67 m. W.N.W. of Teneriffe. It is traversed from north to south by a chain of mountains, the highest of which is 7,900 ft. above sea-level. At the broadest part is a crater 9 m. in diameter, known as the Caldera (*i.e.*, cauldron). The bottom of the crater has an elevation of 2,300 ft., and it is overhung by peaks that rise more than 5,000 ft. above it. Santa Cruz de la Palma (pop. 7,024) on the east coast is the chief town.

PALM BEACH and **WEST PALM BEACH,** two cities of Florida, U.S.A., on the most easterly point of the east coast, 300 m. S.S.E. of Jacksonville. They are on Federal highway 1 and the East Coast Inland waterway, and are served by the Florida East Coast and the Seaboard Air Line railways, and several steamship lines. Palm Beach, on a long narrow island between the Atlantic Ocean and Lake Worth (an arm of the ocean) had a resident population of 1,150 in 1925 (State census). It is one of the most luxurious winter resorts in America, with palatial hotels, clubs and private estates. West Palm Beach, stretching for 12 m. along the opposite side of Lake Worth, is also a pleasure resort and centre for tourists, with many hotels and furnished apartments, and in addition is the county seat of Palm Beach county and the commercial and financial centre of a wide area. Its population in 1928 was estimated locally at 60,000 (25% negroes); transient population of the two cities and their contiguous suburbs ("Greater Palm Beach") in the winter of 1927–28 at about 100,000. Three bridges span the lake, which is usually dotted with yachts, sea-sleds and other small craft, and is the scene of an annual regatta on Feb. 20, 21, and 22. West Palm Beach already has a substantial wholesale distributing trade and ships considerable produce (especially fruits and early vegetables) and its commercial importance will increase with further progress in reclaiming the northern Everglades. Both cities have a commission-manager form of government. The assessed valuation of Palm Beach for 1928–9 was $48,534,624; of West Palm Beach, $98,000,000.

The development of Palm Beach as a winter resort began about 1892. West Palm Beach was incorporated as a town in 1903 and as a city in 1911. In 1900 its population was only 564; in 1910, 1,743; and in 1920, 8,659. In 1924 an extension of the Seaboard Air Line gave connection by rail with the west coast. The Palm Beaches did not suffer from the storm which wrecked Miami in Sept. 1926, but they were badly damaged (to the amount of approximately $30,000,000) by the hurricane of Sept. 1928, which devastated Porto Rico and parts of Florida, especially the Everglades and the south-eastern shores of Lake Okeechobee; and about 13,000 refugees (chiefly from outside the city) were under care of the Red Cross in West Palm Beach for a time. The coco-nut palms fringing Lake Worth, to which the cities owe their name, are the result of the wrecking of a Spanish cargo of coco-nuts off the coast in Jan. 1879.

PALM-CIVET or **PARADOXURE,** the name of the members of the civet-like genus *Paradoxurus*, represented by several species mainly from South-east Asia. (*See* Carnivora.) Palm-civets are about the size of the domestic cat, or rather larger, arboreal in habits, with dark fur. The common Indian palm-civet (*P. niger*) ranges throughout India, wherever there are trees. Its diet consists of small mammals and reptiles, birds and their eggs, fruit and vegetables. From four to six young are brought forth at a litter. Other species occur in Ceylon, the Himalayas and Malay. The small-toothed palm-civets from the Malay Archipelago form the genus *Arctogale*.

PALMELLA, a town of Portugal, in the district of Lisbon at the north-eastern extremity of the Serra da Arrabida, and on the Lisbon-Setubal railway. Pop. (1911), inclusive of the neighbouring village of Marateca, 13,318. Palmella is an ancient and picturesque town, still surrounded by massive but ruined walls and dominated by a mediaeval castle.

PALMER, SIR CHARLES MARK, Bart. (1822–1907), English shipbuilder, was born at South Shields on Nov. 3, 1822. His father, originally the captain of a whaler, removed in 1828 to Newcastle-on-Tyne, where he conducted a ship-owning and ship-broking business. After two years' experience at Marseilles Palmer entered his father's business at Newcastle, and in 1842 he became a partner. He then became a colliery manager, and eventually purchased large colliery interests. Palmer built, largely according to his own plans, the "John Bowes," the first iron screw-collier, and several other steam-colliers, in a yard established by him at Jarrow, then a small Tyneside village. He then purchased iron-mines in Yorkshire, and erected along the Tyne at Jarrow large shipbuilding yards, blast-furnaces, steel-works, rolling-mills and engine-works, fitted on the most elaborate scale. The firm produced warships as well as merchant vessels, and their system of rolling armour plates, introduced in 1856, was generally adopted by other builders. In 1865 he turned the business into Palmer's Shipbuilding and Iron Company, Limited. In 1886 his services in connection with the settlement of the costly dispute between British shipowners and the Suez Canal company (of which he was then a director) were rewarded with a baronetcy. He died in London on June 4, 1907.

PALMER, EDWARD HENRY (1840–1882), English Orientalist, the son of a private schoolmaster, was born at Cambridge, on Aug. 7, 1840. He was educated at the Perse school, and, after a short period as a clerk in London, he returned to Cambridge. He entered St. John's college in 1863, and in 1867 was elected a fellow on account of his attainments as an orientalist, especially in Persian and Hindustani. During his residence at St. John's he catalogued the Persian, Arabic and Turkish manuscripts in the university library, and in the libraries of King's and Trinity. In 1867 he published a treatise on *Oriental Mysticism*, based on the *Maksad-i-Aksā* of Aziz ibn Mohammed Nafasī. He was engaged in 1869 to join the survey of Sinai, undertaken by the Palestine Exploration Fund, and followed up this work in the next year by exploring the desert of El-Tīh in company with Charles Drake (1846–74). They completed this journey on foot and without escort, making friends among the Bedouin, to whom Palmer was known as "Abdallah Effendi." After a visit to the Lebanon and to Damascus, where he made the acquaintance of Sir Richard Burton, then consul there, he returned to England in 1870 by way of Constantinople and Vienna. At Vienna he met Arminius Vambéry. In the close of the year 1871 he became Lord Almoner's professor of Arabic at Cambridge.

In 1881 Palmer left Cambridge, and joined the staff of the *Standard* newspaper to write on non-political subjects. He was called to the English bar in 1874, and early in 1882 he was asked by the Government to assist the Egyptian expedition by his influence over the Arabs of the desert El-Tīh. He was instructed, apparently, to prevent the Arab sheikhs from joining the Egyptian rebels and to secure their non-interference with the Suez Canal. He went to Gaza, without an escort made his way safely through the desert to Suez—an exploit of singular boldness—and was highly successful in his negotiations with the Bedouin. He was appointed interpreter-in-chief to the force in Egypt, and from Suez he was again sent into the desert with Captain William John Gill and Flag-Lieutenant Harold Charrington to procure camels and gain the allegiance of the sheikhs by considerable presents of money. On this journey he and his companions were led into an ambush and murdered (Aug. 1882). Their remains, recovered after the war by the efforts of Sir Charles (then Colonel) Warren, now lie in St. Paul's Cathedral.

Palmer's highest qualities appeared in his travels, especially in the heroic adventures of his last journeys. His brilliant scholarship is displayed rather in the works he wrote in Persian and other Eastern languages than in his English books, which were generally written under pressure. His scholarship was wholly Eastern in character, and lacked the critical qualities of the modern school of Oriental learning in Europe. All his works show a great linguistic range and very versatile talent; but he left no permanent literary monument worthy of his powers.

His chief writings are *The Desert of the Exodus* (1871), *Poems of Behā ed Din* (Ar. and Eng., 1876–1877), *Arabic Grammar* (1874), *History of Jerusalem* (1871), by Besant and Palmer—the latter wrote the part taken from Arabic sources; *Persian Dictionary* (1876) and *English and Persian Dictionary* (posthumous, 1883); translation of the Ḳoran (1880) for the *Sacred Books of the East* series, a spirited but not very accurate rendering. He also did good service in editing the *Name Lists* of the Palestine Exploration.

PALMER, JOHN MCAULEY (1817–1900), American soldier and political leader, was born at Eagle Creek, Ky., on Sept. 13, 1817. In 1831 his family removed to Illinois, and in 1839 he was admitted to the bar in that State. In 1852–55 he was a Democratic member of the State senate, but joined the Republican Party upon its organization and became one of its leaders in Illinois. He was a delegate to the Republican national convention in 1856 and a Republican presidential elector in 1860. During the Civil War he served in the Union army, rising from the rank of colonel to that of major-general in the volunteer service and taking part in the battles of Stone River and Chickamauga, and, under Thomas, in the Atlanta campaign. He was governor of Illinois from 1869 to 1873. In 1872 he joined the Liberal-Republicans, and eventually returned to the Democratic Party. In 1891–97 he was a Democratic member of the United States Senate. In 1896 he was nominated for the presidency, by the "Gold-Democrats," but received no electoral votes. He died at Springfield, Ill., on Sept. 25, 1900.

See *The Personal Recollections of John M. Palmer—The Story of an Earnest Life,* published posthumously in 1901.

PALMER, SAMUEL (1805–1881), English landscape painter and etcher, was born in London on Jan. 27, 1805. In 1819 he exhibited both at the Royal Academy and the British Institution; and shortly afterwards he became intimate with John Linnell, who introduced him to Varley, Mulready, and, above all, to William Blake, whose strange and mystic genius had the most powerful effect on Palmer's art. He died at Reigate on May 24, 1881.

His English metrical version of Virgil's *Eclogues,* which was published posthumously in 1883, contains reproductions of his watercolours, and etchings completed by his son A. H. Palmer. Other representative plates are "The Early Ploughman," in *Etching and Etchers* 1st ed., and "The Herdsman's Cottage" in the 3rd edition.

PALMER, a town of Hampden county, Massachusetts, U.S.A., on the Chicopee river, 15 m. E. of Springfield. It is served by the Boston and Albany, the Boston and Maine, and the Central Vermont railways. Pop. (1920), 9,896 (28% foreign-born white); 11,044 in 1925 (State census). It occupies 31 m. of hilly country, and embraces four villages. The more important manufactures are cotton and wire goods, metal culverts, brushes and carpets. Palmer was settled in 1716, and received a considerable accession of Scotch-Irish in 1718. In 1752 the plantation (called The Elbows) was established as the district of Palmer, and in 1775 the district became a town. It was a centre of Shays' Rebellion.

PALMER, a pilgrim who as a sign or token that he had made pilgrimage to Palestine carried a palm-branch attached to his staff, or more frequently a cross made of two strips of palm-leaf fastened to his hat (*see* PILGRIMAGE). The name "palmer" or "palmer-worm" is often given to many kinds of hairy caterpillars, specifically to that of the destructive tineid moth, *Ypsilophus ligulellus,* which chiefly attacks the apple; also to the grubs of various beetles. Artificial flies used in angling, covered with bristling hairs, are known also as "palmers" or "hackles."

PALMERSTON, HENRY JOHN TEMPLE, 3RD VISCOUNT (1784–1865), English statesman, was born at Broadlands, near Romsey, Hants, on Oct. 20, 1784, the son of Henry, 2nd Viscount Palmerston and his wife Mary Mee. Much of Palmerston's early childhood was spent in Italy, but he was sent to Harrow School at eleven. He had just left school when, in 1802, he succeeded his father in the peerage, an Irish one, which did not prevent membership of the House of Commons. From Harrow he went to Edinburgh, where he attended the lectures of Dugald Stewart, with whom he boarded. He entered St. John's College, Cambridge, in 1803; in 1806 he began his political career.

Before he was four-and-twenty he had stood two contested elections for the University of Cambridge, at which he was defeated, and he entered parliament for a pocket-borough, Newtown, Isle of Wight, in June 1807. Influence secured for him a junior lordship of the admiralty in the Portland administration of 1807. He delivered his maiden speech in the House of Commons in defence of the expedition against Copenhagen. When Perceval formed his government in 1809, he proposed to this young man of five-and-twenty to take the chancellorship of the exchequer. Palmerston, however, preferred the less important office of secretary-at-war, charged exclusively with the financial business of the army, without a seat in the cabinet, and in this position he remained, without any signs of an ambitious temperament or of great political abilities, for twenty years (1809–1828) under five prime ministers, steadily refusing preferment. During the whole of that period Palmerston was chiefly known as a man of fashion, and a subordinate minister without influence on the general policy of the cabinets he served. Some of the most humorous poetical pieces of the *New Whig Guide* were from his pen, and he was entirely devoted, like his friends Peel and Croker, to the Tory party of that day. Palmerston never was a Whig, still less a Radical; he was a statesman of the old English aristocratic type, liberal in his sentiments, favourable to the march of progress, but entirely opposed to the claims of democratic government. He had been elected M.P. for Cambridge University in 1811, and sat for this constituency until 1831 when he was defeated because he had adopted reform principles.

In the later years of Lord Liverpool's administration, after the death of Lord Londonderry in 1822, strong dissensions existed in the cabinet. Palmerston supported the measures of Canning and his friends. The "Canningites," as they were termed—Palmerston, Huskisson, Charles Grant, Lamb (Lord Melbourne) and Dudley—were included by Wellington in his cabinet of 1827, but a dispute between the duke and Huskisson soon led to the resignation of that minister, and his friends resigned with him. In the spring of 1828 Palmerston found himself in opposition. From that moment he appears to have directed his attention closely to foreign affairs; indeed he had already urged on the duke of Wellington a more active interference in the affairs of Greece; he had made several visits to Paris, where he foresaw the impending revolution; and on June 1, 1829, he made his first great speech on foreign affairs. Palmerston was no orator; his language was unstudied, and his delivery somewhat embarrassed; but he addressed the House of Commons in language adapted to the capacity and the temper of his audience. Wellington sought, in September 1830, to induce Palmerston to re-enter the cabinet, which he refused because he was now committed to parliamentary reform, and from that time forward he may be said to have associated his political fortunes with those of the Whig party. Lord Grey placed the department of foreign affairs in his hands upon the formation of the ministry of 1830, and Palmerston entered on the duties of an office over which he continued to exert his powerful influence, both in and out of office, for twenty years.

Foreign Minister.—The revolution of July 1830 had just given a strong shock to the existing settlement of Europe. The British foreign office was especially concerned with the fate of Belgium, in revolution against the king of the Netherlands and coveted by France. In the end the policy of England prevailed; numerous difficulties, both great and small, were overcome by the conference, although on the verge of war, peace was maintained; and Prince Leopold of Saxe-Coburg was placed upon the throne of Belgium. The independence of Belgium was a solid success for Palmerston's diplomacy.

In 1833 and 1834 the youthful queens Donna Maria of Portugal and Isabella of Spain were the representatives and the hope of the constitutional party in those countries—assailed and hard pressed by their absolutist kinsmen Don Miguel and Don Carlos. Palmerston conceived and executed the plan of a quadruple alliance of the constitutional states of the West to serve as a counterpoise to the northern alliance. A treaty for the pacification of the Peninsula was signed in London on April 22, 1834; and, although the struggle was somewhat prolonged in Spain, it accomplished its object. But Louis Philippe was accused of secretly favouring the Carlists, and he positively refused to be a party to direct interference in Spain. The hesitation of the French court on this question was probably one of the causes of the extreme personal hostility Palmerston showed towards the king of the French down to the end of his life. Nevertheless, at this same time (June 1834) Palmerston wrote that "Paris is the pivot of my foreign policy." Thiers was at that time in office. Unfortunately differences with France increased in each succeeding year; and a constant but sterile rivalry was kept up, which ended in results humiliating and injurious to both nations.

In Near Eastern politics Palmerston had been from the beginning a strenuous supporter of the claims of the Hellenes against the Turks and the execution of the Treaty of London. But from 1830 the defence of the Ottoman Empire became one of the cardinal objects of his policy. He believed in the regeneration of Turkey. His two principal aims were to prevent the establishment of Russia on the Bosporus and of France on the Nile, and he regarded the maintenance of the authority of the Porte as the chief barrier against both these aggressions. Towards Russia he was suspicious and hostile. He was a party to the publication of the "Portfolio" in 1834, and to the mission of the "Vixen" to force the blockade of Circassia about the same time. He regarded the treaty of Unkiar Skelessi which Russia extorted from the Porte in 1832, when she came to the relief of the sultan after the battle of Konieh, with great jealousy; and, when the power of Mehemet Ali in Egypt appeared to threaten the existence of the Ottoman dynasty, he effected a combination of all the powers, who signed the collective note of July 27, 1839, pledging them to maintain the independence and integrity of the Turkish Empire. On three former occasions, in 1833, 1835 and 1839, the Turkish policy of Palmerston had been overruled by the cabinet. But in 1840 Lord Palmerston prevailed. France, though her ambassador had signed the collective note in the previous year, declined to be a party to measures of coercion against Mehemet Ali. Palmerston, irritated at her Egyptian policy, flung himself into the arms of the northern powers, and the treaty of July 15, 1840 between England, Russia, Austria and Prussia, engaging to assist the sultan against Mehemet Ali, was signed in London without the knowledge or concurrence of France. This measure was not taken without strong opposition on the part of several members of the British cabinet. By now Palmerston was regarded as one of the most powerful statesmen of the age. At the same time, though acting with Russia in the Levant, the British government engaged in the affairs of Afghanistan to defeat her intrigues in Central Asia, and a contest with China was terminated by the conquest of Chusan, afterwards exchanged for the island of Hong-Kong.

After the fall (1841) of the Melbourne administration Palmerston remained for five years out of office. The crisis was past, but the change which took place by the substitution of Guizot for Thiers in France, and of Aberdeen for Palmerston in England, was a fortunate event for the peace of the world. Palmerston distrusted France and believed that war between the two countries was sooner or later inevitable. Aberdeen and Guizot, by mutual confidence and friendly offices, entirely succeeded in restoring cordial understanding between the two governments, and the irritation which Palmerston had inflamed gradually subsided. During the Peel administration Palmerston led a retired life, but he attacked with characteristic bitterness the Ashburton treaty with the United States, which closed successfully other questions he had long kept open. Palmerston approached questions of foreign policy with an amount of passion, of personal animosity, and imperious language which rendered him in the eyes of the queen and of his colleagues a dangerous minister. Lord John Russell's failure to form a ministry (Dec. 1845) was due to Grey's refusal to join a government in which Palmerston had the direction of foreign affairs. A few months later this difficulty was surmounted; the Whigs returned to power, and Palmerston to the foreign office (July 1846), with a strong assurance that Lord John Russell should exercise a strict control over his proceedings. A few days sufficed to show how vain was this expectation. The French government regarded Palmerston's appointment as a sign of renewed hostility, and a despatch in which Palmerston had put forward the name of a Coburg prince as husband for the young queen of Spain, served as an excuse for a breach of the engagements entered into between Guizot and Aberdeen. The efforts of the British minister to defeat the French marriages of the Spanish princesses, by an appeal to the treaty of Utrecht and the other powers of Europe, were wholly unsuccessful; France won the game, though with no small loss of honourable reputation.

The revolution of 1848 spread like a conflagration through Europe, and shook every throne on the Continent except those of Russia, Spain and Belgium. Palmerston's sympathies had been passionately awakened by the cause of Italian independence. He supported the Sicilians against the king of Naples, and the king of Sardinia against Austria. The British government, or at least Palmerston as its representative, was regarded with suspicion and resentment by every power in Europe, except the French republic; and even that was shortly afterwards to be alienated by Palmerston's attack on Greece.

This state of things was regarded with the utmost annoyance by the British court and by most of the British ministers. Palmerston had on many occasions taken important steps without their knowledge, which they disapproved. Over the foreign office he asserted and exercised an arbitrary dominion, which the feeble efforts of the premier could not control. The queen and the prince consort (*see* VICTORIA, QUEEN) did not conceal their indignation at the position in which he had placed them with all the other courts of Europe. When Kossuth, the Hungarian leader, landed in England, Palmerston proposed to receive him at Broadlands, a design which was only prevented by a peremptory vote of the cabinet; and in 1850 he took advantage of Don Pacifico's very questionable claims on the Hellenic government to organize an attack on the little kingdom of Greece. Greece being a state under the joint protection of three powers, Russia and France protested against its coercion by the British fleet, and the French ambassador temporarily left London, which promptly led to the termination of the affair. But it was taken up in parliament with great warmth. After a memorable debate (June 17), Palmerston's policy was condemned by a vote of the House of Lords. The House of Commons was moved by Roebuck to reverse the sentence, which it did (June 29) by a majority of 46, after having heard from Palmerston the most eloquent and powerful speech ever delivered by him, in which he sought to vindicate, not only his claims on the Greek government for Don Pacifico, but his entire administration of foreign affairs. It was in this speech, which lasted five hours, that Palmerston made the well-known declaration that a British subject—"Civis Romanus sum"—ought everywhere to be protected by the strong arm of the British government against injustice and wrong. Yet, notwithstanding this parliamentary triumph, there were not a few of his own colleagues and supporters who condemned the spirit in which the foreign relations of the Crown were carried on; and in that same year the queen addressed a minute to the prime minister in which she recorded her dissatisfaction at the manner in which Lord Palmerston evaded the obligation to submit his measures for the royal sanction as failing in sincerity to the Crown. This minute was communicated to Palmerston, who did not resign upon it. This distrust and uneasiness reached their climax when Palmerston expressed to the French ambassador in London, without the concurrence of his colleagues, his personal approval of the coup d'état of Louis Napoleon. Upon this Lord John Russell advised his dismissal from office (Dec. 1851). Palmerston avenged himself by turning out the government on a militia bill; but

although he survived for many years, and twice filled the highest office in the state, his career as foreign minister ended for ever, and he returned to the foreign office no more. Indeed, he assured Lord Aberdeen, in 1853, that he did not wish to resume the seals of that department.

Upon the formation of the cabinet of 1853, which was composed by the junction of the surviving Peelites with the Whigs, under Aberdeen, Palmerston accepted with the best possible grace the office of secretary of state for the home office. At one moment he withdrew from it, because Lord John Russell persisted in presenting a project of reform which appeared to him entirely out of season; and he advocated, with reason, measures of greater energy on the approach of war, which might possibly, if they had been adopted, have averted the contest with Russia. As the difficulties of the Crimean campaign increased, it was not Lord Palmerston but Lord John Russell who broke up the government by refusing to meet Roebuck's motion of inquiry. Palmerston remained faithful and loyal to his colleagues in the hour of danger. Upon the resignation of Lord Aberdeen and the duke of Newcastle, the general sentiment of the House of Commons and the country called Palmerston to the head of affairs, and he entered, on Feb. 5, 1855, aged 70, upon the high office, which he retained, with one short interval, to the day of his death.

Prime Minister.—A series of fortunate events followed his accession to power. In March 1855 the death of the emperor Nicholas removed his chief antagonist. In September Sevastopol was taken. The administration of the British army was reformed by a consolidation of offices. In the following spring peace was signed in Paris. Never since Pitt had a minister enjoyed a greater share of popularity and power, and, unlike Pitt, Palmerston had the prestige of victory in war. He was assailed in parliament by the eloquence of Gladstone, the sarcasms of Disraeli, and the animosity of the Manchester Radicals, but the country was with him. Defeated by a hostile combination of parties in the House of Commons on the question of the Chinese war in 1857 and the alleged insult to the British flag in the seizure of the lorcha "Arrow," he dissolved parliament and appealed to the nation. The result was the utter defeat of the extreme Radical party and the return of a more compact Liberal majority. The great events of the succeeding years, the Indian Mutiny, and the invasion of Italy by Napoleon III., belong rather to the general history of the times than to the life of Palmerston; but it was fortunate that a strong and able government was at the head of affairs. Lord Derby's second administration of 1858 lasted but a single year, Palmerston having casually been defeated on a measure for removing conspiracies to murder abroad from the class of misdemeanour to that of felony, which was introduced in consequence of Orsini's attempt on the life of the emperor of the French. But in June 1859 Palmerston returned to power, and it was on this occasion that he proposed to Cobden, one of his most constant opponents, to take office; on his refusal Milner Gibson was appointed to the board of trade, although he had been the prime mover of the defeat of the government on the Conspiracy Bill. Palmerston had learnt that it was wiser to conciliate an opponent than to attempt to crush him. Although Palmerston approved the objects of the French invasion of Italy in so far as they went to establish Italian independence, the annexation of Savoy and Nice to France revived his old suspicions of the good faith of Napoleon III. He believed that war with France was a contingency to be provided against and he induced the House of Commons to vote nine millions for the fortification of British ports and arsenals.

Palmerston resisted the Suez canal project of Lesseps. He did not foresee the advantages to be derived by British commerce from this great work, and he was strongly opposed to the establishment of a powerful French company on the soil of Egypt. He also believed that England would be drawn by her interest, as a great commercial power, in the canal traffic, into a more direct interference in Egypt, which it was desirable to avoid.

Upon the outbreak of the American Civil War in 1861, Palmerston acknowledged that it was the duty of the British government to remain neutral; but his own opinion led him rather to desire than to avert the rupture of the Union, which might have been the result of a refusal on the part of England and France to recognize a blockade of the Southern ports, which was notoriously imperfect, and extremely prejudicial to the interests of Europe. The cabinet was not of this opinion, and, although the belligerent rights of the South were promptly recognized, the neutrality of the Government was observed. When, however, the Southern envoys were taken by force from the "Trent," a British packet, Palmerston insisted upon a full and complete reparation. But the difficulty with the American government over the "Alabama" and other vessels, fitted out in British ports to help the Southern cause, was only settled at last (*see* ALABAMA ARBITRATION) by an award extremely onerous to England.

The last transaction in which Palmerston engaged arose out of the attack by the Germanic Confederation, and its leading States Austria and Prussia, on the kingdom of Denmark and the duchies of Schleswig and Holstein. There was but one feeling in the British public and the nation as to the dishonest character of that unprovoked aggression, and it was foreseen that Austria would ere long have reason to repent her share in it. Palmerston endeavoured to induce France and Russia to concur with England in maintaining the Treaty of London, which had guaranteed the integrity of the Danish dominions. But those powers, for reasons of their own, stood aloof, and the conference held in London in 1864 was without effect. A proposal to send the British fleet into the Baltic was overruled and the result was that Denmark was left to her own resources against her formidable opponents. In the following year, on Oct. 18, 1865, Palmerston expired at Brocket Hall, after a short illness, in the eighty-first year of his age. His remains were laid in Westminster Abbey.

Character.—Although there was much in the official life of Palmerston which inspired distrust and alarm to men of a less ardent and contentious temperament, he had a lofty conception of the strength and the duties of England, he was the irreconcilable enemy of slavery, injustice and oppression; and he laboured with inexhaustible energy for the dignity and security of the Empire. In private life his gaiety, his buoyancy, his high breeding, made even his political opponents forget their differences; and even the warmest altercations on public affairs were merged in his large hospitality and cordial social relations. In this respect he was aided with consummate ability by the tact and grace of Lady Palmerston, the widow of the 5th Earl Cowper, whom he married at the close of 1839, and who died in 1869.

The *Life of Lord Palmerston*, by Lord Dalling (2 vols., 1870), with valuable selections from the minister's autobiographical diaries and private correspondence, only came down to 1847, and was completed by Evelyn Ashley (vol. iii., 1874; iv, v., 1876). The whole was re-edited by Mr. Ashley, in two volumes (1879), the standard biography. The *Life* by Lloyd Sanders (1888) is an excellent shorter work. *See* also B. K. Martin, *The Triumph of Lord Palmerston. A study of public opinion in England before the Crimean war* (1926).

PALMERSTON: *see* NORTHERN AUSTRALIA; PORT DARWIN.

PALMERSTON NORTH, a town in the Manawatu district of New Zealand, 87 miles north of Wellington. Pop. (1927) 20,540. It is the centre of a thriving dairy and sheep-raising district, an important railway junction, and the first borough of New Zealand to institute rating on "unimproved" capital values.

PALMERTON, a borough of Carbon county, Pennsylvania, U.S.A., on the Lehigh river, 15 m. N.W. of Allentown. It is served by the Central of New Jersey, the Chestnut Ridge, and (for freight) the Lehigh and the New England railways. Pop. (1920) 7,168 (33% foreign-born white); 1928 local estimate 9,000. It is the trade centre of a farming region, and manufactures zinc, silk and paints. The borough was incorporated in 1912.

PALMETTE, any decorative form consisting of radiating petals or scales, symmetrically disposed, and growing from a single focus at the bottom. The word is especially used of certain lotus (*q.v.*) derivatives in Egyptian and Asiatic art, and for somewhat similar forms occurring in the Byzantine and Romanesque styles. The classic palmette is usually termed an anthemion (*q.v.*).

PALMETTO, in botany, a popular name for *Sabal Palmetto,* the palmetto palm, a native of the southern United States,

especially in Florida. It has an erect stem, 20 to 80 ft. high and deeply cut fan-shaped leaves, 5 to 8 ft. long; the fruit is a black drupe ⅓ to ½ in. long. The trunks make good piles for wharves, as the wood resists the attacks of borers; the leaves are used for thatching. The palm is grown as a pot-plant in greenhouses. A similar species, the Texas palmetto (*S. texana*) occurs in southern Texas and Mexico. The terminal bud or cabbage is eaten. There is also a third species or dwarf palmetto (Sabal adansonii). The *chamaerops humilis* of South Europe is also called palmetto.

PALMGREN, SELIM (1878–), Finnish composer, was born at Björneborg, Finland, on Feb. 16, 1878. In 1895 he went to Helsingfors conservatoire, where he studied composition under Wegelius and piano under Petzet. He afterwards worked with Ansorge and Busoni, and on his return to Finland became conductor of the Finnish Students choral society and later of the Musical Society at Abo. Since 1912 he has held no fixed appointment but has devoted himself to composition and undertaken concert tours with his wife Maikki Järnefelt, a singer. Palmgren has written two operas, *Daniel Hjort* (produced at Helsingfors 1910) and *Peter Schlemihl,* three piano concertos, and some pieces for violin and piano; but it is in his smaller piano works that his delicate and poetical writing finds the most appropriate medium. Among the best known of these are the *Finnish Lyrics, Finnish Lullaby,* the Studies, *Preludium, The Sea, The Swan, Light and Shade* and *Bird Song.*

PALMIET (*Prionium Palmita*), a shrubby, aloe-like, South African plant of the rush family (Juncaceae), reaching a height of six or seven feet, growing on the edges of streams. The stem is covered with the fibrous remains of old leaves. The plant propagates vegetatively by runners.

PALMISTRY, a predictive system whereby the various irregularities and flexion-folds of the skin of the hand are interpreted as being associated with mental or moral dispositions and powers as well as with the current of future events in the life of the individual. It is also called chiromancy or cheiromancy from χείρ, the hand, and μαντεία, divination.

How far back in prehistoric times this system has been practised it is impossible to say, but in China it is said to have existed 3,000 years before Christ, and in Greek literature it is treated even in the most ancient writings as well-known belief.

At the present day palmistry is practised in nearly all parts of China. It is also extensively practised in India, especially by one caste of Brahmins, the Joshi. In Syria and Egypt the palmist can be seen plying his trade at the cafés; and among the Arabs there are chiromantists who are consulted as to the probable success of enterprises. It is probably from their original Indian home that the traditional *dukkeripen* (fortune-telling) of the gipsies has been derived.

This system of divination has the charm of simplicity and definiteness, as an application of the "doctrine of signatures" which formed so extensive an element in the occult writings of the past six centuries. In the course of ages every detail has been brought under a formal set of rules, which only need mechanical application. There have been in past times considerable divergences in the practice, but at present there is a fairly uniform system in vogue. One school lays special stress on the general shape and outline of the hand. Corvaeus enumerates 70 varieties, Pamphilus cuts them down to 6, John de Indagine to 27, and Tricassus Mantuanus raises them to 80. The characters of softness or hardness, dryness or moisture, etc., are taken account of in these classifications. The lines of cardinal importance are (1) the rasceta or cross sulci, which isolate the hand from the forearm at the wrist, and which are the flexion folds between the looser forearm skin and that tied down to the fascia above the level of the anterior annular ligament. (2) The line which isolates the ball of the thumb, where the skin ceases to be tied to the front of the palmar fascia, is called the line of life. (3) A line starting above the head of the second metacarpal bone and crossing the hand to the middle of its ulnar border is the line of the head. (4) The transverse line below this which passes from the ulnar border a little above the level of the head of the fifth metacarpal and ends somewhere about the root of the index finger is the line of the heart. (5) The vertical line descending from the middle of the wrist to end about the base of the middle finger is the line of fortune. (6) The oblique line which begins at the wrist end of the line of life and descends towards the ulnar end of the line of the head is the line of the liver.

These lines isolate certain swellings or monticuli, the largest of which is (1) the ball of the thumb, called the mountain of Venus; (2) that at the base of the index finger is the mountain of Jupiter; (3) at the root of the middle finger is the mountain of Saturn, while those at the bases of ring and little finger are respectively the mountains of the (4) Sun and (5) of Mercury. Above the mountain of Mercury, and between the lines of head and heart is (6) the mountain of Mars, and above the line of the heart is (7) the mountain of the Moon. The relative sizes of these mountains have assigned to them their definite correlations with characters: the 1st with charity, love, libertinage; the 2nd with religiosity, ambition, love of honour, pride, superstition; the 3rd with wisdom, good fortune, prudence, or when deficient improvidence, ignorance, failure; the 4th when large makes for success, celebrity, intelligence, audacity, when small meanness or love of obscurity; the 5th indicates love of knowledge, industry, aptitude for commerce, and in its extreme forms on the one hand love of gain and dishonesty, on the other slackness and laziness. The 6th is related to degrees of courage, resolution, rashness or timidity; the 7th indicates sensitiveness, morality, good conduct, or immorality, overbearing temper and self-will.

The swellings on the palmar faces of the phalanges of the several fingers are also indicative, the 1st and 2nd of the thumb respectively, of the logical faculty and of the will; the 1st, 2nd and 3rd of the index finger, of materialism, law and order, idealism; those of the middle finger, humanity, system, intelligence; of the ring finger, truth, economy, energy; and of the little finger, goodness, prudence, reflectiveness.

Over and above these there are other marks, crosses, triangles, etc., of which more than a hundred have been described and figured by different authors, each with its interpretation; and in addition the back of the hand has its ridges. The Chinese combine podoscopy with chiromancy.

To the anatomist the roughnesses of the palm are of considerable interest. The folds are so disposed that the thick skin shall be capable of bending in grasping, while at the same time it requires to be tightly bound down to the skeleton of the hand, else the slipping of the skin would lead to insecurity of prehension, as the quilting or buttoning down of the covers of furniture by upholsterers keeps them from slipping. For this purpose the skin is tied by connecting fibres of white fibrillar tissue to the deep layer of the dermis along the lateral and lower edges of the palmar fascia and to the sheaths of the flexor tendons. The folds, therefore, which are disposed for the purpose of making the grasp secure, vary with the relative lengths of the metacarpal bones, with the mutual relations of the sheaths of the tendons, and the edge of the palmar fascia, somewhat also with the insertion of the palmaris brevis muscle. The sulci are emphasized because the subcutaneous fat, which is copious in order to pad the skin for the purpose of firmness of holding, being restricted to the intervals between the lines along which the skin is tied down, makes these intervals project, and these are the monticuli. The swelling of the mountain of Venus is simply the indication of the size of the muscles of the ball of the thumb, and can be increased by their exercise. Similarly the hypothenar muscles for the little finger underlie the three ulnar marginal mountains, the sizes of which depend on their development and on the prominence of the pisiform bone.

That these purely mechanical arrangements have any psychic, occult or predictive meaning is a fantastic imagination, which seems to have a peculiar attraction for certain types of mind, and as there can be no fundamental hypothesis of correlation, its discussion does not lie within the province of reason.

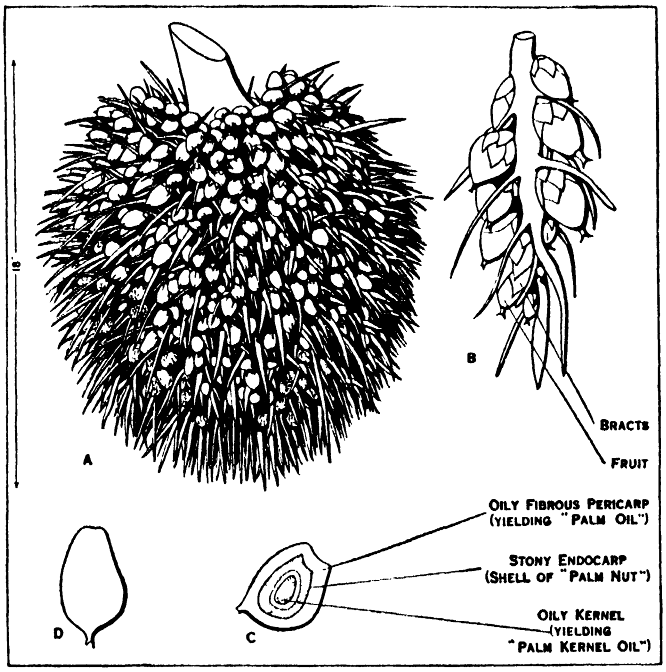
(A. Mac.)

PALMITIC ACID: *see* Fatty Acids.

PALM OIL. A fatty oil obtained from the fleshy part of the fruit of the oil-palm (*Elaeis guineensis* Jacq.), a tree in-

digenous to the west coast of Africa[1]. Palm oil must not be confounded with the oil from the kernel (*palm-kernel oil*), which differs widely from palm oil and resembles coconut oil in its constitution, properties and applications. (*See* Oil Palm.)

The ripe palm-fruit is gathered by natives and stored for three or four days; the fruits are then detached from the bunches and placed in a pit in the ground lined with leaves; water is sprinkled on the top, and the mass covered and allowed to ferment



DETAILS OF THE STRUCTURE OF THE OIL PALM (ELAEIS GUINEENSIS)
A. The fruit bunch (female inflorescence) composed of spikes (B), bearing fruits, the structure of which is shown at C. D. A single fruit (drupe), bracts removed, containing 1 to 3 kernels in the "palm nut." Each bunch bears about 2,000 to 3,000 fruits. Some 1,400 bunches of fruit are required for the production of one ton of oil

for one or two months. Under this treatment the fruit softens, so that the hard kernel can easily be separated. The softened flesh is beaten to a pulp, and roughly squeezed in bags; a further quantity of oil is obtained by boiling the pressed pulp with water. *Chop oil* is a special grade of oil prepared by the natives for food, by boiling the fresh fruits with water and skimming off the oil which rises to the surface. Owing to the fermentation occurring when the fruits are treated by the first method, the oil becomes hydrolysed, giving rise to large amounts of free fatty acids. Since the introduction of machinery, and with improved cultivation of the trees, better quality oils have been produced, and oils with as little as 2% of free fatty acids can be prepared in bulk.

Palm oil, which is liquid in the Tropics but a semi-solid fat in temperate climates, varies in colour from yellowish-red to dark brownish-red; before use it is bleached, either by blowing air through the heated oil or by treating the oil with sodium bichromate and hydrochloric acid. By these means an almost white fat is produced. Large quantities of palm oil are employed in the soap and candle industries; it is also used in tin-plate manufacture for protecting the heated steel plates before tinning, and for edible purposes. Attempts have been made to use palm oil as a fuel for the internal-combustion engines of motor boats on the Congo and other West African rivers. (*See* also Oils and Fats.)

Imports of Palm Oil, 1926

Into	Tons
United Kingdom	69,000
United States	58,000
France	23,000
Germany	14,000

See the *Bulletins* of the Imperial Institute. (E. L.; G. H. W.)

[1]Recently plantation cultivation of the oil-palm under scientific control has been introduced into the West Indies with encouraging results.

PALMSTIERNA, ERIK KULE, Baron (1877–), Swedish statesman, was born on Nov. 10, 1877. He entered the navy as sub-lieutenant, but gave up his naval career for administrative work, and became secretary of the central association for social work in 1906. From 1907 to 1915 he was organizer of the Svenska Stadsforbundt. Elected by the Liberals and Social Democrats to the *Riksdag,* he was minister of marine in the Coalition Government of 1917, and minister of foreign affairs in the Branting Government. In 1920 Palmstierna was appointed minister at the court of St. James; the following year he represented Sweden at Geneva in the Aaland islands question.

PALM SUNDAY, the Sunday before Easter, so called from the custom, still observed in the Roman Catholic Church, of blessing palm branches and carrying them in procession in commemoration of Christ's triumphal entry into Jerusalem. In the Western Church, Palm Sunday is counted as the first day of Holy Week, and its ceremonies usher in the series of services, culminating in those of Good Friday, which commemorate the Passion.

The ceremonies on Palm Sunday as celebrated now in the Roman Catholic Church are divided into: (1) The solemn blessing of the palms, (2) the procession, (3) the mass.

In the Orthodox Eastern Church Palm Sunday (*ἡ κυριακὴ ἑορτὴ τῶν βαΐων, ἑορτὴ βαϊοφόρος,* or *ἡ βαϊοφόρος*) is not included in Holy Week, but is regarded as a joyous festival commemorating Christ's triumphal entry into Jerusalem. There is no longer a procession; but the palms (in Russia willow twigs) are blessed, and are held by the worshippers during the service.

Of the reformed churches, the Church of England alone includes Palm Sunday in the Holy Week celebrations. The blessing of the palms and the procession were, however, abolished at the Reformation, and the name "Palm Sunday," though it survives popularly, is not mentioned in the Book of Common Prayer.

Bibliography.—*See* the article "*Palmsonntag*" in Wetzer und Welte, *Kirchenlexikon* (2nd ed.), ix. 1319 *sqq.;* article "*Woche, grosse,*" by Drews in Herzog-Hauck, *Realencyklopädie* (3rd ed., Leipzig, 1908), xxi. 415; Wiepen, *Palmsonntags Prozessionen und Palmesel* (Bonn, 1903); L. Duchesne, *Origines du culte chrétien* (2nd ed., Paris, 1898), p. 237. For ceremonies anciently observed in England on Palm Sunday *see* M. E. C. Walcott, *Sacred Archaeology* (1868) and J. Brand, *Popular antiquities* (ed. 1870). *See* also *Catholic Encyclopaedia, s.v.* "Palm Sunday."

PALMYRA, the Greek and Latin name of a famous city of the East, now a mere collection of Arab hovels, but still an object of interest on account of its wonderful ruins. In II. Chron. viii. 4, and in the native inscriptions, it is called Tadmor, and this is the name by which it is known among the Arabs at the present day and, it would seem, as far back as the 12th century B.C., for "Tâdmar which is in the land of the Amurru" occurs in an inscription of Tiglath-Pileser I. *c.* 1115–1100 B.C. (Dhorme in *Rev. Bibl.* 1924, pp. 106 ff.). The site lies 150m. N.E. of Damascus and five days' camel journey from the Euphrates, in an oasis of the Syrian desert, 1,300ft. above sea-level. At this point the great trade routes met in ancient times, the one crossing from the Phoenician ports to the Persian gulf, the other coming up from Petra and south Arabia.

In II. Chron. viii. 4, Solomon is said to have built "Tadmor in the wilderness"; I. Kings ix. 18, however, from which the Chronicler derived his statement, reads "Tamar" in the Hebrew text, with "Tadmor" in the Hebrew margin; there can be no doubt that the text is right and refers to Tamar in the land of Judah (Ezek. xlvii. 19; xlviii. 28). The Chronicler, we must suppose, altered the name because Tadmor was a city more renowned in his day, or possibly because he wished to increase the extent of Solomon's kingdom. The date of the Chronicler may be placed about 300 B.C., so Palmyra must have been in existence centuries before then. Of its remoter history, except for the allusion in Tiglath-Pileser's inscription, nothing is known. We may suppose that after the fall of the Babylonian Empire (6th century B.C.), Arabian tribes began to take possession of the partly cultivated lands east of Canaan, and learned to speak and write in Aramaic, the language which was most widely current throughout the region west of the Euphrates in the time of the Persian Empire (6th–4th century B.C.). It is not till much later that Palmyra

first appears in Western literature. We learn from Appian (*Bell. civ.* v. 9) that in 42–41 B.C. the city was rich enough to excite the cupidity of Mark Antony. The series of native inscriptions, written in Aramaic, begins a few years after; the earliest bears the date 304 of the Seleucid era, *i.e.*, 9 B.C. (Cooke, *North-Semitic Inscriptions* No. 141 = Vogüé, *Syrie Centrale* No. 30*a*); by this time Palmyra had become an important trade-post between the Roman and the Parthian states. Its characteristic civilization grew out of a mixture of various elements, Arabic, Aramaic, Greek and Roman. The bulk of the population was of Arab race, and though Aramaic was used as the written language, in common intercourse Arabic had by no means disappeared. The proper names and the names of deities, while partly Aramaic, are also in part unmistakably Arabic: it is suggestive that a purely Arabic term (*faḥd, NSI.* No. 136) was used for the septs into which the citizens were divided.

Originally an Arab settlement, the oasis was transformed in the course of time from a mere halting-place for caravans to a city of the first rank, and a religious centre, with the worship of the Sun-god dominating that of inferior deities.

The chief luxuries of the ancient world, silks, jewels, pearls, perfumes, incense and the like, were drawn from India, China and southern Arabia. The trade followed two routes; one by the Red sea, Egypt and Alexandria, the other from the Persian gulf through the Syro-Arabian desert. The latter, when the Nabataean kingdom of Petra (*q.v.*) came to an end (A.D. 105), passed into the hands of the Palmyrene merchants. Their caravans (συνοδίαι) travelled right across the desert to the great entrepôts on the Euphrates, (*NSI.* Nos. 113–115). The trade was enormously profitable, not only to the merchants but to the town, which levied a duty on all exports and imports; at the same time formidable risks had to be faced both from the desert-tribes and from the Parthians, and successfully to plan or convoy a great caravan came to be looked upon as a service to the state, often recognized by public monuments erected by "council and people" or by the merchants interested in the venture. These monuments, a conspicuous feature of Palmyrene architecture, took the form of statues placed on brackets projecting from the upper part of the pillars which lined the principal thoroughfares. Thus arose, beside minor streets, the imposing central avenue which, starting from a triumphal arch near the great temple of the Sun, formed the main axis of the city from south-east to north-west for a length of 1,240 yards, and at one time consisted of not less than 750 columns of rosy-white limestone, each 55ft. high.

Local industries do not seem to have been important. The prominent townsmen were engaged in the organization and even the personal conduct of caravans, the discharge of public offices such as those of *stratēgos*, secretary, guardian of the wells, president of the banquets of Bel, chief of the market (see *NSI.* Nos. 114, 115, 121, 122), sometimes the victualling of a Roman expedition. The capable performance of these functions, which often involved considerable pecuniary sacrifices, ensured public esteem; and to these honours the head of a great house was careful to add the glory of a splendid tomb, consecrated as the "long home" (lit. "house of eternity," *cf.* Eccles. xii. 5) of himself, his sons and his sons' sons for ever. These tombs, which lie outside the city and overlook it from the surrounding hills, a feature characteristically Arabic, remain the most interesting monuments of Palmyra. Some are lofty towers containing sepulchral chambers in stories; others are house-like buildings with a single chamber and a richly ornamented portico; the sides of these chambers within are adorned with the names and sculptured portraits of the dead. As a rule the buildings of Palmyra do not possess any architectural individuality, but these tombs are an exception. The style of all the ruins is late classic and highly ornate, but without refinement.

The rise of Palmyra to a position of political importance may be dated from the first imperial period, when the city must have admitted the suzerainty of Rome, for decrees respecting its custom-dues were issued by Germanicus (A.D. 17–19) and Cn. Domitius Corbulo (A.D. 57–66). At the same time the city had by no means surrendered its independence; even in the days of Vespasian (A.D. 69–79) the distinctive position of Palmyra as an intermediate state between the two great powers of Rome and Parthia was carefully watched. The splendid period of Palmyra (A.D. 130–270), to which the greater part of the inscribed monuments belong, started from the overthrow of Petra (A.D. 105), which left Palmyra without a competitor for the Eastern trade. Hadrian treated the city with special favour, and on the occasion of his visit in A.D. 130, granted it the name of Hadriana Palmyra (הדריגא תדמר *NSI.* p. 322). Under the same emperor the customs were revised and a new tariff promulgated (April, A.D. 137), cancelling the loose system of taxation "by custom" which formerly had prevailed. The great fiscal inscription, which still remains where it was set up, gives the fullest picture of the life and commerce of the city. (*NSI.* pp. 313–340). The government was vested in the council (βουλή) and people (δῆμος), and administered by civil officers with Greek titles, the *proedros* (president), the *grammateus* (secretary), the archons, syndics and *dekaprōtoi* (a fiscal council of ten), following the model of a Greek municipality under the Roman Empire. At a later date, probably under Septimius Severus or Caracalla (beginning of 3rd century), Palmyra received the *ius italicum* and the status of a colony; the executive officials of the council and people were called *stratēgoi*, equivalent to the Roman *duumviri* (*NSI.* Nos. 121, 127); and Palmyrenes who became Roman citizens began to take Roman names, usually Septimius or Iulius Aurelius, in addition to their native names.

It was the Parthian wars of the 3rd century which brought Palmyra to the front, and for a brief period raised her to an almost dazzling position as mistress of the Roman East. The inscriptions enable us to follow the rise of one house in particular, which prefixed to their Semitic names the Roman *gentilicium* of Septimius; its members, therefore, had received the citizenship under Septimius Severus (A.D. 193–211). In the next generation Septimius Odainath or Odaenathus, son of Hairan, had attained the rank of Roman senator (συγκλητικός, Vogüé No. 21, *NSI.* p. 285 *n.*) conferred no doubt when Alexander Severus visited Palmyra in A.D. 230–231; his son again, Septimius Hairan, seems to have been the first of the family to receive the title of Rās Tadmor ("chief of Tadmor") in addition to his Roman rank (*NSI.* No. 125); while his son, the famous Septimius Odainath, commonly known as Odaenathus (*q.v.*), the husband of Zenobia, received even higher rank, the consular dignity (ὑπατικός) which is given him in an inscription dated A.D. 258, in the reign of Valerian (*NSI.* No. 126). The East was then agitated by the advance of the Parthian Empire under the Sassanidae, and the Palmyrenes with their Roman honours and their Roman civilization, which did not really go much below the surface, had to choose one side or other. Their choice leaned towards Rome mainly because the Roman emperor was further off than the Persian king. In the contests which followed there can be no doubt that the Palmyrene princes cherished the idea of an independent empire of their own, though they never threw over their allegiance to the Roman suzerain until the closing act of the drama. Their opportunity came with the disaster which befell the Roman army under Valerian (*q.v.*) at Edessa. The Persians swept victoriously over Asia Minor and North Syria; not however without resistance on the part of Odaenathus, who inflicted considerable losses on the bands returning home from the pillage of Antioch. It was probably not long after this that Odaenathus, with a keen eye for his advantage, made overtures to the Persian king, Shapur I., and when they were rejected he threw himself into the Roman cause. After the death of Valerian, Gallienus succeeded to a merely nominal rule in the East, and made no effort to recover the lost provinces. Thereupon the two leading generals of the Roman army, Macrianus and Callistus, renounced their allegiance and proclaimed the two sons of the former as emperors (A.D. 261). During the crisis Odaenathus remained loyal to Gallienus, and was rewarded for his fidelity by the grant of a position without parallel under ordinary circumstances; as hereditary prince of Palmyra he was appointed *dux Orientis*, a sort of vice-emperor for the East (A.D. 262). He started promptly upon the work of recovery. With his Palmyrene

troops, strengthened by what was left of the Roman army corps, he took the offensive against Shapur, defeated him at Ctesiphon, and in a series of brilliant engagements won back the East for Rome. During his absence at the wars, we learn from the inscriptions (A.D. 262–267) that Palmyra was administered by his deputy Septimius Worod, "procurator ducenarius of Caesar our lord," also styled "commandant," as being Odaenathus' viceroy (ἀργαπέτης, *NSI*. Nos. 127–129). Then in the zenith of his success Odaenathus was assassinated at Ḥomṣ (Emesa) along with his eldest son Herodes (A.D. 266–267). The fortunes of Palmyra now passed into the vigorous hands of Zenobia (*q.v.*), who had been actively supporting her husband in his policy. Zenobia seems to have ruled on behalf of her young son Wahab-allath or Athenodōrus as the name is Graecized, who counts the years of his reign from the date of his father's death. Under Odaenathus Palmyra had extended her sway over Syria and Arabia but now the troops of Zenobia, numbering it is said 70,000, proceeded to occupy Egypt; the Romans under Probus resisted vigorously but without avail, and by the beginning of A.D. 270, when Aurelian succeeded Claudius as emperor, Wahab-allath was governing Egypt with the title of "king." His coins of 270 struck at Alexandria bear the legend *v*(*ir*) *c*(*onsularis*) *R*(*omanorum*) *im*(*perator*) *d*(*ux*) *R*(*omanorum*) and display his head beside that of Aurelian, but the latter alone is styled *Augustus*. Meanwhile the Palmyrenes were pushing their influence not only in Egypt but in Asia Minor while still professing to act under the terms of the joint rule conferred by Gallienus. Then in the course of the year A.D. 270–271 came the inevitable and open breach. In Palmyra Zenobia is still called "queen" (*βασίλισσα*, *NSI*. No. 131; *cf*. Wadd. 2628), but in distant quarters, such as Egypt, she and her son claim the dignity of Augustus; Wahab-allath (5th year) begins to issue coins at Alexandria without the head of Aurelian and bearing the imperial title; and Zenobia's coins bear the same. It was at this time (A.D. 271) that the two chief Palmyrene generals Zabdā and Zabbai, set up a statue to the deceased Odaenathus and gave him the sounding designation of "king of kings and restorer (or perhaps *corrector*) of the whole city" (*NSI*. No. 130). These assumptions marked a definite rejection of all allegiance to Rome. Aurelian, the true Augustus, quickly grasped the situation. At the close of A.D. 270 Probus brought back Egypt into the empire; then in 271 Aurelian made preparations for a great campaign against the seat of the mischief itself. He approached by way of Cappadocia, where he reduced the Palmyrene garrisons, and thence through Cilicia he entered Syria. At Antioch the Palmyrene forces under Zabdā attempted to resist him, but they were compelled to fall back, and at Emesa they were defeated in a stiffly contested battle. The way was now open to Palmyra and probably in the spring of A.D. 272 Aurelian captured the city. In accordance with the judicious policy which he had observed in Asia Minor and at Antioch, he granted full pardon to the citizens; only the chief officials and advisers were put to death; Zenobia and her son were captured and reserved for his triumph when he returned to Rome. But the final stage in the conquest of the city was yet to come. A few months later, in the autumn of 272—the latest inscription is dated August 272 (Vogüé, No. 116)—the Palmyrenes revolted, killed the Roman garrison quartered in the city, and proclaimed one Antiochus as their chief. Aurelian heard of it just when he had crossed the Hellespont on his way home. He returned instantly before any one expected him, and took the city by surprise. Palmyra was destroyed and the population put to the sword. Aurelian restored the walls and the great Temple of the Sun (A.D. 273); but the city never recovered its splendour or importance. The famous Palmyrene archers, however, served in the Roman army in Africa and elsewhere, even in Britain, as the inscription now at South Shields gives evidence (*NSI*. pp. 250, 312; Lidzbarski, *Ephemeris*, ii. 92).

Language.—The language spoken at Palmyra was a dialect of western Aramaic, and belongs to the same group as Nabataean and the Aramaic spoken in Egypt. In some important points, however, the dialect was related to the eastern Aramaic or Syriac (*e.g*. the plur. ending in *ē'*; the dropping of the final *ī* of the pronominal suffix third pers. sing. with nouns, and of the final *ū* of the third pers. pl. of the verb; the infin. ending *ū*, etc.). But the relation to western Aramaic is closer; specially characteristic are the following features: the imperf. beginning with *y*, not as in Syriac and the eastern dialects with *n* or *l*; the plur. ending *-ayyā'*; the forms of the demonstrative pronouns, etc. As the bulk of the population was of Arab race, it is not surprising that many of the proper names are Arabic and that several Arabic words occur in the inscriptions. The technical terms of municipal government are mostly Greek, transliterated into Palmyrene; a few Latin words occur, of course in Aramaic forms. The writing is a modified form of the old Aramaic character, and especially interesting because it represents almost the last stage through which the ancient alphabet passed before it developed into the Hebrew square character.

The names of the months were the same as those used by the Nabataeans, Syrians and later Jews, viz., the Babylonian. The calendar was practically a reproduction of the Julian, which Roman influence disseminated throughout Syria. Dates were reckoned by the Seleucid era, from October 312 B.C.

Religion.—The religion of Palmyra did not differ in essentials from that of the north Syrians and the Arab tribes of the eastern desert. The chief god of the Palmyrenes was a solar deity, called Samas or Shamash ("sun"), or Bel, or Malak-bel, transcribed Μαλαχβῆλος, Malagbelus (*NSI*. p. 268; Lidzbarski, *Ephemeris*, ii. pp. 84, 92), whose great temple is still the most imposing feature among the ruins of Palmyra. Both Bel and Malak-bel were of Babylonian origin. Sometimes associated with the Sun-god was 'Agli-bol the Moon-god, who is represented as a young Roman warrior with a large crescent attached to his shoulders (Chabot, *Choix d'Inscr. de Palmyre*, Pl. xix. 1). The great goddess of the Aramaeans, 'Athar-'atheh, in Greek Atargatis (*q.v.*), and Allath, the chief goddess of the ancient Arabs, were also worshipped at Palmyra. Another deity whose name occurs in votive inscriptions, is Baal-shamin, *i.e.*, "Baal of the heavens," = Ζεὺς μέγιστος κεραύνιος, sometimes called "lord of eternity." Another interesting divine name is that of a distinctly Arabic deity "She'a-alqūm the good and bountiful god who does not drink wine" (*NSI*. No. 140 B); the name means "he who accompanies, the protector of, the people"—the divine patron of the caravan. A common formula in Palmyrene dedications runs "To him whose name is blessed for ever, the good and the compassionate"; out of reverence the name of the deity was not pronounced; was it Bel or Malak-bel? It is worth noticing that this epithet like "lord of eternity" (or, "of the world"), has a distinctly Jewish character. Altogether about 22 names of gods are found in Palmyrene; some of them, however, only occur in compound proper names.

After its overthrow by Aurelian, Palmyra was partially revived as a military station by Diocletian (end of 3rd century A.D.), as we learn from a Latin inscription found on the site. Before this time Christianity had made its way into the oasis, for among the fathers present at the Council of Nicaea (A.D. 325) was Marinus bishop of Palmyra. The names of two other bishops (5th and 6th centuries) have come down to us and the foundations of two churches have been discovered, the larger of which, 148ft. by 88ft., may have held the seat of the bishop. About A.D. 400, Palmyra was the station of the first Illyrian legion (*Not. dign.* i. 85, ed. Böcking); Justinian in 527 furnished it with an aqueduct, and built the wall of which the ruins still remain (Procopius, *De aedif*, ii. 11). At the Moslem conquest of Syria, Palmyra capitulated to Khālid (*see* CALIPHATE) without embracing Islam (Yāqūt, i. 831). The town became a Moslem fortress and received a considerable Arab colony. The ruins of Palmyra greatly interested the Arabs, and are commemorated in several poems quoted by Yāqūt and others; they are referred to by the early poet Nābigha as proofs of the might of Solomon and his sovereignty over their builders the Jinn (Derenbourg, *Journ. As*. xii. 269). References to Palmyra in later times have been collected by Quatremère, *Sultans Mamlouks*, ii. pt. I. p. 255 *seq.* All but annihilated by earthquake in the 11th century, it recovered considerable prosperity; when Benjamin of Tudela visited the city,

which was still called Tadmor, he found 2,000 Jews within the walls (12th century). It was still a wealthy place as late as the 14th century; but in the general decline of the East, and owing to changes in the trade routes, it sunk at length to a poor group of hovels gathered in the courtyard of the Temple of the Sun. The ruins first became known to Europe through the visit of Dr. William Halifax of Aleppo in 1691 (see *PEFQ. St.* 1890). The architecture was carefully studied by Wood and Dawkins in 1751, whose splendid folio (*The Ruins of Palmyra*, London, 1753) also gave copies of inscriptions. But the epigraphic wealth of Palmyra was first opened to study by the collections of Waddington (vol. iii.) and De Vogué (*La Syrie centrale*) made in 1861–62. Since that time the most valuable document which has come to light is the great fiscal inscription discovered in 1882 by Prince Abamelek Lazarew.

See also J. Mordtmann, *Palmyrenisches* (1899); Clermont-Ganneau, *Études d'arch. or.* i., *Receuil d'arch or.* iii., v., vii., viii.; Lidzbarski, *Ephemeris*, i. and ii.; Sobernheim, *Palm. Inschr.* (1905). The *Répertoire d'épigr. sém* contains the new texts which have been published since 1900, and Chabot, *Choix d'Inscriptions de Palmyre*, 1922, a valuable collection of texts and photographs For the dialect, *see* Noldeke, *ZDMG.* xxiv. 85–109, and S A Cook *JQR.* xvi. 274 ff. Critical discussions of the history will be found in Mommsen, *Provinces of the Roman Empire*, (Eng trans, 1886), pp 92 *sqq.* An expedition was made in 1914 by Pères Jaussen and Savignac, under the auspices of the Académie des Inscriptions et Belles-Lettres; the report is given in the *Revue Biblique*, 1920, pp 359–419. The whole site is being explored afresh (1927) for the Académie by Prof. A. Gabriel, see *Syria*, viii. (1927) pp. 71–92. (G. A C.)

PALNI HILLS, a range of hills in south India, in the Madura district of Madras They are an offshoot from the Western Ghats, and, while distinct from the Anamalai hills, form part of the same system. They contain the hill station of Kodaikanal (7,200 ft) Coffee is cultivated on the lower slopes.

PALO ALTO, a city of Santa Clara county, California, U S A., on the San Francisco peninsula, 28 m S E. of the city and 18 m. from the ocean. It is served by the Southern Pacific railway and by motor-coach lines. Pop. 5,900 in 1920 (83% native white); estimated locally at 12,500 in 1928. It is a beautiful residential city, the seat of Stanford university (*q v.*), five military academies, several private preparatory schools and a U S. Veterans' hospital. Palo Alto was laid out in 1891 by Senator Stanford, as a university town, and was incorporated in 1894. In 1909 it was chartered as a city The name was suggested by an isolated redwood-tree which stood on the site.

PALO ALTO, a battlefield in Cameron county, Texas, between Point Isabel and Matamoras, about nine miles north-east of the latter. There on May 8, 1846, took place the first battle of the war between Mexico and the United States (1846–1848). Brigadier General Zachary Taylor's forces of some 2,200 regulars, in an effort to join with beleagered troops at Fort Brown, came upon a superior number of Mexicans (variously estimated between 4,000 and 6,000) under General Arista. Between the *chaparral* and the marshes the two lines were drawn up opposite each other, the Mexicans astride the road to Ft. Brown. Taylor's artillery, better handled than the Mexican heavy pieces, cut great swaths in the enemy's lines in process of forming. An attempt to turn the American right by a superior force of Mexican cavalry was met by a hollow square of the 5th Infantry. The grass was set on fire by the powder wads from the shells, so that a dense smoke screen kept the two armies from seeing each other well In this haze, the trained and disciplined subordinate leaders of the United States forces promptly met the Mexican attempt to encircle the left. Ringgold's and Duncan's batteries moved and fired handily in spite of the smoke. Because the battle began in the afternoon, there was not sufficient daylight for either side to have a decision. When darkness closed the issue for the day the Mexican loss was, according to estimate, about seven times that of the Americans. The engagement is interesting in that it was the first instance in United States history where superiority of training against an organized enemy rested with the Americans.

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PALOLO WORM (*Leodice viridis*), a marine annelid worm of the order Polychaeta, native to the waters surrounding the Samoan and Fiji islands. At the full of the October moon it comes to the surface in immense numbers to breed and is caught in large quantities by the natives for food.

PALOMINO DE CASTRO Y VELASCO, ACISCLO ANTONIO (1653–1726), Spanish painter and writer on art. Although negligible as an artist, he produced a work on art, *El Museo pictorico y escala optica* (1715–24), the third volume of which is a mine of biographical material relating to Spanish artists. On the strength of this he has been called "the Spanish Vasari." The work was partially translated into English in 1739; an abridgment of the original (*Las Vidas de los pintores y estatuarios españoles*) was published in London in 1742, and afterwards appeared in a French translation in 1749. A German version was published at Dresden in 1781, and a reprint of the entire work at Madrid in 1797

PALO VERDE (*Cercidium Torreyanum*), a North American tree of the pea family (Leguminosae), native to the highly arid deserts of south-eastern California and adjacent Arizona and Mexico. It is a short-trunked, intricately branched tree, 15 to 20 ft. high, with smooth, conspicuously green bark and minute leaves which quickly wither and fall, their function being assumed by the green elements (chlorophyll) in the bark. The bright yellow flowers, borne in axillary clusters, are followed by bean-like pods about 3 in long The palo verde (Span *palo verde*, green tree) is a characteristic woody plant along washes in the Colorado desert.

PALTOCK, ROBERT (1697–1767), English writer, a Londoner by birth, owes his fame to his romantic *Life and Adventures of Peter Wilkins* (1751). It has been several times reprinted, notably with an introduction by A. H. Bullen in 1884. Paltock died in London on March 20, 1767.

PALUDAN-MÜLLER, FREDERIK (1809–1876), Danish poet, was the third son of Jens Paludan-Muller, from 1830 to 1845 bishop of Aarhus, and born at Kjerteminde in Fünen, on Feb. 7, 1809. In 1819 his father was transferred to Odense, and Frederik began to attend the Latin school there. In 1828 he passed to the university of Copenhagen In 1832 he opened his poetical career with *Four Romances*, and a successful romantic comedy entitled *Kjaerlighed ved hoffet* ("Love at Court"). This was succeeded in 1833 by *Dandserinden* ("The Dancing Girl"). He was not, however, well inspired in his lyrical drama of *Amor and Psyche* in 1834, nor in his Oriental tale of *Zuleimas flugt* ("Zuleima's Flight") in 1835, both written under the strong influence of Byron But he regained all that he had lost by his two volumes of poems in 1836 and 1838 From 1838 to 1840 Paludan-Muller was making the grand tour in Europe and his genius greatly expanded; in Italy he wrote *Venus*, a lyrical poem of extreme beauty. In the same year, 1841, he began to publish a great work on which he had long been engaged, and which he did not conclude until 1848; this was *Adam Homo*, a narrative epic, satirical, modern and descriptive, into which Paludan-Müller wove all his variegated impressions of Denmark and of love. This remains a Danish classic. In 1844 he composed three enchanting idylls, *Dryadens bryllup* ("The Dryad's Wedding"), *Tithon* ("Tithonus") and *Abels död* ("The Death of Abel"). From 1850 a certain decline in the poet's physical energy became manifest and he wrote less. His majestic drama of *Kalanus* belongs to 1854 Then for seven years he kept silence. *Paradiset* ("Paradise") 1861; and *Benedikt fra Nurcia* ("Benedict of Nurcia") 1861; bear evidence of malady, both physical and mental. Paludan-Müller wrote considerably after this, but never recovered his early raptures, except in the very latest of all his poems, the enchanting welcome to death, entitled *Adonis*. The poet died at Copenhagen on Dec. 27, 1876.

Paludan-Müller was also the author of two prose romances: *Ungdomskilden* ("The Fountain of Youth") (1865); and *Ivar Lykke's Historie* (3 vols., 1866–73). His *Poetiske Skrifter* (8 vols.) were published in 1878–79.

PALWAL, a town of British India, in Gurgaon district, Punjab. Pop. (1921), 9,352. It is a place of great antiquity, supposed to figure in the earliest Aryan traditions under the name of Apelava, part of the Pandava kingdom of Indraprastha.

PAMIERS, a town of southern France in the department of Ariège, 40 m. S. by E. of Toulouse on the railway to Foix. Pop. (1926) 9,777. Pamiers was originally a castle built in the early 12th century by Roger II., count of Foix, on lands of the abbey of St. Antonin de Frédelas. The abbots of St. Antonin, and afterwards the bishops, shared the authority over the town with the counts, which gave rise to numerous disputes. Pamiers was sacked by Jean de Foix in 1486, again during the religious wars, when the abbey of St. Antonin was destroyed, and finally in 1628, by Henry II. of Bourbon prince of Condé. Pamiers is the seat of a bishopric dating from the 13th century. The cathedral (chiefly 17th century) with an octagonal Gothic tower, is a mixture of the Graeco-Roman and Gothic styles; the church of Notre-Dame du Camp (17th and 18th centuries) has a crenelated and machicolated façade of the 13th century. Iron and steel of good quality are among its products. There are nursery gardens in the vicinity, and the white wine of the district is well known.

PAMIRS. The name of a chain of mountains in Central Asia. Our estimate of the extent of Pamir conformation depends much on the significance of the word Pamir. If we accept the Persian derivation of the term, *pai-mir,* or "the foot of mountain peaks," we have a definition which is by no means an inapt illustration of the actual facts of configuration. The plateau of Tibet and the uplands of the Pamirs are not analogous in physiography, and do not merge into each other. Littledale points out (*R.G.S. Journ.*, vol. vii.) that the high-level valleys of glacial formation which distinguish the Pamirs have no real counterpart in the Chang-t'ang or high plains of Tibet. The latter are 2,000 ft. higher, intersected by narrow ranges, are drained by no rivers of importance, but form a region of salt lakes and stagnant marshes, relieved by wide flat spaces of open plateau country. The absence of any vegetation beyond grass or scrub is a striking feature common to both Pamir and Chang-t'ang, but there the resemblance ceases, and the physical conformation of mountain and valley to the east and to the west of the upper sources of the Zarafshan is radically distinct.

The Pamirs are divided by the great meridional mountain chain of Sarikol with Muztag Ata (24,388 ft.). This chain divides the high-level sources of the Oxus on the west from the streams which sweep downwards into the Turkestan depression of Kashgar on the east. There are the true Pamirs (*i.e.*, valleys reaching up in long slopes to the foot of mountain peaks) on either side, and those on the west differ in some essential respects from those on the east. On the west the following are generally recognized as distinct Pamirs: (1) the Great Pamir, with Lake Victoria; (2) the Little Pamir, separated from the Great Pamir on the north by the Nicolas range; (3) the Pamir-i-Wakhan; the narrow trough of the Wakhan tributary of the Oxus, the term Pamir applying to its upper reaches only; (4) the Alichur—the Pamir of the Yeshil Kul and Ghund—immediately to the north of the Great Pamir; (5) the Sarez Pamir, the valley of the Murghab river, which has here found its way round the east of the Great Pamir and the Alichur from the Little Pamir, and now makes westwards for the Oxus. At the foot of the Sarez Pamir stands Murghabi. To the north-east of the Alichur are the Rang Kul and the Kara Kul Pamirs. Rang Kul lake occupies a central basin or depression; but the Kara Kul drains away north-eastwards through the Sarikol (as the latter, bending westwards, merges into the Trans-Alai) to Kashgar and the Turkestan plains. Similar characteristics distinguish all these Pamirs. They are hemmed in and separated by snow-capped mountain peaks and ridges, which are seamed with glaciers terminating in moraines. Long sweeps of grassy upland bestrewn with boulders lead from the streams up to the snowfields, yellow, grey or vivid green, according to season and the measure of sunlight, fold upon fold in interminable succession, their bleak monotony being only relieved by the grace of flowers for a short space during the summer.

To the east of the Sarikol chain is the Taghdumbash Pamir which claims many of the characteristics of the western Pamirs at its upper extremity, where the Karachukar, which drains it, is a comparatively small stream. But where the Karachukar, joining forces with the Khunjerab, flows northwards to Tashkurghan, dividing the two parallel ranges of Sarikol and Kandar, which together form the Sarikol chain, the appellation Pamir can hardly be maintained. This is the richest portion of the Sarikol province. Here are stone-built houses collected in scattered detachments, with a spread of cultivation reaching down to the river. Here are water-mills and many permanent appliances of civilization suited to the lower altitude (11,500 ft., the average height of the upper Pamirs being about 13,000), and here we are no longer near the sources of the river at the foot of the mountain peaks. One other so-called Pamir exists to the east of Sarikol, separated therefrom by the Kandar, which is known as Mariom or Mariong. But this Pamir is situated nowhere near the sources of the Zarafshan or Raskam river, which it borders, and possesses little in common with the Pamirs of the west. The Mariom Pamir defines the western extremity of the Kuen Lun, which stretches eastwards for 250 m. before it becomes the political boundary of northern Tibet.

The Muztagh Chain and Karakoram Extension.—The Muztagh chain, which holds within its grasp the mightiest system of glaciers in the world, forms a junction with the Sarikol at the head of the Taghdumbash, and also with the Hindu Kush. The political boundary between Kashmir and Sinkiang is carried by the Zarafshan or Raskam river to a point in about 79° 20′ E. where it is transferred to the watershed of the Kuen Lun. Within the limits of these partially explored highlands, lying between the Pamirs and the Tibetan table-land, exact geographical definition is impossible. Godwin-Austen considers the main chain of the Muztagh to merge into the central system of the Tibetan Chang-t'ang, its axis being defined and divided by the transverse stream of the Shyok at its westward bend; whilst the Karakoram range, in which the Shyok rises, is a subsidiary northern branch. The pass over the Karakoram (18,500 ft.) is the most formidable obstacle on the main trade route between Leh (*q.v.*) and Kashgar.

The Taghdumbash Pamir.—The Taghdumbash Pamir occupies a geographical position of some political significance. One important pass (the Beyik, 15,100 ft.) leads from the Russian Pamirs into Sarikol across its northern border. A second pass (the Wakhjir, 16,150 ft.) connects the head of the Wakhan valley of Afghanistan with the Sarikol province across its western head, whilst a third (the Kilik, 15,600 ft.) leads into the head of the Hunza river and opens a difficult and dangerous route to Gilgit.

Glacial Sources of the Oxus.—The true source of the Oxus probably lies in the snowfields of the Nicolas range and Lakes Chakmaktin (13,020 ft.) and Victoria (13,400 ft.) may be regarded as incidents, diminishing in volume day by day, in the course of glacial streams, rather than original springs or sources. The Nicolas glaciers also send down streams to the Panja or Wakhan river, below its junction with the ice stream from Wakhjir.

Climate and Population.—What is known of the climate of the Pamirs is based on observations taken at Pamirski Post, on the Murghab river. The rainfall is that of the steppe régime, most rain falling in late spring and early summer. The air is remarkably dry, especially in summer. The mean winter (January) temperature is $-1°$, and the mean summer temperature (July) 58°. A very strong south-west wind blows up the valleys by day throughout the year. There is much snow in the valley bottoms, but the ridges are snow free and without glaciers. At the height of 12,000 ft. the rainfall is only 2 in. per annum.

The population is mainly nomadic and includes a variety of "drifts" from various surrounding regions. The main element is usually called Pamiri, and is very broad-headed, with a white, fresh skin, often much bronzed, and abundant brown hair, inclined to be curly; the men have much face hair. The stature is slightly above the average (say 5 ft. 6½ in.), the nose is narrow, prominent and straight or aquiline, the eyes are straight, as in Europeans, and may be light. Among the Pamiri tribes the purest are the mountaineers called Galchas. To the south are Dardi elements

more related to the people of north-west India, but not usually with such extreme long heads as are found among the Rajputs and Sikhs. To the west occur the broad-headed Kirghiz, with yellowish-white skin, usually bronzed, very broad heads, large cheekbones, rather narrow noses, dark eyes of European type, and a tendency to stoutness. The first, or Pamiri type is, in practically every feature, akin to the Alpini type of Europe. Some of the Pamiri peoples are nearly related to the gypsies. There are Jews in the towns below the Pamirs.

The Kirghiz are Sunni Mohammedans, but are said to retain traces of ancient Nestorian Christianity in their ritual practices, and it is thought that a Christian bishopric survived at Yarkand till about a century after its presence there was noted by Marco Polo. The last Gurkhan of the Kara Kitai Empire in the early 13th century (the legendary Prester John) was a member of a Christian tribe named Naiman, mentioned by Ney Elias and claiming kinship with the Kipchaks.

Through the Pamirs have passed famous trade routes, *e.g.*, from Yarkand, via Tashkurgan and Rang Kul, to the stations in Turkistan north of the Oxus, or, via Tashkurgan and Lake Victoria, to Badakshan, while the Buddhist pilgrim route from Yarkand, and other cities of Sinkiang, across the Baroghil pass to Chitral, is also of historic importance.

Exploration.—Native explorers from India first began to be busy in the Pamirs about 1860, and in 1874 the mission of Sir D. Forsyth to Yarkand led to the first systematic geographical exploitation of the Pamir country. In 1885 Ney Elias made his famous journey across the Pamirs from east to west, identifying the Rang Kul as the Dragon lake of Chinese geographers—a distinction which has also been claimed by some geographers for Lake Victoria. Lockhart and Woodthorpe in 1886 passed along the Wakhan tributary of the Oxus from its head to Ishkashim in Badakshan, and completed an enduring record of most excellent geographical research. Bonvalot in 1887, Littledale in 1888, Cumberland, Bower and Dauvergne, followed by Younghusband in succeeding years, extending to 1890; Dunmore in 1892 and Sven Hedin in 1894–95, have all contributed to Pamir geography; but the honours of successful inquiry in those high altitudes still fall to the late Lord Curzon, whose researches in 1894 led to a singularly clear and comprehensive description of Pamir geography, as well as to the best map compilation made up to that time. Meanwhile Russian explorers and Russian topographers had been equally busy from the north. The famous soldier Skobelev was probably the first European to visit the Great Kara Kul. He was followed by scientific missions systematically organized by the Russian government. In 1883 Putiata's mission started south. Gromchevsky was hard at work from 1888 to 1892. Yano began again in 1891, after a short spell of rest, and has left his mark as a permanent record in the valley of Sarhad (or Wakhan), between the Baroghil pass and Bozai Gumbaz. Finally, in 1895, the Russian mission under General Shveikovsky met the British mission under General Gerard on the banks of Lake Victoria, and from that point to the Chinese frontier eastward demarcated the line which thereafter divided Russian from British interests in highest Asia.

PAMPA, LA, a territory of the southern pampas region of Argentina, bounded north by Mendoza, San Luis and Córdoba, east by Buenos Aires, south by the territory of Río Negro, from which it is separated by the river Colorado, and west by Mendoza. Pop. (1914) 101,338. It belongs geographically to the south-western part of the great Argentine pampas, from which its name is derived, but in reality only a part of its surface belongs to the plain region. The western and southern part (perhaps the larger) is much broken by hills, swamps and sandy wastes, with occasional stretches of wooded country. The western half is crossed by a broad depression, extending from Mendoza south-east to an intersection with the valley of the Colorado, which was once, perhaps, the outlet of the closed drainage basin occupied by the provinces of Mendoza, San Juan and San Luis. This depression is partially filled with swamps and lakes, into which flow the rivers Atuel and Salado. An obscure continuation of these rivers, called the Chadi-leubu, flows south-east from the great swamps into the large lake of Urrelauquén, about 60 m. north of the Colorado. There are a great number of lakes in La Pampa, especially in the south-east. The eastern half is described as fertile and well adapted for grazing, although the rainfall is very light. Since the closing years of the 19th century there has been a large migration of stock-raisers and agriculturists into La Pampa, and the territory has become an important producer of cattle and sheep, wheat, Indian corn, linseed, barley and alfalfa. The climate is dry, and the temperature ranges from the severe frosts of winter to an extreme of 104° F in summer. Strong, variable winds are characteristic of this region. Railways have been extended into the territory from Buenos Aires and Bahía Blanca, the latter being the nearest seaport. There is connection also with the Transandine railway line on the north. The capital is General Achá (pop. about 2,000), and the only other places of importance are Santa Rosa de Toay and Victorica, both small "camp" villages.

PAMPAS, an extensive plain of Argentina, extending from the Río Colorado north to the Gran Chaco, and from the foot-hills of the Andes east to the Paraná and Atlantic coast. There are other pampas in South America, such as the pampas de Aullagas, in Bolivia, the pampas del Sacramento between the Huallaga and Ucayali rivers in eastern Peru, and others less well known, but when pampas is used alone the great Argentine plain is meant.

The Argentine pampas was once the bed of an ancient sea, covered on the west by shingle and sand, and on the east by deposits of estuary silt. Its western and northern limits, formed by the foot-hills of the Andes, and by the south of the great forested depression of the Gran Chaco, cannot be accurately defined, but its area is estimated at 200,000 to 300,000 square miles. Its greatest breadth is across the south, between the 36th and 37th parallels, and its least in the north. It has a gradual slope from north-west to south-east, from an elevation above sea-level of 2,320 ft. at Mendoza to 20 ft. at Buenos Aires on the La Plata—the distance across being about 635 miles. Apart from a few *sierras* in the north-west and in the south, and a few longitudinal depressions in the west the plain appears perfectly level. The east, which is humid, fertile and grassy, has no natural arboreal growth, except in the vicinity of Córdoba and in the north, where algarrobas and some of the Chaco species are to be found. In the extreme south some species of low, thorny bushes cover considerable areas in the vicinity of the hill-ranges, otherwise the plain is destitute of native trees. Since the arrival of Europeans several species have been introduced successfully, such as the eucalyptus, poplar, peach, willow, *ombú* and others.

The distinctive vegetation of the grassy pampas is the tall, coarse-leaved "pampas grass" whose feathery spikes often reach a height of 8 or 9 feet. It covers large areas to the exclusion of all other species except the trefoils and herbs that grow between its tussocks. Since the advent of Europeans other forage plants have been introduced, the most successful being alfalfa (lucerne).

West of this region is a dry, sandy, semi-barren plain, called the "sterile pampas." It has large saline areas, brackish streams and lakes and immense sandy deserts, and in singular contrast to the fertile, treeless region of the east it supports large areas of stunted trees and thorny bushes. The grassy plains are well watered by streams flowing to the Paraná, La Plata and coast, though some of these are brackish.

Civilized occupation is working many changes in the character and appearance of the pampas. The first change was in the introduction of cattle and horses. Cattle were pastured on the open pampas and were guarded by men called *gauchos,* who became celebrated for their horsemanship, hardihood and lawlessness. Attention was then turned to sheep-breeding, which developed another and better type of plainsmen. Then followed the extensive cultivation of cereals, forage crops, etc., which led to the general use of fences, the employment of immigrant labourers, largely Italian and Spanish, the building of railways and the growth of towns. The picturesque gaucho is disappearing in the eastern provinces, and the herds are being driven farther inland.

PAMPERO, the cold south-west wind which blows over the great plains of southern Argentina. The term is somewhat loosely applied to any strong south-west wind in that region, but more strictly to a rain squall or thunderstorm arising suddenly in the

prevailing currents from north and north-east. Pamperos occur at Buenos Aires on an average about a dozen times in the year.

PAMPHILUS (1st century A.D.), a Greek grammarian, of the school of Aristarchus. He was the author of a comprehensive lexicon, in 95 books, of foreign or obscure words (γλῶτται ἤτοι λέξεις), the idea of which was credited to another grammarian, Zopyrion, himself the compiler of the first four books. The work itself is lost, but an epitome by Diogenianus (2nd century) formed the basis of the lexicon of Hesychius. A similar compilation, called Λειμών ("meadow") from its varied contents, dealing chiefly with mythological marvels, was probably a supplement to the lexicon.

See M. Schmidt, appendix to his edition of Hesychius (1862) vol. iv.

PAMPHLET, a small tract especially of topical interest (probably from Fr. *pamphilet,* derived from the 12th century poem *Pamphilus seu de amore*). The first use of the word is found in 1344 in Richard de Bury's *Philobiblon.* The leaflets and broadsides of the 15th and 16th centuries were concerned with religious controversy. In the 17th century the more familiar type of polemical pamphlet became common, famous examples being Milton's *Areopagitica,* and the anti-Cromwell tract *Killing no Murder* (1657). But it was not until the 18th century that the pamphlet first in the hands of Addison and Swift, and so down to Burke and Rousseau became a regular weapon of political controversy, the medium as well for a stately argument as for a bitter personal assault. Less pugnacious and less adroit in the 19th and 20th centuries, the pamphlet has become increasingly a means of propaganda. The corn laws, the Indian mutiny, Schleswig-Holstein, Irish home rule, the eastern question, vaticanism (and every sort of religious dispute), Dreyfus, tariff reform, prohibition, nationalization, etc.; all have produced a flood of pamphlet controversy. Generally speaking the pamphlet tends essentially to present one side of an argument and is usually more remarkable for its vigour than its balance.

PAMPHYLIA, the region in the south of Asia Minor, between Lycia and Cilicia, extending from the Mediterranean to Mt. Taurus. It was bounded on the north by Pisidia and was a country of small extent, having a coast-line of about 75 miles with a breadth of about 30 miles. There can be little doubt that the Pamphylians and Pisidians were originally the same people; but the distinction between the two seems to have been established at an early period. Herodotus, who does not mention the Pisidians, enumerates the Pamphylians (i. 28) among the nations of Asia Minor, while Ephorus mentions them both, correctly including the one among the nations on the coast, the other among those of the interior. The early Pamphylians, like the Lycians, had an alphabet of their own, partly Greek, partly "Asianic," which a few inscriptions on marble and coins preserve. Under the Romans the term Pamphylia was extended to include Pisidia and the whole tract up to the frontiers of Phrygia and Lycaonia. The country consisted almost entirely of a plain.

The chief towns on the coast were: Olbia, the first town in Pamphylia, near the Lycian frontier; Attaleia (*q.v.*); and Side (*q.v*). On a hill above the Eurymedon stood Aspendus (*q.v.*) and above the river Cestrus was Perga (*q.v.*). Between the two rivers, but somewhat farther inland, stood Sylleum, a strong fortress, which even ventured to defy the arms of Alexander. The coins of Aspendus, though of Greek character, bear legends in a barbarous dialect; and probably the Pamphylians were of Asiatic origin and mixed race. They became largely hellenized in Roman times, and have left magnificent memorials of their civilization at Perga, Aspendus and Side. The Pamphylians are first mentioned among the nations subdued by the Mermnad kings of Lydia, and afterwards passed in succession under the dominion of the Persian and Macedonian monarchs. After the defeat of Antiochus III. in 190 B.C. they were included among the provinces annexed by the Romans to the dominions of Eumenes of Pergamum; later they joined with the Pisidians and Cilicians in piratical ravages. Pamphylia was for a short time included in the dominions of Amyntas, king of Galatia, but after his death lapsed into a district of a Roman province.

See *Cambridge Ancient History,* vol. iii. (with useful bibliography); C. Lanckomiski, *Les Villes de la Pamphylie et de la Pisidie* (1890).

PAMPLONA, the capital of the Spanish province of Navarre, and an episcopal see; situated 1,387 ft. above sea-level, on the left bank of the Arga, a tributary of the Ebro. Pop. (1920) 32,635. Pamplona has a station on the Ebro railway connecting Alsasua with Saragossa. From its position it has always been the principal fortress of Navarre. Originally a town of the Vascones, Pamplona was rebuilt in 68 B.C. by Pompey the Great, whence the name Pompaelo or Pompelo (Strabo). It was captured by Euric the Goth in 466 and by the Franks under Childebert in 542; it was dismantled by Charlemagne in 778, but repulsed the emir of Saragossa in 907. In the 14th century it was greatly strengthened and beautified by Charles III., who built a citadel on the site now occupied by the Plaza de Toros and by the Basilica de S. Ignacio, the church marking the spot where Ignatius de Loyola received his wound in defending the place against André de Foix in 1521.

The citadel, south-west of the city, was constructed by order of Philip II. (1556–98), and was modelled on that of Antwerp. The cathedral is a late Gothic structure begun in 1397 by Charles III. (El Noble) of Navarre, who is buried within its walls; of the older Romanesque cathedral only a small portion of the cloisters remains. The fine interior is remarkable for the peculiar structure of its apse, and for the choir-stalls carved in English oak by Miguel Ancheta (1530). The principal façade is Corinthian, from designs of Ventura Rodriguez (1783). The same architect designed the aqueduct by which the city is supplied with water from Monte Francoa, some nine miles off. Pamplona has a flourishing agricultural trade, besides manufactures of cloth, linen stuffs, flour, soap, leather, cards, paper, earthenware, iron and nails. The yearly fair in connection with the feast of San Fermin (July 7), the patron saint of the city, attracts a large concourse.

PAN, an Arcadian deity who never attained any high moral development or prominent place in cult outside of Arcadia (Πάν, Doric contraction of *πάων, "pasturer," *cf.* Lat. *pa-sco;* but commonly supposed in antiquity to be connected with πᾶν "all"). His father is generally said to be Hermes; as his mother is often named PENELOPE (*q.v.*), probably not the wife of Odysseus, but commonly identified with her, hence one or another of the characters in the *Odyssey* is sometimes called his father. He is represented as more or less bestial in shape, generally having the horns, legs and ears of a goat; in later art the human parts of his form are much more emphasized, the bestial characteristics dwindling to a little pair of horns. His activities are those of a giver of fertility; hence he is represented as vigorous and lustful. His chief concern is with flocks and herds, not with agriculture; hence he can make men, like cattle, stampede in "panic" terror; like a shepherd, he is a piper, a late legend representing him as the lover of a nymph Syrinx ("pan-pipe"), who disappeared into a reed-bed when he pursued her, Pan making the first pipe from the reeds Like a shepherd, again, he rests at noon, and dislikes having his sleep disturbed; he can also send visions and dreams. Again like a shepherd, he haunts the high hills, and another late story makes him love or be loved by the nymph Pitys ("pine-tree").

Two picturesque stories are told of him. When the Athenians sent the runner Pheidippides (or Philippides) to ask help of Sparta before Marathon, he encountered Pan, who asked why Athens did not honour him, seeing that he was her friend and would be so again. After the battle, a cult of him was instituted (presumably because he had sent panic among the Persians). (*See* Herodotus, vi, 105.) In the time of Tiberius, one Thamus, pilot of a ship making for Italy, was thrice called by name and bidden to give the news that "great Pan was dead." (Plutarch, *de defect, orac.*, 17.) It is plausibly suggested by S. Reinach, although several scholars reject the idea, that what was really heard was Θαμοῦς Θαμοῦς Θαμοῦς πάμμεγας τέθνηκε ("Tammuz, Tammuz, Tammuz the all-great is dead"), a ritual lament for Thammuz-Adonis.[1]

See Immerwahr, *Kulte und Mythen Arkadiens* (1891); Roscher, *Lexikon, s.v.* (bibl.); L. R. Farnell, *Cults of the Greek States,* vol. v. (1909); H. J. Rose, *Handbook of Greek Mythology* (1928).

[1]*Cultes, Mythes et Religions,* of course Πάν μέγας and πάμμεγας would be practically indistinguishable in pronunciation.

PANA, a city of Christian county, Illinois, U.S.A., in the central part of the State; served by the Baltimore and Ohio, the Big Four, the Chicago and Eastern Illinois and the Illinois Central railways. Pop. (1920) 6,122 (86% native white). Coal-mining is the principal industry. Roses are grown, large quantities of hay and grain are shipped, and there are several factories. The city was incorporated in 1857. Its name is probably a corruption of Pani (Pawnee), the name of an Indian tribe.

PANAMA, a Latin American republic lying between Costa Rica and Colombia, and occupying portions of the two geographical divisions, Central and South America; the Panama canal, crossing the narrowest and lowest point of land between the Atlantic and Pacific oceans, bisects the republic from sea to sea. The republic lies approximately between 7° 15′ and 9° 39′ N. lat. and between 77° 15′ and 83° 30′ W. longitude. It is bounded on the north by the Caribbean sea, east by Colombia, south by the Bay of Panama and the Pacific ocean, and west by Costa Rica. The area is about 32,800 sq.m.; pop., exclusive of the Canal Zone (1927), about 446,000, or about 12 to the square mile. The coast line on the Atlantic side is 477 m. and on the Pacific 767 miles. The greatest length of the country is 420 m. and the greatest width 118 miles.

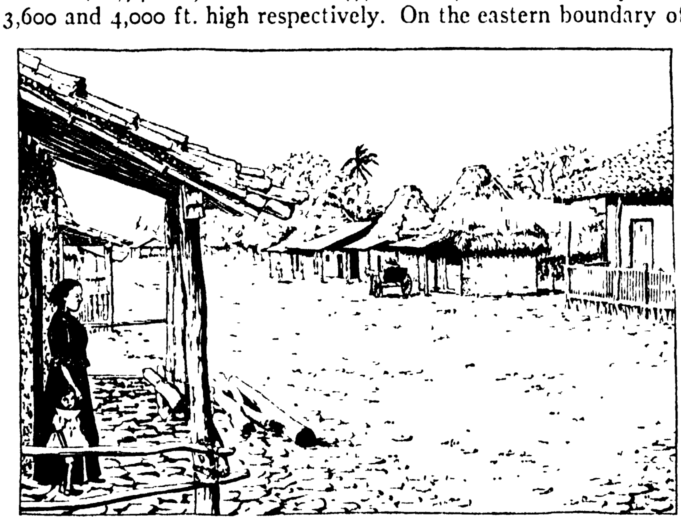
Physical Features.—The Isthmus of Panama, co-extensive with the republic, is the whole neck of land between the American continents; in another use the term "Isthmus of Panama" is applied to the narrow crossing between the cities of Colon and Panama, the other narrow crossings, further east, being the Isthmus of San Blas (31 m.) and the Isthmus of Darien (46 m.). The use of the term "Isthmus of Panama" to include the whole country is becoming more common. The Caribbean coast-line is concave, the Pacific deeply convex. The Mosquito gulf is to the north-west, the Gulf of Darien to the north-east, and on the north coast are several bays. Almirante bay, near the Costa Rican boundary, is 2 to 13 m. wide, with many islands and good anchorage, protected by Columbus island, about 8 m. long; immediately east of it, and connected with it, is Chiriqui lagoon (area about 320 sq.m.), 32 m. long, 12 m. wide at the widest point, with a maximum depth of 120 ft., protected on the sea side by Chiriqui archipelago; immediately east of Colon, at the narrowest part of the isthmus, is the Gulf of San Blas, protected by a peninsula and by the Mulatas archipelago and having the excellent harbour of Mandinga in the south-west; still farther east is Caledonia bay with another good harbour. On the north coast there are about 630 islands with a total area of about 150 square miles. The Pacific coast is deeply indented by the Gulf of Panama, which is 100 m. wide between Cape Garachine and Cape Malo, and has the Bay of Parita on its west side, north of Cape Malo, and the Gulf of San Miguel on its east side, north of Cape Garachine. Darien harbour, formed by the Tuira and Savannah rivers, is a part of the Gulf of San Miguel and is 11 m. long, 2 to 4 m. wide and nearly land-locked. In the Gulf of Panama there are 16 large and about 100 smaller islands (the Pearl islands), with a total area of 450 sq.m., the largest being Rey or San Miguel (15 m. long and 7 m. wide), and San José (25 sq.m.); both are well wooded. West of the Gulf of Panama and separated from it by Azuero peninsula is the Gulf of Montijo, 20 m. long and 14 m. wide at its mouth, across which stretches Cebaco island, 13½ m. long and 3 m. wide; west of Cebaco is Coiba. the largest island of the republic, 21 m. long and 4 to 12 m. wide. (W. Tho.)

Geology.—The surface everywhere shows great irregularity, produced by heavy rainfall, which has developed a mature drainage system, and by marine erosion, shown by bold, rugged islands, such as those in the Gulf of Panama. There have been no active volcanoes in Panama since Pliocene time. A record of the earthquakes that have occurred in Panama from the time of the Spanish conquest until 1886 shows only two severe shocks, one in 1621, the other in 1882. The line of volcanoes in Mexico and Central America probably dates from the end of Cretaceous time. Great volcanism, which was accompanied by orogenic changes, occurred in late Cretaceous and early Tertiary time.

Most of the mountains of Panama were formed not by folding due to lateral pressure, as nearly all the mountains of western America are, but by intrusions of volcanic rocks as irregular cores, sills and dikes. The intrusive rocks include basalt, diorite, andesite, granodiorite and rhyolite. They were injected in a molten condition through masses of volcanic agglomerate, breccia and tuff, and sedimentary beds of sandstone, argillite, limestone and shale, nearly all of Oligocene age. Most of the intrusions that formed basalt, andesite and rhyolite seem to have occurred in Miocene time. The diorite is at least in part probably Eocene.

The Isthmus appears to have been considerably uplifted and depressed during several geologic periods, some of the depressions carrying it below sea-level and thus uniting the Atlantic and the Pacific ocean and preventing the migration of land animals between North and South America. (G. McL. Wo.)

The country has no lakes; the apparent exceptions are the artificial lakes, Bohio (or Gatun) and Sosa, of the Canal Zone. There are a few swamps, especially on the northern shore. But the drainage is good; about 150 streams empty into the Caribbean and some 325 into the Pacific. In the eastern part are three complicated drainage systems of rivers very largely tidal. The largest is that of the Tuira (formerly called Rio Darien), whose headwaters are near the Caribbean and which empties into the Pacific in the Gulf of San Miguel. The Chepo (or Bayano) also is a digitate system with a drainage area reaching from the Caribbean to the Pacific; it is navigable for about 120 m. by small boats. The Chagres flows from a source near the Pacific south-west and then north to the Caribbean; is a little more than 100 m. long and is navigable for about half that distance; it varies greatly in depth, sometimes rising 35 ft. in 24 hours (at Gamboa), and drains about 1,000 sq.m. West of these three rivers are simpler and comparatively unimportant river systems, rising near the centre of the isthmus. Orographically the country is remarkable. The "exceedingly irregularly rounded, low-pointed mountains and hills covered by dense forests" (Hill) are Antillean, not Andean, and lie at right angles to the axes of the systems of North and South America. The only regular ranges in Panama are in the extreme western part where the Costa Rica divide continues into Panama, and, immediately south of this and parallel to it, the Cordillera of San Blas, or Sierra de Chiriqui, where the highest peaks are Chiriqui (11,265 ft.) and, on the Costa Rican boundary, Pico Blanco (11,740 ft.) and Rovalo (7,020 ft.); there are two passes, 3,600 and 4,000 ft. high respectively. On the eastern boundary of



BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL

STREET IN CHORRERA, A TYPICAL TOWN OF THE INTERIOR OF PANAMA

the republic is the Serrania del Darien, an Andean range, partly in Colombia. The rough country between contains the following so-called "Sierras," which are not really ranges: in Veragua province, Sierra de Veragua, with Santiago (9,275 ft.) near the Chiriqui range, and Santa Maria (4,600 ft.), immediately north of the city of Santa Fé; in Los Santos province (Azuero Peninsula), bold hills rising 3,000 ft., and in Panama province, the much-broken Sierra de Panama, which has a maximum height of 1,700 ft. and a minimum, at the Culebra Pass, of 290 ft., the lowest point, except the interoceanic water-parting in Nicaragua,

which is 153 ft., in the western continental system. There have been no active volcanoes since the Pliocene Tertiary period, but the country is still subject to dangerous earthquakes. There are a few plains, like that of David, in Chiriqui province, but irregular surface is normal; and this irregularity is the result of very heavy rains with a consequent extremely developed drainage system cutting river valleys down nearly to the sea-level, and of marine erosion, as may be seen by the bold and rugged islands, notably those in the Gulf of Panama. It is improbable that there has been any connection by water between the two oceans here since Tertiary time.

Climate.—The climate of most of Panama is entirely tropical, with warm days and cooler nights, the temperature at Colon varying from 68° to 95° F; that for Panama is similar. The seasons are divided into wet and dry, the former from April to December, the rainfall being from 85 to 155 in. yearly. Panama was in former times literally a pest-hole from coast to coast. Yellow fever and malaria were endemic, and smallpox and other scourges followed in their wake. The country is now probably the most healthy spot in the tropics, thanks directly to the modern sanitation introduced by the American health authorities of the Canal Zone, whose authority is extended, by treaty, throughout the republic.

Inhabitants.—The population of 442,522 in 1923 was divided into racial classifications as follows: 52,069 whites, 85,970 negroes, 33,425 Indians, 3,061 orientals and 267,961 mestizos or mixed bloods. The population figures of Panama are always given as distinct from the population of the Canal Zone, which is U.S. leased territory. (*See* PANAMA CANAL.) The country is very cosmopolitan and grows more so each year, owing to the increasing traffic of the canal and the varied ships that come there. The lower strata of the city populations, particularly Colon, at the northern or Atlantic terminus of the canal, are negro, however, chiefly from the British West Indies, or their descendants.

Panama is marked for the concentration of its population in towns, the chief of these being Panama (*q.v.*), at the Pacific or southern end of the canal, whose port is Balboa, the American city on the canal proper and within the Canal Zone. Colon, at the northern end of the canal, has as its port and sister town in the Canal Zone, Cristobal, from which it is separated only by an imaginary line. Ancon, which adjoins and is virtually a part of Panama city, is the Canal Zone town corresponding to Cristobal in its relation with Colon, but Ancon is not a port. Other towns of historic or commercial importance are Porto Bello, east of Colon on the Caribbean, the scene of Columbus's ill-fated colony of Nombre de Dios, the terminus of the causeway which traversed the isthmus in Spanish colonial days and the loading port of galleons and thus the scene of the activities of the buccaneers; Bocas del Toro, now an important banana shipping centre; and David, the capital of Chiriqui Province, near the Pacific coast and Costa Rica.

Education.—Education is compulsory for children from 7 to 15 years of age. To furnish the facilities for making this law effective the Government had, in 1926, 446 schools, with 52,214 pupils and 1,492 teachers, and there were 71 private schools. The National institute or university had 1,573 pupils, the normal school for girls, 696. There is also an arts and crafts school for boys. The Bolivarian university, founded at one of the ceremonies of a conference of Pan-American States at Panama in 1926, has the support of Panama, Colombia, Ecuador and Peru.

Government.—The Panama Constitution was adopted on Feb. 13, 1904, and divides the Government into the three usual branches. The legislative power is vested in the national assembly, a single chamber with 46 members, elected for four years, a deputy for every 10,000 inhabitants. The president heads the executive, with a four-year term, and there is no vice president, the succession being provided by the selection by the national assembly, of three "designates" every two years. The president, elected Aug. 5,1928, was Florencio Harmodio Arosemena. The presidential cabinet consists of five ministers as follows: of government and justice, of foreign relations, of finance and the treasury, of public instruction and of agriculture and public works. The judiciary consists of a supreme court of five judges appointed by the president for a term of four years, a superior court, several circuit courts and various municipal courts. The judges of the superior and circuit courts are appointed by the supreme court for four years, the municipal judges by the circuit courts for one year.

Defence.—Panama has no army or navy, the police force being an efficient body organized originally and still directed by American officers. Under the treaty with the United States, that Government protects the isthmian republic from foreign aggression and intervenes in case of serious domestic strife, on the call of the president of Panàma.

Communications.—The Panama canal brings to Panama the largest tonnage of shipping of any country in Latin America, and its ports rival the great centres of the world. The chief railway is the Panama railroad, now owned by the U.S. Government, but originally built in 1849–55 by the American bankers and merchants, Howland and Aspinwall. When completed in 1855, it had cost $7,500,000; its length between termini is 47½ miles. The line was bought by the French Canal Company for $25,500,000, and was sold to the U.S. Government when the assets of the French company were purchased at the time the United States took over the construction of the canal. Another railway, in Chiriqui Province, comprising about 40 m., was completed in 1927–28 by President Arosemena, just prior to his election. The United Fruit Co. operates 151 m. of banana railway. The highways of Panama include a fine paved road from Panama city into Chiriqui Province, various highways in the Canal Zone, and the plans for highway construction include military roads of concrete throughout the Canal Zone, north and south into the adjacent territory, and across the country paralleling the canal.

Finance.—Panama's foreign debt is $16,000,000, contracted in 1928, chiefly for roads and other public works; $4,000,000 of this 1928 issue replaced an issue of similar amount put out for the same purpose in 1923. The U.S. Government pays Panama an annual rental of $250,000 on the Canal Zone, and the remainder of the income of the country comes from duties on imports and a few direct taxes. The Canal Zone constitutes a free zone, and the residents there, all of whom are employees of the U.S. Government, enjoy the privileges of purchase of duty-free supplies in the commissaries.

The monetary unit of Panama is the *balboa,* equal in value to the U.S. dollar, and although no gold balboas are in circulation, silver subsidiary coins are minted, although they are scarce. The circulating medium is chiefly U.S. currency. The half-balboa, or half-dollar, is sometimes called a *peso* and divided into an imaginary 100 centavos; 50 centavos, therefore, means 25 cents.

Panaman revenue and expenditures have risen gradually in recent years, the budget for 1927–28 being $2,979,682, more than double that of 1921–22.

Commerce and Trade.—The trans-shipment and transfer of goods at the Canal Zone ports do not appear in the movements of business in Panama, as such shipments are within the Canal Zone, and are under the regulations of free entry. The chief export of Panama is bananas, the 1924 figures showing an export value of $1,891,000, all going to the United States. Cacao is the second item of importance, the year's total exports being valued at $267,000. Coconuts were valued at $224,299, ivory nuts at $116,398 and pearls, once a great source of revenue and interest in Panama, $68,524. Mother-of-pearl exports were $68,472, and tortoise shell $85,308.

There are gold mines in Panama and other minerals of importance, but these are located chiefly in the difficult country of the interior, towards Colombia, and transportation is a serious problem. Oil has been found in this same region, and copper and iron have been located but not mined. There are two promising coal deposits, near Bocas del Toro and on the Golfo Dulce. The latter deposits also extend into Colombia, but neither has been developed. There are important salt mines at Parita bay on the Golfo Dulce.

History.—Panama had a distinctive and picturesque history antedating its independence from Colombia in 1903. The isthmus was the chief route of travel and of the shipment of treasure from

all of Latin America south of Mexico, and even the galleys from Manila trans-shipped their cargoes there. All of the South American provinces of Spain were reached via Panama; even the provinces of the Rio de la Plata, now Argentina and Uruguay, sent their produce and received their supplies and mails overland through Peru and thence up the Pacific coast to Panama. The isthmus was probably visited by Alonso de Ojeda in 1499, and in 1501 Rodrigo Bastidas, coasting the northern border of South America from Venezuela westward, reached Porto Bello. Columbus in 1502 entered the mighty gulf which was named in his honour, Admiral or Almirante bay. He planted the colony, Nombre de Dios, at Porto Bello, but this was destroyed by the hostile Indians as soon as he had sailed away. In 1510, it was re-established by Diego de Nicuessa, the first governor of the Province of Castilla del Oro, including most of Panama, Costa Rica, and part of Nicaragua. In the same year, Darien colony (originally called Santa María de la Antigua del Darien) was founded by Martín Fernández de Enciso. In December of that year, an insurrection against Enciso put Vasco Nuñez de Balboa in command of the province. Balboa, who had been in Panama since 1501, gradually pushing his fortunes upward, crossed the isthmus in 1513 and discovered the Pacific ocean, lying to the southward of the coastline; he named it the Southern ocean, and took possession of it in the name of the King of Spain, on Sept. 25 or 26.

Pedro Arias de Avila, sent out from Spain to succeed Enciso, displaced Balboa, and uniting the provinces of Nueva Andalucía and Castilla del Oro, established that of Tierra Firma in 1514, and in 1519 founded the city of Panama. Panama became the terminus of transport across the isthmus, with Porto Bello at the eastern or rather the northern end; a paved causeway was built and pack animals and slaves carried the unrecorded treasures of the Indies along the road. Pirates came again and again to waylay the caravans, to lay siege to the ports of Panama and Porto Bello, and to sack and burn both at various times. William Paterson (*q.v.*) established in 1698 a Scottish settlement at what is still known as Porto Escocés in the north-east, but in 1700 the Spaniards expelled the remaining members.

In 1718, when the viceroyalty of Nueva Granada was created, Panama was incorporated under its administration and throughout the various vicissitudes of the independence period was regarded as but one province of Nueva Granada in the Colombian federation. In 1841, however, Panama seceded, with the neighbouring Province of Veragua, setting up the independent State of the Isthmus of Panama. Colombia quelled the rebellion, but in 1853, under the new Granadine Confederation, from which the States had a right to withdraw, Panama again seceded, but later returned. In 1885 Panama was bitterly resentful of the action of President Nuñez, in overriding the 1863 Constitution recognizing the sovereignty of the States of Colombia, and the 1886 Constitution was adopted without Panama being heard; it changed Panama from a State to a department and vested its government in Federal appointees. When the French Canal Company began activities, Panama was a rich field for corrupt officials, and the people suffered considerably at the hands of many of the appointees from Bogota. In 1895 there was an abortive uprising, and from 1898 to 1903 the province was in continual revolt.

The treaty of the United States and Colombia in 1846, allowing the United States the right of transport across the isthmus and guaranteeing, on the part of the United States, the sovereignty of Nueva Granada on the isthmus, early brought the United States into the Panaman situation. In 1901, the Hay-Pauncefote Treaty settled the right of the United States to build the canal and to control it, alone. Negotiations were begun with Colombia for the site and authority, and in Jan. 1903, the Hay-Herran treaty was finally signed. The Colombian Congress delayed ratification, possibly in the hope of securing better terms, possibly waiting for the expiration of the French concession, when the sums which the United States had agreed to pay the French company would possibly be available for Colombian interests. The session of Congress called to ratify the treaty adjourned without doing so on October 31. On Nov. 3, the independence of Panama was declared in Panama City, and the revolutionary activities of Panama surged up. The Colombian troops, landed at Colon to cross the isthmus and engage the revolutionists, were stopped by 47 marines of the U.S. cruiser "Nashville," under the provisions of the treaty of 1846, on the ground that in that document the United States had guaranteed to keep the isthmus open, and civil war would close it. Meanwhile, on Nov. 7, the Panaman minister was received in Washington, and on Nov. 18 a treaty was signed between the United States and the new republic, ceding the Canal Zone for a payment of $10,000,000 and $250,000 annual rental. The Panaman Government was organized and a constitutional assembly met on Jan. 15, 1904, when the present Constitution was drawn up. The haste with which President Roosevelt recognized the new republic has been the subject of wide criticism, and the payment to Colombia, after 1923, of $25,000,000 was taken in some quarters as acknowledgment of the fault, but this payment was officially made in settlement of various claims for the use of Colombian property and to clear title to the physical properties of the canal.

The relations of the United States and Panama in connection with the canal have been, on the whole, extremely cordial. The two countries have carried on their affairs through the medium of the treaty of 1904 and the so-called Taft Agreement, a series of orders issued by William Howard Taft while secretary of war under President Roosevelt. These were regarded by Panama as outgrown, however, and in 1922, the question of a new treaty, replacing that of Feb. 23, 1904, and the Taft Agreement, was taken up. A treaty was finally signed in 1927, in Washington, but the Panaman Congress has not ratified it. The difficulties are chiefly connected with the commercial administration of the Canal Zone, under which civilian employees of the United States are allowed to buy from the commissary instead of in Panama, where duty is collected on imported goods. Limitation of the right of eminent domain, a definite settling of the final extensions of the Canal Zone, and finally a determination of the sovereignty of the Canal Zone, are involved.

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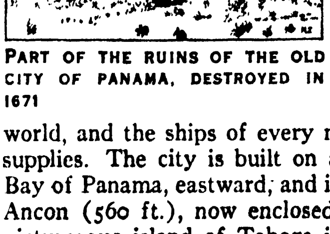
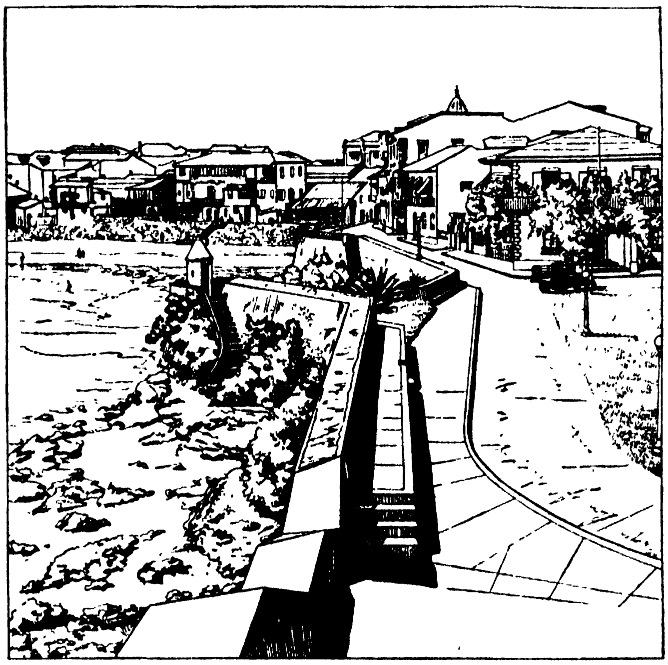
PANAMA, capital of the Republic of Panama, located at the southern or Pacific terminus of the Panama canal. Panama is the oldest settlement on the continental Western Hemisphere, having been founded in 1519 by Pedro Arias de Avila. It is the southern terminus of the Panama railroad, 47½ m. from Colon. Pop. (1926) 59,458, excluding, of course, the population of the adjoining American town of Ancon, within the Canal Zone. Panama city is virtually surrounded by the Canal Zone. It is connected by a road with the site of the ancient city, which was destroyed by Sir Henry Morgan in 1671.


PART OF THE RUINS OF THE OLD CITY OF PANAMA, DESTROYED IN 1671

Through its port of Balboa, in the Canal Zone, Panama is in communication with the whole world, and the ships of every nation stop there to load coal and supplies. The city is built on a rocky peninsula jutting into the Bay of Panama, eastward, and its most commanding site is Mount Ancon (560 ft.), now enclosed within the Canal Zone, and the picturesque island of Taboga in the harbour (935 ft.). Taboga was one of the sites taken over by the United States for canal defence during the war and has been one of the issues brought up by Panama in the negotiation of the new treaty. (*See* PANAMA and PANAMA CANAL ZONE.)

Panama was, during the early Spanish régime, strongly fortified and richly endowed with buildings and churches. It was the storehouse of the gold and silver from South America and the treasures of the Orient, and was the envy of the pirates and buccaneers. The ruins of the old city, destroyed in 1671, are still standing and are the object of tourist visits. The site was removed 5 m. west and the town was rebuilt in 1673 by Alfonso Mercado de Villacorta, to be nearer the port. The new city was entirely surrounded by a granite wall, whose remains are still landmarks in the modern city and a portion of which, along the sea, is a famous promenade, Las Bovedas. The streets of the old town are narrow and tortuous, and automobiles have complicated an already difficult traffic problem. There are several old squares, the four chief centres being Cathedral, Santa Ana, Bolivar and de Lesseps. The old cathedral was built in 1760, and is a handsome landmark. Other public buildings include the new Government palace, on the water front, the municipal palace, the episcopal palace, the church of Santa Ana, the national theatre, school of arts and crafts, a handsome new railway station, various old office buildings and colonial residences. The prevailing architecture is stone, flat or red tile roofed, two or three storeys high. The streets are well lighted and paved in the central portion and the tramways system is adequate. The water supply and drainage were established by the U.S. Government engineers, and are maintained by them.



BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL
THE SEA WALL AT PLAZA DE FRANCIA, CITY OF PANAMA

Ancon, including the residence of American officials, the Canal Zone hospitals and administration buildings, and the large hotel operated by the U.S. Government for travelers, adjoins Panama, while Balboa, the actual port (formerly called La Boca), is on the canal and entirely within the Canal Zone; it is connected with Panama by railway and tram-line. (W. THO.)

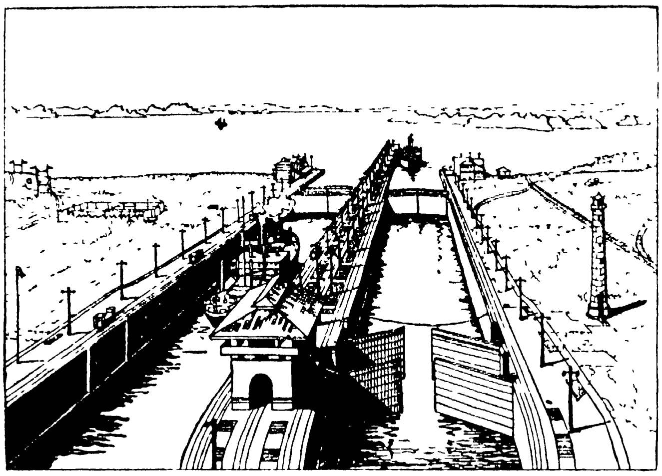
PANAMA CANAL, the canal connecting the Atlantic and Pacific oceans through the narrow isthmus of Panama, where the Continental Divide dips to one of its lowest points. Its length from shore line to shore line is 40·27 m., and from deep water in the Atlantic to deep water in the Pacific 50·72 miles. The canal does not, as is generally supposed, cross the isthmus from east to west. It runs due south from its entrance in Limon bay, through the Gatun locks to a point in the widest portion of Gatun lake, a distance of 11½ m.; it then turns sharply toward the east and follows a course generally south-east till it reaches the Bay of Panama, on the Pacific side. Its terminus near Panama is about 22½ m. E. of its terminus near Colon. In passing from the Atlantic to the Pacific a vessel enters the approach channel in Limon bay, which has a bottom width of 500 ft. and extends to Gatun locks, a distance of 6⅗ miles. At Gatun it enters a series of three locks in flight which lift it 85 feet. It then enters upon Gatun lake which covers an area of 164 sq.m. with a depth varying from 45 to 87 feet. The channel within the lake varies from 500 to 1,000 ft. in width for a distance of nearly 24 m. to Gamboa, where the Gaillard (Culebra) cut begins. The channel through the cut, a distance of about 8 m., has a bottom width of 300 ft. and a depth of 45 ft., and extends to the locks at Pedro Miguel, the Pacific end of the water bridge. At Pedro Miguel the vessel is lowered in the single lock 31 ft. to a small lake, at an elevation of 54 ft. above sea-level, through which the vessel passes one mile to the two locks at Miraflores. These lower it to sea-level, and through an approach passage 8 m. long, with a bottom width of 500 ft., it passes into the Pacific. The locks are duplicate or "double-barrelled" so that ships may be passed in opposite directions simultaneously. The cut has eight angles and at these the channel is widened sufficiently to allow a 1,000-ft. vessel to make the turn. In the whole canal there are 22 angles, the total curvature being 600° 54′. The sharpest curve is 67° 11′. A thorough system of lights and buoys makes the canal as safe to use at night as by day.

Gatun Dam.—The largest dam is at Gatun, on the Atlantic side. It spans the northern and lower end of a deep valley through which the Chagres river formerly flowed to the sea. It is 1½ m. long measured on its crest, ½ m. wide at the base, 400 ft. wide at the water surface, 100 ft. wide at the top; and its crest is at an elevation of 105 ft. above sea-level. It is really two dams in one, for in its centre there is a natural hill or rock 110 ft. high. In this the spillway of the dam is constructed, and against its two sides rest the two sections of the great dam. The dam itself contains 23,000,000 cu.yd. of material. The spillway is a concrete-lined channel, 1,200 ft. long and 285 ft. wide, the bottom being 10 ft. above sea-level, sloping to sea-level at the lower end.

Across the lake-opening of the channel is a concrete dam in the form of an arc of a circle, making its length 808 ft., although it closes a channel with a width of only 285 feet. The crest of this dam is 69 ft. above sea-level, or 16 ft. below the normal level of the lake. On the crest are 13 concrete piers with their tops 115·5 ft. above sea-level, and between these are 14 regulating gates of the Stoney type which move up and down on roller trains in niches in the piers. The gates permit a discharge of water greater than the maximum known discharge of the Chagres river during a flood. Near the north wall of the spillway is a hydro-electric station capable of generating, through turbines which are supplied with water from the lake through a forebay, sufficient electricity to meet all demands, including the lighting of the canal and all canal zone towns and buildings; the machinery of the locks, the machine shops, dry-dock and coal-handling plant; and the telephone and telegraph systems. There is an emergency Diesel electric plant at Miraflores.

BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL
GATUN MIDDLE AND LOWER LOCKS IN PROCESS OF CONSTRUCTION, 1913, WITH ATLANTIC ENTRANCE IN THE BACKGROUND

Dams on the Pacific Side.—At Pedro Miguel, at the south or Pacific end of the cut, the water is held at summit level (level of Gatun lake and the cut, normally 85 ft. above the sea) by Pedro Miguel lock and two flanking dams extending from the side walls of the lock to hills on either side The distance between the hills at elevation 92 ft. is 2,000 feet. The situation of the lock at the base of Cerro Luisa made it practicable to connect



BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL
GATUN LOCKS, LOOKING SOUTH FROM MIDDLE CHAMBER TOWARD ATLANTIC OCEAN, AFTER COMPLETION

with that hill by a short concrete wall, 260 ft in length, subsequently covered with earth On the west side a rock and earthen dam was built with a puddled and rolled impervious core, 1,400 ft in length. The Pedro Miguel lock raises or lowers ships 31 ft. —the difference between the summit level of 85 ft. and the normal surface of Miraflores lake—54 ft. above sea-level The Miraflores lake is a mile in length, and its waters are retained by the Miraflores locks and flanking dams. The east dam at Miraflores is of concrete, and the greater part of it is the spillway of Miraflores lake. This spillway is 432 ft in length, with the crest of its dam 38 67 ft above sea-level, and the supporting piers for the gates rising to 85 17 ft above sea-level. Eight gates, similar to those in the Gatun Spillway, each 47 ft. 10¾ in long by 19 ft in height, and weighing 44 tons each are used; but the dam at Miraflores is straight, instead of being in the form of an arc, as at Gatun. The west dam at Miraflores is of earth and rock and extends almost parallel with the axis of the locks to a hill to the south. Its length is 2,300 ft, top 70 ft above sea-level, width of top 40 ft, and slope of sides approximately 12 to 1.

The Locks.—All locks are in duplicate, constructed in the same manner, and their chambers, with walls and floors of concrete, have the same usable dimensions—1,000 ft long and 110 ft wide. There are six pairs, making 12 in all The side walls are from 45 to 50 ft. wide at the surface of the floor, are vertical on the chamber side, and narrowed on the outside from a point 24½ ft. from the floor, by means of a series of steps each 6 ft. long, to a width of 8 ft. at the top. A culvert 254 sq ft. in cross-section, extends the entire length of each middle and side wall, and from each of these large culverts, smaller culverts, 33 to 44 sq ft. extend to holes in the floors. Fifteen feet above the top of the culvert in the middle wall there is a U-shaped space 19 ft wide at the bottom and 44 ft. at the top. This space is divided into three storeys; the lowest for drainage; the middle for wires that carry the electric current to operate the gates and valve machinery installed in the centre wall; and the upper a passage-way for the operators All lock walls are 81 ft. high, except in the lower pair of locks at Miraflores, where they are 82 ft. because of the extreme tidal oscillations of about 21 ft. in the Bay of Panama. In the walls at Gatun there are 2,068,000 cu yd. of concrete, and in those on the Pacific side 2,440,000 cu. yards. All lock walls rest on rock foundations. The approach wall at the north entrance at Gatun, 1,031 ft. long, rests upon piles driven from 35 to 70 ft. into the earth; that at the south or lake entrance 1,009 ft. long, rests on piles reaching to rock, in some places over 100 ft. below sea-level.

Lock Gates.—The lock gates, each composed of two leaves, are 65 ft. wide, from 47 ft. 4 in. to 82 ft. high, 7 ft. thick, and weigh from 390 to 730 tons. Each is a huge webbed steel box, the girders of which are covered with a steel sheathing. All portions of the interior are accessible, with watertight compartments providing for the adjustment of the buoyancy so as to control within limits the dead load on the bearings, making the leaf practically float in the water. This watertight compartment is subdivided vertically into three sections, each independently watertight, so that if the shell should be broken or leak, probably only one section would be affected. An air shaft, 26 in. in diameter, runs from the bottom compartment up to the top of the gate, and is also watertight where it passes through the upper half of the leaf.

The girders are made with manholes through the webs, providing communication from the top to the bottom of the leaf, and are connected by several sets of vertical transverse diaphragms of solid plates, running from top to bottom of the leaf, thus making a cellular construction, and dividing the spaces between the horizontal girders into small pockets, all of which are accessible through manholes Each leaf rests at the bottom of its heel post upon a hemispherical pivot of forged nickel steel, and is hinged at the top to the masonry of the lock wall It swings free on the pivot like a door, without wheels or other support beneath it Intermediate gates are used in all except one pair of locks, and divide the space into two chambers, one 600 and the other 400 ft. in length. This makes possible a saving of water and time in locking small vessels through, for 95% of the vessels navigating the high seas are less than 600 ft in length. The highest gates and the highest lock walls on the canal are those of the lower locks at Miraflores, and these locks are the only ones which have no intermediate gates. The depth of water on the mitre sills is 40 feet

The locks are filled and emptied through the large and smaller culverts. The large culverts are controlled at points near the gates by large valves, and each of the small culverts feeds in both directions through the laterals, thus permitting the passage of water from one twin lock to another, effecting a saving of water if desired. The average time required to fill or empty a lock chamber is 8 min. if both centre and side wall culverts are used, and 12 min. if only one culvert is used The average time to pass a vessel through the three flights at Gatun locks is an hour, from arrival to clearance; for the one lift at Pedro Miguel half an hour, and for the two flights at Miraflores three-quarters of

BY COURTESY OF THE WASHINGTON OFFICE OF THE PANAMA CANAL
SHIP-DISPATCHING AT WEST LIRIO SLIDE IN THE PANAMA CANAL
Southbound shipping is waiting at Empire mooring on left bank while northbound ships pass in close formation under slide emergency schedule

an hour The time of passage of a vessel from one terminal port of the canal to the other is 7 hours

Passage of Locks.—With the exception of small craft no vessel can pass through the locks under its own power. On arrival at the locks it is taken in tow by towing locomotives or "electric mules." These locomotives operate on cog tracks on the lock walls at the rate of 2 m. an hour. The usual number required for a vessel is six: two ahead, one on each wall, two slightly forward of amidships, one on each side, the four imparting forward motion to the vessel; and two astern aid in keeping the vessel in a

central position and in bringing it to rest within the chamber while the emptying or filling is carried on.

Before a lock can be entered, a fender chain, stretched across the walls of the approach, must be passed. If all is proceeding properly, this chain is dropped into its groove at the bottom of the channel. If by any chance the ship is moving too rapidly for safety, the chain remains stretched and the vessel runs against it. The chain, which is operated by hydraulic machinery in the walls, then pays out slowly by automatic release until the vessel is brought to a stop If the vessel should get away from the towing locomotive and, breaking through the chain, ram the first gate, there is a second gate 50 ft away, protecting the lock, which arrests further advance. When the leaves of this gate swing open, the vessel is towed in, and the gate is closed behind it Then, from 105 openings placed at regular intervals in the lock floor, water pours in, lifting the vessel to the level of the lock above

The gates are opened and closed by a powerful machine invented by Edward Schildhauer, an electrical engineer in the employ of the Isthmian Canal Commission. It consists of a crank gear or wheel moving through an arc of 197°, placed horizontally in the lock wall. To the outer rim of the wheel is attached a strut or connecting rod which is fastened to the top of a lock gate 17 ft. from the pintle or hinge. When the wheel turns in either direction the gate leaf is opened or shut, the operation taking two minutes. The crank gear, constructed of cast steel, is 19 ft 2 in in diameter and weighs approximately 35,000 pounds. It is connected with an electric motor, and a small electric switch sets it in motion Every operation in the passage of a vessel through the lock, except the movements of the towing locomotives, is controlled by one man in a building at the top of the centre wall commanding an unobstructed view of every part of the locks.

Breakwaters.—Long breakwaters have been constructed near the approach channels in both oceans. One in Limon bay, or Colon harbour, called the west breakwater, is 11,526 ft. in length, 15 ft wide at the top and 10 ft above mean sea-level. A second, also in Limon bay, known as the east breakwater, is without land connection, one mile in length and runs in an easterly direction at nearly a right angle with the canal channel It has a lighthouse on the channel end The west breakwater protects the harbour against severe gales, while the east breakwater prevents silting in the canal channel. The breakwater at the Pacific entrance extends from Balboa to Naos island, a distance of 17,000 feet. It was constructed for a twofold purpose first, to divert cross-currents that would carry soft material from the shallow harbour of Panama into the Canal channel, second, to furnish rail connection between the islands and the mainland

ACCESSORIES

Permanent Canal Buildings.—Upon the completion of the canal a number of villages along the line occupied during the construction days were abandoned, the sites of several being covered by the filling of Gatun lake. The buildings in good condition were transferred to the permanent towns located at the ends of the canal and adjoining the locks. Culebra, the former headquarters of operations, situated on the west bank of the cut near its deepest part, was turned into an army post The permanent headquarters were located at Balboa Heights, and the offices of the departments centred in a large 3-storey concrete administration building situated on a hill 100 ft. above sea-level, and overlooking the Pacific entrance to the canal. On the hill in the rear of this building are the residences of the governor and other officials. On the low land in front of the building, in a site which was formerly a tidal swamp and was raised to 20 ft above sea-level by filling with material from the Cut and hydraulic fill from excavation in the harbour, is the town of Balboa. This is laid out on both sides of a central avenue called the Prado, and contains permanent buildings of concrete blocks roofed with red tile. In addition to the dwellings of employees there are a police station, post office, fire-station, sanitary office, dispensary, clubhouse, a community house conducted by the Catholic Church, an army and navy Y.M.C.A., restaurant, churches, lodge hall, schoolhouses and playground.

Terminal Facilities.—At the ports on both oceans have been constructed facilities ample for commercial shipping and the naval needs of the United States. Modern piers, 1,200 ft. in length by 240 ft. in width, with enclosed sheds, built of reinforced concrete and steel, are ample for the transshipping of cargo and the storage of goods consigned there for orders At the Pacific end, at the foot of Sosa Hill, Balboa, are marine and railway repair shops, foundry, etc., covering 60 ac., thoroughly equipped and including a dry dock having a usable length of 1,000 ft and entrance width of 110 ft, capable, like the locks and other parts of the canal, of accommodating any vessel afloat The depth over keel blocks is 43 ft. at mean tide Smaller shops and a dry dock 300 ft long and 48 ft wide with depth of 13½ ft. are operated at the Atlantic end. Coaling plants capable of rapid bunkering are operated at both terminals, as well as oil-pumping plants connected with storage tanks for fuel oil, Diesel oil and gasolene Storehouses supply all kinds of ship chandlery and repair material, as well as foodstuffs, beef and other fresh meats and cold storage supplies ice, etc Ships' every need of repair or supply can be met Radio stations for communication with ships are operated by the United States navy at Cristobal and Balboa, and also at Cape Mala, 90 m S of the Pacific entrance, and a high-power station, primarily for Government communication with the United States, is situated at Darien, midway of the isthmus Salvage tugs and other wrecking equipment are available for use of vessels within a radius of 1,000 m. or more of the canal. Hotels and hospitals are situated at both terminals

Fortifications and Military Occupation.—By executive order dated Dec. 5, 1912, President Taft declared that "all land and land under water within the limits of the canal zone are necessary for the construction, maintenance, operation, protection, and sanitation of the Panama canal," and title to all such land was acquired by the Government of the United States The canal zone is thus a military reservation, and the only activities carried on by other than Government forces are on land rented to steamship interests and to agriculturists under revocable licences. Heavy fortifications have been built at both entrances to the canal and brigade posts established near the locks Both the army and the navy have aerial forces at the canal, and a base for submarines is maintained at the Atlantic end The total military force is 10,000 men.

Panama Railroad.—The Panama Railroad extends between Colón and Panama on the eastern side of the canal, and is 47.61 m long The railroad as built in 1850–55 followed the course of the Chagres from Gatun to Gamboa, and was for the most part on the west side of the route of the Canal With the building of the canal it was necessary to relocate the railroad throughout practically its whole length The construction of the original railroad was done by an American company under great difficulties, its completion antedated by 14 years the completion of the first transcontinental railroad in the United States The railroad was an essential factor in the construction of the canal, and is an important adjunct to its operations It is equipped with 90-lb rails, rock-ballasted track, and automatic signals It uses modern American rolling-stock, including oil-burning locomotives

ADMINISTRATION AND FINANCE

Under an act of Congress, approved on Aug 24, 1912, the Panama canal is governed and operated, and the canal zone is governed through a governor of the Panama canal, appointed by the president, with the approval of the senate, for a term of four years, at a salary of $10,000 a year. In addition to the operation of the canal, the governor has official control and jurisdiction over the canal zone and performs all duties in connection with its civil government, it being held, treated and governed as an adjunct to the canal. There is one United States District court in the canal zone, with the same jurisdiction and procedure as the same courts in the United States, the judge of which is appointed by the president. Appeals are made to the Circuit Court of Appeals of the Fifth Circuit of the United States. At Balboa and Cristobal there is a magistrate's court for minor cases, the judges being appointed by the governor. General Goethals was the first

governor and served until Jan. 11, 1917, when he resigned and was succeeded by Col. Chester Harding, U.S.A., who held the office until March 27, 1921, when he was succeeded by Col. Jay J. Morrow, U.S.A. The latter resigned in Oct. 1924, and was succeeded by Col. Meriwether L. Walker, U.S.A.

The organization on the Isthmus includes a number of departments and divisions in charge of the various activities, as follows: Department of Operation and Maintenance, including the Marine Division, Mechanical Division, Dredging Division, Section of Lock Operation, Electrical Division, Division of Municipal Engineering, Fortifications Division, and several sections; the Supply Department, made up of the Quartermaster section, Subsistence section, Commissary Division, Cattle Industry and Plantations, and Hotel Washington; the Accounting Department, the Health Department; the Executive Department and the Panama Railroad. The Panama canal has an office in Washington, D.C., and the Panama Railroad company has an office at 24 State street, New York.

A census of the canal zone taken in June 1928 showed a total civil population of 28,002. The civilians included 2,421 adult male Americans, 2,492 American women, 2,569 American children and people of other nationalities as follows: men, 6,904; women, 4,516; children, 9,100. The working force at the end of Dec. 1927 numbered 13,478, of whom 2,979 were Americans, chiefly in official and clerical positions and skilled trades, and 10,499 were alien labourers, chiefly West Indian negroes.

Tolls.—The Hay-Pauncefote Treaty between Great Britain and the United States, abrogating and succeeding the Clayton-Bulwer Treaty, was ratified on Dec. 16, 1901. It contained this clause:

The Canal shall be free and open to the vessels of commerce and of war of all nations observing these rules, on terms of entire equality, so that there shall be no discrimination against any such nation or its citizens or subjects in respect of the conditions or charges of traffic or otherwise. Such conditions and charges of traffic shall be just and equitable.

In 1912 Congress passed an act for the operation and government of the Panama canal, which contained the provision that "no tolls shall be levied upon vessels engaged in the coastwise trade of the United States." A formal protest against this exemption was made by Great Britain on the ground that it was a violation of the Hay-Pauncefote Treaty. In June 1914, under a special appeal from President Wilson, Congress passed a bill which repealed the Exemption Act of 1912. This was approved by President Wilson on June 15, 1914. Under authority given to him by the Panama Canal Act of Aug. 24, 1912, President Wilson issued a proclamation, on Nov. 21, 1913, fixing the canal tolls at $1.20 per net ton on laden ships and $.72 on vessels in ballast on the basis of tonnage as determined by the Panama canal rules of measurement. On Feb. 15, 1915, President Wilson issued supplementary instructions that where application of the $1.20 per-net-ton rate produced a sum in excess of the sum produced by the application of the $1.25 rate on net registered tonnage as determined by the United States rules of measurement, the excess amount should be uncollectable. The effect of this ruling was to reduce by approximately 14% the revenue from tolls paid by ships of all nationalities using the canal. Confusion and annoyances resulting from the dual system has caused the canal administration to advocate the adoption of the Panama Canal rules only as the basis of tolls and the rates to be set at $1 per net ton for laden ships and $.60 for ships in ballast.

Canal Traffic.—The number of commercial transits, the amount received from tolls and other collections, and the current expenses of maintenance and operation for the fiscal years ending June 30, 1915–28 are shown in the table in the next column.

Up to June 30, 1927, toll-paying traffic through the canal had aggregated 40,377 vessels, of 226,157,500 gross registered tons, 174,677,954 Panama Canal net tons; tolls paid amounted to $166,075,423.60; total transit revenue to $169,081,920.81; net canal transit expenses to $95,077,644.54; and net revenue (surplus) to $74,004,276.27. The transit revenues for the years 1915 and 1916 were considerably reduced by "slides" which closed the canal to traffic for a portion of each year. For the four years ending June 30, 1927, ships of 27 nationalities passed through the

Fiscal year	Number of commercial transits	Tolls and other transit revenues	Current expenses of operation and maintenance
1915	1,072	$4,343,383.69	$4,123,128.09
1916	760	2,558,542.38	6,909,750.15
1917	1,806	5,808,398.70	6,788,047.60
1918	2,068	6,411,843.28	5,920,342.94
1919	2,028	6,354,016.98	6,112,194.77
1920	2,478	8,935,871.57	6,548,272.43
1921	2,892	12,040,116.70	9,328,300.14
1922	2,736	11,385,592.32	7,919,017.63
1923	3,967	17,691,844.06	7,690,777.56
1924	5,230	24,681,853.89	8,373,905.39
1925	4,673	21,582,618.16	8,116,693.44
1926	5,197	23,145,136.53	7,993,468.47
1927	5,475	24,608,808.82	8,997,715.02
1928		27,176,045.68	8,951,200.82

Canal; American ships were slightly over 50% of the total, British slightly over 25%. About 39% of the cargo was in the United States inter-coastal trade. Of the 1927 traffic 8,583,327 cargo tons passed from the Atlantic to the Pacific and 19,164,888 cargo tons passed from the Pacific to the Atlantic.

Public vessels of the United States, Panama and Colombia and vessels which are sent through the canal solely for repair at the Balboa shops are exempt from the payment of tolls, and such vessels are omitted from the statistics in the above table. From the opening of the canal on Aug. 15, 1914 to June 30, 1927, they numbered 4,144, the majority of them being American naval vessels or army transports.

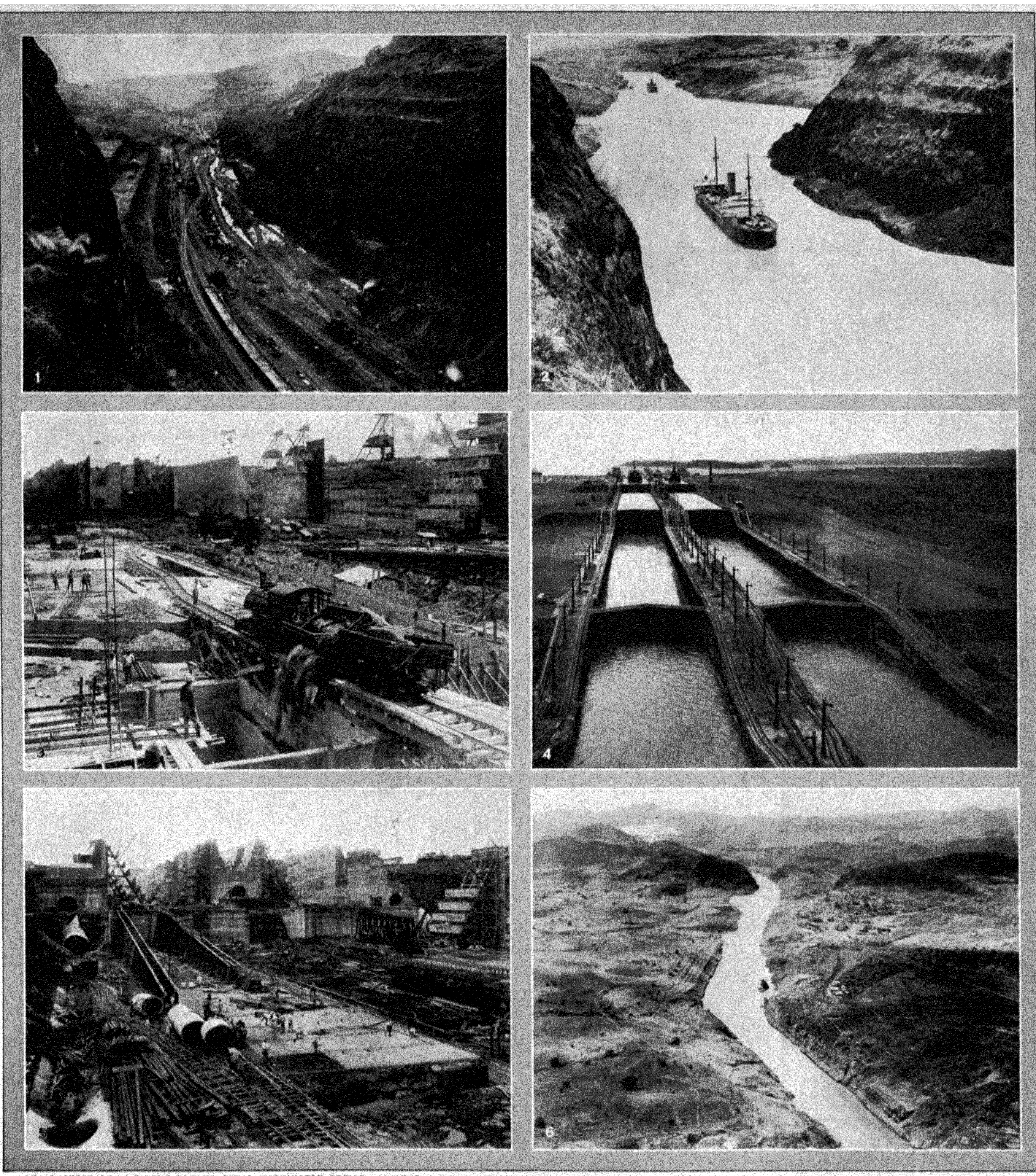
The following is the saving in nautical miles effected by the Panama canal in length of all-water routes between certain European and Atlantic-Gulf ports of the United States and various Pacific ports.

To	From				
	Liverpool	Hamburg	Gibraltar	New York	New Orleans
Sitka, Alaska	5,666	5,528	4,950	7,873	8,868
Portland, Oregon	5,666	5,528	4,950	7,873	8,868
San Francisco, Cal.	5,666	5,528	4,950	7,873	8,868
Acapulco, Mexico	5,874	5,736	5,158	8,081	9,076
San Jose, Guatemala	6,128	5,990	5,412	8,335	9,330
Guayaquil, Ecuador	5,198	5,060	4,482	7,405	8,400
Callao, Peru	4,043	3,905	3,327	6,250	7,245
Valparaiso, Chile	1,540	1,402	824	3,747	4,742
Honolulu, Hawaii	4,403	4,265	3,687	6,610	7,604
Wellington, N. Z.	1,564	1,403	489	2,493	3,488
Hongkong, China	4,072*	5,168*	5,943*	18*	1,919
Manila, P. I.	4,940*	5,188*	6,161*	41*	1,978

*Distance less via Suez Canal.

HISTORY

Early Interest in an Isthmian Canal.—When Columbus crossed the Atlantic, the object he had in view was to find a western passage from Europe to Cathay. It was with the greatest reluctance, and only after a generation of unremitting toil that the explorers who succeeded him became convinced that the American continent was continuous, and formed a barrier of enormous extent to the passage of vessels. The question of cutting a canal through this barrier at some suitable point was immediately raised. In 1550 the Portuguese navigator Antonio Galvao published a book to demonstrate that a canal could be cut at Tehuantepec, Nicaragua, Panama or Darien, and in 1551 the Spanish historian F. L. de Gomara submitted a memorial to Philip II. urging that the work be undertaken without delay. But the project was opposed by the Spanish Government, who had now concluded that a monopoly of communication with their possessions in the New World was of more importance than a passage by sea to Cathay. For more than two centuries no serious steps were taken towards the construction of the canal, if exception be made of William Paterson's disastrous Darien scheme in 1698. In 1771 the Spanish Government, having changed its policy ordered a survey for a canal at Tehuantepec, and finding that line impracticable, ordered surveys in 1779 at Nicaragua, but political



BY COURTESY OF (1-5) THE PANAMA CANAL WASHINGTON OFFICE, (6) THE U.S. ARMY AIR FORCES

VIEWS OF PANAMA CANAL, SHOWING CONSTRUCTION WORK AND LOCKS

1. Culebra Cut, Culebra, showing the deepest excavated portion of the Panama canal during the process of construction. On the right is Gold Hill, and on the left is Contractor's Hill
2. Gaillard Cut, Culebra, looking north from Contractor's Hill, June, 1921
3. Gatun Locks, showing the progress of construction, Aug. 5, 1911
4. Gatun locks, looking south from top of crane in lower lock
5. Gatun middle lock, looking south from east bank, during construction, April 15, 1911
6. Dredging Division Activities: Improvement Project No. 2. Aerial view looking southward, showing dredge at work on the new west prism line at Lirio, April 12, 1928

disturbances in Europe soon prevented further action. In 1808 the isthmus was examined by Alexander von Humboldt, who pointed out the lines which he considered worthy of study. After the Central American republics acquired their independence in 1823, there was a decided increase of interest in the canal question. In 1825 the Republic of the Centre, having received applications for concessions from citizens of Great Britain, and also from citizens of the United States, made overtures to the United States for aid in constructing a canal, but they resulted in nothing. Subsequently numerous concessions were granted to citizens of the United States, France and Belgium, both for the Nicaragua and the Panama lines, but with the exception of the concession of 1878 for Panama and that of 1887 for Nicaragua, no work of construction was done under any of them.

The United States Becomes Interested.—Knowledge of the topography of the isthmus was extremely vague until the great increase of travel due to the discovery of gold in California in 1848 rendered improved communications a necessity. A railroad at Panama and a canal at Nicaragua were both projected. Instrumental surveys for the former in 1849, and for the latter in 1850, were made by American engineers, and, with some small exceptions, were the first accurate surveys made up to that time. In order to determine the most practicable route for a ship canal across the American isthmus, the United States Government sent out, between 1870 and 1875, a series of expeditions under officers of the navy, by whom the various routes were examined. The result was to show that the only lines by which a tunnel could be avoided were the Panama and the Nicaragua lines; and in 1876 a United States Commission reported that the Nicaragua route possessed greater advantages and offered fewer difficulties than any other. At Nicaragua the distance is greater, being about 156 m. in a straight line, but more than one third is covered by Lake Nicaragua, a sheet of fresh water with an area of about 3,000 sq m. and a maximum depth of over 200 ft., the surface being about 105 ft. above sea-level. Lake Nicaragua is connected with the Atlantic by a navigable river, the San Juan, and is separated from the Pacific by the continental divide, which is about 160 ft. above sea-level. At Nicaragua only a canal with locks is feasible, but at Panama a sea-level canal is a physical possibility.

Treaties Effecting the Canal.—By the Clayton-Bulwer Treaty of 1850 with Great Britain, the United States guaranteed that the projected canal, whether the Panama cr the Nicaraguan, should be neutral, and, furthermore, that it be used and enjoyed upon equal terms by the citizens of both countries in each case. A modification of the Clayton-Bulwer Treaty being necessary to enable the United States to build the canal, a treaty making such modifications, but preserving the principle of neutrality, known as the Hay-Pauncefote Treaty, was negotiated with Great Britain in 1900; it was amended by the United States Senate, and the amendments not proving acceptable to Great Britain, the treaty lapsed in March 1901. A new treaty, however, was negotiated in the autumn, and accepted in December by the United States Senate. In the meantime (1876) an association entitled "Société Civile Internationale du Canal Interocéanique" was organized in Paris to make surveys and explorations for a ship canal. In May 1878 Lieut. Wyse, in the name of the association, obtained a concession from the Colombian Government, commonly known as the Wyse Concession. This is the concession under which work upon the Panama Canal was later prosecuted.

First Panama Company.—In May 1879 an International Congress composed of 135 delegates from various nations—some from Great Britain, United States and Germany, but the majority from France—was convened in Paris under the auspices of Ferdinand de Lesseps, to consider the best situation for, and the plan of, a canal. After a session of two weeks the Congress decided that the canal should be at the sea-level, and at Panama. Immediately after the adjournment of the Congress the Panama Canal Company was organized under a general law of France, with Lesseps as president, and it purchased the Wyse Concession at the price of 10,000,000 francs. An attempt to float this company in Aug. 1879 failed, but a second attempt, made in Dec. 1880, was fully successful. The next two years were devoted to surveys and examinations and preliminary work upon the canal. The plan adopted was for a sea-level canal having a depth of 29½ ft. and bottom width of 72 ft., involving excavation estimated at 157,000,000 cu.yd. The cost was estimated by Lesseps in 1880 at 658,000,000 francs, and the time required at eight years. The terminus on the Atlantic side was fixed by the anchorage at Colon, and that on the Pacific side by the anchorage at Panama.

Work under this plan continued until the latter part of 1887, the management being characterized by a degree of extravagance and corruption rarely if ever equalled in the history of the world. By that time it had become evident that the canal could not be completed at the sea-level with the resources of time and money then available. The plan was accordingly changed to one including locks, and work was pushed on with vigour until 1889, when the company, becoming bankrupt, was dissolved by a judgment of the Tribunal Civil de la Seine, dated Feb. 4, 1889, a liquidator being appointed by the court to take charge of its affairs. One of the more important duties assigned to this official was to keep the property together and the concession alive, with a view to the formation of a new company for the completion of the canal. He gradually reduced the number of men employed, and finally suspended the works on May 15, 1889

Second Panama Company.—The liquidator finally secured the organization of a new company on Oct. 20, 1894. The old company and the liquidator had raised by the sale of stock and bonds the sum of 1,271,682,637 francs. The securities issued to raise this money had a par value of 2,245,151,200 francs, held by about 200,000 persons. Immediately after its organization the new company took possession of the property (except the Panama railroad shares, which were held in trust for its benefit), and proceeded to make a new study of the entire subject of the canal in its engineering and commercial aspects. It resumed the work of excavation, with a moderate number of men sufficient to comply with the terms of the concession, in a part of the line—the Emperador and Culebra cuts—where such excavation must contribute to the enterprise if completed under any plan. By the middle of 1895, about 2,000 men had been collected, and after that time the work progressed continuously, the number of workmen varying between 1,900 and 3,600. The engineering questions had been solved to the satisfaction of the company, but the financial questions, by 1899, had been made extremely difficult, if not insoluble, by the appearance of the United States Government in the field as a probable builder of an isthmian canal. The company continued to conduct its operations in a provisional way, without appealing to the public for capital.

Nicaragua Scheme.—The occupation of the Panama route by Europeans, and the prospect of a canal there under foreign control, was not a pleasing spectacle to the people of the United States. The favour with which the Nicaragua route had been considered since 1876 began to assume a partisan character, and the movement to construct a canal on that line to assume a practical shape. In 1884 a treaty, known as the Frelinghuysen-Zarala Treaty, was negotiated with Nicaragua, by the terms of which the United States Government was to build the canal without cost to Nicaragua, and after completion it was to be owned and managed jointly by the two Governments. The treaty was submitted to the United States Senate, and in the vote for ratification, on Jan. 29, 1885, failed to receive the necessary two-thirds vote This failure led to the formation in New York by private citizens in 1886 of the Nicaragua Canal Association, for the purpose of obtaining the necessary concessions, making surveys, laying out the route, and organizing such corporations as should be required to construct the canal. They obtained a concession from Nicaragua in April 1887, and one from Costa Rica in Aug. 1888, and sent parties to survey the canal. On Feb. 20, 1889 the Maritime Canal Company of Nicaragua was incorporated by Congress, and on May 4, 1889 the company was organized. It took over the concessions and began work upon the canal in June 1889. Operations upon a moderate scale and mainly of a preliminary character were continued until 1893, when the financial disturbances of that period drove the construction company into bankruptcy and compelled a suspension of the work.

Congress continued to take an interest in the enterprise, and in 1895 provided for a board of engineers to inquire into the possibility, permanence, and cost of the canal as projected by the Maritime Canal Company. The report of this board led to the appointment in 1897 of another board, to make additional surveys and examinations. Its report was not completed when the revival of the Panama scheme attracted the attention of Congress, and led to the creation in 1899 of the Isthmian Canal Commission.

Isthmian Canal Commission.—The Spanish-American War of 1898 gave a tremendous impetus to popular interest in an isthmian canal, and it seemed an article of the national faith that the canal must be built, and, furthermore, that it must be under American control. To the American people the canal appeared a means of unifying and strengthening their national political interests, and of developing their industries, particularly in the Pacific States; in short, a means essential to their national growth. The Isthmian Canal Commission created by Congress in 1899 to examine all practicable routes, and to report which was the most practicable and most feasible for a canal under the control, management and ownership of the United States, reported that there was no route which did not present greater disadvantages than those of Panama and Nicaragua. The cost of a canal at Panama, built essentially upon the French plans, was estimated at $156,378,258. The time required to build the Nicaraguan canal was estimated at ten years and its cost at $200,540,000.

The report of the commission recommended the Nicaragua route. This caused the New Panama Canal Company, which was having serious financial difficulties, to view the question of selling its property in a new light and in the spring of 1901 it obtained permission from the Colombian Government to dispose of it to the United States. It showed itself, however, somewhat reluctant to name a price to the Canal Commission, and it was not till Jan. 1902 that it definitely offered to accept $40,000,000. In consequence of this offer, the commission in a supplementary report issued on Jan. 18, 1902 reversed the conclusion it had stated in its main report, and advised the adoption of the Panama route, with purchase of the works, etc., of the French company. The Hepburn bill, then before Congress, authorizing the Nicaragua canal at a cost of $180,000,000, was amended so that the president was authorized to acquire all the property of the Panama Canal Company, including not less than 68,869 shares of the Panama Railroad Company, for a sum not exceeding $40,000,000, and to obtain from Colombia perpetual control of a strip of land 6 m. wide; while if he failed to come to terms with the company and with Colombia in a reasonable time and on reasonable terms, he was by treaty to obtain from Costa Rica and Nicaragua the territory necessary for the Nicaragua canal.

Declaration of Panama Independence.—Negotiations were forthwith opened with Colombia, and ultimately a treaty (the Hay-Herran treaty) was signed in Jan. 1903. The Colombian Senate, however, refused ratification, and it seemed as if the Panama scheme would have to be abandoned when the complexion of affairs was changed by Panama revolting from Colombia and declaring itself independent in Nov. 1903. Within a month the new republic, by the Hay-Bunau-Varilla Treaty, granted the United States the use, occupation and control of a strip of land 10 m. wide for the purposes of the canal. A few days after the ratification of this treaty by the United States Senate in Feb. 1904—the concession of the French company having been purchased—a commission was appointed to undertake the organization and management of the enterprise, and in June Mr. J. F. Wallace was chosen chief engineer. Work was begun without delay, but the commission's methods of administration and control soon proved unsatisfactory, and in April 1905 it was reorganized, three of its members being constituted an executive committee which was to be at Panama continuously. Shortly afterwards Wallace resigned his position and was succeeded by John F. Stevens.

Construction Problems.—In connection with the reorganization of the commission a board of consulting engineers, five being nominated by European Governments, was appointed in June 1905 to consider the question, which so far had not been settled, whether the canal should be made at sea-level, without locks (at least except tidal regulating locks at or near the Pacific terminus), or should rise to some elevation above sea-level, with locks. The majority of the board declared in favour of a sea-level canal as the only plan "giving reasonable assurance of safe and uninterrupted navigation"; while the minority recommended a lock canal, rising to an elevation of 85 ft. above mean sea-level, on the grounds that it would cost about $100,000,000 less than the proposed sea-level canal, that it could be built in much less time, that it would afford a better navigation, that it would be adequate for all its uses for a longer time, and that it could be enlarged if need should arise with greater facility and less cost. These conflicting reports were then submitted to the Isthmian Canal Commission for consideration, with the result that on Feb. 5, it reported, one member only dissenting, in favour of the lock canal recommended by the minority of the board of consulting engineers. Finally this plan was adopted by Congress in June 1906.

Tenders of private contractors proving unsatisfactory President Roosevelt decided that it would be best for the Government to continue the work, which was placed under the more immediate control of the U.S.A. Corps of Engineers. At the same time the Isthmian Canal Commission was reorganized, Col. G. W. Goethals, of the Corps of Engineers, becoming engineer in chief and chairman on the resignation of J. F. Stevens (April 1, 1907). This commission was composed of four army engineers, an army doctor, one navy engineer and one civilian. President Roosevelt, who was convinced that the best results could not be obtained through an executive body of seven members, issued an executive order in January 1908 placing supreme power in the hands of Col. Goethals, abolishing the commission as an executive body, and making its members, who were heads of departments, subordinate to him, giving Col. Goethals all civil, military and other powers in the canal zone, and this course was subsequently approved in the act of 1912 for the government and operation of the canal after its completion.

The construction period of the Panama canal covered about 10 years, but the actual work of construction was accomplished in about seven years; the first three years were devoted to preliminary preparation, during which time the thorough sanitation of the Canal Zone was accomplished, yellow fever banished, an operating plant assembled, the railways modernized, a working force gathered, living quarters erected and a food and water supply provided. The plans for the canal itself had yet to be worked out in detail when the third commission took charge. Important changes in the general plan of the canal made it necessary to evolve an entirely new set of plans for lock and dam construction on the Pacific side and also for basal dimensions of the channel. The original plans provided for a total excavation of 95,000,000 cu.yd. and a total cost of $190,000,000 exclusive of $40,000,000 paid to the French Canal company, $10,000,000 paid to the Panama republic, and the cost of sanitation and civil administration. Changes made in 1908–09 increased the total excavation to 175,000,000 cu.yd. and the estimated cost to $375,210,000 inclusive of payments to the French Canal Company and the Republic of Panama. When the lock canal plan was adopted in 1906, it was estimated that nine years would be required for its completion, placing the date at Jan. 1, 1915. This date was accepted and the work was adjusted and prosecuted to this end. During the first five years under the Third Commission 75% of the entire excavation of the canal was accomplished. In spite of the fact that "slides" added more than 25% of the total excavations from Culebra cut, and were not taken into account in the estimated time or cost, the work was advanced to such a stage that the first ocean steamer was passed through on Aug. 3, 1914, and but for an unexpected slide which occurred on Oct. 14 of that year would have been completed in its entirety within the estimated time and below the estimated cost. When the canal was declared formally complete and open, a total of about 240,000,000 cu.yd. had been excavated and the total cost, exclusive of expenditures for naval and military defence, was only $366,650,000, of which $10,000,000 was for "slides" or breaks in the walls of the cut of which there were about 30 at different times.

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PAN-AMERICAN CONFERENCES. The six International Conferences of the American States, with various scientific, financial, commercial, legal and journalistic conferences held in the past 100 years are generally classified under this head, as being part of the movement toward co-operation amongst the 21 republics of the Western Hemisphere These conferences include representatives of all the national areas of the hemisphere, excepting Canada and the British, French and Dutch colonies

The original Pan-American Congress was called by Simon Bolivar (*q.v.*), and met in Panama in 1826, with representatives of Great Colombia, Guatemala, Mexico and Peru in attendance Representatives of the United States were named, but did not arrive until the Congress had adjourned A treaty of "union, league, and perpetual confederation" was signed, June 22, 1826, but Mexico, Peru and Guatemala failed to ratify it The postponed sessions of the Panama conference, which was to reconvene at Tacubaya, near Mexico City, were never held

In 1856, representatives of Peru, Chile and Ecuador met in Santiago, Chile, and signed the "Continental Treaty," which was designed to promote the union of the Latin American republics, but also expressed hostility toward the United States, on account of the recent activities of William Walker (*q v*), the filibuster, in Nicaragua; the treaty never became effective In 1864, another conference, called at the invitation of Peru, met in Lima, for the avowed object of forming a union of the Latin American States This conference was attended by representatives of Guatemala, Venezuela, Colombia, Ecuador, Peru, Bolivia and Argentina

In 1877 and 1878, jurists from Peru, Bolivia, Chile, Ecuador, Cuba, Honduras, Argentina, Venezuela and Costa Rica met at Lima and drew up treaties of extradition and made the first steps toward agreement on private international law (conflict of laws) Uruguay and Guatemala agreed to adhere to these treaties Progress was being made slowly, and in 1881 Colombia called a conference to be held in Panama, but owing to the War of the Pacific, between Peru and Bolivia, and Chile, this was not held

In 1882, invitations were issued by the U S Government, James G Blaine being secretary of State, for a conference to be held in Washington in November of that year, to discuss arbitration between the nations of the American hemisphere The assassination of President James A Garfield, and the accession of President Chester A Arthur, caused the withdrawal of the invitations, which were not reissued until 1889 Meanwhile, in 1888–89, jurists from Argentina, Bolivia, Brazil, Chile, Paraguay, Peru and Uruguay met at Montevideo and concluded treaties on international law, civil, commercial and penal, on international law of procedure, copyrights, trade-marks and patents, several of which were ratified by the signatory powers

In May 1888, the United States invited the Latin American countries to join with it in a conference in Washington "to consider measures for preserving the peace," the formation of a customs union, better communications, a common silver coin, a uniform system of weights and measures, patent rights, copyrights, trade-marks, sanitary regulation of ships and ports, etc President Benjamin Harrison had recalled Blaine to be his secretary of State and this was one of his first acts All the countries except Santo Domingo accepted the invitation. This conference, later to be known as the First Pan-American Conference, met on Oct 2, 1889, with Blaine presiding, and continued its sessions to April 19, 1890. The conference voted for compulsory arbitration, and recommendations were made regarding reciprocity in trade, customs regulations, port duties, sanitary regulations, free navigation of rivers, a monetary union, common weights and measures, patents and trade marks, extradition of criminals, an intercontinental railway (first voiced at this conference by Blaine), and other matters Failure to ratify or no action at all by the Governments nullified virtually all the work done, but from this conference came the establishment of the International Bureau of American Republics, later to become the present Pan-American Union (*q.v.*).

The Second Conference.—The Second Pan-American Conference, or properly the Second International Conference of the American States, was called, at the suggestion of President William McKinley of the United States, to meet in the City of Mexico, and convened Oct 22, 1901 Every country was represented and the sessions continued until Jan 31, 1902 The chief issue was arbitration, and the session was divided between those who favoured compulsory and those who felt that voluntary arbitration was the only practical step at the time; the final decision was a recommendation that all the countries adhere to the Hague Conventions of 1899, which provided for voluntary arbitration Ten delegations, however, signed a pact for compulsory arbitration This conference also took up the moot question of pecuniary claims of individuals against the Governments of countries not their own, and the conference adopted a resolution recommending that such claims be submitted to the arbitration court set up under The Hague Convention The conference recommended the construction of railways that would fit into the proposed route of the Pan-American railway At the Mexico Conference the International Bureau of American Republics was placed under the control of a governing board composed of the Latin American diplomatic chiefs of mission resident in Washington, with the secretary of State of the United States as ex-officio chairman. The Bureau was instructed to publish a bulletin monthly, and was made a repository of documents and given other more important functions. The governing board was instructed to take in hand the arrangements for the Third Pan-American Conference

The Third Conference.—The Third Pan-American Conference was held in Rio de Janeiro, Brazil, from July 21 to Aug 26, 1906, and was attended by representatives of all the 21 republics with the exception of Haiti and Venezuela Elihu Root, the American secretary of State, went to Rio for the conference, and sounded its keynote in an address which is still regarded as the essence of the Pan-American idea The subjects taken up at this conference followed the same line as the two previous ones. The arbitration issue was transferred to The Hague, by a resolution urging that the American delegates to The Hague seek the celebration of a general arbitration convention "so effective and definite that, meriting the approval of the civilized world, it shall be accepted and put in force by every nation" The resolutions passed at Mexico City with regard to patents, copyrights and trade-marks were reaffirmed with some modifications, and naturalization and return to nationality of birth were made easier. With respect to the forcible collection of public debts, to which the "Drago Doctrine" is opposed, the conference recommended that "the Governments represented therein consider the point of inviting the Second Peace Conference at The Hague to consider the question of the compulsory collection of public debts, and, in general, means tending to diminish between nations conflicts having an exclusively pecuniary origin" The first Pan-American Scientific Congress met at Santiago, Chile, on Dec 25, 1908, for the consideration of distinctly American problems. It continued in session until Jan 5, 1909, and resolved that a second congress for the same purpose should meet at Washington in 1912

The Fourth Conference.—The Fourth Pan-American Conference was held at Buenos Aires from July to August 1910. It agreed to submit to arbitration such money claims as cannot be amicably settled by diplomacy, and changed the name of the organization to the Bureau of Pan-American Union During the same year the Pan-American Union building, erected through a gift of $750,000 from Andrew Carnegie and $250,000 contributed by the various republics of the Union, was formally dedicated. The second Pan-American Scientific Congress met in Washington during the three weeks following Dec. 25, 1915. Among the speakers was President Wilson, who urged friendly settlement of

international disputes by arbitration. The congress appointed an International High Commission, which sat at Buenos Aires in April 1916. Improvement and extension of cable, telegraph and railway services between the countries was urged. A permanent International High Commission was established to promote uniform commercial laws throughout the countries represented in the Union. In Feb. 1918, the governing board of the Pan-American Union approved a plan to establish a Section of Education to promote better knowledge of the languages and history of the American republics through educational institutions.

In Nov. 1918, a Pan-American Federation of Labour Conference met at Laredo, Texas. Delegates were present from the United States, Mexico and Central America. An influenza epidemic interfered with South American attendance, Colombia alone being represented. A permanent federation was organized. Pan-American Child Welfare Congresses met at Montevideo, Uruguay, in Dec. 1918, and in May 1919; at the second meeting provision was made for establishing at Montevideo an International Bureau of Child Welfare. In June 1919, the second Pan-American Commercial Congress was held in Washington, and in the same city, in Jan. 1920, a Pan-American Financial Congress. The sixth International Sanitary Conference was held in Montevideo, Dec. 12 to 20, 1920. It re-organized the International Sanitary Bureau, which has been active in disseminating valuable bulletins on sanitation and public health.

The Fifth Conference.—The Fifth Pan-American Conference was held March 25 to May 3, 1923, at Santiago, Chile, Henry P. Fletcher, U.S. ambassador to Belgium, being head of the U.S. delegation. Delegations from all the American republics, except Bolivia, Mexico and Peru, were present, and a large number of subjects were discussed. A proposal by Uruguay that the principle of the Monroe Doctrine be adopted by all American States was not supported by the United States delegates, and was recommended for report to the next Pan-American Conference. Similarly, an attempt to arrive at an agreement for the limitation of naval armaments failed on account of disagreement between Brazil, Argentina and Chile. Costa Rica strongly urged the establishment of an American Permanent Court of Justice but failed to obtain the support of the conference, because the plan submitted included arbitration of questions involving the vital interests of nations, and the matter was referred to the commission of jurists at Rio de Janeiro in 1925.

Four conventions were completed and signed, viz., an agreement under which international disputes might be investigated and settled by a commission empowered to ascertain facts; a trade-mark convention, protecting users of trade-marks in the countries where ownership of the mark is acquired through registration; a convention to secure uniformity of nomenclature in the classification of merchandise; and one providing for the publicity of customs documents. No fewer than 73 resolutions were passed, one of the most important of which created four permanent committees to assist the Union in the study of (1) the best means of developing the economic and commercial relations between the American States; (2) the international organization of labour in America; (3) hygiene in the countries of the American continent; and (4) the best means of developing intellectual co-operation, with especial reference to co-operation between the universities and the exchange of professors and students.

The Sixth Conference.—The Sixth Pan-American Conference was held in Havana, Cuba, from Jan. 16 to Feb. 20, 1928. This was attended by President Coolidge of the United States, and delegations from all the other countries were present. Charles Evans Hughes, former American secretary of State, headed the delegation of the United States. A few months prior to this conference, the jurists of the American nations had met in Rio de Janeiro and approved drafts for the codification of Public International Law and Private International Law, and the discussion of these ambitious projects occupied much of the attention of the conference. The Pan-American Union was placed on a treaty basis, although pending the signature of the treaty by the American powers. The usual resolution, under which it had existed from conference to conference, was also passed. It was provided that the nation members of the Union might designate special members of the governing board, who might or might not, as they deemed fit, be the same individuals as their diplomatic representatives in Washington. The conference authorized 14 conferences of various sorts, to be handled or arranged for by the Pan-American Union. The most important of these was that on arbitration, which was held in Washington beginning Dec. 10, 1928. A Pan-American convention on aerial navigation was adopted, with provisions that other nations might adhere if they so desired. The Seventh Conference was tentatively set for Montevideo, Uruguay, in 1933.

The Washington conference on arbitration, Dec. 10, 1928, to Jan. 5, 1929, adopted conventions for conciliation and arbitration. The former provided for commissions of inquiry with authority to suggest bases of settlement for international disputes. The arbitration treaty provided for compulsory arbitration of all juridical questions, only two exceptions being cited, *i.e.*, domestic questions not controlled by international law, and matters in which third parties were concerned. Neither national honour nor the Monroe Doctrine was excepted. The treaties were signed by the United States and 19 other countries, 13 with reservations.

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PAN-AMERICAN UNION. At the first international Conference of American States held at Washington, a recommendation was approved on March 29, 1890, for the establishment of an inter-American organization to be known as "the International Union of American republics" for the prompt collection and distribution of commercial data and information. This Union was to be represented at Washington, D.C. by a bureau called "the commercial bureau of the American republics," its organ of publicity to be a publication in English, Spanish, Portuguese and French—the four languages spoken in Latin America and the United States—entitled *The Bulletin of the Commercial Bureau of the American Republics*. It was also provided that this bureau was to be "at all times available as a medium of communication and correspondence for persons applying for information in regard to matters pertaining to the commerce of the American republics." To defray the expenses of maintaining the bureau the sum of $36,000 was set aside to be advanced by the U.S. Government, which was to be reimbursed by the other republics by their respective quotas in proportion to their population. Subsequently the Dominican republic joined the Union, as did later Cuba and Panama. The report of the committee adopted by the first conference is the original charter of the bureau.

At the second conference a resolution was adopted on Jan. 29, 1902, for the reorganization of the bureau. In Art. I. of this resolution it is provided that the international bureau of the American republics shall be under the management of a governing board, which shall consist of the secretary of State of the United States of America, who shall be its chairman, and of the diplomatic representatives of all the Governments represented in the bureau and accredited to the U.S. Government. The resolution contained 13 articles and provided in detail for the management of the bureau, and conferred upon the governing board full power over its affairs. The name of the bureau was changed from "the commercial bureau of the American republics" to "the international bureau of the American republics." The third international conference, which met at Río de Janeiro, adopted on Aug. 19, 1906, a resolution, signed by all of the delegates, for the reorganization of the bureau. This resolution did not change in any particular the essentials of the resolution of Mexico City so far as the administration of the bureau, its character as an international

institution, and the work to be performed by it were concerned. It did change many of the details of administration within the bureau and imposed upon it additional work.

The action of the fourth international conference, which met at Buenos Aires in 1910, further enlarged the scope of the organization and changed the name to that of "Pan-American Union," while the name of the organization of American countries which support the Pan-American Union was changed to "Union of American republics" instead of "International Union of the American republics"; the chief executive officer of the Union was made director general and the secretary was made assistant director and secretary of the governing board. The principal change made at the fifth conference, held in Santiago, Chile, in 1923, was in the organization of the governing board. It was provided that the offices of chairman and vice chairman should be elective; and also that if for any reason an American republic should not have a diplomatic representative accredited to the U.S. Government that Government might appoint a special representative on the governing board.

At the sixth conference, held at Havana, Cuba, in Jan. 1928, a convention was signed, providing for the organization of the Pan-American Union; this convention, however, continues the present organization with very slight changes. The only important modification is that the Governments' representatives may either send special representatives to the governing board or designate their diplomatic representatives at Washington.

Purpose and Activities.—The Pan-American Union is housed in a building, the gift of Andrew Carnegie. The basic purpose of the Pan-American Union is to develop closer intellectual and commercial relations between the republics of the American continent and to promote international co-operation in every possible way. The Union is supported by quotas paid by the republics of America in proportion to population. It publishes a monthly bulletin in English and other languages which contains a record of Pan-American progress and practical information on Pan-American affairs. The Union also publishes a series of pamphlets on each of the republics of the American continent and also special pamphlets on the capital cities, the leading products and the commercial relations of these countries. Recently four special series were established, dealing with agriculture, commerce and finance, education and hygiene and child welfare. The Union has a library, known as the Columbus Memorial library, containing more than 70,000 vol., and also a large collection of maps, photographs, lantern slides and negatives. One of the most important functions of the Pan-American Union is to prepare the agenda for the Pan-American Conferences, which meet at intervals of five years. (L. S. Ro.)

PANATHENAEA, an annual festival at Athens of great antiquity and importance. Traditionally begun by Erechtheus and changed from Athenaea (festival of Athena) to Panathenaea (festival of all Athenians, universal festival of Athena) by Theseus, its elaboration seems to date from Peisistratus. In its developed form it was celebrated every fourth year with especial splendour, probably in deliberate rivalry to the Olympic games; its date was the third year of each Olympiad. The annual festival, probably about the middle of August, consisted solely of the sacrifices and rites proper to this season in the cult of Athena. One of these rites originally consisted in carrying a new *peplos* through the streets to the Acropolis, to clothe the ancient carved image of the goddess; but it is probable that this rite was afterwards restricted to the great penteteric festival. The *peplos* was a costly, saffron-coloured garment, embroidered with scenes from the battle between the gods and giants. At least as early as the 3rd century B.C. the custom was introduced of spreading the *peplos* like a sail on the mast of a ship, which was rolled on a machine in the procession. At the Great (quadrennial) Panathenaea representatives of all the dependencies of Athens were present, bringing victims, and a most brilliant procession resulted. After the presentation of the *peplos* the hecatomb was sacrificed. The subject of the frieze of the Parthenon is this great procession.

Pericles introduced a regular musical contest in place of the recitations of rhapsodes, which were an old-standing accompaniment of the festival. This contest took place in the Odeum, originally built for this purpose by Pericles himself. The order of the *agones* from this time onwards was—first the musical, then the gymnastic, then the equestrian contest. Many kinds of contest, such as the chariot race of the *apobatai* (said to have been introduced by Erechtheus), which were not in use at Olympia, were practised in Athens. *Apobates* was the name given to the companion of the charioteer, who showed his skill by leaping out of the chariot and up again while the horses were going at full speed. There were in addition several minor contests: the *Pyrrhic,* or war dance; the *Euandria,* or parade of "crack" troops; the *Lampadedromia,* or torch-race; the *Naumachia* (regatta), which took place on the last day of the festival. The proceedings were under the superintendence of ten *athlothetai,* one from each tribe, the lesser Panathenaea being managed by *hieropoioi.* In the musical contests, a golden crown was given as first prize; in the sports, a garland of leaves from the sacred olive trees of Athena and vases filled with oil from the same. The season of the festival was the 24th to the 29th of Hecatombaeon, and the great day was the 28th.

See A. Michaelis, *Der Parthenon* (1871, bibl.); L. R. Farnell, *Cults of Greek States,* i. (1896); A. Mommsen, *Feste d. Stadt Athen* (1898); *cf.* ATHENA.

PANCH MAHALS, a district of British India, in the northern division of Bombay. Area, 1,606 sq.m. Pop. (1921) 374,860. The administrative headquarters are at Godhra. The tract, which includes Champaner, the old Hindu capital of Gujarat, now a ruin, became British territory as recently as 1861, by a transfer from Sindhia. There are rich mineral deposits, and manganese is mined on a large scale. The district is crossed by the branch of the Bombay and Baroda railway from Anand, through Godhra to Ratlam; and a line runs from Godhra to Baroda city.

PANCREAS or SWEETBREAD, in anatomy, the pink tongue-shaped, digestive gland which lies across the posterior wall of the abdomen about the level of the first lumbar vertebra behind, and the transpyloric plane in front (*see* ANATOMY: *Superficial and Artistic*). Its right end is a little to the right of the mid line of the abdomen and is curved round the superior mesenteric vessels, into the form of a ⊂. This hook-like right end (the head) is adapted to the concavity of the duodenum. The first inch of the straight limb forms the neck and lies in front of the beginning of the portal vein, below the pyloric opening of the stomach and above the superior mesenteric vessels. The next three or four inches of the pancreas, form the body and this part lies in front of the left kidney and adrenal body, while it helps to form the posterior wall of the "stomach chamber" (*see* ALIMENTARY CANAL). At its left extremity the body tapers to form the tail, which usually touches the spleen (*see* DUCTLESS GLANDS) just below the hilum.

The pancreas is altogether behind the peritoneum. There is one main duct (the duct of Wirsung) which runs the whole length of the organ nearer the back than the front. As it reaches the head it turns downward and opens into the second part of the duodenum, joining the common bile duct while they are both piercing the walls of the gut. A smaller accessory pancreatic duct communicates with the main duct.

The pancreas has no capsule, but is divided up into lobules held together by their ducts and by loose areolar tissue; the glands of which these lobules are made up are acino-tubular (*see* GLANDS). Small groups of epithelium-like cells without ducts (Islets of Langerhans) occur among the glandular tissue and are characteristic of the pancreas. They are the source of insulin (*q.v.*) and degenerate in most cases of diabetes mellitus (*q v.*).

Embryology.—The pancreas is developed, by three diverticula, from that part of the foregut which will later form the duodenum. Of these diverticula the left ventral disappears early, but the right ventral, which is really an outgrowth from the lower part of the common bile duct, forms the head of the pancreas. The body and tail are formed from the dorsal diverticulum, and the two parts, at first separate, join one another so that the ducts communicate, and eventually the ventral one takes almost all the secretion

of the gland to the intestine, while that part of the dorsal one which is nearest the duodenum atrophies and forms the duct of Santorini. The main pancreatic duct (of Wirsung) is therefore formed partly by the ventral and partly by the dorsal diverticulum. As the diverticula grow they give off lateral branches, which branch again and again until the terminal buds form the acini of the gland. At first the pancreas grows upward, behind the stomach, between the two layers of the dorsal mesogastrium (*see* COELOM AND SEROUS MEMBRANES), but when the stomach and duodenum turn over to the right, the gland becomes horizontal and the opening of the right ventral diverticulum becomes more dorsal. Later, by the unequal growth of the duodenal walls, it comes to enter the gut on its left side where the papilla is permanently situated. After the turning over of the pancreas to the right the peritoneum is absorbed from its dorsal aspect. The islets of Langerhans are now regarded as portions of the glandular epithelium which have been isolated by the invasion and growth round them of mesenchyme (*see* Quain's *Anatomy,* vol. i., 1908).

Comparative Anatomy.—In the Acrania (Amphioxus) no representative of a pancreas has been found, but in the Cyclostomata (hags and lampreys) there is a small lobular gland opening into the bile duct which probably represents it. In the Elasmobranchs (sharks and rays) there is a definite compact pancreas of considerable size. In the Teleostomi, which include the true bony fish (Teleostei), the sturgeon and Polyterus, the pancreas is sometimes a compact gland and sometimes diffuse between the layers of the mesentery; at other times it is so surrounded by the liver as to be difficult to find. Among the Dipnoi (mud fish), Protopterus has it embedded in the walls of the stomach and intestine. The Amphibia have a definite compact pancreas, which lies in the U-shaped loop between the stomach and duodenum, and is massed round the bile duct. In the Reptilia there are sometimes several ducts, as in the crocodile and the water tortoise (Emys), and this arrangement is also found in birds. In mammals the gland is usually compact, though sometimes (rabbit) it is diffuse. It usually has two ducts, as in man, though in many animals (ox, sheep and goat) only one persists. When there is only one duct it may open with the common bile duct, *e.g.,* sheep and cat, or may be very far away as in the ox and rabbit. (F. G. P.)

PANCREAS, DISEASES OF THE. In sclerosis, atrophy, acute and chronic inflammatory changes and new growths in the pancreas an absence or lessening of pancreatic secretion may be evident. *Haemorrhage into the pancreas* is of some medico-legal importance as being a cause of death. *Acute haemorrhagic pancreatitis* is a combination of inflammation with haemorrhage in which the pancreas is enlarged and infiltrated with blood. Violent pain, vomiting and collapse, are the chief features as is also the case in *pancreatic abscess* in which the abscess may be single or multiple. In the latter condition operation has been followed by recovery. Haemorrhagic inflammation has been followed by *gangrene of the pancreas,* which usually terminates fatally. In two remarkable cases, however, reported by Chiari recovery followed on the discharge per rectum of the necrosed pancreas. *Chronic pancreatitis* has been said by Mayo Robson to occur in connection with the symptoms of catarrhal jaundice, which he suggested is due to the pressure on the common duct by the swollen pancreatic tissue. The organ is enlarged and very hard, and the symptoms are pain, dyspepsia, jaundice, loss of weight and the presence of fat in the stools. This latter sign is common to all forms of pancreatic disease. In connection with many pancreatic diseases small yellowish patches are found in the pancreatic tissue, mesentery, omentum and abdominal fatty tissue generally, and the tissues appear to be studded with whitish areas often not larger than a pin's head. The condition, which was first observed by Balser, has been termed "fat-necrosis," and is due to the action on the fat of lipolytic ferment set free by disorganization of the pancreas. The pancreas like other organs, is subject to the occurrence of new growths, tumours and cysts, syphilis and tuberculosis. Of these carcinoma of the head of the organ is the most common. Diabetes (*q.v.*) is the subject of a special article.

PANDA (*Aelurus fulgens*), a mammal of the family *Procyonidae* (*see* CARNIVORA). This animal, rather larger than a cat, ranges from the Eastern Himalaya to North-west China. It is found among rocks and trees and feeds on fruits and other vegetable substances. Its fur is rich reddish-brown, darker below; the face is white, save for a vertical stripe of red from just above the eye to the gape; there are several pale rings on the tail.

PANDARUS, in Greek legend, son of Lycaon, a Lycian. In the *Iliad* he breaks the truce between the Trojans and the Greeks by treacherously wounding Menelaus with an arrow, and finally he is slain by Diomedes. In the mediaeval tale of Troilus and Cressida he was the latter's uncle and acted as the lovers' go-between; hence the modern "pander."

PANDEAN PIPE: *see* SYRINX.

PANDECTS, a name given to a compendium or digest of Roman law compiled by order of the emperor Justinian in the 6th century A.D. (530–533). (*See* JUSTINIAN; and ROMAN LAW.)

PANDERMA (Gr. *Panormus*), a district in the vilayet of Karassi in Asia Minor, on the south shore of the Sea of Marmora, near the site of Cyzicus. It has a trade in cereals, cotton, opium, valonia and boracite and is connected by railway with Smyrna. Pop. (1927) 61,918.

PANDHARPUR, a town of British India, in Sholapur district of Bombay, on the right bank of the river Bhima, 38 m. W. of Sholapur town. Pop. (1921), 25,210. Pandharpur is the most popular place of pilgrimage in the Deccan; its celebrated temple, dedicated to Vithoba, a form of Vishnu, is visited by large numbers, particularly in July. It is connected by a light railway with Barsi Road on the Great Indian Peninsula railway.

PANDORA, according to Hesiod (*Theog.* 570–612, *Works and Days* 59 et seq.), the first woman (Gr., the "All-giving"). After Prometheus had stolen fire from heaven and bestowed it upon mortals, Zeus determined to counteract this blessing. He accordingly commissioned Hephaestus to fashion a woman out of earth, upon whom the gods bestowed their choicest gifts. Hephaestus gave her a human voice; Aphrodite, beauty and powers of seduction; Hermes, cunning and the art of flattery. Zeus gave her a jar (πίθος), the so-called "Pandora's box" (*see* below), containing all kinds of misery and evil, and sent her, thus equipped, to Epimetheus, who, forgetting the warning of his brother Prometheus to accept no present from Zeus, made her his wife. Pandora afterwards opened the jar, from which all manner of evils flew out over the earth (for parallels in other countries, *see* Frazer's *Pausanias* ii. 320). Hope alone remained at the bottom, the lid having been shut down before she escaped (Hesiod, *Works and Days* 54–105). But in a later story, the jar contained, not evils, but blessings, which would have been preserved for the human race had they not been lost through the opening of the jar out of curiosity by man himself (Babrius, *Fab.* 58).

See J. E. Harrison, "Pandora's Box," in *Journal of Hellenic Studies* xx. (1900); O. Gruppe, *Griechische Mythologie* i. 94 (1906); Preller-Robert I. 97.

PANDROSEUM, a temenos or sacred area, on the north side of the Athenian acropolis, dedicated to Pandrosos, the daughter of Cecrops, legendary first king of Athens. Its position and shape determine the plan of the west side of the erechtheum (*q.v.*).

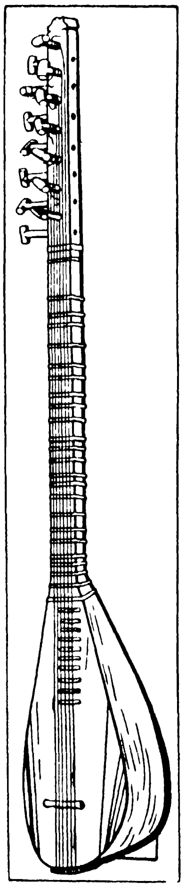
PANDUA, a ruined city in Malda district of Bengal, once a Mohammedan capital. It is situated 9 m. N.E. of Old Malda, and about 20 m. from the other great ruined city of Gaur (*q.v.*). About A.D. 1340, Shamsuddin Ilyas Shah, one of the early kings of Bengal, transferred his capital from Gaur to Pandua; but the time of its prosperity was short, for in A.D. 1455 the capital was transferred back to Gaur. Its most celebrated building is the Adina mosque built by Sikandar Shah (1357–90), which was described by James Fergusson as the finest example of Pathan architecture in existence. Other notable buildings are the Ekhlakhi mosque or tomb and the Sona or golden mosque which with the Adina mosque are conserved by Government.

PANDULPH [PANDOLFO] (d. 1226), Roman ecclesiastical politician, papal legate to England and bishop of Norwich, was born in Rome, and first came to England in 1211, when he was commissioned by Innocent III. to negotiate with King John. He is said to have produced the papal sentence of excommunication in the very presence of the king. In May 1213 he again visited

England to receive the king's submission. The ceremony took place at Dover, and on the following day John, of his own motion, formally surrendered England to the representative of Rome to receive it again as a papal fief. Pandulph repaid this act of humility by using every means to avert the threatened French invasion of England. For nearly a year he was superseded by the cardinal-legate Nicholas of Tusculum; but returning in 1215 was present at the conference of Runnymede, when the great charter was signed. He rendered valuable aid to John who rewarded him with the see of Norwich. The arrival of the cardinal-legate Gualo (1216) relegated Pandulph to a secondary position; but after Gualo's departure (1218) he came forward once more. As representing the pope he claimed a control over Hubert de Burgh and the other ministers of the young Henry III ; and his correspondence shows that he interfered in every department of the administration. His arrogance was tolerated while the regency was still in need of papal assistance; but in 1221 Hubert de Burgh and the primate Stephen Langton successfully moved the pope to recall Pandulph and to send no other legate *a latere* in his place Pandulph retained the see of Norwich, but from this time drops out of English politics He died in Rome on Sept. 16, 1226 but his body was taken to Norwich for burial.

See W. Shirley, *Royal and Other Historical Letters* ("Rolls series") vol. i ; Miss K Norgate, *John Lackland* (1902) ; W. Stubbs, *Constitutional History* (1897) vol i.

PANDURA, an ancient Oriental stringed instrument, a member of the lute family, having a long neck, a highly vaulted back, and originally two or three strings plucked by the fingers There were in antiquity at least two distinct varieties of pandura or tanbur (1) the more or less pear-shaped type used in Assyria and Persia and introduced by way of Asia Minor into Greece, whence it passed to the Roman empire; (2) the oval type, a favourite instrument of the Egyptians, also found in ancient Persia and among the Arabs of North Africa



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TURKISH PANDURA

PANEGYRIC, a strictly formal public speech delivered in high praise of a person or thing In Athens such speeches were delivered at national festivals or games, with the object of rousing the citizens to emulate the glorious deeds of their ancestors The most famous are the *Olympiacus* of Gorgias, the *Olympiacus* of Lysias, and the *Panegyricus* and *Panathenaicus* (neither of them, however, actually delivered) of Isocrates Funeral orations, such as the famous speech put into the mouth of Pericles by Thucydides, also partook of the nature of panegyrics The Romans confined the panegyric to the living The most celebrated example of a Latin panegyric is that delivered by the younger Pliny (A D 100) on the occasion of his assumption of the consulship, containing a somewhat fulsome eulogy of Trajan Towards the end of the 3rd and during the 4th century, as a result of the orientalizing of the imperial court by Diocletian, it became customary to celebrate the superhuman virtues and achievements of the reigning emperor Twelve speeches of the kind have been collected under the title of *Panegyrici veteres latini* (ed. E. Bährens, 1874).

See C. G. Heyne, "Censura xii. panegyricorum veterum," in his *Opuscula academica* (1812) vi 80–118; H Ruhl, *De xii panegyricis latinis* (Greifswald, 1868) ; R. Pichon, *Les derniers écrivains profanes* (1906).

PANEL, originally a small piece of cloth or parchment; this meaning persists only in certain legal terms, such as jury panel, so-called from the original strip of parchment on which the names were written in early days; and in Scotch law in the use of the word for an indictment or for a person or persons named in an indictment; or in the use of the word for the cloth-stuffed lining of a saddle. In architecture and furniture, the word signifies, originally, a small piece of thin wood enclosed in a surrounding framework. Casts of charred wooden doors taken in Pompeii, as well as many ancient classic representations prove that the construction of wooden panels was well understood by the Greeks and Romans. Moreover, numerous Italian Romanesque wooden church doors of the 10th to the 12th centuries, usually of many small, nearly square panels, manifestly continue Roman types.

In much Gothic decorative work tracery forms are frequently used to divide a large surface into small recessed panels of various shapes. This decorative panelling is particularly common on tombs, screens, chancel rails and the like, in which multiplication of cusping frequently gives it great richness, especially in England In France, panelling is used with more restraint and in simpler forms, usually confined to slim, arch-headed shapes. During the late Gothic period of the 15th and 16th centuries, decorative panelling was used more lavishly throughout north Europe, and in the Perpendicular work of England large wall areas were often covered by a series of rectangular or Tudor arch-headed, sunk, tracery panels Meanwhile, the use of structural wood panelling, at first reserved for doors, cupboards, chests and similar furniture, was spreading to wainscotting; in this development the English lead. Occasionally an applied moulding is used at the sides and top only of a panel with a chamfer at the bottom The rich, interior, wood panelling of the Tudor and Elizabethan periods in England often combined with linenfold (*q v.*) decoration and sometimes with crude, classic pilasters and entablatures, is one of the most beautiful characteristics of those styles

In the Renaissance of Italy, panelling is of importance only in furniture such as choir stalls, etc , and in the rich coffered ceilings which cover many palace halls and church interiors In France, on the other hand, the use of panelling grew continuously more important as the Renaissance developed, and reached a climax in the lavish panelled interiors of the Louis styles (*q v.*) In this Louis panelling, as in work of the same date in England, the development is toward greater use of large panels made by glueing together smaller pieces of wood (T. F H)

PANGALOS, THEODORE (1878–), Greek soldier and politician, was born in Salamis of Albanian origin and in 1895 entered the Athenian Military Academy, whence he proceeded to complete his studies in Paris During the World War he commanded a regiment in Macedonia, in 1917 he held a post in the Ministry of War, in 1918 commanded the first infantry division and in 1919 was chief of the General Staff during the campaign in Asia Minor When the revolution of 1922 dethroned King Constantine for the second time, he was chairman of the commission of enquiry into the responsibilities for the Asiatic disaster, and was consequently concerned in the execution of the six Royalist ministers. In the first Republican cabinet of Papanastasiou in 1924 he was successively minister of Law and Order (for the repression of brigandage) and War On June 25, 1925, by a bloodless *coup d'état*, he made himself premier, then forced the Chamber to accept him, prorogued and subsequently dissolved it, took two Royalists into his cabinet as a sign of "reconciliation," and, Jan 3, 1926, became dictator In April 1926 Gen Pangalos was elected president of the Hellenic Republic in succession to Admiral Condouriotis But on Aug. 22 General Kondyles made a *coup d'état* against him in his absence at Spetsai. He was arrested without resistance, and imprisoned in the Cretan fortress of Izzeddin and subsequently in Athens He was released on July 10, 1928, and put himself up for Athens at the general election later in the year He did not get in, and since then has played no prominent part in Greek politics (W M)

PAN-GERMANISM. Pan-Germanism is the name given to an imperialist movement which, though it had long been gaining strength, received but little serious notice in Anglo-Saxon countries until the years immediately preceding the World War. Its importance may then have been exaggerated, yet there can be little doubt that it helped largely to popularize the belief that there had been at work in Germany forces bent upon ambitious schemes of territorial aggrandisement and political dominion.

Its Two Aspects.—There are, indeed, two aspects of Pan-Germanism—the purely national and defensive and the outspokenly chauvinistic and aggressive. The Pan-German is accustomed to describe his endeavours as merely designed to realize, under modern conditions, the ideas of men like Fichte, Arndt and other patriots who over a century ago looked to the time when the sundered German tribes would be gathered into one political fold. In the middle of the century the political economists Friedrich List and Wilhelm Roscher, both forward-looking in many ways, gave more purposive form to this vague notion of an all-embracing Germanic commonwealth. List dreamed of a German empire extending from the Adriatic to the Black sea, offering scope for German colonization for centuries to come. He also predicted the eventual inclusion in that empire of Holland, holding that without control of the mouth of the Rhine Germany was "like a house whose front door is owned by a neighbour."

List's speculations would appear to have given encouragement and direction to the later more definite activities of the Pan-Germanist movement; for many of the imperialistic schemes which have been advanced by contemporary writers are only variations or augmentations—mostly the latter—of his ideas. List's influence can first be traced in the works of men like Paul A. de Lagarde, Gustav A. C. Frantz and Paul Dehn, who all wrote on the subject in the '70s or '80s of last century. Thus, in his *Deutsche Schriften,* Lagarde wrote:—

> We must create a Central Europe which will guarantee the peace of the entire Continent from the moment when it shall have driven the Russians from the Black sea and the Slavs from the South and shall have conquered large tracts to the east of our frontiers for German colonization. We cannot let loose *ex abrupto* the war which will create this Central Europe. All we can do is to accustom our people to the thought that this war must come.

Frantz, too, in his book *Die Weltpolitik,* advocated the formation under German direction of a powerful confederation of States comprising, besides Germany, Austria, Holland, Belgium, Flanders,) Lorraine, Switzerland, Franche-Comté, Savoy, and, in the East, the Balkan principalities and Russian Poland.

During the years preceding the World War these ideas acquired a wide influence in Germany and were reinforced by influential political names. They had been kept alive by a host of writers of unequal merit, among the most influential being Ernst von Halle, Friedrich Lange and Ernst Hasse. The special aspect of the Pan-German question to which Hasse devoted his pen was "frontier policy," the title of his best-known book. One of his favourite schemes was the hedging of the empire on its landward frontiers by a military *glacis,* a day's march wide, to be settled by the families of ex-non-commissioned officers and other picked men who had had a military training. This real *Landwehr* was to be the *rocher de bronze* of which Frederick the Great spoke, a bulwark against which the attacks of Germany's enemies would hurl themselves in vain. He also advocated the incorporation in the German confederation of Belgium, Luxembourg, Holland and certain French frontier districts, as well as of Bohemia and Moravia (to be taken from Austria) and parts of Western Russia. For, he wrote: "We want territory, even if it be inhabited by foreign peoples, so that we may shape their future in accordance with our needs."

It was only in 1891 that the Pan-Germans resorted to systematic organization and propagandism. The colonial movement was then in full flood, and the idea of imperial expansion had captured the national imagination in a high degree. Five years before a congress of colonial enthusiasts and organizations had been called for conference in Berlin by Dr. Karl Peters, who later acquired a sinister notoriety. A loose federation of these bodies was formed for the more successful advancement of national interests, particularly territorial expansion, and Peters was for a time accepted as its head.

Formation of the League.—In 1891 this federation was reconstituted as the General German league (*Allgemeiner Deutscher Verband*) under pressure of the strong public feeling evoked by the conclusion of the Zanzibar convention of the previous year, by which Germany ceded to Great Britain a large part of her East African empire in exchange for the island of Heligoland. A membership of 20,000 appears to have been obtained, but this number gradually fell off to 5,000, until in 1894 the movement was taken in hand by Prof. Ernst Hasse of Leipzig, a fanatical imperialist, then a member of the imperial diet, who directed it for 15 years. Simultaneously the name Pan-German league (*Alldeutscher Verband*) was taken; the machinery of organization was improved and expanded; an energetic agitation by means of meetings, leaflets and a weekly news sheet, *Pan-German Papers* (*Alldeutsche Blätter*), was begun; and both members and money again came in freely.

The new league sought to create a world-wide national union of all the Germans, adopting as its motto the saying of the great elector of Brandenburg, Frederick William, the founder of the German colonial movement and the creator of the German navy: "Remember that you are Germans." The propagandist manifesto in circulation before the war set forth: "We must strengthen our national sentiment and bring home to the mass of our people the fact that Germany's development did not end in 1871." The programme of action comprised the following measures:—

> The quickening of the patriotic consciousness of Germans at home and the combating of all tendencies antagonistic to national development.
>
> The solution of questions relating to the education and training of the young and the schools in the sense of Germanism.
>
> The fostering and support of German national movements in all countries where our kinsmen have to struggle for the maintenance of Germanism, and the union of all Germans throughout the world. (At the same time Germans living abroad were warned against direct interference in the internal affairs of the countries of their adoption.)
>
> The promotion of an energetic German "policy of interests" in Europe and across the seas, and especially the carrying forward of the colonial movement to practical objectives.

Had the Pan-Germans kept their endeavours within the limits of the party's programme much reproach might have been saved them later. Individual members of the league, however, were not slow to supplement its avowed aims by all sorts of immoderate schemes of aggression in Europe, Asia Minor and Africa. As time passed and the relations of the Great Powers became increasingly strained, the league itself developed into a powerful piece of political machinery. The fact that many of its members sat in the imperial diet gave to the league an excellent forum for the propagation of its ideas, and in all the more critical episodes and controversies in foreign politics during two decades prior to the war it proved an unwearying exponent of a spirited imperialist policy.

Yet influential though the Pan-Germanist movement was before the war, and inflammatory as was much of its influence on public opinion, injustice would be done by identifying the German nation as a whole with its more aggressive propagandism. In the main the movement appealed to and was embraced by the powerful nationalist and chauvinist parties—in other words, by the military men and the political reactionaries—for though many intellectuals supported the league the soberer heads among them kept aloof, and the historian Mommsen even called the Pan-Germans "patriotic idiots."

Character of Pan-Germanism.—It would be equally unfair to draw general conclusions from the many extravagances which were uttered and written in Germany during the years of war. The real significance of the Pan-German propagandism at that time lay in the new importance attached to the idea of a Central European confederation under German influence, then revived by Dr. F. Naumann in his book *Mittel-Europa,* perhaps the ablest contribution from the German side to the literature of a "new Europe," the expansion of the old Berlin-to-Baghdad programme into a grandiose scheme of empire extending from Antwerp and the North sea to Basra and the Persian gulf, and the claim to a vast consolidated colonial empire stretching across tropical Africa, to be acquired at the expense of France, Belgium and particularly of Great Britain. These ambitious projects are not recalled in order to prove that the war aims of Germany were more immodest than those of some of her enemies, still less for the purpose of pointing the contrast between aspiration and achievement, but rather as showing how many years of intensive Pan-Germanic

agitation had clearly familiarized the national mind with the idea of imperial expansion as one which might be better realized by force of arms than by the slow methods of peaceful penetration.

When criticized, the Pan-Germanist is ready with his answer. "Put yourself in our position," he says; and the challenge is one to be met. Viewing the question from the German standpoint it is not difficult to discover facts and tendencies in national and international politics that explain, and within limits may be said to have condoned, the anxiety and spirit of unrest which settled upon Germans when, in 1885 or thereabouts, they began to feel the pressure of the population question, the growing need for new markets and the stirring of ambitions which pointed outwards. It is significant that the movement made its greatest advance when J. Chamberlain, colonial secretary from 1895–1902, was uttering his clear and resounding call to the commonwealths of the British empire to coalesce and to raise their frontier barriers, commercially, to the outer world. In the past the British empire had opened its door freely to Germans as immigrants and traders, but it was suspected that they were no longer as welcome as heretofore. Even had it been otherwise, the Germans chafed against the inequality in the partition of the undeveloped territories of the earth which compelled their emigrants to seek homes under alien flags and thus to be eventually lost to the fatherland. Further, while many German politicians feared a future agglomeration of the Anglo-Saxon races, the whole nation was haunted by the twofold menace of a restless Russia in the East and of a France in the West unreconciled to the loss of territory in 1871.

These and other facts, weighing on an emotional and politically immature people, probably gained for Pan-Germanist ideas a hearing and a sympathy which in different circumstances might have been refused to them. When all due allowances have been made, however, it is but the more justifiable to say that the Pan-Germanism of the past was condemned by its excesses. The great mistake of the Pan-Germans of pre-war days was that they allowed a justifiable national pride and an eager and natural hankering for more elbow-room to degenerate into hostile designs against other nations which, owing to historical reasons, had preceded Germany in the colonization of the empty spaces of the earth, and that they often avowed these designs with so brutal a candour. Since the war the Pan-German league, refraining from aggressive agitation, has concentrated its attention upon the task of strengthening the national sentiment and spirit, hardly tried by adversity. The latest version of its statutes (Feb. 1927) is substantially directed towards the political rehabilitation of Germany as a great Power and the removal of the territorial and economic penalties imposed by the Treaty of Versailles. Stress is laid upon the maintenance and strengthening of the national spirit, the cultivation of the German individuality, the need for a powerful defence force, the recovery of the lands of which Germany has been deprived and the union of German-Austria with the Reich. From the beginning the movement had had a definite anti-Semitic bias, and Jews are bracketed with people of coloured race as ineligible for membership of the Pan-German league.

The Movement in Austria.—The most important development of the Pan-German movement since the war is the great stimulus which it has received in Austria. There an autonomous league was formed in 1919 with an independent organization; and working from Graz it has carried on a vigorous agitation in all parts of the country, and has even succeeded in making its influence felt in the German districts which have passed from Austrian rule under the Treaty of St. Germain. While its programme has much in common with that of the parent league, it emphasizes union with Germany as the hope of the future.

That great enthusiasm is being thrown into the agitation is shown by the fact that some 200 local branches of the league have been organized, representing an enrolled membership of many thousands. These Austrian reunion endeavours practically revive the Great Germany movement of the middle of last century. It is not the least strange of the ironies of history that an idea which at that time reft in twain the old German Bund should serve to-day as a symbol of national unity. Local groups exist in other countries where Germans are numerous, and particularly in America.

BIBLIOGRAPHY.—The German literature of the Pan-German movement is very large and inevitably of very unequal value. Better known writers include, besides those already named, Alexander von Pecz, Albert Ritter, Gen. Friedrich von Bernhardi, the Anglo-German Houston S. Chamberlain, Baron L. von Vietinghoff, Count von Reventlow, Albrecht Wirth, H. Frobenius and Friedrich Lange. Noteworthy German works on the league itself are an official survey of Pan-Germanic endeavours entitled *Zwanzig Jahre alldeutscher Arbeit und Kämpfe* (1910); Martin Wenck's *Alldeutsche Taktik* (*Pan-German Tactics*) (1917); and Otto Burchard's *Geschichte des alldeutschen Verbandes* (1920). Of a number of works in English there may be named Rowland G. Usher's *Pan-Germanism* (1913), and a translation of Charles Audler's *Pan-Germanism*, published in 1915. (W. H. DA.)

PANGOLIN, the name given to scaly ant-eaters comprising several genera of the family *Manidae* of the order Edentata (*q.v.*). These animals are found in tropical Asia and in Africa, ranging from 1 to 3ft. in length, exclusive of the tail, which may be shorter than, or twice the length of, the rest of the body. The legs are short and the tongue long and worm-like. There are no teeth. Except the under surface of the body and, in two African species, the lower part of the tip of the tail, the whole animal is covered with broad, overlapping, horny scales. The Asiatic species, three in number, are characterised by hairs between the scales and by small external ears. These are wanting in the four African species. The commonest Asiatic form is *Manis pentadactyla* of India.


WHITE-BELLIED PANGOLIN, OF TROPICAL AFRICA

PANIC. By panic, in the economic sense, we mean a psychological state in which either or both of the two following beliefs are irrationally entertained—viz., either that the banks are not in a position to repay their depositors or that they are not in a position to lend, so that the normal processes of the money market will be completely upset. The synonym for the first type of Panic is the Run: of the second, the Financial Crisis. The first is marked by a demand by the public for legal tender, in extreme cases, by a demand for *gold:* the second is marked by a demand for *bank balances*, that is, loans, which are hoarded by the borrowers for the same reason that notes or gold are hoarded by the depositor: not because the money is needed at once, but because it may not be available in case it is needed. Examples of the financial panic are the crises of 1847, 1857 and 1866 in Great Britain, which led to the suspension in each case of the Bank Charter Act: of the run, the state of affairs in New York in the autumn of 1907.

Since the run is a purely irrational mob manifestation, based upon the instinct of self-preservation, it cannot be met in any other way than by boldness. The claims of the depositors must be met without argument and without question because, at the height of the run, any attempt at expostulation will be interpreted as a sign that all is not well, and the run thereby becomes intensified. It follows from this that during a run the commercial banks cannot afford to see any really sound concern go to the ground: for a weakening of one link in the chain may lead to the ruin of all.

What applies to a run, is also true of those morbid states of the money market which are known as financial crises If loans really *are* refused, the only effect is to intensify the evil. And thus, both in the case of runs and in the case of financial panics, what is required is some organisation which is prepared to assume the responsibilities of leadership in the moment of peril. This organisation in the modern world is the central bank. The rules by which a central bank ought to be guided in the event of a financial crisis were worked out empirically by the Bank of England between

1825 and 1866, and were erected into a philosophy in Walter Bagehot's celebrated book, *Lombard Street* (1873).

These rules are essentially two in number. The first is that loans ought to be made freely and on any security, provided that that security is in itself sound. The knowledge that loans can be got is in itself an element of pacification. The second rule is that the loans so made should be made at a high price, for otherwise an amount will be demanded which it may not be within the power even of a central bank to grant, and a higher price will in itself be a deterrent to purposeless borrowing induced merely by fear.

In the case of Great Britain, experience in the middle part of the 19th century showed very conclusively that the mere existence of a central bank does not of itself allay a financial panic, so long as the ability of a central bank to lend freely is doubted. Owing to the provisions of the Bank Charter Act of 1844, the ability of the Bank of England to lend was doubted, and it was not until the issue of the so-called "Government Letter," by which the Bank was advised that in the event of its breaking the law by issuing a volume of notes in excess of the statutory amount the Government would seek to obtain an Act of Indemnity from Parliament, that excitement was allayed. The modern central bank, which is given power to issue notes in excess of any statutory reserve percentage, provided that it is prepared to pay a tax upon the amount so issued in excess, is in a very much stronger position. This valuable element of elasticity was provided in Great Britain by the terms of the Currency and Bank Notes acts, 1914–5, by which the Bank could increase its fiduciary circulation with the consent of the Treasury: an element of safety which is perpetuated by the new Currency and Bank Notes act (1928).

The severity of financial crises and the frequency of runs diminished very greatly in the last decade of the nineteenth century and the opening years of the twentieth century. This was due to a gradual realization by bankers that the true method of cure lay in prevention: that is, in the maintenance of high standards of caution and discretion in the granting of loans. The result was that the Baring crisis of 1890 was successfully surmounted without the necessity of having recourse to a suspension of the Bank act of 1844. Since that time until the outbreak of the war, whilst there were isolated cases of runs against particular banks (Birkbeck Building Society, Yorkshire Penny Bank) there was no general crisis involving even the discussion of the expediency of suspending the act of 1844, until the outbreak of the World War of 1914. The older conception of the phenomenology of the trade cycle, in which the transition from boom to decline was marked by panic in the money market, if not by the failure of a certain number of commercial banks, has long since disappeared in Europe. (T. E. G.)

United States.—The principal panics witnessed in the United States may be sketched as follows (original compilation made by the *Wall Street Journal,* of New York). Jay Cooke and Co. failed on Sept. 18, 1873; on the following day Fisk and Hatch suspended; runs on the Fourth National Bank and the Union Trust Company followed; on Sept. 20, the Union Trust Company, the Bank of the Commonwealth, and the National Trust Company failed. The stock market experienced wild panic and excitement, which became so great that the governors of the Exchange announced at 11 A.M. that day trading would be suspended indefinitely. On Sept. 30 trading was resumed. Among other dates of interest in Wall Street may be mentioned Black Friday (*q.v.*), Sept. 24, 1869. It was on this day that the Gould-Fisk clique attempted to corner the gold supply. After forcing the price up from 150 in the morning to 162½ at noon, the price dropped precipitately to 133, causing many failures and wild panic. The Government broke the corner by selling $4,000,000 in gold. On May 8, 1884, Grant and Ward failed; Ex-President Grant was subsequently ruined. The Marine Bank failed and pandemonium reigned in the stock market.

Panic as the result of the Baring failure in London began on Nov. 10, 1890. Call money reached 186%; the North River Bank suspended; the Clearing House issued certificates on Nov. 11. On May 3, 1893, panic again set in; call money reached 40% and there were many bank failures in the United States and in Australia. Several brokerage houses failed and prolonged business depression followed. May 9, 1901, witnessed one of the worst stock market disturbances in history. This panic, known as the Northern Pacific corner, was precipitated by the contest between the Harriman-Kuhn-Loeb interests on one side and the Hill-Morgan on the other, for the control of the Northern Pacific road. From a price of 106 on May 6, quotations on stock of this road jumped to 1,000 on cash sales (May 8). On May 9, the whole list collapsed. Union Pacific common dropped from 113 to 76; Southern Pacific common dropped from 49 to 29; Atchison from 78¼ to 43; Baltimore and Ohio from 102 to 84; steel common from 47 to 24; steel preferred from 98 to 69. Call money went to 75%.

The panic of 1907 occurred in October and was the direct result of the collapse of the copper industry; the price of that metal dropped in six months from 26 cents to 12 cents. The Knickerbocker Trust Company closed its doors on Oct. 22; on Oct. 23, a run was started on the Trust Company of America. The run continued throughout the month and is regarded as one of the most stubborn in history. The stock market was in a panic and other runs started. Steel common touched 27⅛; call money reached 125%. Under the provision of the Federal Reserve Act (*q.v.*) enacted in 1913, it is believed that the United States will hereafter be more free from financial panics. (J. H. B.)

PANICLE, in botany the name given to an inflorescence which is a compound raceme (*q.v.*) as in oats. (*See* also FLOWER.)

PANICUM, a genus of grasses (*q.v.*) comprising some 500 species, found chiefly in the warmer regions of both hemispheres, about 150 occurring in the United States. Several are important cereals, as *P. miliaceum* (common millet), cultivated for food in India and Europe; others are valuable forage plants, as *P. maximum* (guinea-grass) and *P. barbinode* (Para grass), the only grasses extensively grown for forage in tropical America. Representative North American species are *P. capillare* (old-witch grass), *P. virgatum* (switch-grass) and *P. texanum* (Texas millet).

PANIN, NIKITA IVANOVICH, COUNT (1718–1783), Russian statesman, was born at Danzig on Sept. 18, 1718. He passed his childhood at Pernau, where his father was commandant. In 1740 he entered the army, and rumour had it that he was one of the favourites of the empress Elizabeth. In 1747 he was accredited to Copenhagen as Russian minister, but a few months later was transferred to Stockholm, where for the next twelve years he played a conspicuous part as the chief opponent of the French party. It is said that during his residence in Sweden Panin, who certainly had a strong speculative bent, conceived a fondness for constitutional forms of government. Politically he was a pupil of Alexis Bestuzhev; consequently, when in the middle 'fifties Russia suddenly turned Francophil instead of Francophobe, Panin's position became extremely difficult. However, he found a friend in Bestuzhev's supplanter, Michael Vorontsov, and when in 1760 he was unexpectedly appointed the governor of the little grand duke Paul, his influence was assured. He was on Catherine's side during the revolution of 1762, but his jealousy of the influence which the Orlovs seemed likely to obtain over the new empress predisposed him to favour the proclamation of his ward the grand duke Paul as emperor, with Catherine as regent only.

Panin was never chancellor; but he was the political mentor of Catherine during the first eighteen years of her reign. He was the inventor of the famous "Northern Accord," which aimed at opposing a combination of Russia, Prussia, Poland, Sweden, and perhaps Great Britain, against the Bourbon-Habsburg League. The idea, though never quite realized, influenced the policy of Russia for many years. It explains, too, Panin's tenderness towards Poland, whom he regarded as an indispensable member of his "Accord," wherein she was to supply the place of Austria, whom circumstances had temporarily detached from the Russian alliance. All the diplomatic questions concerning Russia from 1762 to 1783 are intimately associated with the name of Panin. It was only when the impossibility of realizing the "Northern Accord" became patent that his influence began to wane.

After 1772, when Gustavus III. upset Panin's plans in Sweden, Panin became more and more subservient to Frederick II. of Prussia. As to Poland, his views differed widely from the views

of both Frederick and Catherine. He seriously guaranteed the integrity of Polish territory, after placing Stanislaus II. on the throne, in order that Poland, undivided and as strong as circumstances would permit, might be drawn wholly within the orbit of Russia. But he did not foresee the complications which were likely to arise from Russia's interference in the domestic affairs of Poland. Thus the confederation of Bar, and the Turkish War thereupon ensuing, took him completely by surprise. He was forced to acquiesce in the first partition of Poland, and when Russia came off third best, Gregory Orlov declared in the council that the minister who had signed such a partition treaty was worthy of death. Panin further incensed Catherine by meddling with the marriage arrangements of the grand duke Paul and by advocating a closer alliance with Prussia, whereas the empress was beginning to incline more and more towards Austria.

Nevertheless, even after the second marriage of Paul, Panin maintained all his old influence over his pupil, who, like himself, was now a warm admirer of the king of Prussia. There are even traditions from this period of an actual conspiracy of Panin and Paul against the empress. As the Austrian influence increased Panin found a fresh enemy in Joseph II., and the efforts of the old statesman to prevent a matrimonial alliance between the Russian and Austrian courts determined Catherine to get rid of a counsellor of whom, for some mysterious reason, she was secretly afraid. The final rupture seems to have arisen on the question of the declaration of "the armed neutrality of the North"; and in May 1781 Panin was dismissed. He died in Italy on March 31, 1783. Panin was one of the most learned, accomplished and courteous Russians of his day. Catherine called him "her encyclopaedia." The earl of Buckinghamshire declared him to be the most amiable negotiator he had ever met. He was also of a most humane disposition and a friend of Liberal institutions.

See anonymous *Life of Count N. I. Panin* (Rus.; St Petersburg, 1787); *Political correspondence* (Rus. and Fr.), Collections of Russian Histor. Society, vol. ix. (St Petersburg, 1872); V. A. Bilbasov, *Geschichte Katharina II.* (Berlin, 1891–1893); A. Brückner, *Materials for the Biography of Count Panin* (Rus.; St Petersburg, 1888).

(R. N. B.; X.)

PANIPAT, a town of British India, in Karnal district of the Punjab, 53 m. north of Delhi by rail. Pop. (1921), 27,343. The town is of great antiquity, dating back to the great war of the *Mahābhārata* between the Pāndavas and Kaurava brethren. In modern times, the plains of Panipat thrice formed the scene of decisive battles which sealed the fate of upper India—in 1526, when Bābur completely defeated the imperial forces; in 1556, when his grandson, Akbar, on the same battlefield, conquered Himu, the Hindu general of the Afghān Adil Shāh; and finally, on the 7th of January 1761, when Ahmad Shāh Durāni shattered the Mahratta confederacy.

PANIQUITAN, a group of tribes of South American Indians, constituting a linguistic stock or more probably sub-stock. The Paniquitas, from whom the group takes its name, lived in Colombia in the Cordillera Central between the upper Cauca and Magdalena rivers, between 2° and 3° N. lat. Other tribes of the stock held the region between the rivers as far north as 5° N. lat. together with both banks of the Magdalena as far south as Neiva. The Paniquitan tribes were bitter enemies of the Chibchas (*q.v.*) whom they bordered on the west and south. Unlike the Chibchas and like the peoples to the north and east they used the blowgun and employed poisoned darts and arrows. From some of the early accounts they appear to have been head-hunters.

See P. de Aguado, *Historia de Santa Marta y Nuevo Reino de Granada, 1575* (Madrid, 1916); H. Pittier de Fabrega, "Ethnographic and linguistic notes on the Paez Indians of Tierra Adentro, Cauca, Colombia" (*Mem. Amer. Anthropological Assoc.* vol. i.); H. Beuchat and P. Rivet, "Affinités des langues de la sud de la Colombie, etc." (*Museon,* vol. xi.).

PANISLAMISM. This word was first employed in journalistic literature in the early '80s of the 19th century to describe the efforts made in the Muslim world to bring about some unity of action in opposition to the Christian powers of Europe. Invented to express what was believed to be a new order of circumstances, the word has led to much misunderstanding, since it has obscured the facts that Muhammadan political theory has always embodied a hostile attitude towards unbelievers unless they submitted to Muhammadan rule, and that the ideal of the unity of all believers has formed an integral part of the religious outlook of Islam since its very inception. The only new circumstance in the relations between the Christian Powers and the various Muslim populations was that the expansion of the Press in the East had improved methods of communication and had enormously facilitated the rapid circulation of ideas. The alarmists who regarded Panislamism as a danger, credited Sultan Abdul Hamid II. (1876–1909) with a wide-spread propaganda designed to gain for himself recognition as the spiritual head of all the Muslims throughout the world, whatever might be the Government to which they owed temporal allegiance. It was feared that this recognition of the sultan of Turkey as Caliph might be a cause of political disturbance among the Muhammadan subjects of European Powers. The growing decline of political power in the Muhammadan world had indeed given to Turkey an increasing importance in Muslim eyes as being the single Muhammadan state of importance that could take part in the councils of Europe. But the emissaries of Abdul Hamid were ill-chosen, and the success of their efforts appears to have been slight, and the Panislamist movement was mainly confined to journalistic denunciations of the oppression of the Muslims by Christian Governments and exhortations to promote the unity of Islam. But no practical scheme was worked out, and Abdul Hamid who was theoretically the head of the movement, showed great discretion and restraint in his propaganda, which was rendered the less effective by the profound distrust which his cruelty and despotism excited especially among his own subjects. After his deposition an attempt was indeed made by the Committee of Union and Progress at the Salonika Congress of 1911 to adopt a definite scheme of Panislamic propaganda, and it was resolved that a congress of delegates from all the Muslim countries of the world ought to meet annually in Constantinople to discuss questions of interest to all Muslims. Emissaries appear to have been actually sent out during these years to win or to confirm adherents to the Ottoman Caliph wherever Muslims were subject to Europeans, even to remote parts of Africa, including Morocco; others worked among the Muslims of China.

Attempts were also made to deal with the old difficulty which had confronted Panislamism, the schism between Sunni and Shi'ah. Early in 1911 a letter was published by a number of Ottoman and Persian jurists assembled at Nejef, asserting that there was no difference of principle between the two sects and urging co-operation between the two empires, Persia being at that time, it was supposed, menaced by England and Russia. The sympathies of the Muhammadan world became again focussed on Turkey with the outbreak of the Italian war in Sept. 1911 and of the Balkan war in Oct. 1912. The talk about the need for union between Muslims was renewed in the Muhammadan press throughout the world and it became more widely realised among them that someone claiming to be their Caliph existed.

But the outbreak of the World War in 1914 revealed the weakness of Panislamism, and the more active influence of nationalist feeling thrust the Panislamic idea into the background. The European Powers against whom it was directed—England, France, Russia and afterwards Italy—received during the course of it great proofs of loyalty and attachment from their Muslim subjects; and it seems clear that there was little sense of unity with the Turks on the ground of common religion on the part of these populations, in which, on the contrary, the sense of loyalty to the empires within which they are incorporated had been developed. The proclamation of a *jihād* with no response shows that the time for the employment of that instrument had passed, if it was ever effective. The reduction of the Ottoman Empire after the conclusion of the war to a comparatively small area produced a feeling of depression among the Islamic peoples, who could no longer look with confidence to a great Islamic Power as the natural leader in any scheme for the recovery of hegemony in Asia and Africa. The Turkish republic (one of the few independent Muhammadan states now surviving) on more than one occasion made it clear that it did not concern itself with the fate of Muslim populations in other countries.

This attitude of aloofness on the part of the Turkish Government dealt a severe blow at Panislamism, for those who worked for the unity of Islam during the 19th century had looked on Turkey as the rallying point of their efforts The last refuge of the Panislamist movement was India, in which the Khilafat movement was started in Oct. 1919, maintaining that the dignity of the Caliphate required that the holder of this office should be left in possession of territories adequate for the defence of the faith, and that the guardianship of the Holy Places should remain in his hands. But the declaration of a republic in Turkey in Oct 1923, followed in March 1924 by the abolition of the Caliphate, compelled the Indian Muhammadans to adopt a new programme, and accordingly the Central Khilafat Committee, at its meeting in Bombay in May 1924, resolved in future to endeavour to promote friendly relations between the various Muslim countries and to exchange communications regarding a settlement of the Caliphate question, in accordance with the Sacred Law of Islam The altered circumstances of the problem were much discussed in Egypt and Java also, and as a result two separate congresses were held in 1926, the Caliphate Congress in Cairo and the All-Muslim Congress in Mecca But in neither of these gatherings was any decision of a practical nature arrived at, and it is uncertain whether any attempt will be made to convene such meetings again

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PANIZZI, SIR ANTHONY (1797–1879), English librarian, was born at Brescello, in the duchy of Modena, Italy, on Sept. 16, 1797 After taking his degree at the university of Parma, Antonio Panizzi became an advocate He was implicated in the revolutionary movement of 1821, and escaped arrest by a precipitate flight. He first established himself at Lugano, but was expelled from Switzerland at the joint instance of Austria, France and Sardinia He came to England in May 1823, in a state bordering upon destitution His countryman, Ugo Foscolo, provided him with introductions, and he earned a living for some time by giving Italian lessons By Brougham's influence he was made, in 1828, professor of Italian at University College, London In 1831 Brougham, then lord chancellor, obtained for him the post of an extra assistant librarian of the Printed Book department Panizzi was then working at his edition of Boiardo's *Orlando innamorato* Boiardo's fame had been eclipsed for three centuries by the adaptation of Berni; and it is highly to the honour of Panizzi to have redeemed him from neglect His edition of the *Orlando innamorato* and the *Orlando furioso* was published between 1830 and 1834, prefaced by an essay on the influence of Celtic legends on mediaeval romance In 1835 he edited Boiardo's catalogue of the library of the Royal Society

To the parliamentary committee (1835–36) to inquire into the management of the British Museum Panizzi contributed an enormous mass of statistics respecting foreign libraries, and evidence on the catalogue of printed books then in contemplation In 1837 he was appointed keeper of printed books The entire collection, except the King's Library, had to be removed from Montague House to the new building, the reading-room service had to be reorganized, rules for the new printed catalogue had to be prepared, and the catalogue itself undertaken All these tasks were successfully accomplished; and the rules of cataloguing devised by Panizzi and his assistants became the basis of subsequent work His report, printed in 1845, upon the museum's extraordinary deficiencies in general literature, ultimately procured the increase of the annual grant for the purchase of books to £10,000. His friendship with Thomas Grenville (1755–1846) led to the nation being enriched by the bequest of the unique Grenville library In 1847–1849 a royal commission sat to inquire into the general state of the museum, and Panizzi was the centre of the proceedings. His administration, fiercely attacked from many quarters, was triumphantly vindicated in every point Panizzi did not succeed to the principal librarianship until 1856. It was thus as merely keeper of printed books that he conceived and carried out the achievement by which he is probably best remembered—the erection of the new library and reading-room. Purchases had been discouraged from lack of room in which to deposit the books. Panizzi cast his eye on the empty quadrangle enclosed by the museum buildings, and conceived the idea of occupying it with a central cupola too distant, and adjacent galleries too low, to obstruct the inner windows of the original edifice The cupola was to cover three hundred readers, the galleries to provide storage for a million of books. The original design, sketched by Panizzi's own hand on April 18, 1852, was submitted to the trustees on May 5; in May 1854 the necessary expenditure was sanctioned by parliament, and the building was opened in May 1857

Many important additions to the collections were made during his administration, especially the Temple bequest of antiquities, and the Halicarnassean sculptures discovered at Budrun (Halicarnassus) by C. T Newton Panizzi retired in July 1866, but continued to interest himself actively in the affairs of the museum until his death, on April 8, 1879. He had been created a K C.B in 1869

His administrative faculty was extraordinary. to the widest grasp he united the minutest attention to matters of detail. His moral character was the counterpart of his intellectual: he was warm-hearted and magnanimous; extreme in love and hate—a formidable enemy, but a devoted friend His intimate friends included Lord Palmerston, Gladstone, Roscoe, Grenville, Macaulay, Lord Langdale and his family, Rutherford (lord advocate), and, above all perhaps, Francis Haywood, the translator of Kant His greatest friendship was with Prosper Mérimée (R G ; X)

See Fagan, *Life of Sir Anthony Panizzi* (1880)

PANJABI LANGUAGE (alternatively PUNJABI), the language of the Central Punjab (properly Panjāb) It is spoken by over 71,000,000 people between (approximately) the 77th and 74th degrees of east longitude The vernacular of this tract was originally an old form of the modern Lahndā, a member of the outer group of Indo-Aryan languages (*q v*), but it now belongs to the intermediate group, possessing most of the characteristics of the Midland language, with occasional traces of the old outer basis which become more and more prominent as we go westwards At 74° E it merges into the modern Lahndā

The vocabulary of Panjabi is very similar to that of western Hindi Panjabi has no literature to speak of and is free from the burden of words borrowed from Persian or Sanskrit, only the commonest and simplest of such being found in it. Its vocabulary is thus almost entirely *tadbhava*, and, while capable of expressing all ideas, it has a charming rustic flavour, like the Lowland Scots of Burns, indicative of the national character of the sturdy peasantry that employs it The indigenous alphabet of the Punjab is called *Landā* or "clipped" It is related to Nāgarī, but is hardly legible to any one except the original writer, and sometimes not even to him To remedy this defect an improved form of the alphabet was devised in the 16th century by Angad, the fifth Sikh Guru, for the purpose of recording the Sikh scriptures It was named *Gurmukhī*, "proceeding from the mouth of the Guru," and is now generally used for writing the language

See *Linguistic Survey of India*, vol ix pt 1, p 607, *seq* for a full account with specimens of the language and bibliography.

PANJDEH or PENJDEH, a village in the Turkmen S S R in 36° 10′ N, 62° 30′ E, rendered famous by "the Panjdeh scare" of 1885 It is situated on the east side of the Kushk river near its junction with the Murghab at Pul-i-Khishti In March 1885 when the Russo-Afghan Boundary Commission should have been engaged in settling the boundary-line, this portion of it was in dispute between the Afghans and the Russians. A part of the Afghan force was encamped on the west bank of the Kushk, and on March 29 General Komarov sent an ultimatum demanding their withdrawal On their refusal the Russians attacked them at 3 A M on March 30 and drove them across the Pul-i-Khishti Bridge with a loss of some 600 men. The incident nearly gave rise to war between England and Russia; but the amir Abdur-Rahman, who was present at the Rawalpindi conference with Lord Dufferin at the time, affected to regard the matter as a mere frontier scuffle The border-line subsequently laid down gives

to Russia the corner between the Kushk and Murghab rivers as far as Maruchak on the Murghab, and the Kushk post has now become the frontier post of the Russian army of occupation.

PANKHURST, EMMELINE (1858–1928), British suffragist, the daughter of Robert Goulden, a calico-printer of Manchester, was born July 14, 1858. From 1873 to 1877 she was educated at the École Normale in Paris, where she came under the influence of a daughter of Henri Rochefort. In 1879 she married Richard Marsden Pankhurst, a barrister and an advocate of women's suffrage, and served with him on the committee which promoted the Married Women's Property Act. She was at that time a member of the Manchester Women's Suffrage Committee and, during a short residence in London in 1886, took part in the strike of the match girls at Bryant and May's factory. In 1889 she helped to found the Women's Franchise League, and in 1892 left the Liberal Party and became a member of the Independent Labour Party. Returning to Manchester in 1893, she acted for five years as Poor Law guardian. On the death of her husband in 1898 she took the post of registrar of births and deaths at Chorlton-on-Medlock, but was later obliged to resign on account of her propaganda activities. In October 1903, inspired by her daughter Christabel, she was chiefly instrumental in founding the Women's Social and Political Union on a non-party basis.

Having failed to induce the Liberal party to make votes for women a part of their programme she utilized her organization to oppose their candidates, took headquarters in London, held public meetings and organized processions and deputations to the House of Commons. On May 16, 1906, she spoke for her society at a joint deputation of suffrage societies which met Sir H. Campbell-Bannerman at the Foreign Office. But the Liberal party being divided on the question, their leaders refused facilities for the discussion of private bills. In Feb. 1908 Mrs. Pankhurst was arrested on her way to the House of Commons with a petition for the Prime Minister, but was released from prison on grounds of ill-health after the expiration of five weeks of her six weeks' sentence. Later in the same year she was imprisoned in Holloway for inciting to a breach of the peace, and once more in 1909 she was arrested for a technical assault. She entered an appeal founded on the Bill of Rights and a statute of Charles II., and pending the hearing undertook a lecturing tour in America and Canada. During her absence some unknown person paid her fine. In 1910 there was a short lull in the movement pending the consideration of a moderate measure framed by a non-party committee of the House, but as the Government opposed the measure the agitation was again resumed. The census was boycotted in 1911, and on her return from a second American visit at the end of the year Mrs. Pankhurst and her daughter directed a window-breaking campaign. Mrs. Pankhurst was sentenced to 9 months' imprisonment for inciting to violence in March 1912.

In 1913–4 arson and the destruction of property were added to the methods of the W.S.P.U. After the bomb outrage at Lloyd George's house at Walton, Mrs. Pankhurst was sentenced at the Old Bailey to three years' penal servitude. After serving at intervals less than three weeks of her sentence she joined her daughter Christabel in Paris and later went to America. In the summer of 1914, when she had again been re-arrested and released several times after her return to England, the remainder of her term was allowed to lapse.

At the outbreak of the World War Mrs. Pankhurst and her eldest daughter, supported by the other militant leaders, lent their organization to the cause of national service. Mrs. Pankhurst, an exceptionally able public speaker, devoted her energies to the encouragement of recruiting in England and America. In 1917 Mrs. Pankhurst visited Russia and subsequently, for the benefit of her health, spent some years in Canada and Bermuda. On her return to England at the end of 1925 she again showed great interest in politics. At the time of her death (London, June 14, 1928) she was the candidate for Whitechapel and St. George's nominated by the Conservative Party, which she had joined after the passing of the Representation of the People Act, 1918, which included the extension of the suffrage to women.

Mrs. Pankhurst had one son, who died in 1910, and three daughters. Christabel (b. 1880) has abandoned politics. Sylvia (b. 1882) opposed the war, became a Communist, and was imprisoned in 1920 under the Defence of the Realm Act. *See* E. Pankhurst, *My Own Story* (1914).

PANLOGISM, in philosophy, is the metaphysical theory that thought or reason is the ultimate reality, or that the universe is completely rational or intelligible (Greek πᾶν, all, λόγος, reason). The term is sometimes applied to the absolute idealism of Hegel. *See* IDEALISM; HEGEL.

PANNAGE, an English legal term for the feeding of swine in a wood or forest, hence used of a right or privilege to do this.

PANNONIA, a country bounded north and east by the Danube, conterminous westwards with Noricum and upper Italy, and southward with Dalmatia and upper Moesia. Its original inhabitants were probably of Illyrian race. From the 4th century B.C. it was invaded by various Celtic tribes, probably survivors of the hosts of Brennus. Little is heard of Pannonia until 35 B.C., when its inhabitants, having taken up arms in support of the Dalmatians, were attacked by Augustus, who conquered and occupied Siscia (Sissek). The country was not, however, definitely subdued until 9 B.C., when it was incorporated with Illyria, the frontier of which was thus extended as far as the Danube. In A.D. 7 the Pannonians, with the Dalmatians and other Illyrian tribes, revolted, and were overcome by Tiberius and Germanicus, after a hard-fought campaign which lasted for two years. In A.D. 10 Pannonia was organized as a separate province. The proximity of dangerous barbarian tribes (Quadi, Marcomanni) necessitated the presence of a large number of troops (seven legions in later times), and numerous fortresses were built on the bank of the Danube. Some time between the years 102 and 107, which marked the termination of the first and second Dacian wars, Trajan divided the province into Pannonia *superior,* the western, and *inferior*, the eastern portion.

Under Diocletian a fourfold division of the country was made. In the middle of the 5th century Pannonia was ceded to the Huns by Theodosius II., and after the death of Attila passed into the hands of the Ostrogoths, Longobards (Lombards), and Avars.

The inhabitants of Pannonia are described as brave and warlike, but cruel and treacherous. Except in the mountainous districts, the country was fairly productive, especially after the great forests had been cleared by Probus and Galerius. Before that time timber had been one of its most important exports. Its chief agricultural products were oats and barley, from which the inhabitants brewed a kind of beer. Pannonia was famous for its breed of hunting-dogs.

The native settlements consisted of *pagi* (cantons) containing a number of *vici* (villages), the majority of the large towns being of Roman origin. In Upper Pannonia were Vindobona (Vienna), probably founded by Vespasian; Arrabona (Raab), a considerable military station; Savaria or Sabaria (Stein-am-Anger), founded by Claudius, a frequent residence of the later emperors, and capital of Pannonia *prima*. In Lower Pannonia were Sirmium (first mentioned in A.D. 6, also a frequent residence of the later emperors), and Sopianae (Fünfkirchen), an important place at the meeting of five roads.

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PANOAN, an independent linguistic stock of South American Indians, so called from the Pano, one of its important tribes. The Indians of this stock occupy a large area in north-eastern Peru and the adjacent parts of Brazil and Bolivia. The region may be roughly described as covering the territory south of the Amazon between the mouths of the Huallaga and Yaruri rivers, and including the region along the Huallaga, Ucayali, upper Yurua and Purus rivers extending south to the lower Beni and Mamore in about 12° S. lat. The better known tribes are the Cashibos, Chacobos, Conibos, and Shipibos.

See P. Rivet, "Sur quelques dialectes Panos peu connus" (with bibliography) (*J. Soc. Américanistes de Paris* [n.s.] vol. vii. pp. 221–242);

D. G. Brinton, *The American Race* (New York, 1891).

PANORAMA (Gr. πᾶν, all, and ὅραμα, view), the name given originally to a pictorial representation of the whole view visible from one point by an observer who in turning round looks successively to all points of the horizon. In an ordinary landscape picture only a small part of the objects visible from one point is included. If a greater part of a landscape has to be represented, it becomes more convenient for the artist to suppose himself surrounded by a cylindrical surface in whose centre he stands, and to project the landscape from this position on the cylinder. In a panorama such a cylinder, originally of about 60 ft., but now extending to upwards of 130 ft. diameter, is covered with an accurate representation in colours of a landscape, so that an observer standing in the centre of the cylinder sees the picture like an actual landscape in nature completely surround him in all directions. This gives an effect of great reality to the picture, which is skilfully aided in various ways. The observer stands on a platform representing, say, the flat roof of a house, and the space between this platform and the picture is covered with real objects which gradually blend into the picture itself. The picture is lighted from above, but a roof is spread over the central platform so that no light but that reflected from the picture reaches the eye. To make this light appear the more brilliant, the passages and staircase which lead the spectator to the platform are kept nearly dark. These panoramas, suggested by a German architectural painter named Breisig, were first executed by Robert Barker, an Edinburgh artist, who exhibited one in Edinburgh in 1788, representing a view of that city. A view of London and views of sea fights and battles of the Napoleonic wars followed. Panoramas gained less favour on the continent of Europe, until, after the Franco-German War, a panorama of the siege of Paris was exhibited in Paris. This panorama, executed by Henri Philippoteoux, French painter, included plastic objects in the foreground which strengthened the optical illusion. Paul Philippoteoux, the son of the above painter, was noted for his "Battle of Gettysburg" (1883) which was exhibited in New York and other American cities, "Plevna" and "Falls of Niagara."

Other distinguished painters of panoramas were Ludwig Braun and Anton von Werner in Germany, and De Neuville and Detaille in France.

The name panorama, or panoramic view, is also given to drawings of views from mountain peaks or other points of view, such as are found in many hotels in the Alps, or, on a smaller scale, in guide-books to Switzerland and other mountainous districts. In photography a panoramic camera is one which enables a wide picture to be taken.

See Bapst, *Essai sur l'histoire des panoramas et dioramas* (Paris, 1891).

PAN-PACIFIC UNION, THE, an international organization which took out its charter in 1917. It is the first of a number of similar organizations born in Hawaii and throughout the Pacific area.

The Union called several small conferences prior to the World War; in 1921 it called and financed the first of the Pan-Pacific science congresses, now the recognized official science body of the Pacific area. It next called and financed in quick succession a Pan-Pacific educational congress, a Pan-Pacific press congress, a Pan-Pacific commercial congress, and a Pan-Pacific food conservation congress. Out of this latter grew a permanent International Sugar Technologists Conference body, a Pan-Pacific Fisheries Association and the Pan-Pacific Research Institution.

The Pan-Pacific Union organized the calling of a Pan-Pacific Y.M.C.A. secretarial congress. Out of this grew the Institute of Pacific Relations. The Pan-Pacific Union has issued or is issuing calls for the following conferences: a Pan-Pacific women's congress, Aug. 1928; a Pan-Pacific surgical congress, Aug. 1929, and a Pan-Pacific medical congress 1930, as well as Pan-Pacific ethical and students conference within the near future, and a second Pan-Pacific commercial congress and a Pan-Pacific botanic conference.

At these conferences points of agreement are sought and plans laid for accomplishing definite projects on which all peoples of the Pacific can agree are for the welfare of the great area which is the home of more than half of the human race. Representatives from Pacific lands only and of the League of Nations are invited to these conferences.

The heads of all Pacific Governments are the honorary heads of the Pan-Pacific Union, which itself is a non-official organization. The operating offices have been established in Honolulu.

In 1908 the Hon. Walter F. Frear, then governor of Hawaii, became president of what later became the Pan-Pacific Union. He was followed by Gov. C. J. McCarthy, president of the Union, then by the Hon. Wallace R. Farrington, as governor of Hawaii. There were in 1928 30 trustees of the Union, who were leading men of Pacific nationalities. In many of the Pacific lands Pan-Pacific Associations have been organized, national in scope, as the Union is international. Under the associations are Pan-Pacific clubs in the various cities; these are local. In Japan, Prince I. Tokugawa heads the association and Viscount T. Inouye the Tokyo Pan-Pacific club which is the open forum for international discussion in Japan. There are other Pan-Pacific clubs in Osaka, Kyoto, etc., and in China, as well as elsewhere in Pacific lands.

The Pan-Pacific Union has as its official organ *The Mid-Pacific Magazine*, an illustrated monthly, and publishes the Bulletin of the Pan-Pacific Union monthly (free) as well as the *Journal* of the Pan-Pacific Research Institution and *Pan-Pacific Youth*. It also publishes in book-form the proceedings of the conferences.

(W. R. F.)

PAN-PIPES: *see* SYRINX.

PANPSYCHISM, a philosophical term applied to any theory of nature which recognizes the existence of a psychical element throughout the objective world (Gr. πᾶν, all; ψυχή, soul). In such theories not only animals and plants but even the smallest particles of matter are regarded as having some rudimentary kind of sensation or "soul" which plays the same part in relation to their objective activities or modifications as the soul does in the case of human beings. Such theories are the modern scientific or semi-scientific counterparts of the primitive animism of savage races, and may be compared with the hylozoism of the Greek physicists. In modern times the chief exponents of panpsychist views are Thomas Carlyle, Fechner and Paulsen: a similar idea lay at the root of the physical theories of the Stoics.

PANSLAVISM. The term Panslavism has had very various interpretations. Roughly it may be summarized as the doctrine that all Slavonic peoples should have as large a measure as possible of political solidarity. The first great Panslavist writer was a Croat Catholic priest, Jurij Križanić (b. 1616), who conceived a remarkably broad and liberal programme of Slavonic political unity, and undertaking the life's task of propagating this idea, was trained in Rome as a missionary to Slavonic countries and spent the major part of his later life in Russia, in the reign of Alexis, father of Peter the Great. Križanić, like many of his successors, emphasized the remarkably close kinship between the Slavonic languages.

Language has been almost the sole link between the Slav peoples, and they only had a common history in the period before the consolidation of political states. Slav political unity had been fatally broken by the invasion of the Danubian Plain by the Magyars at the end of the 9th century, introducing a wedge of Asiatic origin between the East, West and South Slavs, which has lasted till to-day. The Tartar invasion of Russia in the 13th century not only arrested the promising growth of Russian culture, but led indirectly to the loss of the Dnieper water-road, which had been the central nerve of the first Russian State of Kiev. This territory now passed to Lithuania which, by the marriage of its prince, Jagailo (Jagellon), with the heiress to the Polish throne in 1386, fell into the orbit of Polish administration and policy. The Poles had accepted Latin Christianity in the 10th century when the Russians accepted the Orthodox form, and this religious difference, coupled with the passing of so much Russian territory under Catholic rule, led to an interminable series of wars between Poland and Russia lasting up to the final partition of Poland in 1795, and, in different conditions, even to 1814. The Hungarian

invasion and the course of events just enumerated between them made almost impossible the creation of a great Slav empire. On the other hand, several of the most eminent statesmen in Russia and Poland saw the evils of this struggle and the blessings which might result from peaceful co-operation. Of these the most distinguished was Ordyn-Nashchokin, the peculiarly modern minded foreign minister of Tsar Alexis, who was himself greatly taken with the same idea. Križanić belonged to a Slavonic people which, like many other smaller Slav units, had fallen under German domination, and he sought the help and co-operation of Alexis definitely as "the Tsar of his own people" against Germans, Turks and all non-Slavs.

Križanić obtained only a very qualified success in Russia, and in fact left behind him little more than a great political ideal Succeeding Russian sovereigns, such as Peter the Great, Anne, Catherine II, and Alexander I., always had this ideal in view as an instrument of political expansion, and frequently their policy was strongly tinged with it, but in their diplomatic relations with Turkey, Austria and Prussia, there were often compromises which seriously restricted its realization Of these compromises the most important was the joint partition of a Slavonic state, Poland, between Russia, Prussia and Austria, initiated by Frederick the Great, and adopted by Catherine II

In the short period while Russia with an autocratic régime and Poland with a constitutional, were united under one sovereign (1815–30), some Russian statesmen showed a great interest in the cause of Slavonic intellectual reciprocity, the movement towards which was greatly advanced by the philological studies of the Czech Dobrovsky and others relating to the period when the Slavs had a common history.

The Slavophils.—Towards the middle of the 19th century as a reaction against the policy of Peter the Great and the wholesale adoption of Western forms and ideas in Russia, arose a group of Russian thinkers known as Slavophils Slavophilism must be very carefully distinguished from Panslavism In the interpretation of its two principal exponents, A. Homyakov and I. Kireyevsky, it cannot be identified with any programme for the political expansion of Russia Both believed that Western civilization had been permanently thrown out of gear by the break which had occurred in the West with the triumph of humanism in the Italian Renaissance and the rupture brought about by the Reformation Homyakov saw in Russia, as a country which had remained intact from this disturbance, elements which offered the promise of a much more healthy and normal development, and Kireyevsky found in the Orthodox Fathers the elements of a creed in which reason and instinct, instead of being in constant conflict, can freely co-operate to form a complete and harmonious human personality. The Slavophil creed, however, was always very vague, and this helped to facilitate its utilisation for political objects

The doctrine of the Slavophils, which found ardent adherents in the *élite* of Russian educated opinion, might easily be perverted into a creed of Russian expansion. The Russian Government never identified itself wholly with this creed but frequently utilized it Its principal exponent in this limited political sense was M Katkov (b. 1821), for many years the powerful and influential editor of the *Moscow Gazette* (1856–87). Katkov had much of the Slavophil in him, but aimed before all things at being the recognized independent exponent of a specifically Russian political opinion. He safeguarded himself effectively from any charge of subservience to Government policy, which he constantly attacked in the most vigorous way, and more or less successfully took up the position of arbiter of patriotic Russian opinion

Modern Thinkers and Writers.—There were others who went much further, notably the Panslavist writer N Danilevsky (1822–85), who in 1869 published his chief work *Russia and Europe*. Danilevsky took no particular interest in the Slavophils, but considered that every Russian should necessarily be a born Panslavist. The principal public critic of his theory was the philosopher Vladimir Solovyev.

Unquestionably the intrusion of Russian dynastic and state interests into the questions raised by Panslavism, tended in many ways to hinder the realization of its ideals It was impossible for the smaller Slavonic countries outside the Russian empire to have any full confidence in Russia during the long period (1831–1915) in which Russian administration in Poland was based on a policy of extinction of the Polish nationality. Thus Poland's subjection to the Russian empire and her geographical situation as next of the Slavonic peoples to Russia, impeded any movement in favour of Panslavism

After the institution of the Russian Duma, 1905, the Czech statesman Kramař promoted, for a time successfully, a movement of co-operation between Slavonic members of the respective parliaments in which the Slav peoples were represented (1908–11). This so-called Neo-Slavophil movement, which was frankly political and relied on democratic representation, received severe rebuffs in the annexation of Bosnia to Austria (1908), and in the fiasco which, by Austrian intervention, terminated the collaboration of Serbia and Bulgaria in the Balkan wars of 1912.

Consequences of the World War.—The World War completely revolutionized the Slavonic question In the other Slavonic countries Communist propaganda had even less success than elsewhere, and Russia's relative withdrawal into Asia and defiance of the accepted principles followed by other governments put an effective end to any Russian leadership in the matter. Meanwhile, in Russia's default, as far as the other Slavonic countries were concerned, the Slavonic question travelled infinitely nearer to a solution than could ever have been dreamed before, but generally on lines adopted by the Western Powers of the Entente, and in particular on the basis of self-determination, which was the main principle adopted at Versailles in the delimitation of the new frontiers. New national states were constituted with far smaller minority elements than had been the case before. Of these new states the majority were republics. This led to a total revision of Slavonic aspirations, many of which were already practically achieved.

On the other hand Slavophilism in its purer form underwent a remarkable revival The theory of Kireyevsky, which saw in the course of Western European history a bankruptcy of humanism, seemed to some remarkable Russian thinkers, such as Berdiayev and Bulgakov, to receive striking confirmation from the present situation in Russia, and these thinkers, calling attention to the historical fact that Byzantine Caesaro-Papism had ended with the fall of Tsardom, reverted to the first Slavophils in the hope of finding bases for deeper social consciousness for Russia

See A Fischel, *Der Panslavismus bis zum Weltkrieg* (1919; bib; good, clear and generally fair account from standpoint of a political opponent); *The Slavonic Review, passim* especially in 1928.

(B. P.)

PANSY or **HEARTSEASE,** a favourite garden flower, one of the oldest in cultivation, belonging to the violet family (Violaceae) It has been grown for so long a period under such diverse conditions and in such a variety of forms that its origin is uncertain The numerous handsome forms, with their striking variations of size and colour, are purely an artificial production of the gardeners and differ in a marked degree from any related wild plant now known. The pansy is generally supposed to be merely a cultivated form of *Viola tricolor* (*see* VIOLET), a weed of European grain fields, while others assert it to be the result of hybridization between *V tricolor* and other species such as *V. altaica* and *V. grandiflora*

The tufted or bedding pansy, called also horned violet, is a cultivated form of *Viola cornuta,* a native of Spain and the Pyrenees mountains It differs from the true pansy in its tufted habit of growth and in the shape and position of its flower parts. The petals, which are obovate in form, do not overlap as in the true pansy, but stand distinctly apart. The spur on the lower petal, instead of being short and rounded, is long, slender and sharp-pointed, whence the name horned violet. There are numerous garden forms varying greatly in colour, ranging from violet to white

Some recent experiments go to show that seeds of the wild *V. tricolor* will produce forms so like those of the cultivated pansy that it is reasonable to assume that that flower has originated from the wild plant by continuous selection. The changes that have been

effected from the wild type are, however, more striking to the eye than really fundamental—increase in size, an alteration in form, by virtue of which the narrow oblong petals are converted into circular ones, and variations in the intensity and distribution of the colour. The modern varieties of the pansy consist of the show varieties, and the fancy varieties, obtained from Belgium, and now much improved. Show varieties are subdivided according to the colour of the flowers into selfs, white grounds and yellow grounds. The fancy or Belgian pansies have various colours blended, and the petals are blotched, streaked or edged. The bedding varieties, known as violas or tufted pansies, have been raised by crossing the pale-blue *Viola cornuta,* and also *V. lutea,* with the show pansies. They are hardier than the true pansies and are free-blooming sorts marked by effectiveness of colour in the mass.

For details of wild forms, *see* G. Drabble, "The British Pansies," *Journal of Botany* (1909–26–27).

PANTAENUS, head of the catechetical school at Alexandria, *c.* A.D. 180–200, known chiefly as having been the master of Clement, who succeeded him, and of Alexander, bishop of Jerusalem. Clement speaks of him as the "Sicilian bee," but of his birth and death nothing is known. Eusebius and Jerome speak of him as having been, originally at least, a Stoic, and as having been sent, on account of his zeal and learning, as a missionary to "India." There is some reason to think that this means the Malabar coast. Only a few brief reminiscences of his teaching are extant. (*See* Routh, *Rel. sac.* i. 375–383.)

PANTALEONI, MAFFEO (1857–1924), Italian economist and politician, was born at Frascati in 1857. After studying in Germany, he returned to Rome and attended the law faculty of the university where he took his degree. In 1902 he was appointed professor of political economy in the University of Rome, a post which he held until his death. His *Pure Economics* (published in 1889, Eng. trans., 1898) was the first organic treatise in which—in accordance with the teaching of Marshall—the doctrines of the classical writers on value were harmonized with the new utility theory of Gossen and Jevons. Pantaleoni was deputy for Macerata in the XI. Legislature, and at first showed some sympathy for socialism of which he afterwards became an uncompromising opponent. On the outbreak of the World War he was an ardent pro-Entente interventionist. After the Armistice he opposed Bolshevism, and was a warm supporter of the Fascist movement, being one of the first senators created by the Fascist government. In 1923 Pantaleoni was appointed Italian delegate on the League of Nations committee for the restoration of Austria's finances, of which he was president. He died in Milan on Oct. 29, 1924.

Pantaleoni's works include: *Teoria della translazione dei tributi* (1882); *Dell' ammontare probabile della ricchezza in Italia* (1885); *Manuale di economia pura* (1889); *Scritti varii di economia; La caduta del Credito Mobizliare; Note in margine alla guerra, Bolscevismo italiano* and *Erotemi di Economia* (1926).

PANTALOON [Ital. *pantalone*], a character in the old Italian popular comedy, said to represent a Venetian, from the favourite Venetian saint San Pantaleone, and transferred from it to pantomime (*q.v.*). The Italian pantaloon was always a silly old man with spectacles and wearing slippers, and his character was maintained in pantomime and has also made his name a synonym for a tottering dotard, as in Shakespeare's *As You Like It* (II. vii. 158). From the Venetian usage the word "pantaloon" (whence "pants") has also been given to certain forms of garment for the legs, the exact meaning varying at different times.

PANTELLERIA, an island in the Mediterranean (ancient *Cossyra*), 62 m. S. by W. of the south-western extremity of Sicily, and 44 m. E. of the African coast, belonging to the Sicilian province of Trapani. Pop. (1921), 9,051. It is entirely of volcanic origin, and about 45 sq.m. in area; the highest point, an extinct crater, is 2,743 ft. above sea-level. Hot mineral springs and ebullitions of steam still testify to the presence of volcanic activity. The island is fertile, but lacks fresh water. The principal town (pop. 6,874) is on the north-west, upon the sole harbour (fit only for small steamers), which is fortified. There is also a penal colony here. Sweet wine and raisins are exported.

On the west coast, 2 m. south-east of the harbour, a neolithic village was situated, with a rampart of small blocks of obsidian, upon the east: within it remains of huts were found, with pottery, tools of obsidian, etc. To the south-east are tombs, known as *sesi*, similar to the *nuraghi* of Sardinia, consisting of round or elliptical towers with sepulchral chambers in them, built of rough blocks of lava. Fifty-seven of them can still be traced. The largest is an ellipse of about 60 by 66 ft., but most of the *sesi* have a diameter of 20–25 ft. only. After a considerable interval, during which the island probably remained uninhabited, the Carthaginians took possession of it, occupying as their acropolis the twin hill of San Marco and Sta. Teresa, 1 m. south of the town of Pantelleria.

The Romans occupied the island in 255 B.C., lost it again the next year, and recovered it in 217 B.C. Under the Empire it served as a place of banishment for prominent persons and members of the imperial family. About 700 the Christian population was annihilated by the Arabs, from whom the island was taken in 1123 by Roger of Sicily. In 1311 a Spanish fleet, under the command of Requesens, won a considerable victory here, and his family became princes of Pantelleria until 1553, when the town was sacked by the Turks.

See Orsi, "Pantelleria" (in *Monumenti dei Lincei* 1899, ix. 193–284).
(T. A.)

PANTHEISM (Gr. πᾶν, neut. of πᾶς, all, every, θεός, God) and its kindred terms are of modern origin. Toland, in 1705, described himself as a Pantheist, and it is commonly said that the word had not been used before. Johnson defines a Pantheist as "one who confounds God with the Universe: a name given to the followers of Spinoza." But once coined, the terms were found convenient to describe much older systems. Thus we find one system called pantheistic because it treats God as "first in rank and not in time," and so implicitly denies creation; another system because it believes, not in "individual substantial souls, but instead in one universal vital sensitive force"; another because it conceives God as "permeating the world like an all-pervading breath" and the human soul as "part of the Deity"; another because instead of creation out of nothing it affirms an infinite eternal substance which rouses itself into action and clothes itself in a multiplicity of forms—forms which in the aggregate make up the Universe and in the end return into the Inscrutable Oneness from whence they came forth.

The use of the term is further illustrated: (1) By the saying of Ritschl that "if we obliterate the limit between God and the world, and thus prefer the pantheistic to the Christian conception, we ignore the Christian principle which treats the individual man as of higher worth than the whole world" (*Rechtfertigung und Versöhnung*, iii. p. 201); (2) by the Roman Catholic argument that Pantheism implies a conception of "emanation from God," or of "evolution in God," which is contrary to His nature (Tanqueray, *Syn. Theol. Dog.*, ii. 423); (3) by the well-known saying of Schopenhauer that a Pantheism which "explains every phenomenon as a theophany" must "also be applied to the most terrible and abominable phenomena."

Definitions.—If, then, we seek for definitions of Pantheism we shall find them variously given. A system may be called pantheistic if it sets value upon the unity of the world, without insisting upon ultimate distinctness of personality either in God or man; if it teaches a single immanent principle—a "life-force" or what not—in such a way as to diminish the importance or independence of individuals; if without a doctrine of creation, it recognizes God as working in natural law generally, or even in any single department of reality. "Where Love is, there God is"; "It is God that mortal should help mortal"; "God is the moral order of the Universe"—even "God is the moral and redemptive order of the world which Christ revealed"—might from some points of view be regarded as pantheistic sentiments.

Thus we must recognize different forms of pantheistic theory. "For Pantheism," it has been said, "God is immanent in the Universe of finite things." In the more popular or easy-going form of it, which has received classical expression in the famous passage of Pope ("Warms in the sun, refreshes in the breeze," etc.), God is a pervading presence. In the profounder forms of

it, as in Spinoza, everything is a fragment or mode of God, is unreal or only relatively real apart from God and finds its reality in God (S. Alexander, *Space, Time and Deity,* ii. 389). No one, it is sometimes said, "should be called a Pantheist unless he regards everything as *equally* a manifestation of God." Such Pantheism is in extreme opposition to Hegelianism—itself sometimes labelled "pantheistic" (Tanqueray, *S.T.D.*, i. 79)—for which appearances are on different and graded levels

Religious Objections.—The common religious objections to Pantheism are based on the fear that it must obliterate moral distinctions; or that it must destroy faith in a God with whom man can hold converse. Yet religion has an obvious interest in the unity which Pantheism affirms. Faith implies that in the Universe at large (through evil overcome) the good is realized in its entirety. On no other basis is complete religious trust possible. For faith, therefore, God cannot be less than the Whole. A God not inclusive of all good is less than perfect. If God, all-inclusive of good, is not also the all-inclusive reality, the Universe is not the realization of the good. A consummate work of any kind is injured as much by addition as by diminution. The objections to Dante's theory that God's self-revelation must leave behind it an "infinite excess of unrevealed good" (*Parad.,* xix. 45) are clear from the context (67–78). God, then, must be thus conceived as just the Good in its full realization. He is not merely an omniscient Being. He must also include all the truth and reality which He knows. He is not merely a Cause whose effect is outside itself. The Christian conception of mankind as within God "in whom all things hold together" (Col. i. 17) is itself a species of Pantheism. The chief problem that remains is to reconcile this all-inclusive unity with the distinction of good from evil and of God from men. (C. J. Sh.)

Philosophy.—In philosophy and theology, pantheism is the theory that "God is all, and all is God." The Universe is not a creation distinct from God, nor merely a part of God; neither is God outside the universe, or transcendental, nor is He merely a part, or an immanent aspect, of the universe. God is the Universe, and the Universe is God. Finite minds and finite things, all the objects of ordinary human experience are only modes, modifications, or fragments of God, who is so much more than any of them or the mere sum of all of them. Such, briefly, is the meaning of Pantheism. It must be remembered, however, that Pantheism is not merely an abstract theory, but a total attitude, a religion, and the attitude may be there in the form of a religious sentiment, or in the form of a poet's feeling for Nature, and yet may not attain to anything so articulate as an explicit, reasoned philosophy. It is likely enough that with most of the pantheists past and present pantheism has been little more than a vague intuition and an inarticulate mood.

The classical exponent of the philosophy of pantheism was Spinoza. But pantheism is very old and international. It is found in ancient India, perhaps 1000 B.C., in the identification of *Brahman* with the universe. In Egypt also it is met with quite early in the successive identifications of *Ra, Isis* and *Osiris,* with everything that exists. According to Plutarch the temple of *Isis* bore the inscription: "I am all that hath been, is, or shall be; and no mortal has lifted my veil." Among the Greeks there were pantheistic philosophers from the 6th century B.C. onwards. The best known of them are Xenophanes, Parmenides, Heraclitus, and Cleanthes the Stoic, whose hymn to Zeus is one of the beauties of pantheistic poetry. During the Middle Ages a pantheistic strain is observable in Neoplatonism, and in some representatives of all the historic religions. Christianity is represented by John Scotus Erigena (9th century) and David of Dinant (12th century) among others. Islam had its great pantheist in Averroes, or Ibn Roschd (12th century). Judaism had its pantheistic Kabbalists. The Revival of Learning during the 14th, 15th and 16th centuries brought with it a more sympathetic attitude towards Nature, more like that of the Greeks and of the Hebrew nature poets than that which had found expression in the familiar quotation which linked together "the world, the flesh and the devil." The most famous of the pantheists of this period of the Renaissance was Giordano Bruno, who perished at the stake in 1600, by order of the Inquisition. There followed Spinoza, and later John Toland, the first to introduce the term "pantheist," in 1705. Until near the end of the 18th century there was little inducement to profess pantheism even if one embraced it. "Pantheism" was used as a synonym of "atheism" and applied as a term of abuse. But from then on one meets with renowned names in the chronicles of pantheism—the poets Lessing and Goethe, the philosophers Fichte, Schelling and Hegel, and even Christian theologians like Schleiermacher and Strauss.

The question of "personality" has always been one of the chief objections urged by opponents of pantheism. And that in two ways. On the one hand, the idea of a God who is not personal, towards whom they cannot feel as children towards their Father, leaves them rather cold and disconsolate. On the other hand, they cannot relish the thought that human beings are not permanent or eternal personalities. On both these points, omitting altogether the more childish and cruder forms of the claims implied in these objections, there has been much misunderstanding. What pantheism really objects to is the conception of God as though He were a big man. Human personality is largely the result of limitations and deficiencies such as cannot be attributed to the Infinite. There must be something as infinitely superior to human personality as human personality is superior to the unity of a grain of sand. If one insists on speaking of divine "personality" this must be conceived as differently from human personality "as the heavens are high above the earth." And then the term really loses its ordinary meaning, as Spinoza insisted in another connection. What alarms some people is probably the assumption that to say that God is not "personal" is to say that He is less than that; but that, of course, is an absurd misinterpretation of a view which insists on the incomparable superiority of the infinite to the finite. With regard to the second point, the anxiety to be reassured about human immortality or the perpetuation of human personality, on this point, too, there has been much misunderstanding. Pantheism, it is true, does not exactly encourage anything like a belief in personal resurrection. But it does leave room for the kind of immortality which can be accepted or desired by people who think and are not vain.

Goethe in his poem "One and All" expressed the thought that to lose oneself in the Infinite is *the* way to find oneself. Many lesser men have felt that to identify oneself with some great cause is the worthiest kind of immortality. And, on the other hand, some of those who have achieved most have readily attributed the credit for their achievements to a greater power working through them.

As Spinoza was the great philosopher of pantheism so Goethe was its great poet. Strains more or less pantheistic may, of course, be found in all the great nature poets from some of the Psalmists to Wordsworth, just as a more or less pantheistic mood is to be found in many of the religious mystics. But Goethe's pantheism was partly at least the fruit of a close study of Spinoza's philosophy. It was both "Truth and Poetry" with him. The great systems of philosophy are all akin to great poetic creations. Plato already described philosophy as the highest kind of poetry. This is perhaps especially true of pantheistic philosophy. And what the student of pantheistic philosophy needs above all is "a heart that understands." In this respect the poetry of Wordsworth and, even more so, that of Goethe may be found most helpful and illuminating, at least as an introduction to the proper study of pantheism as a rational philosophy.

See METAPHYSICS, MONISM, SPINOZA, and the articles on the other subjects and persons named.

See also J. A. Picton, *Pantheism* (1914) and *The Religion of the Universe* (1904); J. Hunt, *An Essay on Pantheism* (1893); C. E. Plumptre, *The History of Pantheism* (1878). (A. Wo.)

PANTHEON, a building for the worship of all the gods revered in a certain locality; hence a building where many famous men are buried, or a structure built to commemorate a number of national heroes. The most famous example of this usage is that of the pantheon at Regensburg, sometimes known as the Valhalla, erected by Ludwig I. of Bavaria, in memory of German heroes.

More specifically, pantheon is the name of two famous buildings, one in Rome and one in Paris. The Roman pantheon was

begun by Agrippa in 27 B.C., probably as a rectangular building of ordinary temple type. It was completely rebuilt by Hadrian, in its present circular form (110–125), the columns of the present front porch being probably those of the earlier building. Under Septimus Severus repairs and alterations were made; it is likely that at this time the rectangular coffers were cut on the inside face of the dome. The Roman pantheon is remarkable, not only for its size, the dome being 144 ft. in diameter, and for its elaborate brick construction, but also for its perfect preservation and the fact that for almost 2,000 years it has served continuously as a place of worship, having been dedicated in A.D. 609 as the church of S. Maria Rotunda. The gilt bronze tiles that once covered the dome were stripped off and carried to Constantinople at an early date, and in the 17th century the bronze trusses and girders which carried the portico roof were melted and used to make Bernini's baldachino in S. Peter's at Rome. The present stucco panels and pilasters that circle the interior above the order cornice and below the spring of the dome are of late Renaissance date, and the bronze rosettes and mouldings that once decorated the coffers have disappeared. Otherwise, the interior of the building exists in its exquisite original form.

The pantheon at Paris was begun in 1764 by Soufflot as the church of S. Genevieve. This was secularized under the Revolution and then received its present name—*panthéon*. It served as a church, also, from 1828–30 and from 1851–70. The panthéon at Paris bears little resemblance to the Roman example. It is a cruciform building with a high triple dome over the crossing and the four arms vaulted with lower saucer domes on pendentives.

PANTHER, another name for the leopard (*q.v.*), also used in America as the name of the puma (*q.v.*). The panther was formerly supposed to be a distinct animal from the *pardus*, pard, the leopard. In modern times a distinction had been unscientifically drawn between a larger type of leopard to which the name panther was given, and a smaller and more graceful specimen.

PANTIN, a suburb 6 kilometres north-east of Notre Dame de Paris in the department of Seine, on the Canal d'Ourcq. Pop. (1926) 39,080. It manufactures boilers, wagons, machinery, pianos, oil, glass, chemicals, chocolates, polish, perfumery and tobacco. There are also dye-works, foundries and distilleries.

PANTOGRAPH: *see* MATHEMATICAL INSTRUMENTS; LINKAGES.

PANTOMIME, the representation of emotions, action and various situations entirely by body movement, gesture and steps. It occurs in all primitive stages of civilization, expressing itself in war-dances, animal mimicry and sacrificial rites, and in Indian and Egyptian civilization it had already developed artistic forms. The Greeks sometimes employed choruses to accompany their pantomimes. The Romans, especially, cultivated pantomime, and in the time of the empire they even had a special school for its development. They distinguished the various characters in the pantomime by means of masks. They also employed scenic effects, resulting in dramatic action presented in the manner of the theatre. In Roman usage the term was applied both to the actor of this kind of play and to the play itself; less logically, we also use the term to signify the method of the actor when confined to gesticulation. Historically speaking, so far as the Western drama is concerned there is no intrinsic difference between the Roman *pantomimus* and the modern "ballet of action," except that the latter is accompanied by instrumental music only, and that the personages appearing in it are not usually masked. The English "dumb-show," though fulfilling a special purpose of its own, was likewise in the true sense of the word pantomimic. The modern pantomime, as the word is still used, more especially in connection with the English stage, signifies a dramatic entertainment in which the action is carried on with the help of spectacle, music and dancing, and in which the performance of that action or of its adjuncts is conducted by certain conventional characters, originally derived from Italian "masked comedy."

Later Development.—The religious mystery plays of the middle ages again show traces of the old pantomime—as a later development came the *commedia dell' arte* (*q.v.*) introducing the popular figures of Harlequin (*q.v.*), the clown, Truffaldino, etc.—in which song and dance alternated with improvised jests. Plays of this nature written round the traditional *Hanswurst* enjoyed the greatest popularity in Germany and especially in Vienna, until well into the 19th century.

In Germany, where the term pantomime was not used, a rude form of dramatic buffoonery, corresponding to the coarser sides of the modern English species so-called, long flourished, and threw back for centuries the progress of the regular drama. The banishment of *Hanswurst* from the German stage was formally proclaimed by the famous actress Caroline Neuber at Leipzig in a play composed for the purpose in 1737. After being at last suppressed, it found a commendable substitute in the modern *Zauberposse*, the more genial Vienna counterpart of the Paris *féerie* and the modern English extravaganza.

About 1723, this type of entertainment gained a firm footing in England, where the harlequinade, *Dr. Faustus*, was given at Drury Lane, and was followed by many similar plays. Besides, this pantomime form, consisting solely of a series of dances with musical accompaniment, continued to hold its own. These were known as "ballets" or ballet (*q.v.*) and reached their highest development under Jean Georges Noverre (*q.v.*) who, in the 18th century, introduced the same reforms into the art of dancing which C. W. Gluck had introduced into music. He composed elaborate dance-dramas, in which wide use was made of emotional situations. He attempted to restore pantomime proper to the stage as an independent species, by treating mythological subjects seriously in artificial ballets. This attempt, which of course could not prove permanently successful, met in England also with great applause. Noverre's pantomime or ballet *Cupid and Psyche* is commended as of very extraordinary merit in the choice and execution of the subject. It seems to have been without words. The writer of the tract states that "very lately the serious pantomime has made a new advance in this country, and has gained establishment in an English theatre"; but he leaves it an open question whether the grand ballet of *Medea and Jason* (apparently produced a few years earlier, for a burlesque on the subject came out in 1781) was the first complete performance of the kind produced in England. He also notes *The Death of Captain Cook*, adapted from the Parisian stage, as possessing considerable dramatic merit, and exhibiting "a pleasing picture of savage customs and manners."

Recent Revival.—In the 19th century the pantomime very nearly disappeared from the stage owing to the decline in the art of the ballet. It is gratifying to observe that the "new dance" which is being developed mainly in Germany, under the leadership of Rudolf von Laban and Mary Wigman, has revived the art of the pantomime. The new dance-drama (*neue Tanzbühne*) founded and directed by Hanns Niedecken-Gebhard has as its main object the cultivation of pantomime in opera. Under the choreographic direction of Kurt Joss and Jens Keith, it has produced the fantasy *Die Brautfahrt* and the *Tanztragödie* and applied Mozart's music for Noverre's *Les Petits Riens* to a new form of ballet production. At the Berlin opera house the ballet master, Max Terpis, has produced a series of pantomimes on a more important scale. The work at Hanover of the ballet master, Mme. Yvonne Georgi, deserves special notice; in collaboration with Harald Kreutzberg, she has produced remarkable dances which consciously combine stage-craft and the medium of expression provided by the art of the modern theatre. The ballets by Diaghileff, with their combination of the old art of the ballet and the new expressionist dance, are also striking representations of the real pantomime dance.

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Account of the English Stage (10 vol. Bath, 1832), especially vol. iii.; Dibdin, *Complete History of the Stage* (5 vol. London, 1800), especially vol. ii., iv. and v.; *Apology for the Life of Colley Cibber*, ed. R. W. Lowe (2 vol. London, 1889); P. Fitzgerald, *Life of Garrick* (2 vol. London, 1868); R. J. Broadbent, *A History of Pantomime* (1901); O. Bie, *Der Tanz* (1905); H. Niedecken, *Jean Georges Noverre, Sein Leben und seine;* A. Levinson, *J. G. Noverre, Lettres sur la danse* (1927). (H. Kr.)

PANTOPODA, an alternative name for the Pycnogonida (*q.v.*), an aberrant group of arthropods, perhaps related to the Arachnida (*q.v.*).

PANTUN, a quatrain in Malay literature, generally a riddle or puzzle-verse where the third and fourth lines pose a problem or carry a surprise. The first and third and the second and fourth lines rhyme, but there is often a species of alliteration accompanied by internal rhymes. The *pantun* is used almost as a proverb.

In imitation of the Malay quatrain, Victor Hugo, in *Les Orientales* (1829), used the *pantoum* and set a fashion which was followed by Théodore de Banville and Leconte de Lisle. In English the best example of *pantoum* is Austin Dobson's *In Town*

See R. J. Wilkinson and R O. Winstedt *Pantun Melayu* (1914); O. T. Dussek, *Teka-Teki* (1918).

PAN-TURANIANISM. In the Persian epic *Turan* means the steppes and deserts of Central Asia, in contrast to the cultivated country of *Iran* or Persia. The people of Turan were the nomads who had constantly overrun Persia from the north-east, and who belonged linguistically to the peoples speaking the so-called agglutinative languages The word Turanian was coined by modern European philologists to cover this agglutinative group

Turanian researches were first taken up seriously by the Magyars of Hungary, and this for two reasons. The first reason was that the Magyar language belongs to the Ugro-Finnic branch of the agglutinative group The second motive was political. During the half-century before the World War, the Hungarian statesmen were on the look-out for allies against the Pan-Slav movement, and seized on the fact that Turkish also was a Turanian language (though of a different branch from Hungarian), in order to commend to the Turks the idea of a Magyar-Turkish entente against the Slavs, a supposed linguistic kinship being assumed to imply a common racial origin The Turks however translated Pan-Turanianism into Pan-Turkism, that is, into the narrower idea of a brotherhood between all peoples speaking Turkish dialects, with an insistence upon the aboriginal Turkish element in their own Osmanli language and culture. But the Ottoman Turks felt vividly their solidarity with the whole Muslim world. Thus the leaders of the Committee of Union and Progress always tried to run Pan-Islamism and Pan-Turkism in double harness. It is only since the rise of a new Turkish national movement in 1919 that the Turks have consciously and completely abandoned the Islamic basis of the Turkish state, and have constructed a Turkish republic on exclusively national foundations. Meanwhile, Mustafa Kemal Pasha and his party have thrown over the other side of the original movement, which insisted not merely upon Turkifying the Ottoman state, but on re-creating the links between the Ottoman Turks and other Turkish peoples

It is worthy of note, that the 15,000,000 or 16,000,000 Turks of the Union of Socialist Soviet Republics have been given a far-reaching political autonomy within the framework of the Union, which they never enjoyed under the Tsardom. Of the six republics constituting the Union two, namely the Turkmen and the Uzbeg Republic, are Turkish. Again, one of the three members of the Trans-Caucasian Republic (which itself is a member of the Union) is the Turkish Republic of Azerbaijan. Finally, within the Russian Socialist Federal Soviet Republic, which is the leading member of the Soviet Union, there are a number of autonomous Turkish units, such as the Tatar Republic, the Bashkir Republic. the Kirghiz Republic, the Karakalpak autonomous district, and several other less important territories like the Yakutsk Republic in the far north-east of Siberia.

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PANYASIS (more correctly, Panyassis), of Halicarnassus, Greek epic poet, uncle or cousin of Herodotus, flourished about 470 B.C. He was put to death by the tyrant Lygdamis (*c.* 454). His chief poems were the *Heracleias* in 14 books, describing the adventures of Heracles in various parts of the world, and the *Ionica* in elegiacs, giving an account of the founding and settlement of the Ionic colonies in Asia Minor. Although not much esteemed in his own time, some later critics assigned him the next place to Homer (*see* Quintilian, *Inst orat* x. i. 54).

Fragments in G., Kinkel, *Epic poet. fragmenta* (1877), ed separately by J P. Tzschirner (1842); F P Funcke, *De Panyasidis vita* (1837); R Krausse, *De Panyasside* (1891).

PAOLI, CESARE (1840–1902), Italian historian and palaeographer, son of senator Baldassare Paoli, was born and educated in Florence In 1874 he was appointed first professor of palaeography and diplomatics at the Istituto di Studii Superiori in Florence, where he continued to work at the interpretation of mss. In 1887 he became editor of the *Archivio storico italiano*

See C. Lupi, "Cesare Paoli," in the *Archivio storico italiano,* vol. xxix. (1902), with a complete list of his works.

PAOLI, PASQUALE (1725–1807), Corsican general and patriot, was born at Stretta in the parish of Rostino He was the son of Giacinto Paoli, who had led the Corsican rebels against Genoese tyranny. Pasquale followed his father into exile, studied at Naples under the reformer Genovese, and entered the Neapolitan army, serving with distinction as a cavalry officer; on his return to Corsica in 1755, he was chosen commander-in-chief of the rebellion against Genoese rule. After a series of brilliant actions he drove the Genoese from the whole island except a few coast towns From 1757 to 1768 he was the head of the Corsican Government; he completely reorganized the administration, introduced many useful reforms and founded a university at Corte In 1764 Genoa concluded a treaty with France, whereby 3,000 French soldiers were sent to assist the Genoese to hold the fortresses, but only for defensive purposes. Paoli continued the struggle, wrested the island of Capraia from the Genoese and captured the towns where there were no French troops, as the Corsican revolutionaries did not consider themselves at war with France But in May 1768 Genoa, despairing of ever being able to subjugate the island, sold it to France, and the French forces in the island were at once greatly increased Paoli now fought against the French, whom he defeated in many hard-fought battles But with the further increase of the French forces the Corsican resistance gradually broke down, until in May 1769 Paoli had to abandon Corte, the capital, and to take refuge in England During his sojourn in London he enjoyed wide popularity, and was the friend of many celebrities, including Dr. Johnson On the outbreak of the French Revolution the Government allowed the Corsican exiles to return, and after visiting Paris, Paoli landed at Bastia in Jan 1791, with the rank of lieutenant-general and governor of Corsica He resumed his work of reform and development, enjoying wide popularity, and when the republic replaced the monarchy in France he was confirmed in his appointment But he had enemies in Corsica itself, who accused him of reactionary sentiments and of responsibility for the defeat of the French expedition to Sardinia He was deprived of his command by the Convention, and a commission was sent to the island to hold an enquiry on his conduct. The commissioners set up a government of their own, side by side with that of Paoli, who was supported by the majority of the islanders. Anarchy ensued, and in July 1793, Paoli was outlawed A civil war broke out between Paoli and his followers, assisted by British forces, and the Republicans, assisted by the French The latter were finally defeated and the French forced to surrender; a *consulta* at Corte decided to place the island under British protection and drew up a constitution, and although Paoli was not too favourable to the British protectorate, he ended by accepting it The British Government, instead of appointing Paoli viceroy, as had been expected, appointed Gen Sir Gilbert Elliot, who relied upon another Corsican, Pozzo di Borgo, rather than on Paoli, and eventually got Paoli out of Corsica by having him summoned to London, where he went in 1795 This created a good deal of ill feeling, and rebellions broke out all over the island;

the movement received support from the French, and the British were driven out. Paoli again had a very cordial reception in London and was awarded a pension from the British Government. He died in London on Feb. 5, 1807.

See Boswell's *Life of Johnson* and his *Account of Corsica and Memoirs of P. Paoli* (1768); N. Tommaseo, "Lettere di Pasquale de Paoli" (in *Archivio storico italiano,* 1st series, vol xi.), and *Della Corsica,* etc. (*ibid.,* nuova serie, vol. xi., parte ii.); Pompei, *De l'état de la Corse* (1821); Comte de Buttafuoco, *Fragments pour servir à l'histoire de la Corse de 1764 à 1769* (Bastia, 1859); Giovanni Livi, "Lettere inedite di Pasquale Paoli" (in *Arch. stor. ital.,* 5th series, vols. v. and vi.); and Lencisa, *P. Paoli e la guerra d'indipendenza della Corsica* (1890); Bartoli, *Historia di Pascal Paoli* (Bastia, 1891).

PAOLO VERONESE (1528–1588), the name given to Paolo Caliari or Cagliari, Italian painter of the Veronese and Venetian schools, who was born in Verona in 1528. His father, Gabriele Caliari, was one of a family of stone-carvers come to Verona from Bissone on the Lake of Lugano. Paolo was at first trained as a stone-carver, but soon took to painting. He worked under Antonio Badile, a painter of small ability who cannot have helped him much. Vasari states that Paolo then became the pupil of Giovanni Caroto, a distinguished architect and archaeologist as well as a painter, but there seems to be no stylistic connection between them. Other Veronese artists such as Domenico Brusasorci and the Farinati probably influenced his development. "The Holy Family and St. John," in the Cannon collection at Fiesole, is an example of his early style. It is essentially Veronese, simple, solid, sincere; the inimitable brilliance of the flesh tones and the space arrangement presage the later and more accomplished work of his Venetian period. In the spring of 1552 Cardinal Ercole Gonzaga commissioned Paolo and three other Veronese painters, Battista del Moro, Paolo Farinato, and Domenico Brusasorci to paint a series of altarpieces for the cathedral at Mantua. Paolo's altarpiece, "The Temptation of St. Anthony," has recently been identified with a picture in the museum at Caen. At this early period he also worked in several country places with his fellow townsman, Battista Zelotti, on large decorations of churches and palaces. Some of this work is still to be seen in the church of Castelfranco. The frescoes of ladies standing behind a balustrade in the Villa Giacomelli at Maser, though much restored, are good examples of this decorative type of work. In 1555 we find Paolo settled in Venice, but it is now thought that he worked in Venice even before that date, and that he executed the paintings for the Sala del Consiglio dei Dieci with "Jupiter Thrusting Thunderbolts" (Louvre) about the year 1554. Among his earliest work in Venice are the paintings in the sacristy and the church of S. Sebastian, where an uncle of his was prior of the monastery. In 1556 he was asked to paint three tondi with allegorical subjects for the library of St. Mark's. Six other painters were employed on similar tasks, but Paolo's work was generally recognized as the best, and he was tendered a golden chain as an honorary distinction. It is doubtful whether Paolo ever visited Rome. Ridolfi states that he went there in the company of Girolamo Grimani, the Venetian ambassador, whose journey took place about 1560. On June 6, 1562, he received the commission for "The Marriage at Cana" for the refectory of S. Giorgio in Venice. This gigantic and stupendous picture, containing some hundred figures and heads, several of them portraits, was completed in 1563. It was one of the treasures taken to France by the armies of the Revolution, and it was placed in the Salon Carré in the Louvre, where it remains; its great size and the difficulty of moving it served as an excuse for retaining it, when, in 1815, other pictures had to be returned. In 1566 Paolo went to Verona, where he had a commission to paint in his own parish church, and there married the daughter of his former master, Badile. In 1573 he painted another great banquet scene—"The Feast of Levi"—for the refectory of S. Giovani e Paolo in Venice—but he had to appear before the tribunal of the Inquisition to explain that the dwarfs and fools and other figures introduced for decorative effect meant no disparagement to religion. In 1575 he painted "The Martyrdom of St. Giustina" at Padua. Meanwhile, fires had destroyed several rooms in the doge's palace and Paolo was called in to make good the damage. In the Sala del Collegio he painted the "Commemoration of the Battle of Lepanto." For the rich ceiling designed by Ant. del Ponte he painted a "Glorification of Venice," and for the ceiling of the Sala del Gran Consiglio he painted the "Triumph of Venice."

The qualities that strike one in Paolo's works are their splendour and spaciousness. He was eminent as a decorator of large architectural spaces, and supreme in representing numerous figures in a luminous and diffused atmosphere, while in richness of contemporary costumes he surpassed all other Venetians. The colour effects are orchestral in richness and variety; and his silvery tone, obtained by the juxtaposition of warm and cold hues, is essentially Veronese, and differentiates his best works from the golden lustre of Titian. Paolo Veronese died in Venice on April 19, 1588. He was buried in the church of S. Sebastiano and his bust, by Camillo Bozzetti, was placed over his grave by his brother and his sons. In his workshops in Venice he employed many assistants, among whom were his relatives, notably his brother Benedetto (1538–1598), his nephew Alvise Benfatto (1544–1609), and his two sons Gabriele (1568–1631), and Carlo, known as Carletto (1570–1596). Certain pictures executed after Paolo's death, those for instance in the doge's palace, are signed Heredes Paoli.

It is impossible to enumerate all the great works of this prolific master. Among his most celebrated works are: "The Family of Darius at the Feet of Alexander," in which the principal figures are portraits of the Pisani family—in the National Gallery, London. Here the master displays his great gift of portraiture, and his gift of combining in groups the members of some patrician family as taking part in some historical event. The Dresden gallery has some fine examples: "The Madonna of the Cuccina Family," the "Adoration of the Magi" and "The Marriage at Cana." In the Louvre is the "Feast in the House of Simon the Pharisee," painted for the Servites in Venice (1570–78); the Venetian academy has some of the finest works of the master: "The Marriage of St. Catherine," painted for the church of St. Caterina, and "Ceres and Venice," a ceiling painting from the doge's palace, besides the "Feast in the House of Levi."

See C. Ridolfi, *Le Maraviglie dell Arte* (edit. D. v. Hadelm, 1914); Dal Pozzo, *Vite de pittori Veronesi;* Zanetti, *Della pittura Veneziana;* P. Caliari, *Paolo Veronese* (Verona, 1888); A. Bell, *Paolo Veronese* (1904); Giuseppe Fiocco, *Paolo Veronese* (Bologna, 1928).

(I. A. R.)

PAOTOU. The present terminus of the Chinese Government railway (Peking-Suiyuan railway) west of Peking. It stands near the Hoangho, at some distance before the river bends southward between the Ordos plateau and Shansi. It is an important trading and distributing centre for Mongolian products.

PAPACY, the name most commonly applied to the office and position of the bishop or pope of Rome, in respect both of the ecclesiastical and temporal authority claimed by him, *i.e.,* as successor of St. Peter and Vicar of Christ, over the Catholic Church, and as sovereign of the former papal states. The word is formed from Lat. *papa,* pope, on the analogy of "abbacy." The present article is a general history in outline of the papacy itself. Special periods or aspects are dealt with in fuller detail elsewhere, *e.g.,* in the biographical notices of the various popes, or in such articles as CHURCH HISTORY; ROMAN CATHOLIC CHURCH; INVESTITURES; CANON LAW; ECCLESIASTICAL JURISDICTION; ULTRAMONTANISM, etc.

I. FROM THE ORIGINS TO 1087

Primitive Roman Church.—The Christian community at Rome, founded, apparently, in the time of the emperor Claudius (41–54), at once assumed great importance, as is clearly attested by the Epistle to the Romans (58). It received later the visit of Paul while a prisoner, and, according to a tradition which is now but little disputed, that of the apostle Peter. Peter died there, in 64, without doubt, among the Christians whom Nero had put to death as guilty of the burning of Rome. Paul's career was also terminated at Rome by martyrdom. Other places had been honoured by the presence and preaching of these great leaders of new-born Christianity; but it is at Rome that they had borne witness to the gospel by the shedding of their blood;

there they were buried, and their tombs were known and honoured. These facts rendered the Roman Church in the highest degree sacred. About the time that Peter and Paul died in Rome the primitive centre of Christianity—that is to say, Jerusalem—was disappearing amidst the disaster of the war of the Roman empire with the Jews. Moreover, the Church of Jerusalem, narrowed by Jewish Christian particularism, was hardly qualified to remain the metropolis of Christianity, which was gradually gaining ground in the Graeco-Roman world. The true centre of this world was the capital of the empire; the transference was consequently accepted as natural at an early date. The idea that the Roman Church is at the head of the other Churches, and has towards them certain duties consequent on this position, is expressed in various ways, with more or less clearness, in writings such as those of Clemens Romanus, Ignatius of Antioch and Hermas. In the 2nd century all Christendom flocked to Rome; there was a constant stream of people—bishops from distant parts, apologists or heresiarchs. All that was done or taught in Rome was immediately echoed through all the other Churches; Irenaeus and Tertullian constantly lay stress upon the tradition of the Roman Church, which in those very early days was almost without rivals, save in Asia, where there were a number of flourishing churches, also apostolic in origin, forming a compact group and conscious of their dignity. The great reception given to Polycarp on his visit to Rome in A.D. 155 and the attitude of St. Irenaeus show that on the whole the traditions of Rome and of Asia harmonized quite well. They came into conflict, however (*c.* A.D. 190), on the question of the celebration of the festival of Easter. The bishop of Rome, Victor, desired his colleagues in the various parts of the Empire to form themselves into councils to inquire into this matter. The invitation was accepted by all; and, the consultation resulting in favour of the Roman usage, Victor thought fit to exclude the recalcitrant Churches of Asia from the Catholic communion. His conduct in this dispute, though its severity may have been open to criticism[1] indicates a very definite conception on his part of his authority over the universal Church. In the 3rd century the same position was maintained, and the heads of the Roman Church continued to speak with the greatest authority. We find cases of their intervention in the ecclesiastical affairs of Alexandria, of the East, of Africa, Gaul and Spain. Though the manner in which they wielded their authority sometimes meets with criticism (Irenaeus, Cyprian, Firmilianus), the principle of it is never questioned. However, as time went on, certain Churches became powerful centres of Christianity, and even when they did not come into conflict with her, their very existence tended to diminish the prestige of the Roman Church.

Centrifugal Forces in the Catholic Church.—After the period of the persecutions had passed by, the great ecclesiastical capitals Carthage, Alexandria, Antioch and Constantinople, as secondary centres of organization and administration, drew to themselves and kept in their hands a share in ecclesiastical affairs. It was only under quite exceptional circumstances that any need was felt for oecumenical decisions. Further, the direction of affairs, both ordinary and extraordinary, tended to pass from the bishops to the state, which was now christianized. The Eastern Church had soon *de facto* as its head the Eastern emperors. Henceforth it receded more and more from the influence of the Roman Church, and this centrifugal movement was greatly helped by the fact that the Roman Church, having ceased to know the Greek language, found herself practically excluded from the world of Greek Christianity.

In the West also centrifugal forces made themselves felt. After Cyprian the African episcopate, in proportion as it perfected its organization, seemed to feel less and less the need for close relations with the apostolic see. In the 4th century the Donatist party was in open schism; the orthodox party had the upper hand in the time of Aurelius and Augustine; the regular meeting of the councils further increased the corporate cohesion of the African episcopal body. From them sprang a code of ecclesiastical laws and a whole judicial organization. With this organization, under the popes Zosimus, Boniface and Celestine the Roman Church came into conflict on somewhat trivial grounds, and was, on the whole, being worsted in the struggle, when the Vandal invasion of Africa took place, and for nearly a century to come the Catholic communities were subjected to very hard treatment.

During the 4th century it is to be noticed that, generally speaking, the Roman Church played a comparatively insignificant part in the West. From the time of popes Damasus and Siricius various affairs were referred to Rome from Africa, Spain or Gaul. The popes were asked to give decisions, and in answer to those demands drew up their first decretals. However, side by side with the Roman see was that of Milan, which was also the capital of the Western empire. From time to time it seemed as if Milan would become to Rome what Constantinople was to Alexandria. However, any danger that menaced the prestige of Rome disappeared when the emperor Honorius removed the imperial residence to Ravenna, and still more so when the Western emperors were replaced in the north of Italy by barbarian sovereigns, who were Arians.

In Spain, Gaul, Brittany and the provinces of the Danube, similar political changes took place. When orthodox Christianity had gained the upper hand beyond the Alps and the Pyrenees, the episcopate of those countries grouped itself, as it had done in the East, around the sovereigns. In Spain was produced a fairly strong religious centralization around the Visigothic king and the metropolitan of Toledo. In Gaul there was no chief metropolitan; but the king's court became, even sooner than that of Spain, the centre of episcopal affairs. The Britons and Irish, whose remoteness made them free from restriction, developed still more decided individuality. In short, the workings of all the Western episcopates, from Africa to the ocean, the Rhine and the Danube, lay outside the ordinary influence of the Roman see. All of them, even down to the metropolitan sees of Milan and Aquileia, practised a certain degree of autonomy, and in the 6th century this developed into what is called the Schism of the Three Chapters. With the exception of this schism, these episcopates were by no means in opposition to the Holy See. They always kept up relations of some kind, especially by means of pilgrimages, and it was admitted that in any disputes which might arise with the Eastern Church the pope had the right to speak as representative of the whole of the Western Church.

Rome and Constantinople.—This was the situation when St. Gregory was elected pope in 590. We may add that in peninsular Italy, which was most clearly under his ecclesiastical jurisdiction, the Lombards had spread havoc and ruin; so that nearly 90 bishoprics had been suppressed, either temporarily or definitively. The pope could act directly only on the bishoprics of the coast districts or the islands. Beyond this limited circle he had to act by means of diplomatic channels, through the governments of the Lombards, Franks and Visigoths. On the Byzantine side his hands were less tied; but here he had to reckon with the theory of the five patriarchates which had been a force since Justinian. According to Byzantine ideas, the Church was governed—under the supreme authority, of course, of the emperor—by the five patriarchs of Rome, Constantinople, Alexandria, Antioch and Jerusalem. Rome had for a long time opposed this division, but, since some kind of division was necessary, had put forward the idea of the three sees of St. Peter—Rome, Alexandria and Antioch—those of Constantinople and Jerusalem being set aside, as resulting from later usurpations. But the last named were just the most important; in fact the only ones which counted at all, since the monophysite secession had reduced the number of the orthodox in Syria and Egypt practically to nothing. This dissidence Islam was to complete, and by actually suppressing the patriarchate of Jerusalem to reduce Byzantine Christendom to the two patriarchates of Rome and Constantinople.

There was no comparison between the two from the point of view of the East. The new Rome, where the emperor reigned, prevailed over the old, which was practically abandoned to the

[1] Victor's conduct in this matter was not approved by a number of bishops (including Irenaeus), who protested against it (ἀντιπαρακελεύονται) in the interests of peace and Christian love (Eusebius, *Hist. eccl.* v. 24).—[ED.]

barbarians. She was still by courtesy given the precedence, but that was all; the council in Trullo (692) even claimed to impose reforms on her. When Rome, abandoned by the distant emperors, was placed under the protection of the Franks (754), relations between her and the Greek Church became gradually more rare, the chief occasions being the question of the images in the 8th century, the quarrel between Photius and Ignatius in the 9th, the affairs of the four marriages of the emperor Leo VI. and of the patriarch Theophylact in the 10th. On these different occasions the pope, ignored in ordinary times, was made use of by the Byzantine government to ratify measures which it had found necessary to adopt in opposition to the Greek episcopate.

These relations were obviously very different from those which had been observed originally, and it would be an injustice to the Roman Church to take them as typical of her relations with other Christian bodies. She had done all she could to defend her former position. Towards the end of the 4th century, when southern Illyricum (Macedonia, Greece, Crete) was passing under the authority of the Eastern emperor, she tried to keep it within her ecclesiastical obedience by creating the vicariate of Thessalonica. Pope Zosimus (417) made trial of a similar organization in the hope of attaching the churches of the Gauls more closely to himself. He also vainly struggled against the autonomy of Africa.

Gregory the Great, 590–604.—It was Gregory I. who, though with no premeditated intention, was the first to break this circle of autonomous or dissident Churches which was restricting the influences of the apostolic see. As the result of the missions sent to England by him and his successors there arose a church which, in spite of certain Irish elements, was and remained Roman in origin, and, above all, spirit and tendency. In it the traditions of old culture and religious learning imported from Rome, where they had almost ceased to bear any fruit, found a new soil, in which they flourished. Theodore, Wilfrid, Benedict Biscop, Bede, Boniface, Ecgbert, Alcuin, revived the fire of learning, which was almost extinct, and by their aid enlightenment was carried to the Continent, to decadent Gaul and barbarian Germany. The Churches of England and Germany, founded, far from all traditions of autonomy, by Roman legates, tendered their obedience voluntarily. In Gaul there was no hostility to the Holy See, but on the contrary a profound veneration for the great Christian sanctuary of the West.

The surprising thing is that, although Rome was then included within the empire of the Franks, so that the popes were afforded special opportunities for activity, they showed for the most part no eagerness to strengthen their authority over the clergy beyond the Alps. Appeals and other matters of detail were referred to them more often than under the Merovingians. They gave answers to such questions as were submitted to them; the machinery moved when set in motion from outside; but the popes did not attempt to interfere on their own initiative. The Frankish Church was directed, in fact, by the government of Charlemagne and Louis the Pious. When this failed, as happened during the wars and partitions which followed the death of Louis, the fate of this Church, with no effective head and under no regular direction, was very uncertain. It was then that a clerk who saw that there was but an uncertain prospect of help from the pope of his time, conceived the shrewd idea of appealing to the popes of the past, so as to exhort the contemporary generation through the mouth of former popes, from Clement to Gregory. This design was realized in the celebrated forgery known as the "False Decretals" (*see* DECRETALS).

Nicholas I., 858–867.—Hardly were they in circulation throughout the Frankish empire when it happened that a pope, Nicholas I., was elected who was animated by the same spirit as that which had inspired them. There was no lack of opportunities for intervening in the affairs not only of the Western but of the Eastern Church, and he seized upon them with great decision. He staunchly supported the patriarch Ignatius against his rival, Photius, at Constantinople; he upheld the rights of Teutberga, who had been repudiated by her husband, Lothair II. of Lorraine, against that prince and his brother, the emperor Louis II.; and he combated Hincmar, the powerful metropolitan of Rheims. It was in the course of this last dispute that the False Decretals found their way to Rome. Nicholas received them with some reserve; he refrained from giving them his sanction, and only borrowed from them what they had already borrowed from authentic texts, but in general he took up the same attitude as the forger had ascribed to his remote predecessors. The language of his successors, Adrian II. and John VIII., still shows some trace of the energy and pride of Nicholas. But the circumstances were becoming difficult. Europe was being split up under the influence of feudalism; Christendom was assailed by the barbarians, Norsemen, Saracens and Huns; at Rome the papacy was passing into the power of the local aristocracy, with whom after Otto I. it was disputed from time to time by the sovereigns of Germany. It was still being held in strict subjection by the latter when, towards the end of the 11th century, Hildebrand (Gregory VII.) undertook its enfranchisement.

In Eastern Christendom the papacy was at this period an almost forgotten institution, whose pretensions were always met by the combined opposition of the imperial authority, which was still preponderant in the Byzantine Church, and the authority of the patriarchate of Constantinople, around which centred all that survived of Christianity in those regions. To complete the situation, a formal rupture had occurred in 1054 between the patriarch Michael Cerularius and Pope Leo IX.

Position of the Papacy in Theory and Practice.—In the West, Rome and her sanctuaries had always been held in the highest veneration, and the pilgrimage to Rome was still the most important in the West. The pope, as officiating in these holiest of all sanctuaries, as guardian of the tombs of St. Peter and St. Paul and the inheritor of their rank, their rights, and their traditions, was the greatest ecclesiastical figure and the highest religious authority in the West. The greatest princes bowed before him; it was he who consecrated the emperor. In virtue of the spurious donation of Constantine, forged at Rome in the time of Charlemagne, which was at first circulated in obscurity, but ended by gaining universal credit, it was believed that the first Christian emperor, in withdrawing to Constantinople, had bestowed on the pope all the provinces of the Western empire, and that in consequence all sovereignty in the West, even that of the emperor, was derived from pontifical concessions. From all points of view, both religious and political, the pope was thus the greatest man of the West, the ideal head of all Christendom.

When it was necessary to account for this position, theologians quoted the text of the Gospels, where St. Peter is represented as the rock on which the Church is built, the pastor of the sheep and lambs of the Lord, the doorkeeper of the kingdom of heaven. The statements made in the New Testament about St. Peter were applied without hesitation to all the popes, considered as his successors, the inheritors of his see (*Petri sedes*) and of all his prerogatives. This idea, moreover, that the bishops of Rome were the successors of St. Peter was expressed very early—as far back as the 2nd century. Whatever may be said as to its historical value, it symbolizes very well the great authority of the Roman Church in the early days of Christianity; an authority which was then administered by the bishops of Rome, and came to be more and more identified with them. The councils were also quoted, and especially that of Nicaea, which does not itself mention the question, but certain texts of which contained the famous gloss: *Ecclesia Romana semper habuit primatum.* But this proof was rather insufficient, as indeed it was felt to be. The Gospel and unbroken tradition offered a better argument.

In his capacity as head of the church, "and president of the Christian *agape*," as St. Ignatius of Antioch would have said, the pope was considered to be the supreme president and moderator of the oecumenical assemblies. When the episcopate met in council the bishop of Rome had to be at its head. No decisions of a general nature, whether dogmatic or disciplinary, could be made without his consent. The appeal from all patriarchal or conciliary judgments was to him; and on those occasions when he had to depose bishops of the highest standing, notably those of Alexandria and Constantinople, his judgments

were carried into effect. During the religious struggles between the East and West he was on a few occasions condemned (by the Eastern council of Sardica, by Dioscorus, and by Photius); but the sentences were not carried out, and were even, as in the case of Dioscorus, considered and punished as sacrilegious attacks. In the West the principle, "prima sedes a nemine iudicatur," was always recognized and applied.

In ordinary practice this theoretically wide authority had only a limited application. The apostolic see hardly ever interfered in the government of the local Churches. Save in its own metropolitan province, it took no part in the nomination of bishops; the provincial or regional councils were held without its authorization; their judgments and regulations were carried out without any suggestion that they should be ratified by Rome. It is only after the False Decretals that we meet with the idea that a bishop cannot be deposed and his place filled without the consent of the pope. And it should be noticed that this idea was put forward, not by the pope with the object of increasing his power, but by the opinion of the Church with a view to defending the bishops against unjust sentences, and especially those inspired by the secular authority.

It was admitted, however, throughout the whole Church that the Holy See had an appellate jurisdiction, and recourse was had to it on occasion. At the council of Sardica (343) an attempt had been made to regulate the procedure in these appeals, by recognizing as the right of the pope the reversing of judgments, and the appointment of fresh judges. In practice, appeals to the pope, when they involved the annulling of a judgment, were judged by the pope in person.

But the intervention of the Holy See in the ecclesiastical affairs of the West, which resulted from these appeals, was only of a limited, sporadic and occasional nature. Nothing could have been more removed from a centralized administration than the condition in which matters stood with regard to this point. The pope was the head of the Church, but he exercised his authority only intermittently. When he did exercise it, it was far more frequently at the request of bishops or princes, or of the faithful, than of his own initiative.

Beginning of Temporal Power.—The Roman church had from a very early date possessed considerable wealth. Long before Constantine we find her employing it in aid of the most distant churches, as far afield as Cappadocia and Arabia. Her real property, confiscated under Diocletian, was restored by Constantine, and since then had been continually increased by gifts and bequests. In the 4th and 5th centuries the Roman Church possessed property in all parts of the empire; but gradually, whether because the confiscations of the barbarian emperors had curtailed its extent, or because the popes had made efforts to concentrate it nearer to themselves, the property of the Holy See came to be confined almost entirely to Italy. In the time of St. Gregory there subsisted only what lay in Byzantine Italy, the Lombards having confiscated the property of the Church as well as the imperial domains. During the quarrels between the papacy and the Byzantine Empire her domains in lower Italy and Sicily also disappeared as time went on, and the territorial possessions of the Roman Church were concentrated in the neighbourhood of Rome.

It was then, towards the middle of the 8th century, that the pope, who already exercised a great influence over the government of the city and province of Rome, defending her peacefully and with difficulty against the advancing Lombard conquests, saw that he was forced, short of the protection of the Greek Empire, to put himself under the protection of the Frankish princes. Thus there arose a kind of sovereignty, disputed, it is true, by Constantinople, but which succeeded in maintaining itself. Rome, together with such of the Byzantine territories as still subsisted in her neighbourhood, was considered as a domain sacred to the apostle Peter, and entrusted to the administration of his successor, the pope. To it were added the exarchate of Ravenna and a few other districts of central Italy, which had been recently conquered by the Lombards and retaken by Pippin and Charlemagne. Such was the foundation of the papal state.

The higher places in the government were occupied by the clergy, who for matters of detail made use of the civil and military officials who had carried on the administration under the Byzantine rule. But these lay officials could not long be content with a subordinate position, and hence arose incessant friction, which called for constant intervention on the part of the Frankish sovereigns. In 824 a kind of protectorate was organized, and serious guarantees were conceded to the lay aristocracy.

Shortly afterwards, in the partition of the Carolingian empire, Italy passed under the rule of a prince of its own, Louis II., who, with the title of emperor, made his authority felt in political matters. Shortly after his death (875) fresh upheavals reduced to nothing the power of the Carolingian princes; the clergy of Rome found itself without a protector, exposed to the animosity of the lay aristocracy. The authority of the pontificate was seriously impaired by these circumstances. One of the great families of Rome, that of the *vestiarius* Theophylact, took possession of the temporal authority, and succeeded in influencing the papal elections. After Theophylact the power passed to his daughter Marozia, a woman of the most debased character; then to her son Alberic, a serious-minded prince; and then to Alberic's son Octavius, who from "prince of the Romans" became pope (John XII.) when yet a mere boy. After Marozia and Alberic and the rest another branch of the same family, the Crescentii, exercised the temporal powers of the Holy See; and after them the same régime was continued by the counts of Tusculum, who were sprung from the same stock, which sometimes provided the Church with the most unlikely and least honourable pontiffs.

Election of the Popes.—The pope, like all the bishops, was chosen by means of election, in which both the clergy and the laity took part. The latter were represented in the most essential functions of the election by the aristocracy: at first by the senate, and later by the *exercitus romanus,* or rather of its staff, composed of Byzantine officers. It was the latter which gave rise to the feudal aristocracy which we see appearing under the Carolingians. The new pope was chosen by the principal members of the clergy and nobles, and then set before the assembled people, who gave their decision by acclamation; and this acclamation was accepted as the vote of the assembly of the faithful. The pope-elect was then put in possession of the episcopal house, and after waiting till the next Sunday his consecration was proceeded with. This ceremony was at first celebrated in the Lateran, but from Byzantine times onwards it took place at St. Peter's. It was also under the Byzantine régime that the condition was imposed that the pope should not be consecrated until the emperor had ratified his election. This had not been required under the old Latin emperors nor under the Gothic kings, and it disappeared of its own accord with the Byzantine régime. It was revived, however, by the emperor Louis the Pious, much to the disgust of the Romans, who resisted on several occasions. The Roman "princes" or "senators" in the 10th century went still further: it was they who actually nominated the pope. The same was the case with the Saxon emperors (Otto I., II. and III.), and in the 11th century of the lords of Tusculum, the latter nominating themselves and choosing members of their own family for the pontificate. When the emperor Henry III. (1046) put an end to this oppression it was only to substitute another. The popes of Tusculum did, at least, belong to the country, while the German kings chose bishops from the other side of the Alps.

The Hildebrandine Reform.—The entry of Hildebrand into the counsels of the papacy marks the beginning of a great change in this institution. He cannot, however, claim the honour of having opened the way which he impelled his predecessors to follow even before following it himself. All good Christians were calling for reforms; bishops, princes and monks were in agreement on this point when they spoke or acted according to their convictions. Many of them had tried to effect something; but these isolated efforts were often countermined by incompatible aims, and had produced no serious results. It is in the supreme head of the Church that the movement ought to have found its origin and inspiration. There was no dispute as to his possessing the authority in spiritual matters necessary to impose reform and

overbear the resistance which might arise; no one was better qualified than he to treat with the holders of the temporal power and obtain the support which was necessary from them. The Fathers of the Church had repeated times without number that the priesthood stands above even the supreme secular authority; the bible was full of stories most aptly illustrating this theory; nobody questioned that, within the Church, the pope was the vicar of Christ, and that, as such, his powers were unlimited; as proof positive could be cited—by councils and decretals—whether authentic or spurious; at any rate all authorized by long usage and taken as received authorities. It only remained to take possession of this incontestable power and use it with firmness and consistency. The example of Nicholas I., two centuries before, had shown the position which a pope could occupy in Christendom; but for a long time past the man had come short of the institution, the workman of his tool. Under Leo IX. (1048–1054) the pope suddenly came forward as the active and indefatigable champion of reform; simony and incontinence of the clergy were attacked by the one most qualified to purify the Church of them. Henceforth the way was open, and it became clear that, given good popes, the reform movement might be carried into effect. The choice of the pope was then subject to the pleasure of the sovereign of Germany, against whom the Roman feudal lords, devoted as they were to the old abuses, were in constant revolt. In the midst of the frequent changes of pope which went on during these years, and the political vicissitudes of Italy, Hildebrand took such measures as enabled him to checkmate the opposition of the Roman barons by turning against them, now the armed force of the Normans, now the influence of the German king[1]. Side by side with the general movement towards reform, he had set before himself the object of freeing the papacy, not only from its temporal oppressors but also from its protectors. He was successful at the council of 1059, the pontifical election was placed out of reach of the schemes of the local feudal lords and restored to the heads of the clergy; certain reservations were made with regard to those rights which the Holy See was considered to have conceded personally to Henry of Germany (the young king Henry IV., son of the emperor Henry III.), but nothing more. At the election of Alexander II. (1061–1073)—a rival who for a long time had been supported by the German king—and even at the election of Hildebrand, this rule had its effect. Henceforth the elections remained entirely free from those secular influences which had hitherto been so oppressive. In 1073 Hildebrand was raised to the pontifical throne by the acclamation of the people of Rome, under the name of Gregory VII.

Gregory VII., 1073–1085.—The work of reform was now in a good way; the freedom of the pontifical elections had been assured, which gave some promise that the struggle against abuses would be conducted successfully. All that now remained was to go on following wisely and firmly the way that had already been opened. But this attitude was not likely to appeal to the exuberant energy of the new pope. Now that Gregory's hands were no longer tied, he could act freely. The choice of the pope had been almost entirely removed from the sphere of secular influence, and especially from that of the German king. Gregory claimed that the same condition should apply to bishops, and these were the grounds of the dispute about investitures—a dispute which could find no solution, for it was impossible for the Teutonic sovereigns to renounce all interest in a matter of such importance in the workings of their state. Since the time of Clovis the German sovereigns had never ceased to intervene in such matters. But this question soon fell into the background. Gregory's contention was that the secular sovereigns should be entirely in the power of the head of the Church, and that he should be able to advance them or dispossess them at will, according to the estimate which he formed of their conduct. A terrible struggle arose between these obviously exorbitant demands and the resistance which they provoked. Its details cannot be described in this place (*see* INVESTITURES); we need only say that this ill-fated quarrel was not calculated to advance the reform movement, but rather to impede it, and, further, that it ended in failure. Gregory died far away from Rome, upon which he had brought incalculable evils; and not only Rome, but the papacy itself had to pay the penalty for the want of moderation of the pope. Great indeed was the difference between the state in which he received it and that in which he left it. We must not, however, let this mislead us. This struggle between spiritual and secular powers, owing to the tremendous sensation which it created throughout Christendom, showed the nations that at the head of the Church there was a great force for justice, always able to combat iniquity and oppression, and sometimes to defeat them, however powerful the evil and the tyrants might seem. The scene at Canossa, which had at the moment a merely relative importance, remained in the memories of men as a symbol which was hateful or comforting, according to the point of view from which it was considered.

(L. D.)

II. PERIOD FROM 1087 TO 1305

Gregory VII. had clearly revealed to the world the broad lines of the religious and political programme of the mediaeval papacy, and had begun to put it into execution. To reform the Church in every grade and purge the priesthood in order to shield it from feudal influences and from the domination of lay sovereignties; to convert the Church thus regenerated, spiritualized and detached from the world, into an organism which would be submissive to the absolute authority of the papal see, and to concentrate at Rome all its energies and jurisdictions; to establish the supremacy of the Roman see over all the Christian Churches, and win over to the Roman Church the Churches of the Byzantine Empire, Africa and Asia; to establish the temporal domain of St. Peter, not only by taking possession of Rome and Italy, but also by placing all the crowns of Europe under the supreme sovereignty of the popes, or even in direct vassalage to them; and, finally, to maintain unity of faith in Christendom and defend it against the attacks of unbelievers, Mussulmans, heretics and pagans—these were the main features of his scheme. The task, however, was so gigantic that after 150 years of strenuous effort, at the period which may be considered as the apogee of its power, that is, in the first half of the 13th century, the papacy had attained only incomplete results. At several points the work remained unfinished, for decadence followed close upon the moment of extreme greatness.

1. FROM URBAN II. TO CALIXTUS II. (1087–1124)

Gregory VII.'s successors accomplished the most pressing work by liberating the Church from feudal subjection, either by force or by diplomacy. This was, indeed, the indispensable condition of its internal and external progress. The great figure of this period is unquestionably the French Cluniac Urban II. (1088–99), who led the Hildebrandine reformation with more vehemence than Gregory himself and was the originator of the crusades. Never throughout the middle ages was pope more energetic, impetuous or uncompromising. His inflexible will informed the movement directed against the enemy within, against the simoniacal prelate and the princely usurper of the rights of the Church, and prescribed the movement against the enemy without, against the infidel who held the Holy Sepulchre. Urban set his hand to reforms from which his predecessor Gregory had recoiled. He simultaneously excommunicated several sovereigns and mercilessly persecuted the archbishops and bishops who were hostile to reform. He took no pains to temper the zeal of his legates, but incited them to the struggle, and, not content with prohibiting lay investiture and simony, expressly forbade prelates and even

[1]On the 5th of April 1058, six days after the death of Pope Stephen X., John, bishop of Velletri, the nominee of the Roman nobles, was enthroned as Pope Benedict X. Hildebrand set up Gerard, bishop of Florence, as a rival candidate, won over a part of the Romans to his cause, and secured the support of the empress regent Agnes at the Diet of Augsburg in June. Gerard was elected pope at Siena (as Nicholas II., *q.v.*) by those cardinals who had fled from Rome on the elevation of Benedict X. A synod was held at Sutri, at which the powerful Godfrey, duke of Lorraine and Spoleto, and margrave of Tuscany, and the chancellor Wibert were present. Measures were here concerted against Pope Benedict, who was driven out of Rome in Jan. 1059, Nicholas II. being regularly enthroned on the 24th of the same month. A synod assembled at the Lateran in April passed the famous new regulations for the elections to the papacy. (*See* CONCLAVE and LATERAN COUNCILS.)—[ED.]

priests to pay homage to the civil power. Distrusting the secular clergy, who were wholly sunk in the world, he looked to the regular clergy for support, and thus led the papacy into that course which it continued to pursue after his death. Henceforth the monk was to be the docile instrument of the wishes of Rome, to be opposed to the official priesthood according to Rome's needs. Urban was the first to proclaim with emphasis the necessity of a close association of the Curia with the religious orders, and this he made the essential basis of the theocratic government.

As the originator of the first crusade, Urban is entitled to the honour of the idea and its execution. There is no doubt that he wished to satisfy the complaints that emanated from the Christians dwelling in Jerusalem and from the pilgrims to the Holy Sepulchre, but it is no less certain that he was disturbed by the fears aroused throughout the Latin world by the recrudescence of Mussulman invasions, and particularly by the victory won by the Almoravides over the Christian army at Zalaca (1086). The progress of these African Mussulmans into Spain and their incessant piracies in Italy were perhaps the occasional cause that determined Urban II. to work upon the imagination of the infidels by an expedition into Syria. The papacy of that time believed in the political unity of Islam, in a solidarity—which did not exist—among the Mussulmans of Asia Minor, Syria, Egypt and the Barbary coasts; and if it waited until the year 1095 to carry out this project, it was because the conflict with the Germanic empire prevented the earlier realization of its dream. The essential reason of Urban II.'s action, and consequently the true cause of the crusade, was the ambition of the pope to unite with Rome and the Roman Church the Churches of Jerusalem, Antioch, Alexandria and even Constantinople, which the Greek schism had rendered independent. Urban II. addressed himself with wonted decision to the execution of this enormous enterprise. With him, as with all his successors, the idea of a collective expedition of Europe for the recovery of the holy places was always associated with the sanguine hope of extinguishing the schism at Constantinople, its very centre, by the substitution of a Latin for a Byzantine domination. Of these two objects, he was only to realize the former; but the crusade may well be said to have been his own work. He created it and preached it; he organized it, dominated it, and constantly supervised it. He was ever ready to act, either personally or through his delegates, and never ceased to be the effective leader of all the feudal soldiers he enrolled under the banner of the Holy See

The vast conflict aroused by the Hildebrandine reformation, and particularly the investiture quarrel, continued under the three successors of Urban II.; but with them it assumed a different character, and a tendency arose to terminate it by other means. The violence and disorders provoked by the struggle brought about a reaction, which was organized by certain prelates who advocated a policy of conciliation, such as the Frenchman Ivo, bishop of Chartres (*c.* 1040–1116). These conciliatory prelates were sincere supporters of the reformation, and combated simony, the marriage or concubinage of priests, and the immorality of sovereigns with the same conviction as the most ardent followers of Gregory VII. and Urban II ; but they held that the intimate union of Church and State was indispensable to the social order, and that the rights of kings should be respected as well as the rights of priests. The text they preached was harmony between the priesthood and the state. Dividing what the irreconcilables of the Hildebrandine party considered as an indissoluble whole, they made a sharp distinction between the property of the Church and the Church itself, between the political and territorial power of the bishops and their religious authority, and between the feudal investiture which confers lands and jurisdiction and the spiritual investiture which confers ecclesiastical rights. This doctrine gradually rallied all moderate minds, and finally inspired the directors of Christendom in Rome itself.

Paschal II., 1099–1118.—History has not fully recognized the Italian monk Paschal II., who was the equal of Urban in private virtues, personal disinterestedness, and religious conviction, but was surpassed by him in ardour and rigidity of conduct. Altered circumstances and tendencies of opinion called for a policy of conciliation. In France, Paschal granted absolution to Philip I.—who had many times been anathematized by his predecessors—and reconciled him solemnly with the Church, on the sole condition that he should swear to renounce his adulterous marriage. The pope could be under no delusion as to the value of this oath, which indeed was not kept; he merely regularized formally a state of affairs which the intractable Urban II. himself had never been able to prevent. As for the French question of the investitures, it was settled apparently without any treaty being expressly drawn up between the parties. The kings of France contemporary with Paschal II. ceased to practise spiritual investiture, or even to receive feudal homage from the bishops. They did not, however, renounce all intervention or all profit in the nominations to prelacies, but their intervention was no longer exhibited under the forms which the Hildebrandine party held to be illegal. In England, Paschal II. put an end to the long quarrel between the royal government and Anselm of Canterbury by accepting the Concordat of London (1107). The crown in England also abandoned investiture by the pastoral staff and ring, but, more fortunate than in France, retained the right of receiving feudal homage from the episcopate. As for Germany, the Emperor Henry V. wrung from the pope, by a display of force at Rome, concessions which provoked the indignant clamours of the most ardent reformers in France and Italy. It must not, however, be forgotten that, in the negotiations at Sutri, Paschal had pride and independence enough to propose to the emperor the only solution of the conflict that was entirely logical and essentially Christian, namely, the renunciation by the Church of its temporal power and the renunciation by the lay lords of all intervention in elections and investitures—in other words, the absolute separation of the priesthood and the state. The idea was contrary to the whole evolution of mediaeval Catholicism, and the German bishops were the first to repudiate it. At all events, it is certain that Paschal II. prepared the way for the Concordat of Worms.

On the other hand, with more acuteness than his predecessors, he realized that the papacy could not sustain the struggle against Germany unless it could rely upon the support of another Christian kingdom of the West; and he concluded with Philip I. of France and Louis the Fat, at the Council of Troyes (1107), an alliance which was for more than a century the salvation of the court of Rome. It is from this time that we find the popes in moments of crisis transporting themselves to Capetian territory, installing their governments and convening their councils there, and from that place of refuge fulminating with impunity against the internal and external foe. Without sacrificing the essential principles of the reformation, Paschal II. practised a policy of peace and reaction in every way contrary to that of the two preceding popes, and it was through him that the struggle was once more placed upon the religious basis.

Calixtus II. (1119–24).—Guy, archbishop of Vienne, who had been so keen to disavow the policy of Paschal II., was obliged to continue it when he assumed the tiara under the name of Calixtus II. By the Concordat of Worms, which he signed with the Emperor Henry V. in 1122, the investiture was divided between the ecclesiastical and the lay powers, the emperor investing with the sceptre, the pope with the pastoral staff and ring. The work did honour to the perseverance and ability of Calixtus, but it was merely the application of the ideas of Paschal II. and Ivo of Chartres. The understanding, however, between the two contracting parties was very far from being clear and complete, as each party still sought to attain its own aim by spreading in the Christian world divergent interpretations of the concordat and widely differing plans for reducing it to its final form. The two great agitations directed by the papacy at the end of the 11th century and the beginning of the 12th—the reformation and the crusade—were of capital importance for the foundation of the immense religious monarchy that had its centre in Rome; and it is from here that the papal monarchy actually dates.

The entry of the Christians into Jerusalem produced an extraordinary effect upon the faithful of the West. In it they saw the most manifest sign of the divine protection and of the supernatural power of the pope, the supreme director of the expedition

At its inception the Latin kingdom of the Holy Land was within a little of becoming an ecclesiastical principality, ruled by a patriarch under the authority of the pope. Daimbert, the first patriarch of Jerusalem, was convinced that the Roman Church alone could be sovereign of the new state, and attempted to compel Godfrey of Bouillon to hand over to him by a solemn agreement the town and citadel of Jerusalem, and also Jaffa. The clergy, indeed, received a large share; but the government of the Latin principality remained lay and military, the only form of government possible for a colony surrounded by perils and camped in a hostile country. Not only was the result of the crusade extremely favourable to the extension of the Roman power, but throughout the middle ages the papacy never ceased to derive almost incalculable political and financial advantages from the agitation produced by the preachers and the crusading expeditions

As for the reformation, which under Urban II. and his immediate successors was aimed not only at the episcopate but also at the capitulary bodies and monastic clergy, it, too, could but tend to a considerable extension of the authority of the successors of St. Peter, for it struck an irremediable blow at the ancient Christian hierarchy. The first manifest result of the change was the weakening of the metropolitans. The visible symptom of this decadence of the archiepiscopal power was the growing frequency during the Hildebrandine conflict of episcopal confirmations and consecrations made by the popes themselves or their legates. From an active instrument of the religious society, the archiepiscopate degenerated into a purely formal power; while the episcopate itself, which the sincere reformers wished to liberate and purge in order to strengthen it, emerged from the crisis sensibly weakened as well as ameliorated. The episcopate, while it gained in intelligence and morality, lost a part of its independence. It was raised above feudalism only to be abased before the two directing forces of the reformation, the papacy and the religious orders. To place itself in a better posture for combating the simoniacal and concubinary prelates, the court of Rome had had to multiply exemptions and accelerate the movement which impelled the monks to make themselves independent of the bishops. Even in the cities, the seats of the episcopal power, the reformation encouraged the attempts at revolt or autonomy which tended everywhere to diminish that power. The cathedral chapters took advantage of this situation to oppose their jurisdiction to that of the bishops, and to encroach on their prerogatives. When war was declared on the schismatic prelates, the reforming popes supported the canons, and, unconsciously or not, helped them to form themselves into privileged bodies living their own lives and affecting to recognize the court of Rome as their only superior authority.

Under Urban II.'s papacy the formulary of the papal bulls began to crystallize, and the letters amassed in the papal offices were differentiated clearly into great and little bulls, according to their style, arrangement and signs of validation Under Paschal II. the type of the leaden seal affixed to the bulls (representing the heads of the apostles Peter and Paul) was fixed, and the use of Roman minuscule finally substituted for that of the Lombard script.

2. HONORIUS II. TO CELESTINE III. (1124–1198)

After the reformation and the crusade the papal monarchy existed, and the next step was to consolidate and extend it. This task fell to the popes of the 12th century. Two of them in particular—the two who had the longest reigns—viz. Innocent II. and Alexander III., achieved the widest extension of the power entrusted to them, and in many respects their pontificates may be regarded as a preparation for and adumbration of the pontificate of Innocent III. This period, however, is characterized not only by the thoroughgoing development of the authority of the Holy See, but also by the severe struggle the popes had to sustain against the hostile forces that were opposed to their conquests or to the mere exercise of what they regarded as their right.

The Papacy and the German Emperors.—In the secular contest, Germany and its imperialist leaders were invariably the principal obstacle. Until the accession of Adrian IV., however, there had been considerable periods of tranquillity, years even of unbroken peace and alliance with the Germanic power. Under Honorius II. (1124–30), the empire, represented by Lothair III. of Supplinburg, yielded to the papacy, and Lothair, who was elected by the clergy and protected by the legates, begged the pope to confirm his election. Before his coronation he had renounced the right, so jealously guarded by Henry V., of assisting in the election of bishops and abbots, and he even undertook to refrain from exacting homage from the prelates and to content himself with fealty. This undertaking, however, did not prevent him from bringing all his influence to bear upon the ecclesiastical nominations. When the schism of 1130 broke out he endeavoured to procure the cancellation of the clauses of the Concordat of Worms and to recover lay investiture by way of compensation for the support he had given to Innocent II., one of the competing popes. This scheme, however, was frustrated by the firmness of Innocent and St. Bernard, and Lothair had to resign himself to the zealous conservation of the privileges granted to the Empire by the terms of the concordat. The ardour he had displayed in securing the recognition of Innocent and defending him against his enemies, particularly the anti-pope Anacletus and the kingdom of the Two Sicilies, involved him in a course which was not precisely favourable to the imperial rights. Innocent II. (1130–43) was the virtual master of this monarch, whose championship of the papacy brought not the smallest advantage, not even that of being crowned emperor with the habitual ceremonial at the place consecrated by tradition. It may even be maintained that his elevation was due solely to his personal claims This was a victory for Rome, and it was repeated in the case of the first Hohenstaufen, Conrad III., who owed his elevation (1138) mainly to the princes of the Church and the legate of Innocent II., by whom he was crowned. He also had to submit to the consequences of his origin on the occasion of a double election not foreseen by the Concordat of Worms, when he was forced to admit the necessity of appeal to Rome and to acknowledge the supremacy of the papal decision The situation changed in 1152, under Eugenius III. (1145–53) when Frederick Barbarossa was elected German king He notified his election to the pope, but did not seek the pope's approval None the less, Eugenius III felicitated the new sovereign on his election, and even signed the treaty of Constance with him (1153) The pope had need of Frederick to defend him against the revolted Romans and to help him to recover his temporal power, which had been gravely compromised Anastasius IV (1153–54) pursued the same policy, and summoned the German to Rome (1154) Frederick, however, was determined to keep the seat of the empire for himself, to dispute Italy with the pope, and to oppose the divine right of kings to the divine right of priests When he had taken Lombardy (1158) and had had the principles of the imperial supremacy proclaimed by his jurists at the diet of Roncaglia, the court of Rome realized that war was inevitable, and two energetic popes, Adrian IV. (1154–59) and Alexander III. (1159–81), resolutely sustained the struggle, the latter for nearly twenty years Victims of the communal claims at Rome, they constituted themselves the champions of similar claims in northern Italy, and their alliance with the Lombard communes ultimately led to success. In his duel with Barbarossa, Alexander III., one of the greatest of mediaeval popes, displayed extraordinary courage, address and perseverance. Yet we must not exaggerate the importance of the act by which Barbarossa, kneeling before his conqueror, recognized the spiritual supremacy of the Holy See, and swore fidelity and respect to it. In its final form, the truce of Venice was not only not unfavourable secularly to the Empire, but even granted it extensive advantages

Other Conflicts.—This great triumph was not the only success gained by Alexander III. over lay sovereigns. The conflict of the priesthood with the kingdoms and nations that were tending to aggrandize themselves by transcending the religious limits of the mediaeval theocracy took place in another theatre. The affair of Thomas Becket (*q.v.*) involved the papacy in a quarrel with the powerful monarchy of the Angevins, whose representative, Henry II., was master of England and of half of France. Alexander's diplomatic skill and moral authority, reinforced by the Capetian alliance and the revulsion of feeling

caused by the murder of Becket, enabled him to force the despotic Henry to yield, and even to do penance at the tomb of the martyr.

Unfortunately for the papacy, the successors of Alexander III. lacked vigour, and their pontificates were too brief to allow them to pursue a strong policy against the Germanic imperialism. Never were the leaders of the Church in such jeopardy as during the reign of Barbarossa's son, Henry VI. This vigorous despot, whose ambitions were not all chimerical, had succeeded where his predecessors, including Frederick, had failed. His marriage with the heiress of the old Norman kings had made him master of Sicily and the duchy of Apulia and Calabria, and he succeeded in conquering and retaining almost all the remainder of the peninsula.

The Norman kingdom, which had conquered Sicily and southern Italy at the end of the 11th century, was almost as grave a source of anxiety to the popes of this period. Not only was its very existence an obstacle to the spread of their temporal power in the peninsula, but it frequently acted in concert with the pope's enemies and thwarted the papal policy. The attempts of Honorius II. (1128) and Innocent II. (1139) to wrest Apulia and Calabria from King Roger II., and Adrian IV.'s war with William I. (1156), were one and all unsuccessful; and the papacy had to content itself with the vassalage and tribute of the Normans, and allowed them to organize the ecclesiastical government of their domains in their own fashion, to limit the right of appeal to Rome, and to curtail the power of the Roman legates. At this period, moreover, the "Norman question" was intimately connected with the "Eastern question." The Norman adventurers in possession of Palermo and Naples perpetually tended to look for their aggrandizement to the Byzantine empire. In the interests of their temporal dominion, the 12th-century popes could not suffer an Italian power to dominate on the other side of the Adriatic and instal itself at Constantinople. This contingency explains the vacillating and illogical character of the papal diplomacy with regard to the Byzantine problem, and, *inter alia,* the opposition of Eugenius III. in 1150 to Roger II.'s projected crusade, directed towards the conquest of the Greek state.

As regards its temporal aims on Italy, the most inconvenient and tenacious, if not the most dangerous, adversary of the 12th-century papacy was the Roman commune. Since the middle of the 12th century the party of municipal autonomy and, indeed, the whole of the European middle classes, who wished to shake off the feudal yoke and secure independence, had been ranged against the successor of St. Peter. The first symptoms of resistance were exhibited under Innocent II. (1142), who was unable to stem the growing revolution or prevent the establishment of a Roman senate sitting in the Capitol. The strength of classical reminiscence and the instinct of liberty were reinforced by the support given to communal aspirations by the popular agitator and dangerous tribune, Arnold of Brescia (*q.v.*), whose theories arrived at an opportune moment to encourage the revolted commons. He denied the power of clerks to possess fiefs, and allowed them only religious authority and tithes. The successors of Innocent II. were even less successful in maintaining their supremacy in Rome. Lucius II., when called upon to renounce all his regalian rights, fell mortally wounded in an attempt to drive the autonomists by force from the Capitol (1145). Under Eugenius III. the Romans sacked and destroyed the houses of the clerks and cardinals, besieged St. Peter's and the Lateran, and massacred the pilgrims. The pope was forced to fly with the Sacred College, to escape the necessity of recognizing the commune, and thus left the field free to Arnold of Brescia (1145). On his return to Rome, Eugenius had to treat with his rebel subjects and to acknowledge the senate they had elected, and he was unable to procure the expulsion of the agitator. The more energetic Adrian IV. refused to truckle to the municipality, placed it under an interdict (1155), and allied himself with Frederick Barbarossa to quell an insurrection which respected the rights of emperors no more than the rights of popes. From the moment that Arnold of Brescia, absorbed in his chimerical project of reviving the ancient Roman republic, disregarded the imperial power and neglected to shelter himself behind the German in his conflict with the priesthood, his failure was certain and his fate foredoomed. He was hanged and burned, probably in pursuance of the secret agreement between the pope and the emperor; and Adrian IV. was reconciled with the Romans (1156). The commune, however, subsisted, and was on several occasions strong enough to eject the masters who were distasteful to it. Unfortunately for Alexander III. the Roman question was complicated during his pontificate with the desperate struggle with the empire. The populace of the Tiber welcomed and expelled him with equal enthusiasm, and when his body was brought back from exile, the mob went before the *cortège* and threw mud and stones upon the funeral litter. All obeyed the pontiff of Rome—save Rome itself. Lucius III., who was pope for four years (1181–1185), remained in Rome four months, while Urban III. and Gregory VIII. never entered the city. At length the two parties grew weary of this state of revolution, and a régime of conciliation, the fruit of mutual concessions, was established under Clement III. By the act of 1188, the fundamental charter of the Roman commune, the people recognized the supremacy of the pope over the senate and the town, while the pope on his part sanctioned the legal existence of the commune and of its government and assemblies.

Development of Centralized Organization.—Although among other obstacles, the popes of the 12th century had experienced some difficulty in subduing the inhabitants of the city, which was the seat and centre of the Christian world, their monarchy did not cease to gain in authority, solidity and prestige, and the work of centralization, which was gradually making them masters of the whole ecclesiastical organism, was accomplished steadily and without serious interruption. If Rome expelled them, they always found a sure refuge in France, where Alexander III. carried on his government for several years; and the whole of Europe acknowledged their immense power. Under Honorius II. the custom prevailed of substituting legates *a latere,* simple priests or deacons of the Curia, for the regionary delegates, who had grown too independent; and that excellent instrument of rule, the Roman legate, carried the papal will into the remotest courts of Europe. The episcopate and the great monastic prelacies continued to lose their independence, as was shown by Honorius II. deputing a cardinal to Monte Cassino to elect an abbot of his choosing. The progress of the Roman power was especially manifested under Innocent II., who had triumphed over the schism, and was supported by the empire and by Bernard of Clairvaux, the first moral authority of his time.

At the second Lateran Council (1139), Innocent II. declared to the bishops that he was the absolute master of Christendom. "Ye know," he said, "that Rome is the capital of the world, that ye hold your dignities of the Roman pontiff as a vassal holds his fiefs of his sovereign, and that ye cannot retain them without his assent." Under Eugenius III., the papal absolutism grew weaker, and the cardinals are once said to have addressed to the pope this astounding protest: "Thou must know that it is by us thou hast been raised to the supreme dignity. We are the hinges (*cardines*) upon which the universal Church rests and moves. It is through us that from a private person thou hast become the father of all Christians. It is, then, no longer to thyself but rather to us that thou belongest henceforth. Thou must not sacrifice to private and recent friendships the traditional affections of the papacy. Perforce thou must consult before everything the general interest of Christendom, and must consider it an obligation of thine office to respect the opinions of the highest dignitaries of the court of Rome." Under Alexander III., however, the papacy became more powerful than ever. The recently created royalties sought from the papacy the conservation of their titles and the benediction of their crowns, and placed themselves voluntarily in its vassalage. The practice of the nomination of bishops by the Curia and of papal recommendation to prebends and benefices of every kind grew daily more general, and the number of appeals to Rome and exemptions granted to abbeys and even to simple churches increased continually. The third Lateran Council (1179) was a triumph for the leader of the Church. At that council wise and urgent measures were taken against the abuses that discredited the priesthood, but the principle of appeals and exemptions and the ques-

tion of the increasing abuse of the power wielded by the Roman legates remained untouched. The treatise on canon law known as the *Decretum Gratiani,* which was compiled towards the middle of the 12th century, propagated doctrines in favour of the power of the Holy See, established the superiority of the popes over the councils, and gave legal force to their decretals.

It was by its constant reliance on monachism that the papacy of the 12th century had attained this result, and the popes of that period were especially fortunate in having for their champion the monk St. Bernard, whose admirable qualities enabled him to dominate public opinion. St. Bernard completed the reformation, combated heresy, and by his immense moral ascendancy gained victories by which Rome benefited. As instances of his more direct services, he put an end to the schism of 1130 and attached Italy and the world to the side of Innocent II.

Resistance to Papal Power.—At the moment when the papacy thus attained omnipotence, symptoms of discontent and opposition arose. The bishops resisted centralization. Archbishop Hildebert of Tours protested to Honorius II. against the appeals to Rome, while others complained of the exactions of the legates, or, like John of Salisbury, animadverted upon the excessive powers of the bureaucracy at the Lateran. In the councils strange speeches were heard from the mouths of laymen, who were beginning to carry to extreme lengths the spirit of independence with regard to Rome. When a question arose at Toulouse in 1160 as to the best means of settling the papal schism, this audacious statement was made before the kings of France and England: "That the best course was to side with neither of the two popes; that the apostolic see had been ever a burden to the princes; that advantage must be taken of the schism to throw off the yoke; and that, while awaiting the death of one of the competitors, the authority of the bishops was sufficient in France and England alike for the government of the churches." The ecclesiastics themselves, however, were the first to denounce the abuses at Rome. In common with all enlightened opinion, St. Bernard complained bitterly of the excessive multiplication of exemptions, of the exaggerated extension of appeals to Rome, of the luxury of the Roman court, of the venality of the cardinals, and of the injury done to the traditional hierarchy by the very extent of the papal power, which was calculated to turn the strongest head. In St. Bernard's treatise *De consideratione,* addressed to Pope Eugenius III., the papacy receives as many reprimands and attacks as it does marks of affection and friendly counsel. "I do not find," he said, "that St. Peter ever appeared in public loaded with gold and jewels, clad in silk, mounted on a white mule, surrounded by soldiers and followed by a brilliant retinue. In the glitter that environs thee, rather wouldst thou be taken for the successor of Constantine than for the successor of Peter."

Rome, however, had greater dangers to cope with than the indignant reproofs of her friends the monks, and the opposition of the bishops, who were displeased at the spectacle of their authority waning day by day. It was at this period that the Catholic edifice of the middle ages began to be shaken by the boldness of philosophical speculation as applied to theological studies and also by the growth of heresy. Hitherto more tolerant of heresy than the local authorities, the papacy now felt compelled to take defensive measures against it, and especially against Albigensianism, which had made great strides in the south of France since the middle of the 12th century. Innocent II., Eugenius III. and Alexander III. excommunicated the sectaries of Languedoc and their abettors, Alexander even sending armed missions to hunt them down and punish them. But the preaching of the papal legates, even when supported by military demonstrations, had no effect; and the Albigensian question, together with other questions vital for the future of the papacy, remained unsettled and more formidable than ever when Innocent III. was elected.

3. INNOCENT III. TO ALEXANDER IV. (1198-1261)

Under the pontificates of Innocent III. (1198–1216) and his five immediate successors the Roman monarchy seemed to have reached the pinnacle of its moral prestige, religious authority and temporal power, and this development was due in great measure to Innocent III. himself. Innocent was an eminent jurist and canonist, and never ceased to use his immense power in the service of the law. Indeed, a great part of his life was passed in hearing pleadings and pronouncing judgments, and few sovereigns have ever worked so industriously or shown such solicitude for the impartial exercise of their judicial functions. It is difficult to comprehend Innocent's extraordinary activity. Over and above the weight of political affairs, he bore resolutely for 18 years the overwhelming burden of the presidency of a tribunal before which the whole of Europe came to plead. To him, also, in his capacity of theologian, the whole of Europe submitted every obscure, delicate or controverted question, whether legal problem or case of conscience. This, undoubtedly, was the part of his task that Innocent preferred, and it was to this, as well as to his much overrated moral and theological treatises, that he owed his enormous contemporary prestige. As a statesman, he certainly committed grave faults—through excess of diplomatic subtlety, lack of forethought, and sometimes even through ingenuousness; but it must with justice be admitted that, in spite of his reputation for pugnacity and obstinacy, he never failed, either by temperament or on principle, to exhaust every peaceful expedient in settling questions. He was averse from violence, and never resorted to bellicose acts or to the employment of force save in the last extremity. If his policy miscarried in several quarters it was eminently successful in others; and if we consider the sum of his efforts to achieve the programme of the mediaeval papacy, it cannot be denied that the extent of his rule and the profound influence he exerted on his times entitle him to be regarded as the most perfect type of mediaeval pope and one of the most powerful figures in history.

A superficial glance at Innocent's correspondence is sufficient to convince us that he was pre-eminently concerned for the reformation and moral welfare of the Church, and was animated by the best intentions for the re-establishment in the ecclesiastical body of order, peace and respect for the hierarchy. This was one of the principal objects of his activity, and this important side of his work received decisive sanction by the promulgation of the decrees of the fourth Lateran Council (1215). At this council almost all the questions at issue related to reform, and many give evidence of great breadth of mind, as well as of a very acute sense of contemporary necessities. Innocent's letters, however, not only reveal that superior wisdom which can take into account practical needs and relax severity of principle at the right moment, as well as that spirit of tolerance and equity which is opposed to the excess of zeal and intellectual narrowness of subordinates, but they also prove that, in the internal government of the Church, he was bent on gathering into his hands all the motive threads, and that he stretched the absolutist tradition to its furthest limits, intervening in the most trifling acts in the lives of the clergy, and regarding it as an obligation of his office to act and think for all. The heretic peril, which increased during his pontificate, forced him to take decisive measures against the Albigenses in the south of France, but before proscribing them he spent ten years (1198–1208) in endeavouring to convert the misbelievers, and history should not forget the pacific character of these early efforts. It was because they did not succeed that necessity and the violence of human passions subsequently forced him into a course of action which he had not chosen and which led him further than he wished to go. When he was compelled to decree the Albigensian crusade he endeavoured more than once to discontinue the work, which had become perverted, and to curb the crusading ardour of Simon de Montfort. Failing in his attempt to maintain the religious character of the crusade, he wished to prevent it from ending secularly in its extreme consequence and logical outcome.

Papal Imperialism under Innocent III.—It was particularly in the definitive constitution of the temporal and political power of the papacy, in the extension of what may be called Roman imperialism, that chance favoured his efforts and enabled him to pursue his conquests farthest. This imperialism was undoubtedly of a special nature; it rested on moral authority and

political and financial power rather than on material and military strength. But it is no less certain that Innocent attempted to subject the kings of Europe by making them his tributaries and vassals. He wished to acquire the mastery of souls by unifying the faith and centralizing the priesthood, but he also aspired to possess temporal supremacy, if not as direct owner, at least as suzerain, over all the national crowns, and thus to realize the idea with which he was penetrated and which he himself expressed clearly. He wished to be at once pope and emperor, leader of religion and universal sovereign. And, in fact, he exercised or claimed suzerain rights, together with the political and pecuniary advantages accruing, over the greater number of the lay sovereigns of his time. He was more or less effectively the supreme temporal chief of the kingdom of Sicily and Naples, Sardinia, the states of the Iberian peninsula (Castile, Leon, Navarre and Portugal), Aragon (which, under Peter II., was the type of vassal and tributary kingdom of the Roman power), the Scandinavian states, the kingdom of Hungary, the Slav states of Bohemia, Poland, Servia, Bosnia and Bulgaria, and the Christian states founded in Syria by the crusaders of the 12th century. The success of Roman imperialism was particularly remarkable in England, where Innocent was confronted by one of the principal potentates of the West, by the heir of the power that had been founded by two statesmen of the first rank, William the Conqueror and Henry II. In Richard I. and John he had exceptionally authoritative adversaries; but after one of the fiercest wars ever waged by the civil power against the Church, Innocent at length gained over John the most complete victory that has ever been won by a religious potentate over a temporal sovereign, and constrained him to make complete submission. In 1213 the pope became not only the nominal suzerain but, *de facto* and *de jure,* the veritable sovereign of England, and during the last years of John and the first years of Henry III. he governed England effectively by his legates.

The papacy, however, encountered serious obstacles, at first at the very centre of the papal empire, at Rome, where the pope had to contend with the party of communal autonomy for ten years before being able to secure the mastery at Rome. His immense authority narrowly escaped destruction but a stone's-throw from the Lateran palace; but the victory finally rested with him, since the Roman people could not dispense with the Roman Church, to which it owed its existence. Reared in the nurture of the pope, the populace of the Tiber renounced its stormy liberty in 1209, and accepted the peace and order that a beneficent master gave; but when Innocent attempted to extend to the whole of Italy the régime of paternal subjection that had been so successful at Rome, the difficulties of the enterprise surpassed the powers even of a leader of religion. As guardian of Henry VI.'s son Frederick, Innocent was for some time able to conduct the government of the kingdom of the Two Sicilies, but he was entirely unable, either by diplomacy or force of arms, to make Italian unity redound to the exclusive benefit of the Holy See. Nor was his failure due to lack of activity or energy, but rather to the insuperable obstacles in his path—the physical configuration of Italy, and, above all, the invincible repugnance of the Italian municipalities.

As far as the Empire was concerned, chance at first favoured Innocent. For ten years a Germany weakened and divided by the rivalry of Philip of Swabia and Otto of Brunswick left his hands free to act in Italy, and his pontificate marks a period of comparative quiet in the ardent conflict between pope and emperor which continued throughout the middle ages. Not until 1210, when Otto of Brunswick turned against the pope to whom he owed his crown, was Innocent compelled to open hostilities; and the struggle ended in a victory for the Curia. Frederick II., the new emperor created by Innocent, began by handing over his country to Rome and sacrificing the rights of the empire to the union of the two great authorities of the Christian world. In his dealings with Frederick, Innocent experienced grievous vicissitudes and disappointments, but finally became master of the situation. One nation only—the France of Philip Augustus—was able to remain outside the Roman vassalage.

Finally, Innocent III. was more fortunate than his predecessors, and, if he did not succeed in carrying out his projected crusade and recovering the Holy Places, he at least benefited by the Franco-Venetian expedition of 1202. Europe refused to take any direct action against the Muslim, but Latin feudalism, assembled at Venice, diverted the crusade by an act of formal disobedience, marched on Constantinople, seized the Greek empire and founded a Latin empire in its place; and Innocent had to accept the *fait accompli.* Though condemning it on principle, he turned it to the interests of the Roman Church as well as of the universal Church. With joy and pride he welcomed the Byzantine East into the circle of vassal peoples and kingdoms of Rome bound politically to the see of St. Peter, and with the same emotions beheld the patriarchate of Constantinople at last recognize Roman supremacy. But from this enormous increase of territory and influence arose a whole series of new and difficult problems. The court of Rome had to substitute for the old Greek hierarchy a hierarchy of Latin bishops; to force the remaining Greek clergy to practise the beliefs and rites of the Roman religion and bow to the supremacy of the pope; to maintain in the Greco-Latin Eastern Church the necessary order, morality and subordination; to defend it against the greed and violence of the nobles and barons who had founded the Latin Empire; and to compel the leaders of the new empire to submit to the apostolic power and execute its commands. In his endeavours to carry out the whole of this programme, Innocent III. met with insuperable obstacles and many disappointments. On the one hand, the Greeks were unwilling to abandon their religion and national cult, and scarcely recognized the ecclesiastical supremacy of the papacy. On the other hand, the upstart Latin emperors, far from proving submissive and humble tools, assumed with the purple the habits and pretensions of the sovereigns they had dispossessed. Nevertheless, Innocent left his successors a much vaster and more stable political dominion than that which he had received from his predecessors, since it comprised both East and West; and his five immediate successors were able to preserve this ascendancy. They even extended the limits of Roman imperialism by converting the pagans of the Baltic to Christianity, and further reinforced the work of ecclesiastical centralization by enlisting in their service a force which had recently come into existence and was rapidly becoming popular—the mendicant orders, and notably the Dominicans and Franciscans. The Roman power was also increased by the formation of the universities—privileged corporations of masters and students, which escaped the local power of the bishop and his chancellor only to place themselves under the direction and supervision of the Holy See. Mistress of the entire Christian organism, Rome thus gained control of international education, and the mendicant monks who formed her devoted militia lost no time in monopolizing the professorial chairs. Although the ecclesiastical monarchy continued to gain strength, the successors of Innocent III. made less use than he of their immense power. Under Gregory IX. (1227–1241) and Innocent IV. (1243–1254) the conflict between the priesthood and the Empire was revived by the enigmatic Frederick II., the polyglot and lettered emperor, the friend of Saracens, the despot who, in youth styled "king of priests," in later years personified ideas that were directly opposed to the mediaeval theocracy; and the struggle lasted nearly 30 years. The Hohenstaufen succumbed to it, and the papacy itself received a terrible shock, which shook its vast empire to the foundations.

Nevertheless, the first half of the 13th century may be regarded as the grand epoch of mediaeval papal history. Supreme in Europe, the papacy gathered into a body of doctrine the decisions given in virtue of its enormous *de facto* power, and promulgated its collected decrees and *oracula* to form the immutable law of the Christian world. Innocent III., Honorius III. and Gregory IX. employed their jurists to collect the most important of their rulings, and Gregory's decrees became the definitive repository of the canon law. Besides making laws for the Christendom of the present and the future, these popes employed themselves in giving a more regular form to their principal administrative organ, the offices of the Curia. The development of the Roman chancery

is also a characteristic sign of the evolution that was taking place.

4. URBAN IV. TO BENEDICT XI. (1261-1305)

This period comprises 13 pontificates, all short (three or four years at the most, and some only a few months), with the exception of that of Boniface VIII., who was pope for nine years. This accidental fact constitutes a prime difference in favour of the preceding period, in which there were only five pontiffs during the first 60 years of the 13th century.

Influence of France.—Although there was no theoretical restriction to the temporal supremacy and religious power of the papacy, certain historical facts of great importance contributed to the fatal diminution of their extent. The first of these was the preponderance of the French monarchy and nation in Europe. Founded by the conquests of Philip Augustus and Louis VIII. and legitimated and extended by the policy and moral influence of the crowned saint, Louis IX., the French monarchy enjoyed undisputed supremacy at the end of the 13th century and the beginning of the 14th; and this hegemony of France was manifested, not only by the extension of the direct power exercised by the French kings over all the neighbouring nationalities, but also by the establishment of Capetian dynasties in the kingdom of the Two Sicilies and in Hungary. From this time the sovereign of Rome, like other sovereigns, had to submit to French influence. But, whereas the pope was sometimes compelled to become the instrument of the policy of the kings of France or the adventurers of their race, he was often able to utilize this new and pervading force for the realization of his own designs, although he endeavoured from time to time, but without enduring success, to shake off the overwhelming yoke of the French.

It was the Frenchman Urban IV. (1261–1264) who called Charles of Anjou into Italy to combat the last heirs of Frederick II. and thus paved the way for the establishment of the Angevin dynasty on the throne of Naples. Under Clement IV. (1265–1268), an agreement was concluded by which Sicily was handed over to the brother of St. Louis, and the victories of Benevento (1266) and Tagliacozzo (1267) assured the triumph of the Guelph party and enabled the Angevins to plant themselves definitely on Neapolitan soil. Conradin's tragic and inevitable end closed the last act of the secular struggle between the Holy See and the empire. Haunted by the recollection of that formidable conflict and lulled in the security of the Great Interregnum, which was to render Germany long powerless, the papacy thought merely of the support that France could give, and paid no heed to the dangers threatened by the extension of Charles of Anjou's monarchy in central and northern Italy. The Visconti Gregory X. (1271–1276) made an attempt to bring about a reaction against the tendency which had influenced his two immediate predecessors. He placed himself outside the theatre of French influence, and occupied himself solely with the task of giving to the papal monarchy that character of universality and political superiority which had made the greatness of an Alexander III. or an Innocent III. He opposed the aggrandizing projects of the Angevins, intervened in Germany with a view to terminating the Great Interregnum, and sought a necessary counterpoise to Capetian predominance in an alliance with Rudolph of Habsburg, who had become an emperor without imperilling the papacy. The Orsini Nicholas III. pursued the same policy with regard to the independence and greatness of the Roman See, but died too soon for the cause he upheld, and, at his death in 1280, the inevitable current revived with overpowering force. His successor, Martin IV. (1281–1285), a prelate of Champagne, brother of several councillors of the king of France, prebendary at Rouen and Tours, and one of the most zealous in favour of the canonization of Louis IX., ascended the papal throne under the auspices of Charles of Anjou, and undertook the government of the Church with the sole intention of furthering in every way the interests of the country of his birth. A Frenchman before everything, he abased the papal power to such an extent as to excite the indignation of his contemporaries, often slavishly subordinating it to the exigencies of the domestic and foreign policy of the Angevins at Naples and the reigning house at Paris. But he was prevented from carrying out this policy by an unforeseen blow, the Sicilian Vespers (March 1282), an event important both in itself and in its results. By rejecting the Capetian sovereign that Rome wished to thrust upon it to deliver it from the dynasty of Aragon, the little island of Sicily arrested the progress of French imperialism, ruined the vast projects of Charles of Anjou, and liberated the papacy in its own despite from a subjection that perverted and shook its power. Honorius IV. (1285–1287) and Nicholas IV. (1288–1292) were able to act with greater dignity and independence than their predecessors. Though remaining leagued with the Angevins in southern Italy, they dared to look to Germany and Rudolph of Habsburg to help them in their efforts to add to the papal dominion a part of northern Italy and, in particular, Tuscany. But they still continued to desire the restoration of the Angevin dynasty in Sicily and to assist the designs of France on Aragon by preaching a crusade against the masters of Barcelona and Palermo. The hopes of the Curia were frustrated by the resistance of the Aragonese and Sicilians, and Charles of Valois, to whom the Curia eventually destined the crown of Aragon, had to resign it for that of Constantinople, which he also failed to secure.

Subjection to France.—Boniface VIII. (1294–1303) also at the beginning of his pontificate had yielded to the current, and, like his predecessors, adapted his external policy to the pretensions and interests of the great Capetian house, which, like all his predecessors, he at first countenanced. In spite of his instincts for dominion and the ardour of his temperament, he made no attempt to shake off the French yoke, and did not decide on hostilities with France until Philip the Fair and his legists attempted to change the character of the kingship, emphasized its lay tendencies, and exerted themselves to gratify the desire for political and financial independence which was shared by the French nation and many other European peoples. The war which ensued between the pope and the king of France ended in the complete defeat of the papacy, which was reduced to impotence (1303), and though the storm ceased during the nine months' pontificate of Benedict XI., the see of St. Peter recovered neither its normal equilibrium nor its traditional character. The accession of the first Avignon pope, Clement V., marks the final subjection of the papal power to the Capetian government, the inevitable result of the European situation created in the preceding century.

In other respects the papacy of this period found itself in a very inferior situation to that which it had occupied under Innocent III. and the popes of the first half of the 13th century. The fall of the Latin empire and the retaking of Constantinople by the Palaeologi freed a great part of the Eastern world from the political and religious direction of Rome, and this fact necessarily engaged the diplomacy of Urban IV. and his successors in an entirely different direction. To them the Eastern problem presented a less complex aspect. There could no longer be any serious question of a collective expedition of Europe for the recovery of the Holy Places. The ingenuous faith of a Louis IX. was alone capable of giving rise to two crusades organized privately and without the influence or even the approval of the pope. But the European state of mind no longer lent itself to such enterprises.

The main preoccupation of all these popes was how best to repair the injury done to orthodox Europe and to Rome by the destruction of the Latin empire. Several of them thought of restoring the lost empire by force, and thus giving a pendant to the fourth crusade; but the Curia finally realized the enormous difficulties of such a project, and convinced themselves that the only practical solution of the difficulty was to come to an understanding with the Palaeologi and realize pacifically the long-dreamed union of the Greek and Latin Churches. The negotiations begun by Urban IV. and continued more or less actively by his successors were at last concluded in 1274 by Gregory X. The Council of Lyons proclaimed the union, which was destined to be effective for a few years at least and to be prolonged precariously in the midst of unfavourable circumstances. The Greek mind was opposed to the union; the acquiescence of the Byzantine emperors was but an ephemeral expedient of their foreign policy; and the peace between the Latins and Greeks settled on Byzantine soil could not endure for long. The principal obstacle, however,

was the incompatibility of the popes' Byzantine and Italian policies. The popes were in favour of Charles of Anjou and his dynasty, but Charles was hostile to the union of the two Churches, since it was his intention to seize the Byzantine empire and substitute himself for the Palaeologi. Almost all the successors of Urban IV. were compelled to exert their diplomacy against the aggrandizing aims of the man they had themselves installed in southern Italy, and to protect the Greek emperor, with whom they were negotiating the religious question. On several occasions between the years 1271 and 1273 the Angevins of Naples, who had great influence in Achaea and Albania and were solidly supported by their allies in the Balkan peninsula, nearly carried out their project; and in 1274 the opposition of Charles of Anjou came near to compromising the operations of the council of Lyons and ruining the work of Gregory X. The papacy, however, held its ground, and Nicholas III., the worthy continuer of Gregory, succeeded in preserving the union and triumphing over the Angevin power. The Angevins took their revenge under Martin IV., who was a stanch supporter of the French. Three weeks after his coronation Martin excommunicated the Greek emperor and all his subjects, and allied himself with Charles of Anjou and the Venetians to compass his downfall. In this case, too, the Sicilian Vespers was the rock on which the hopes and pretensions of the sovereign of Naples suffered shipwreck. After Martin's death the last popes of the 13th century, and notably Boniface VIII., in vain thought to find in another Capetian, Charles of Valois, the man who was to re-establish the Latin dominion at Byzantium. But the East was lost; the union of 1274 was quickly dissolved; and the reconciliation of the two Churches again entered into the category of chimeras.

Decay.—During this period the papal institution, considered in the development of its inner life, already showed signs of decadence. The diminution of religious faith and sacerdotal prestige shook it to its very foundations. The growth of the lay spirit continued to manifest itself among the burgesses of the towns as well as among the feudal princes and sovereigns. The social factors of communism and nationalism, against which Innocent III. and his successors had struggled, became more powerful and more hostile to theocratic domination. That a sovereign like St. Louis should be able to associate himself officially with the feudalism of his realm to repress abuses of church jurisdiction; that a contemporary of Philip the Fair, the lawyer Pierre Dubois, should dare to suggest the secularization of ecclesiastical property and the conversion of the clergy into a class of functionaries paid out of the royal treasury; and that Philip the Fair, the adversary of Boniface VIII., should be able to rely in his conflict with the leader of the Church on the popular consent obtained at a meeting of the three estates of France—all point to a singular demoralization of the sentiments and principles on which were based the whole power of the pontiff of Rome and the entire organization of mediaeval Catholicism. Both by its attitude and by its governmental acts, the papacy of the later 13th century itself contributed to increase the discredit and disaffection from which it suffered. Under Urban IV. and his successors the great moral and religious sovereignty of former times became a purely bureaucratic monarchy, in which the main preoccupation of the governors appeared to be the financial exploitation of Christendom. The continued efforts of the popes to drain Christian gold to Rome were limited only by the fiscal pretensions of the lay sovereigns, and it was this financial rivalry that gave rise to the inevitable conflict between Boniface VIII. and Philip the Fair.

By thus devoting itself to material interests, the papacy contemporary with the last Capetians lost its moral greatness and fell in the opinion of the peoples; and it did itself no less injury by the abnormal extension of the bounds of its absolutism. By its exaggerated methods of centralization the papal monarchy had absorbed within itself all the living forces of the religious world and suppressed all the liberties in which the Church of old had lived. The subjection of the secular clergy was complete, while the episcopate retained no shadow of its independence. The decree of Clement IV. (1266), empowering the papacy to dispose of all vacant bishoprics at the court of Rome, merely sanctioned a usage that had long been established. But the control exercised by the Roman Curia over the episcopate had been realized by many other means. It was seldom that an episcopal election took place without a division in the chapter, in which resided the electoral right. In such an event, the competitors appealed to the Holy See and abdicated their right, either voluntarily or under coercion, *in manibus papae*, while the pope took possession of the vacant see. Nominations directly made by the court of Rome, especially in the case of dioceses long vacant, became increasingly numerous. The principle of election by canons was repeatedly violated, and threatened to disappear; and at the end of the 13th century the spectacle was common of prelates, whether nominated or confirmed by the pope, entitling themselves "bishops by the grace of the Holy See."

The regular clergy, who were almost wholly sheltered from the power of the diocesan bishops, found themselves, even more than the secular priesthood, in a state of complete dependence on the Curia. The papacy of this period continually intervened in the internal affairs of the monasteries. Not only did the monks continue to seek from the papacy the confirmation of their privileges and property, but they also referred almost all their disputes to the arbitration of the pope. Their elections gave rise to innumerable lawsuits, which all terminated at the court of Rome, and in most cases it was the pope himself who designated the monks to fill vacant posts in the abbeys. Thus the pope became the great ecclesiastical elector as well as the universal judge and supreme legislator. On this extreme concentration of the Christian power was employed throughout Europe an army of official agents or officious adherents of the Holy See, who were animated by an irrepressible zeal for the aggrandizement of the papacy. These officials originally consisted of an obedient and devoted militia of mendicant friars, both Franciscans and Dominicans, who took their orders from Rome alone, and whose efforts the papacy stimulated by lavishing exemptions, privileges and full sacerdotal powers.

The sovereign direction of this enormous monarchy belonged to the pope alone, who was assisted in important affairs by the advice and collaboration of the College of Cardinals, who had become the sole electors to the papacy. Towards the close of the 13th century the necessity arose for an express ruling on the question of the exercise of this electoral right. In 1274 Gregory X., completing the measures taken by Alexander III. in the 12th century, promulgated the celebrated constitution by which the cardinal-electors were shut up in conclave and, in the event of their not having designated the new pope within three days, were constrained to perform their duty by a progressive reduction of their food-allowance (*see* CONCLAVE). But at the head of this vast body there existed a constant tendency which was opposed to the absorption of all the power by a single and unbridled will. In the last years of this period fresh signs appeared of a reaction that emanated from the Sacred College itself. The cardinal-electors endeavoured to derive from their electoral power a right of control over the acts of the pope elect. In 1294, and again in 1303, they laid themselves under an obligation, previously to the election, to subscribe to the political engagements which each promised rigorously to observe in the event of his becoming pope. In general, these engagements bore upon the limitation of the number of cardinals, the prohibition to nominate new ones without previous notification to the Sacred College, the sharing between the cardinals and the pope of certain revenues specified by a bull of Nicholas IV., and the obligatory consultation of the consistories for the principal acts of the temporal and spiritual government. It is conceivable that a pope of Boniface VIII.'s temperament would not submit kindly to any restriction of the discretionary power with which he was invested by tradition, and he endeavoured to make the cardinals dependent on him and even to dispense with their services as far as possible, only assembling them in consistory in cases of extreme necessity. This tendency of the Sacred College to convert the Roman Church into a constitutional monarchy, in which it should itself play the part of parliament, was a sufficiently grave symptom of the progress of the new spirit. But throughout the ecclesiastical society traditional bonds were

loosened and anarchy was rife, and this at the very moment when the enemies of the priesthood and its leaders redoubled their attack. In fine, the decadence of the papal institution manifested itself in an irremediable manner when it had accomplished no more than the half of its task. The growth of national kingdoms, the anti-clerical tendencies of the emancipated middle classes, the competition of lay imperialisms, and all the other elements of resistance which had been encountered by the papacy in its progress and had at first tended to shackle it, now presented an insurmountable barrier The papacy was weakened by its contest with these adverse elements, and it was through its failure to triumph over them that its dream of European dominion, both temporal and spiritual, entered but very incompletely into the field of realities (A. Lu)

III. FROM 1305 TO 1590

The accession of the Gascon Clement V. (1305–1314) marks the beginning of a new era in the history of the papacy; for this pope, formerly archbishop of Bordeaux, remained in France, without once crossing the threshold of the Eternal City. Clement's motive for this resolution was his fear that the independence of the ecclesiastical government might be endangered among the frightful dissensions and party conflicts by which Italy was then convulsed; while at the same time he yielded to the pressure exercised on him by the French king, Philip the Fair. In March 1309 Clement V. transferred his residence to Avignon, a town which at that time belonged to the king of Naples, but was surrounded by the countship of Venaissin, which as early as 1228 had passed into the possession of the Roman See. Clement V. remained at Avignon till the day of his death, so that with him begins the so-called Babylonian Exile of the popes. Through this, and his excessive subservience to Philip the Fair, his reign proved the reverse of salutary to the Church The pope's subservience was above all conspicuous in his attitude towards the proceedings brought against the order of the Temple, which was dissolved by the Council of Vienne (*see* TEMPLARS)

Character of the Avignon Papacy.—His successor John XXII. (1316–1334), a native of Cahors, was elected as the result of very stormy negotiations, after a two years' vacancy of the see (1316). Like his predecessor he fixed his permanent residence at Avignon, where he had formerly been bishop. But while Clement V. had contented himself with the hospitality of the Dominican monastery at Avignon, John XXII installed himself with great state in the episcopal palace, hard by the cathedral. The essential features of this new epoch in the history of the papacy, beginning with the two popes mentioned, are intimately connected with this lasting separation from the traditional seat of the papacy, and from Italian soil in general: a separation which reduced the head of the Church to a fatal dependence on the French kings Themselves Frenchmen, and surrounded by a college of cardinals in which the French element predominated, the popes gave to their ecclesiastical administration a certain French character, till they stood in more and more danger of serving purely national interests, in cases where the obligations of their office demanded complete impartiality. And thus the prestige of the papacy was sensibly diminished by the view, to which the jealousy of the nations soon gave currency, that the supreme dignity of the Church was simply a convenient tool for French statecraft. The accusation might not always be supported by facts, but it tended to shake popular confidence in the head of the universal Church, and to inspire other countries with the feeling of a national opposition to an ecclesiastical régime now entirely Gallicized. The consequent loosening of the ties between the individual provinces of the Church and the Apostolic See, combined with the capricious policy of the Court at Avignon, which often regarded nothing but personal and family interests, accelerated the decay of the ecclesiastical organism, and justified the most dismal forebodings for the future. To crown all, the feud between Church and Empire broke out again with unprecedented violence The most prominent leaders of the opposition to the papacy, whether ecclesiastical or political, joined forces with the German king, Louis of Bavaria, and offered him their aid against John XXII The clerical opposition was led by the very popular and influential Minorites who were at that time engaged in a remarkably bitter controversy with the pope as to the practical interpretation of the idea of evangelical poverty. Their influence can be clearly traced in the appeal to a general council, issued by Louis in 1324 at Sachsenhausen near Frankfurt-on-the-Main. This document, which confused the political problem with the theological, was bound to envenom the quarrel between emperor and pope beyond all remedy. Side by side with the Minorites, the spokesmen of the specifically political opposition to the papacy were the Parisian professors, Marsilius of Padua and John of Jandun, the composers of the *Defender of the Peace* (*defensor pacis*). In conjunction with the Minorites and the Ghibellines of Italy, Marsilius succeeded in enticing Louis to the fateful expedition to Rome and the revolutionary actions of 1328 The conferring of the imperial crown by the Roman populace, the deposition of the pope by the same body, and the election of an anti-pope in the person of the Minorite Pietro da Corvara, translated into acts the doctrines of the *defensor pacis.* The struggle, which still further aggravated the dependence of the pope on France, was waged on both sides with the utmost bitterness, and the end was not in sight when John XXII died, full of years, on Dec 4, 1334

Even the following pope, Benedict XII. (1334–1342), a man of the strictest morality, failed, in spite of his mild and pacific disposition, to adjust the conflict with Louis of Bavaria and the eccentric Fraticelli King Philip VI. and the cardinals of the French party worked energetically against the projected peace with Louis, and Benedict was not endowed with sufficient strength of will to carry through his designs in the teeth of their opposition

His efforts in the direction of reform, moreover, deserve recognition In Avignon he began to erect himself a suitable residence, which, with considerable additions by later popes, developed into the celebrated papal castle of Avignon

Benedict XII. was also succeeded, in 1342, by a Frenchman from the south, Pierre Roger de Beaufort, who was born in the castle of Maumont, in the diocese of Limoges He assumed the title of Clement VI (1342–1352) In contrast with his peace-loving predecessor, and in accordance with his own more energetic character, he pursued with decision and success the traditions of John XXII in his dealings with Louis of Bavaria. With great dexterity he turned the feud between the houses of Luxemburg and Wittelsbach to the destruction of Louis; and the death-struggle between the two seemed about to break out, when Louis met his untimely end To all appearances the victory of the papacy was decisive· but it was a Pyrrhic victory, as events were quickly to prove In Rome there ensued, during the pontificate of Clement, the revolutions of the visionary Cola di Rienzi (*q v*) who restored the old republic, though not for long By his purchase of Avignon, and the creation of numerous French cardinals, the pope consolidated the close connection of the Roman Church with France: but the interests of that church suffered severely through the riches and patronage which Clement lavished on his relatives, and through the princely luxury of his court

It was fortunate for the Church that Clement VI was followed by a man of an entirely different temperament—Innocent VI (1352–1362). This strict and upright pope appears to have taken Benedict XII for his example. He undertook, though not with complete success, a reformation of ecclesiastical abuses; and it was he who assisted in restoring the Empire at last to some measure of stability But the culminating glory of his reign was the restoration of the almost ruined papal dominion in Italy, by means of the highly-gifted Cardinal Albornoz. The restoration of the Apostolic See to its original and proper seat was now possible; and the need for such a step was the more pressing, since residence in the castle at Avignon had become extremely precarious, owing to the ever-increasing confusion of French affairs

The Return to Rome.—The intention of Innocent was put into execution by his successor—the learned and pious Urban V. (1362–1370). Two events of the first magnitude make his reign one of the most memorable in the century. The first of these was the return to Rome This was an object which the emperor

Charles IV. had prosecuted with all his energies; which alone could revive the languishing reputation of the papacy, by withdrawing it from the turmoils of the Anglo-French war, and bring within the bounds of possibility the much-needed reformation in ecclesiastical affairs. In 1367 it became an accomplished fact. Turning a deaf ear to the remonstrances of the French king and the French cardinals, the pope quitted Avignon on April 13, 1367; and on Oct. 16 he entered Rome, now completely fallen to ruin. The ensuing year, after his return to the Eternal City, witnessed the second great landmark in the reign of Urban V.—the Roman expedition of Charles IV., and the renewal of amicable relations between the Empire and the Church. Unfortunately, the pope failed to deal satisfactorily with the highly complicated situation in Italy; and the result was that, on Sept. 27, 1370, he returned to Avignon, where he died on the following Dec. 19.

Gregory XI. (1370–1378), though equally distinguished for his erudition and pure morals, his piety, modesty and wisdom, was fated to pay dearly for the weakness of his predecessor in abandoning Rome so early. He lived to see the national spirit of Italy thoroughly aroused against a papacy turned French. The disastrous error of almost exclusively appointing Provençals, foreigners ignorant of both the country and the people, to the government of the Papal States, now found a terrible Nemesis: and there came a national upheaval, such as Italy had not yet witnessed. The feud between Italian and Frenchman broke out in a violent form; and it was in vain that St. Catherine of Siena proffered her mediation in the bloody strife betwixt the pope and the Florentine republic. The letters that she addressed to the pontiff, on this and other occasions, are documents, which are, perhaps, unique in their kind, and of great literary beauty. It was also St. Catherine who prevailed on Gregory XI. to return to Rome. On Sept. 13, 1376, he left Avignon; on Jan. 17, 1377, he made his entry into the city of St. Peter. Thus ended the exile in France; but it left an evil legacy in the schism under Gregory's successor. Gregory, the last pope whom France has given to the Church, died on March 27, 1378, after taking measures to ensure a speedy and unanimous election for his successor.

The Great Schism.—The conclave, which took place in Rome for the first time for 75 years, resulted in the election of Bartolomeo Prignano (April 8, 1378), who took the name of Pope Urban VI. (1378–1389). Canonically the election was perfectly valid; so that the only popes to be regarded as legitimate are the successors of Urban. (*See* Pastor, *Geschichte der Päpste*, i., 121.) It is true that his election was immediately impugned by the cardinals on frivolous grounds; but the responsibility for this rests, partially at least, with the pope himself, whose reckless and inconsiderate zeal for reform was bound to excite a revolution among the worldly cardinals still yearning for the fleshpots of Avignon. This revolution could already be foreseen with tolerable certainty, when Urban embroiled himself even with his political friends—the queen of Naples and her husband, Duke Otto of Brunswick. Similarly, he quarrelled with Count Onorato Gaetano of Fondi. The cardinals, excited to the highest pitch of irritation, now knew where they could look for support. Thirteen of them assembled at Anagni, and thence, on Aug. 9, issued a passionate manifesto, announcing the invalidity of Urban's election, on the ground that it had been forced upon the conclave by the Roman populace. As soon as the rebellious cardinals were further assured of the protection of the French king, Charles V., they elected, with the tacit consent of the three Italian cardinals, Robert of Geneva, as anti-pope (Fondi, Sept. 20). Robert assumed the style of Clement VII.; the Great Schism (1378–1417) had begun.

The chief responsibility for this rests with the worldly college of cardinals, who were longing to return to France, and thence drew their inspiration. This college was a creation of the Avignon period; which must therefore, in the last resort, be considered responsible for this appalling calamity. Severe censure, moreover, attaches to Charles V., of France. There may be room for dispute as to the extent to which the king's share in the schism was due to the instigation of the revolted cardinals; there can be not the slightest doubt that his attitude was the decisive factor in perpetuating and widening the breach. The anti-pope was recognized not only by Charles of France, but by the princes of the Empire dependent on him, by Scotland and Savoy, and finally by the Spanish dominions and Portugal. On the other hand, the emperor, Charles IV., and his son, Wenceslaus, the greater part of the Empire, England, Hungary, Poland, Denmark, Norway and Sweden, together with the majority of the Italian States—Naples excepted—remained loyal to the pope. Urban, in fact—who meanwhile had created a new college of cardinals with members of different nationalities—enjoyed one great advantage; his rival failed to hold his own in Italy, with which country the actual decision virtually lay. Unfortunately, in the time that followed, Urban was guilty of the grossest errors, pursuing his personal interests, and sacrificing, all too soon, that universal point of view which ought to have governed his policy. The struggle against his powerful neighbour on the frontier, Queen Joanna of Naples, rapidly became his one guiding motive; and thus he was led into a perfect labyrinth of blunders. He excommunicated the queen as a stiff-necked adherent of the French anti-pope, and in 1381 conferred Naples on the ambitious Charles of Durazzo, with whom he was soon inextricably embroiled; while, a little later, he fell out with his new college of cardinals. On Oct. 15, 1389, he died with few to lament him.

Boniface IX.—After the death of Urban VI., 14 cardinals of his obedience assembled, and after prolonged negotiations elected for this high office Cardinal Pietro Tomacelli (Nov. 2, 1389). The title which he took was that of Boniface IX. (1389–1404). The new pope—a man of high moral character, great sagacity, eloquence, and of a kindly disposition—at once instituted an entirely different policy from that pursued by his predecessor. This was especially the case in his treatment of Naples. In May 1390 Ladislaus, the son of Charles of Durazzo, who had been assassinated in the February of 1386, received the royal crown at the hands of a papal legate. To his cause Boniface IX. closely attached himself; and his support of the king against the Angevins cost him enormous sums, without which Ladislaus could not have secured his victory over the French claimant. By these means, the schism was averted from Italy, and Naples won for the Roman obedience. The situation in the papal State, which Boniface found in the greatest confusion, was at the outset far more difficult to deal with. But here also he attained in time a considerable measure of success, although the methods employed were scarcely above criticism. His greatest success, however, was gained in the Eternal City itself; for he contrived, after many vicissitudes, to induce the Romans to annul their republican constitution and acknowledge the papal supremacy, even in municipal matters.

To give this supremacy a firmer basis, Boniface fortified the Vatican and the Capitol, and restored the castle of St. Angelo—which had previously been used as a quarry—providing it with walls and battlements, and erecting a tower in the centre. This castle, indeed, yielded a safe shelter to the pope in Jan. 1400 when the Colonnas made their attempt to surprise Rome. However, the adventure failed; and by the aid of Ladislaus, the castles of the Colonnas in the vicinity of Rome were destroyed. In 1401 this powerful family made its submission, accepting the favourable terms which the pope had had the good sense to offer. Henceforward quiet prevailed, and Boniface ruled as a stern master in Rome.

Thus Boniface IX., as a secular prince, occupies an important position; but as pope his activity must be unfavourably judged. Even if Dietrich of Niem frequently painted him too black, there is no question that the means which Boniface employed to fill the papal treasury seriously impaired the prestige of the highest spiritual office and the reverence due to it. His nepotism, again, casts a dark shadow over his memory: but most regrettable of all was his indifference towards the ending of the schism

Crisis in Papal History.—On the death of Boniface (Oct 1, 1404), the Roman cardinals once more elected a Neapolitan, Cosimo dei Migliorati, who, at the age of 65, assumed the name of Innocent VII. (1404–1406). Innocent, who was animated by a great love for the sciences and all the arts of peace, enjoyed only a brief pontificate, but his reign is not without importance, if only

as an example of the generous patronage which the papacy—even in its darkest days—has lavished on literature and science. Significant also is the foothold gained at this time in the Curia itself by the humanists—Poggio, Bruni and others.

The crisis came to a head in the pontificate of Gregory XII. (1406–1415). This pope, so distinguished in many respects, owed his election mainly to the circumstance that he was considered a zealous champion of the restoration of unity within the Church: and he displayed, in fact, during the earlier portion of his reign, an exalted enthusiasm for this great task. Later his attitude changed; and the protracted negotiations for a conference with Benedict XIII. remained fruitless. The result of this change in the attitude of Gregory was the formation of a strong malcontent party in the college of cardinals; to counteract whose influence, the pope—faithless to the conditions attached to his election—resorted to the plan of creating new members.

At the same period, the relations of Benedict XIII. (antipope 1394) with France suffered a significant modification. It became more and more manifest that Benedict had no genuine desire to heal the schism in the Church, in spite of the ardent zeal for union which he had displayed immediately before and after his election. In May 1408 France withdrew from his obedience; and it was not long before French policy succeeded in effecting a reconciliation and understanding between the cardinals of Benedict XIII. and those who had seceded from Gregory XII. Precisely as if the Holy See were vacant, the cardinals began to act as the actual rulers of the Church, and issued formal invitations to a council to be opened at Pisa on the Feast of the Annunciation (March 25) 1409. Both popes attempted to foil the disaffected cardinals by convening councils of their own; but their efforts were doomed to failure.

On the other hand, the council of the cardinals—though, by the strict rules of canonical law, its convocation was absolutely illegal—attained the utmost importance. But these rules, and, in fact, the whole Catholic doctrine of the primacy were almost entirely obscured by the schism. Scholars like Langenstein, Gerson and Zabarella, evolved a new theory as to oecumenical councils, which from the point of view of Roman Catholic principles must be described as revolutionary. At the synod of the dissident cardinals assembled at Pisa, views of this type were in the ascendant; and, although protests were not lacking, the necessities of the time served as a pretext for ignoring all objections.

The Triple Schism.—That the council was merely a tool in the hands of the ambitious and adroit Baldassare Cossa, was a fact unsuspected by its members, who were animated by a fiery enthusiasm for the re-establishment of ecclesiastical unity; nor did they pause to reflect that an action against *both* popes could not possibly be lawful. Since whole universities and numerous scholars had pronounced in favour of the new theories, the Pisan synod dismissed all canonical scruples, and unhesitatingly laid claim to authority over both popes, one of whom was necessarily the legitimate pope. It was in vain that Carlo di Malatesta, a staunch adherent of Gregory, sought at the eleventh hour to negotiate a compromise between Gregory and the synod. It was in vain that this cultured prince, imbued with the principles of humanism, represented to the cardinals that this new path would lead quickly to the goal, but that this goal could not be unity but a triple schism. The council declared that it was canonically convened, oecumenical, and representative of the whole Catholic Church; then proceeded immediately to the trial and deposition of Benedict XIII. and Gregory XII. The synod grounded its procedure against the rival popes on a fact, ostensibly patent to all, but actually believed by none—that they were both supporters of the schism, and not merely this, but *heretics* in the truest and fullest sense of the word, since their attitude had impugned and subverted the article of faith concerning the one Holy, Catholic and Apostolic Church. On the ground of this extremely dubious declaration, designed to compensate for the absence of any authentic and firm foundation in ecclesiastical law, the Pisan assembly on June 5 announced the deposition of Gregory XII. and Benedict XIII., as manifest heretics and partisans of the schism. The next step was to elect a new pope; and on June 26, 1409, the choice fell on the venerable cardinal-archbishop of Milan, the Greek Petros Filargis, who assumed the title of Alexander V. (1409–1410).

Alexander V., the pope of the council, died on May 3, 1410. The cardinals at once elected his successor—Baldassare Cossa, who took the name of John XXIII. (1410–1415). Of all the consequences of the disastrous Pisan council, the election of this man was the most unfortunate. True, it cannot be demonstrated that all the fearful accusations afterwards levelled at John XXIII. were based on fact: but it is certain that this cunning politician was so far infected with the corruption of his age that he was not in the least degree fitted to fulfil the requirements of the supreme ecclesiastical dignity. From him the welfare of the Church had nothing to hope. All eyes were consequently turned to the energetic German king, Sigismund, who was inspired by the best motives, and who succeeded in surmounting the formidable obstacles which barred the way to an oecumenical council. It was mainly due to Sigismund's indefatigable and magnificent activity, that the Council of Constance met and was so numerously attended. It is remarkable how fortune seemed to assist his efforts. The capture of Rome by King Ladislaus of Naples had compelled John XXIII. to take refuge in Florence (June 1413), where that dangerous guest received a not very friendly welcome. Since John's most immediate need was now protection and assistance against his terrible opponent Ladislaus, he sent, towards the close of Aug. 1413, Cardinals Chalant and Francesco Zabarella, together with the celebrated Greek Manuel Chrysoloras, to King Sigismund, and commissioned them to determine the time and place of the forthcoming council. The agreement was soon concluded. On Dec. 9 John XXIII. signed the bull convening the council at Constance, and pledged his word to appear there in person. He might have hoped that his share in convening the synod would give him a certain right to regulate its proceedings, and that, by the aid of his numerous Italian prelates, he would be able to influence it more or less according to his views. But in this he was greatly deceived. So soon as he realized the true position of affairs he attempted to break up the council by his flight to Schaffhausen (March 20–21, 1415)—a project in which he would doubtless have succeeded but for the sagacity and energy of Sigismund.

In spite of everything, the excitement in Constance was unbounded. In the midst of the confusion, which reigned supreme in the council, the upper hand was gained by that party which held that the only method by which the schism could be ended and a reformation of ecclesiastical discipline ensured was a drastic limitation of the papal privileges. The limitation was to be effected by the general council: consequently, the pope must be brought under the jurisdiction of that council, and—in the opinion of many—remain under its jurisdiction for all time. Thus, in the 3rd, 4th and 5th general sessions it was enacted, with characteristic precipitation, that an oecumenical council could not be dissolved or set aside by the pope, without its consent: the corollary to which was, that the present council, notwithstanding the flight of John XXIII., continued to exist in the full possession of its powers, and that, in matters pertaining to belief and the eradication of schism, all men—even the pope—were bound to obey the general council, whose authority extended over all Christians, including the pope himself.

By these decrees—which created as the supreme authority within the Church a power which had not been appointed as such by Christ—the members of the Council of Constance sought to give their position a theoretical basis before proceeding to independent action against the pope. But these declarations as to the superiority of an oecumenical council never attained legal validity, in spite of their defence by Pierre d'Ailly and Gerson. Emanating from an assembly without a head, which could not possibly be an oecumenical council without the assent of one of the popes (of whom one was necessarily the legitimate pope)—enacted, in opposition to the cardinals, by a majority of persons for the most part unqualified, and in a fashion which was thus distinctly different from that of the old councils—they can only be regarded as a *coup de main*, a last resort in the universal

confusion. On May 29 the council deposed John XXIII.

The legitimate pope, Gregory XII., now consented to resign, but under strict reservation of the legality of his pontificate. By consenting to this, the synod indirectly acknowledged that its previous sessions had not possessed an oecumenical character, and also that Gregory's predecessors, up to Urban VI., had been legitimate popes. In presence of the council, reconstituted by Gregory, Malatesta announced the resignation of the latter; and the grateful assembly appointed Gregory *legatus a latere* to the marches of Ancona—a dignity which he was not destined to enjoy for long, as he died on Oct. 18, 1417. (*See* CONSTANCE, COUNCIL OF.)

Restoration of Unity.—From the abdication of Gregory XII. to the election of Martin V., the Apostolic See was vacant; and the council, newly convened and authorized by the legitimate pope before his resignation, conducted the government of the Church. After the condemnation and burning of John Huss (*q.v.*), the reformation of the Church, both in its head and members, claimed the main attention of the fathers of the council. Among the many difficulties which beset the question, not the least obvious was the length of time during which the Church must remain without a ruler, if—as Sigismund and the German nation demanded—the papal election were deferred till the completion of the internal reforms. The result was decided by the policy of the cardinals, who since May 1417 had openly devoted their whole energies to the acceleration of that election; and union was preserved by means of a compromise arranged by Bishop Henry of Winchester, the uncle of the English king. The terms of the agreement were that a synodal decree should give an absolute assurance that the work of reformation would be taken in hand immediately after the election; reforms, on which all the nations were already united, were to be published *before* the election; and the mode of the papal election itself was to be determined by deputies. When the last-named condition had been fulfilled on Oct. 28 the conclave began, on Nov. 8, 1417, in the *Kaufhaus* of Constance; and, no later than St. Martin's day, the cardinal-deacon, Oddo Colonna, was elected Pope Martin V. (1417–1431).

With the accession of Martin V. unity was at last restored to the Church, and contemporary Christendom gave way to transports of joy. Any secular power—a bitter opponent of the papacy admits—would have succumbed in the schism: but so wonderful was the organization of the spiritual empire, and so indestructible the conception of the papacy itself, that this (the deepest of all cleavages) served only to prove its indivisibility (Gregorovius, *Geschichte Roms.* vi.). Martin V. appeared to possess every quality which could enable him to represent the universal Church with strength and dignity. In order to maintain his independence, he energetically repudiated all proposals that he should establish his residence in France or Germany, and once more took up his abode in Rome. On Sept. 30, 1420, he made his entry into the almost completely ruinous town. To repair the ravages of neglect, and, more especially, to restore the decayed churches, Martin at once expended large sums; while, later, he engaged famous artists, like Gentile da Fabriano and Masaccio, and encouraged all forms of art by every means within his power. Numerous humanists were appointed to the chancery, and the Romans were loud in their praise of the papal régime.

Nor was the activity of Martin V. less successful in political than in ecclesiastical reform, which latter included the combating of the Fraticelli, the amendment of the clergy, the encouragement of piety by the regulation of feast-days, the recommendation of increased devotion to the sacrament of the altar, and the strengthening of the conception of the Church by the great jubilee of 1423. At the same time the crowning reward of his labours was the effacing of the last traces of the schism. He prosecuted successfully the conflict with the adherents of Benedict XIII., who, till the day of his death (May 23, 1423: *vide* the *Chronicle of Martin de Alpartil*, edited by Ehrle, 1906) clung to the remnants of his usurped authority (*see* BENEDICT XIII.). An attempt on the part of Alphonso V. of Aragon to renew the schism failed; and, in 1429, the Spaniard was compelled to give up his anti-pope, Clement VIII. Martin died on Feb. 20, 1431, and the inscription on his grave—still preserved in the Lateran church—styles him "the felicity of his age" (*temporum suorum felicitas*).

The Second Schism.—The Colonna pope was followed by the strict, moral and pious Gabriel Condulmaro, under the title of Eugenius IV. (1431–1447). His pontificate was not altogether happy. At the very first, his violent and premature measures against the Colonna family, which had received such unbounded favour from his predecessor, embroiled him in a sanguinary feud. Far worse, however, were the conflicts which Eugenius had to support against the Council of Basel—already dissolved on Dec. 18, 1431. At the beginning, indeed, a reconciliation between the pope and council was effected by Sigismund who, on May 31, 1433, was crowned emperor at Rome. But, as early as May 29, 1434, a revolution broke out in Rome, which on June 4 drove the pope in flight to Florence; where he was obliged to remain, while Giovanni Vitelleschi restored order in the papal State.

The migration of Eugenius IV. to Florence was of extreme importance; for this town was the real home of the new art, and the intellectual focus of all the humanistic movements in Italy. At Florence the pope came into closer contact with the humanists, and to this circumstance is due the gradual dominance which they attained in the Roman Curia.

The Italian troubles, which had entailed the exile of Eugenius IV., were still insignificant in comparison with those conjured up by the fanatics of the council in Basel. The decrees enacted by that body made deep inroads on the rights of the Holy See; and the conflict increased in violence. On July 31, 1437, the fathers of Basel summoned Eugenius IV. to appear before their tribunal. The pope retorted on Sept. 18 by transferring the scene of the council to Ferrara—afterwards to Florence. There, in July 1439, the union with the Greeks was effected: but it remained simply a paper agreement. On June 25, 1439, the synod—which had already pronounced sentence of heresy on Eugenius IV., by reason of his obstinate disobedience to the assembly of the Church—formally deposed him; and, on Nov. 5, a rival pontiff was elected in the person of the ambitious Amadeus of Savoy, who now took the title of Felix V. (*See* BASEL, COUNCIL OF, and FELIX V.) Thus the assembly of Christendom at Basel had resulted, not in the reformation of the Church, but in a new schism!

The crime of this new schism was soon to be expiated by its perpetrators. The disinclination of sovereigns and peoples to a division, of the disastrous consequences of which the West had only lately had plentiful experiences, was so pronounced that the violent proceeding of the Basel fathers alienated from them the sympathies of nearly all who, till then, had leaned to their side. While the prestige of the schismatics waned, Eugenius IV. gained new friends; and on Sept. 28, 1443, his reconciliation with Alphonso of Naples enabled him to return to Rome.

During the chaos of the schism, France and Germany had adopted a semi-schismatic attitude: the former by the Pragmatic Sanction of Bourges (June 7, 1438); the latter by a declaration of neutrality in March 1438. The efforts of Aeneas Silvius Piccolomini brought matters into a channel more favourable to the Holy See; and an understanding with Germany was reached. This consummation was soon followed by the death of Eugenius (Feb. 23, 1447). No apter estimate of his character can be found than the words of Aeneas Silvius himself: "He was a great-hearted man; but his chief error was that he was a stranger to moderation, and regulated his actions, not by his ability, but by his wishes." From the charge of nepotism he was entirely exempt; and, to the present day, the purity of his life has never been impugned even by the voice of faction. He was a father to the poor and sick, in the highest sense of the word; and he left behind him an enduring monument in his amendment and regeneration, first of the religious orders, then of the clergy. Again, the patronage which he showed to art and artists was of the greatest importance.

On the death of Eugenius IV. the situation was menacing enough, but, to the surprise and joy of all, Tomaso Parentucelli, cardinal of Bologna, was elected without disturbance, as Pope Nicholas V. (1447–1455). With him the Christian Renaissance ascended the papal throne. He was the son of a physician from

Sarzana, who was not too well endowed with the gifts of fortune; and the boy, with all his talents, could only prosecute his studies at great personal sacrifices. He was possessed of a deep-seated enthusiasm for science and art, of a sincerely pious and idealistic temperament, and of an ardent love for the Church. After his ordination, his great learning and stainless life led him to office after office in the Church, each higher and more influential than the last. Not only did he love the studies of the humanist, but he himself was a Christian humanist. Yet among all his far-reaching plans for the encouragement of art and science, Nicholas V. had always the well-being of the Church primarily in view; and the highest goal of his pontificate, which inaugurated the Maecenatian era of the popedom, was to ennoble that Church by the works of intellect and art. It is astonishing to contemplate how much he achieved, during his brief reign, in the cause of the Renaissance in both art and literature. True, his designs were even greater, but his term of government was too short to allow of their actual execution. A gigantic plan was drawn out, with the assistance of the celebrated Alberti, for the reconstruction of the Leonine city, the Vatican and St. Peter's. The rebuilding of the last-named was rendered advisable by the precarious condition of the structure, but stopped short in the early stages. In the Vatican, however, Fiesole completed the noble frescoes, from the lives of St. Stephen and St. Lawrence, which are still preserved to us. Nicholas, again, lent the protection and encouragement of his powerful arm to science as well as art.

The Jubilee of 1450.—The fostering care of the science-loving pope extended also to the field of ecclesiastical literature; and the greatest importance attaches to the energy he developed as a collector of manuscripts and books. His agents travelled as far as Prussia, and even into the East. All this activity served to enrich the Vatican library, the foundation of which is for Nicholas V. an abiding title to fame. In political and ecclesiastical affairs he similarly manifested great vigour; and his extraordinarily pacific disposition did more than anything else towards diminishing the difficulties with which he had to contend on his entry upon office. An agreement was very quickly concluded with King Alphonso of Naples. In the empire the affairs of the Church were ameliorated—though not so quickly—by the Concordat of Vienna (1448). The Council of Basel was compelled to dissolve, and the anti-pope, Felix V., to abdicate: and, though even after the termination of the synod men like Jacob of Jüterbogk were found to champion ecclesiastical parliamentarianism and the more advanced ideas of Basel, they were confronted, on the other hand, by an array of redoubtable controversialists, who entered the lists to defend, both in speech and writing, the privileges of the Apostolic See. Among these, Torquemada, Rodericus Sancius de Arevalo, Capistrano and Piero del Monte were especially active for the restoration of the papacy.

The long-hoped cessation of civil war within the Church had now come, and Nicholas considered that the event could not better be celebrated than by the proclamation of a universal jubilee—an announcement which evoked a thrill of joy in the whole of Christendom.

It was the wish of the pope that the jubilee should be followed by a revival of religious life in all Christian countries. To put this project into execution, the Church opened her "treasuries of grace," connected with the jubilee dispensation, for the peculiar benefit of those nations that had suffered most from the turmoils of the last few decades, or were prevented from visiting the Eternal City. Nicholas of Cusa was nominated legate for Germany, and began the work of reformation by travelling through every province in Germany dispensing blessings. It was under Nicholas V. that the last imperial coronation was solemnized at Rome. There is a touch of tragedy in the fact that, in the following year, the pope saw his temporal sovereignty—even his life—threatened by a conspiracy hatched among the adherents of the pseudo-humanism. The prime mover in the plot, Stefano Porcaro, was executed. Nicholas had scarcely recovered from the shock, when news came of the capture of Constantinople by the Turks; and his efforts to unite the Christian Powers against the Muslims failed. This darkened the evening of his life, and he died in the night of March 24–25, 1455. From the universal standpoint of history the significance of Nicholas's pontificate lies in the fact that he put himself at the head of the artistic and literary Renaissance. By this means he introduced a new epoch in the history of the papacy and of civilization: Rome, the centre of ecclesiastical life, was now to become the centre of literature and art.

Calixtus III., Pius II., Paul II.—The short reign of the Spaniard, Alphonso de Borgia, as Pope Calixtus III. (1455–1458), is almost completely filled by his heroic efforts to arm Christendom for the common defence against Islam. Unfortunately all the warnings and admonitions of the pope fell on deaf ears, though he himself parted with his mitre and plate in order to equip a fleet against the Turks. The Mohammedans, indeed, were severely punished at Belgrade (1456), and in the sea-fight of Metelino (1457); but the indolence of the European princes, who failed to push home the victory, rendered the success abortive. Bitterly disillusioned, Calixtus died on Aug. 14, 1458.

When Aeneas Sylvius Piccolomini was elected pope as Pius II. (1458–1464), the papal throne was ascended by a man whose name was famous as poet, historian, humanist and statesman, and whose far-seeing eye and exact knowledge of affairs seemed peculiarly to fit him for his position. On the other hand, the troubled and not impeccable past of the new pontiff was bound to excite some misgiving; while, at the same time, severe bodily suffering had brought old age on a man of but 53 years. In spite of his infirmity and the brief duration of his reign, Pius II. accomplished much for the restoration of the prestige and authority of the Holy See. His indefatigable activity on behalf of Western civilization, now threatened with extinction by the Ottomans, excites admiration and adds an undying lustre to his memory. If we except the Eastern question, Pius II. was principally exercised by the opposition to papal authority which was gaining ground in Germany and France. In the former country the movement was headed by the worldly archbishop-elector Diether (*q.v.*) of Mainz; in the latter by Louis XI., who played the autocrat in ecclesiastical matters. In full consciousness of his high-priestly dignity he set his face against these and all similar attempts; and his zeal and firmness in defending the authority and rights of the Holy See against the attacks of the conciliar and national parties within the Church deserve double recognition, in view of the eminently difficult circumstances of that period. Nor did he shrink from excursions in the direction of reform, now become an imperative necessity. His attempt to reunite Bohemia with the Church was destined to failure; but the one great aim of the pope during his whole reign was the organization of a gigantic crusade—a project which showed a correct appreciation of the danger with which the Church and the West in general were menaced by the Crescent. Recurring time after time, with all his intellect and energy, to the realization of his scheme, he finally adopted the high-hearted resolve of placing himself at the head of the crusade. Tortured by bodily, and still more by mental suffering, the old pope reached Ancona. There he was struck down by fever; and on Aug. 15, 1464, death had released him from all his afflictions—a tragic close which has thrown a halo round his memory.

The humanist Pius II. was succeeded by a splendour-loving Venetian, Pietro Barbo, the nephew of Eugenius IV., who is known as Pope Paul II. (1464–1471). With his accession the situation altered; for he no longer made the Turkish war the centre of his whole activity, as both his immediate predecessors had done. Nevertheless, he was far from indifferent to the Ottoman danger. Paul took energetic measures against the principle of the absolute supremacy of the State as maintained by the Venetians and by Louis XI. of France; while in Bohemia he ordered the deposition of George Poděbrad (Dec. 1466). The widely diffused view that this pope was an enemy of science and culture is unfounded. It may be traced back to Platina, who, resenting his arrest, avenged himself by a biographical caricature. What the pope actually sought to combat by his dissolution of the Roman academy was simply the non-Christian tendency of the Renaissance, standing as it did on a purely pagan basis—"the stench of heathendom," as Dante described it. In other respects

Paul II. encouraged men of learning and the art of printing, and built the magnificent palace of San Marco, in which he established a noble collection of artistic treasures.

THE "POLITICAL POPES"

Pope Sixtus IV.—The long pontificate of the Franciscan Francesco della Rovere, under the title of Pope Sixtus IV. (1471–1484), displays striking contrasts of light and shade; and with him begins the series of the so-called "political popes." It remains a lamentable fact that Sixtus IV. frequently subordinated the Father of Christendom to the Italian prince, that he passed all bounds in the preferment of his own family, and in many ways deviated into all too worldly courses. The decay of ecclesiastical discipline grew to alarming proportions under Sixtus During his reign crying abuses continued and grew in spite of certain reforms.

The nepotism in which the pope indulged is especially inexcusable. His feud with Lorenzo de' Medici culminated in the Pazzi conspiracy, the tragic sequel to which was the assassination of Giuliano de'Medici (April 26, 1478). That the pope himself was guiltless of any share in that atrocious deed is beyond dispute; but it is deeply to be regretted that his name plays a part in the history of this conspiracy. Sixtus was far from blind to the Turkish peril, but here also he was hampered by the indifference of the secular powers. Again, the close of his reign was marked by the wars against Ferrará and Naples, and subsequently against Venice and the Colonnas; and these drove the question of a crusade completely into the background. In the affairs of the Church he favoured the mendicant orders, and declared against the cruel and unjust proceedings of the Spanish Inquisition He did splendid service to art and science. The Vatican library was enriched and thrown open for public use, Platina—the historian of the popes—receiving the post of librarian The city of Rome was transfigured. At the papal order there arose the Ponte Sisto, the hospital of San Spirito, Santa Maria del popolo, Santa Maria della pace, and finally the Sistine chapel, for the decoration of which the most famous Tuscan and Umbrian artists were summoned to Rome. This fresco-cycle, with its numerous allusions to contemporary history, is still preserved, and forms the noblest monument of the Rovere pope

Innocent VIII.—This reign (1484–1492) is mainly occupied by his troubles with the faithless Ferdinand of Naples These sprang from his participation in the War of the Barons; but to this the pope was absolutely compelled Innocent's bull concerning witchcraft (Dec. 5, 1484) has brought upon him many attacks. But this bull contains no sort of dogmatic decision on the nature of sorcery. The very form of the bull, which merely sums up the various items of information that had reached the pope, is enough to prove that the decree was not intended to bind anyone to belief in such things Moreover the bull contained no essentially new regulations as to witchcraft It is absurd to make this document responsible for the introduction of the bloody persecution of witches; for, according to the *Sachsenspiegel*, the civil law already punished sorcery with death The action of Innocent VIII. was simply limited to defining the jurisdiction of the inquisitors with regard to magic

Alexander VI.—On the death of Innocent VIII. (July 25, 1492), simoniacal intrigues succeeded in procuring the election of Cardinal Rodrigo Borgia, a man of the most abandoned morals, who did not change his mode of life when he ascended the throne as Pope Alexander VI. (1492–1503). The beginning of his reign was not unpromising; but all too soon that nepotism began which attained its height under this Spanish pope, and dominated his whole pontificate A long series of scandals resulted The cardinals opposed to Alexander, headed by Giuliano della Rovere, found protection and support with Charles VIII. of France, who laid claim to Naples. In prosecution of this design the king appeared in Italy in the autumn of 1494, pursued his triumphant march through Lombardy and Tuscany, and, on Dec. 31, entered Rome. Charles had the word *reform* perpetually on his lips; but it could deceive none who were acquainted with the man. At first he threatened Alexander with deposition: but on Jan 15, 1495, an agreement was concluded between pope and king

While the French were marching on Naples there arose a hostile coalition which compelled them to beat a hasty retreat—the Holy League of March 1495. All their conquests were lost; and the pope now determined to chastise the Orsini family, whose treachery had thrown him into the hands of the French. The project miscarried, and on Jan. 25, 1497, the papal forces were defeated.

In June occurred the mysterious assassination of the duke of Gandia, which appeared for a while to mark the turning-point in Alexander's life. For some time he entertained serious thoughts of reformation; but the matter was first postponed and then forgotten. The last state now became worse than the first, as Alexander fell more and more under the spell of the infamous Cesare Borgia. One scandal followed hard on the other, and opposition naturally sprang up Unfortunately, Savonarola, the head of that opposition, transgressed all bounds in his well-meant zeal He refused to yield the pope that obedience to which he was doubly pledged as a priest and the member of an order Even after his excommunication (May 12, 1497) he continued to exercise the functions of his office, under the shelter of the secular arm. In the end he demanded a council for the deposition of the pope His fall soon followed, when he had lost all ground in Florence; and his execution on May 23, 1498, freed Alexander from a formidable enemy (*see* SAVONAROLA).

After the death of Charles VIII. Alexander entered into an agreement and alliance with his successor, Louis XII. The fruits of this compact were reaped by Cesare Borgia, who resigned his cardinal's hat, became duke of Valentinois, annihilated the minor nobles of the papal State, and made himself the true dictator of Rome. His soaring plans were destroyed by the death of Alexander VI, who met his end on Aug 18, 1503

The only bright pages in the dark chapter of Alexander's popedom are his efforts on behalf of the Turkish war (1499–1502), his activity for the diffusion of Christianity in America, and his judicial awards (May 3–4, 1493) on the question of the colonial empires of Spain and Portugal, by which he avoided a bloody war It is folly to speak of a donation of lands which did not belong to the pope, or to maintain that the freedom of the Americans was extinguished by the decision of Alexander VI The expression "donation" simply referred to what had already been won *under just title:* the decree contained a deed of gift, but it was an adjustment between the Powers concerned and the other European princes, not a parcelling out of the New World and its inhabitants. The monarchs on whom the *privilegium* was conferred received a right of priority with respect to the provinces first discovered by them Precisely as to-day inventions are guarded by patents, and literary and artistic creations by the law of copyright, so, at that period, the papal bull and the protection of the Roman Church were an effective means for ensuring that a country should reap where she had sown and should maintain the territory she had discovered and conquered by arduous efforts; while other claimants, with predatory designs, were warned back by the ecclesiastical censorship. In the Vatican the memory of Alexander VI is still perpetuated by the Appartamenta Borgia decorated by Pinturicchio with magnificent frescoes, and since restored by Leo XIII

Julius II.—The short reign of Pius III. (Sept. 22–Oct. 18, 1503) witnessed the end of Cesare Borgia's dominion. As early as Nov. 1 Cardinal Giuliano della Rovere was elected by the conclave as Julius II. (1503–1513). He was one of those personalities in which everything transcends the ordinary scale He was endowed with great force of will, indomitable courage, extraordinary acumen, heroic constancy and a discriminating instinct for everything beautiful A nature formed on great broad lines—a man of spontaneous impulses carrying away others as he himself was carried away, a genuine Latin in the whole of his being—he belongs to those imposing figures of the Italian Renaissance whose character is summarized in contemporary literature by the word *terribile*, which is best translated "extraordinary" or "magnificent."

As cardinal, Julius II had been the adversary of Alexander VI as pope he stood equally in diametrical opposition to his pred-

ecessor. The Borgia's foremost thought had been for his family; Julius devoted his effort to the Church and the papacy. His chief idea was to revive the world-dominion of the popedom, but first to secure the independence and prestige of the Holy See on the basis of a firmly established and independent territorial sovereignty. Thus two problems presented themselves: the restoration of the papal State, which had been reduced to chaos by the Borgias; and the liberation of the Holy See from the onerous dependence on France—in other words, the expulsion of the French "barbarians" from Italy. His solution of the first problem entitles Julius II. to rank with Innocent III. and Cardinal Albornoz as the third founder of the papal State. His active prosecution of the second task made the Rovere pope, in the eyes of Italian patriots, the hero of the century. At the beginning of the struggle Julius had to endure many a hard blow; but his courage never failed—or, at most, but for a moment—even after the French victory at Ravenna, on Easter Sunday 1512. In the end the Swiss saved the Holy See; and, when Julius died the power of France had been broken in Italy, although the power of Spain had taken its place.

The conflict with France led to a schism in the college of cardinals, which resulted in the *conciliabulum* of Pisa. Julius adroitly checkmated the cardinals by convening a general council, which was held in the Lateran. This assembly was also designed to deal with the question of reform, when the pope was summoned from this world (Feb. 20–21, 1513). Of his ecclesiastical achievements the bull against simony at papal elections deserves the most honourable mention. Again, by his restoration of the papal State, after the frightful era of the Borgias, Julius became the saviour of the papal power. But this does not exhaust his significance; he was, at the same time, the renewer of the papal Maecenate in the domain of art. It is to his lasting praise that he took into his service the three greatest artistic geniuses of the time—Bramante, Michelangelo and Raphael—and entrusted them with congenial tasks. Bramante drew out the plan for the new cathedral of St. Peter and the reconstruction of the Vatican. On April 18, 1506, the foundation-stone of the new St. Peter's was laid; 120 years later, on Nov. 18, 1626, Urban VIII. consecrated the new cathedral of the world, on which 20 popes had laboured, in conjunction with the first architects of the day, modifying in many points the grandiose original design of Bramante, and receiving the contributions of every Christian land (*see* VATICAN).

Leo X.—As so often occurs in the history of the papacy, Julius II. was followed by a man of an entirely different type—Leo X. (1513–1521). Though not yet 37 years of age, Giovanni de' Medici, distinguished for his generosity, mildness and courtesy, was elevated to the pontifical chair by the adroit manoeuvres of the younger cardinals. His policy—though officially he declared his intention of following in the steps of his predecessor—was at first extremely reserved. His ambition was to play the rôle of peacemaker, and his conciliatory policy achieved many successes. Thus, in the very first year of his reign, he removed the schism which had broken out under Julius II. As a statesman Leo X. often walked by very crooked paths; but the reproach that he allowed his policy to be swayed exclusively by his family interests is unjustified. It may be admitted that he clung to his native Florence and to his family with warm affection; but the really decisive factor which governed his attitude throughout was his anxiety for the temporal and spiritual independence of the Holy See. The conquest of Milan by the French led to a personal interview at Bologna, where the "concordat" with France was concluded. This document annulled the pragmatic sanction of Bourges, with its schismatic tendencies, but at the same time confirmed the preponderating influence of the king upon the Gallican Church—a concession which in spite of its many dubious aspects at least made the sovereign the natural defender of the Church and gave him the strongest motive for remaining Catholic. The war for the duchy of Urbino (1516–17) entailed disastrous consequences, as from it dates the complete disorganization of papal finance. It was, moreover, a contributing cause of the conspiracy of Cardinal Petrucci, the suppression of which was followed (July, 1517) by the creation of 31 new cardinals in one day. This—the greatest of recorded creations—turned the scale once and for all in favour of the papal authority and against the cardinals. The efforts of Leo to promote a crusade, which fall mainly in the years 1517 and 1518, deserve all recognition, but very various opinions have been held as to the attitude of the pope towards the imperial election consequent on the death of Maximilian I. The fundamental motive for his proceedings at that period was not nepotistic tendencies—which doubtless played their part, but only a secondary one—but his anxiety for the moral and temporal independence of the Holy See. For this reason Leo, from the very first, entertained no genuine desire for the selection either of Charles V. or Francis I. of France. By playing off one against the other he succeeded in holding both in suspense, and induced them to conclude agreements safeguarding the pope and the Medici. Of the two, the French king appeared the less dangerous, and the result was that Leo championed his cause with all his energies. Not till the eleventh hour, when the election of the Habsburg, to whom he was entirely opposed, was seen to be certain did he give way. He thus at least avoided an open rupture with the new emperor—a rupture which would have been all the more perilous on account of the religious revolution now imminent in Germany. There the great secession from Rome was brought about by Martin Luther; but, in spite of his striking personality, the upheaval which was destined to shatter the unity of the Western Church was not his undivided work. True, he was the most powerful agent in the destruction of the existing order; but, in reality, he merely put the match to a pile of inflammable materials which had been collecting for centuries. (*See* REFORMATION.) A main cause of the cleavage in Germany was the position of ecclesiastical affairs, which—though by no means hopeless—yet stood in urgent need of emendation, and, combined with this, the deeply resented financial system of the Curia. Thus Luther assumed the leadership of a national opposition, and appeared as the champion who was to undertake the much-needed reform of abuses which clamoured for redress. The occasion for the schism was given by the conflict with regard to indulgences, in the course of which Luther was not content to attack actual grievances, but assailed the Catholic doctrine itself. In June 1518 the canonical proceedings against Luther were begun in Rome; but, owing to political influences, only slow progress was made. It was not till June 15, 1520, that his new theology was condemned by the bull *Exsurge*, and Luther himself threatened with excommunication—a penalty which was only enforced owing to his refusal to submit, on Jan. 3, 1521.

The state of Germany, together with the unwise behaviour of Francis I., compelled Leo X. to side with Charles V. against the French king; and the united forces of the empire and papacy had achieved the most brilliant success in upper Italy, when Leo died unexpectedly, on Dec. 1, 1521. The character of the first Medicean pope shows a peculiar mixture of noble and ignoble qualities. With an insatiable love of pleasure he combined a certain external piety and a magnificent generosity in his charities. His financial administration was disastrous, and led simply to bankruptcy. On music, hunting, expensive feasts and theatrical performances money was squandered, while, with unexampled optimism, the pope was blind to the deadly earnestness of the times.

As the Maecenas of Science and Literature Leo has been over-praised. The genuine significance of Leo lies rather in the stimulus which he gave. From this point of view his deserts are undoubtedly great; and for that reason he possesses an indefeasible right to a certain share in the renown of the papacy as a civilizing agent of the highest rank.

As a patron of art Leo occupies a more exalted plane. In this domain the first place must be assigned to the splendid achievements of Raphael, whom the pope entrusted with new and comprehensive commissions—the *Stanza dell' incendio,* the Logge and the tapestry-cartoons, the originals of the last named being now in London. But, though illuminated by the rays of art, and loaded with the exuberant panegyrics of humanists and poets, the reign of the first Medicean pontiff, by its unbounded devotion to purely secular tendencies and its comparative neglect of the Church herself proved disastrous for the see of St. Peter.

REFORMATION AND COUNTER-REFORMATION

The healing successor to this scion of the Medici was Adrian VI. (1522–1523)—a man who saw his noblest task, not in an artistic Maecenate, nor in the prosecution of political designs, but in the reform of the Church in all its members. Careless of the glories of Renaissance art, a stranger to all worldly instincts, the earnest Netherlander inscribed on his banner the healing of the moral ulcers, the restoration of unity to the Church—especially in Germany—and the preservation of the West from the Turkish danger. How clearly he read the causes of religious decadence, how deeply he himself was convinced of the need of trenchant reform, is best shown by his instructions to Chieregati, his nuncio to Germany, in which he laid the axe to the root of the tree with unheard-of freedom. Unfortunately, it was all in vain. Luther and his adherents overwhelmed the noble pope with unmeasured abuse. The two great rivals, Francis I. and Charles V., were deaf to his admonitions to make common cause against the Turks. The intrigues of Cardinal Soderini led to a breach with France and drove Adrian into the arms of the imperial league. Soon afterwards, on Sept. 14, 1523, he died. Long misunderstood and slandered, Adrian VI., the last German pope, is now by all parties ranked among the most revered and most worthy of the popes. No one now denies that he was one of those exceptional men, who without self-seeking spend their lives in the service of a cause and fight bravely against the stream of corruption.

Clement VII.—Under Leo. X. Cardinal Giulio de'Medici, the cousin of that pope, had already exercised a decisive influence upon Catholic policy; and the tiara now fell to his lot. Clement VII. (1523–1534) was soon to discover the weight of the crown which he had gained. The international situation was the most difficult imaginable, and altogether beyond the powers of the timorous, vacillating and irresolute Medicean pope. His determination to stand aloof from the great duel between Francis I. and Charles V. failed him at the first trial. He had not enough courage and perspicacity to await in patience the result of the race between France and Germany for the duchy of Milan—a contest which was decided at Pavia (Feb. 24, 1525). The haughty victors found Clement on the side of their opponent, and he was forced into an alliance with the emperor (April 1, 1525). The overweening arrogance of the Spaniards soon drove the pope back into the ranks of their enemies. On May 22, 1526, Clement acceded to the League of Cognac, and joined the Italians in their struggle against the Spanish supremacy. This step he was destined bitterly to repent. The tempest descended on the pope and on Rome with a violence which cannot be paralleled, even in the days of Alaric and Genseric, or of the Norman, Robert Guiscard. On May 6, 1527, the Eternal City was stormed by the Imperial troops and subjected to appalling devastation in the famous sack. Clement was detained for seven months as a prisoner in the castle of St. Angelo. He then went into exile at Orvieto and Viterbo, and only on Oct. 6, 1528, returned to his desolate residence. After the fall of the French dominion in Italy he made his peace with the emperor at Barcelona (June 29, 1529); in return for which he received the assistance of Charles in re-establishing the rule of the Medici in Florence. During the Italian turmoil the schism in Germany had made such alarming progress that it now proved impossible to bridge the chasm. With regard to the question of a council the pope was so obsessed by doubts and fears that he was unable to advance a single step; nor, till the day of his death could he break off his pitiful vacillation between Charles V. and Francis I. While large portions of Germany were lost to the Church the revolt from Rome proceeded apace in Switzerland and the Scandinavian countries. To add to the disasters, the divorce of Henry VIII. led to the English schism. At the death of Clement (Sept. 25, 1534), the complete disruption of the Church seemed inevitable.

Paul III.—When all seemed lost salvation was near. Even under the two Medici popes the way which was to lead to better things had been silently paved within the Church. Under Leo X. himself there had been formed in Rome, in the Oratory of the Divine Love, a body of excellent men of strictly Catholic sentiments. It was by members of this Oratory—especially St. Gaetano di Tiene, Carafa (later Paul IV.), and the great bishop of Verona, Giberti—that the foundations of the Catholic reformation were laid. Under Clement VII. the establishment of new religious orders—Theatines, Somascians, Barnabites and Capuchins—had sown the seeds of a new life in the ancient Church. The harvest was reaped during the long pontificate of the Farnese pope, Paul III. (1534–1549). With his accession devotion to religion and the Church began to regain their old mastery. True, Paul III. was not a representative of the Catholic reformation, in the full sense of the words. In many points, especially his great nepotism—witness the promotion of the worthless Pier Luigi Farnese—he remained, even as pope, a true child of the Renaissance period in which he had risen to greatness. Nevertheless he possessed the necessary adaptability and acumen to enable him to do justice to the demands of the new age, which imperatively demanded that the interests of the Church should be the first consideration. Thus, in the course of his long reign he did valuable work in the cause of the Catholic reformation and prepared the way for the Catholic restoration. It was he who regenerated the college of cardinals by leavening it with men of ability, who took in hand the reform of the Curia, confirmed the Jesuit order, and finally brought the Council of Trent into existence (sessions I.–X. of the council, first period, 1545–1549). In order to check the progress of Protestantism in Italy Paul III. founded the Congregation of the Inquisition (1542). Political differences, and the transference of the council to Bologna in 1547, brought the pope into sharp collision with the emperor, who now attempted by means of the *Interim* to regulate the religious affairs of Germany according to his wishes—but in vain. The disobedience of his favourite Ottavio hastened the death of the old pope (Nov. 10, 1549).

Under the Farnese pope art enjoyed an Indian summer. The most important work for which he was responsible is the "Last Judgment" of Michelangelo in the Sistine chapel. In 1547 Michelangelo was further entrusted with the superintendence of the reconstruction of St. Peter's. He utilized his power by rejecting the innovations of Antonio da Sangallo, saved the plan of Bramante, and left behind him sufficient drawings to serve the completion of the famous cupola. Titian painted Paul's portrait, and Guglielmo della Porta cast the bronze statue which now adorns his grave in St. Peter's.

Julius III.—After a protracted conclave Giovanni Maria del Monte was elected as Pope Julius III. (1550–1555). He submitted to the emperor's demands and again convened the council (sessions XI.–XVI., second period), but was obliged to suspend it on April 22, 1552, in consequence of the war between Charles V. and Maurice of Saxony. From this time onwards the pope failed to exhibit requisite energy. In his beautiful villa before the Porta del Popolo he sought to banish political and ecclesiastical anxieties from his mind. Yet even now he was not wholly inactive. The religious affairs of England especially engaged his attention; and the nomination of Cardinal Pole as his legate to that country, on the death of Edward VI. (1553), was an extremely adroit step. That the measure was fruitless was not the fault of Julius III., who died on March 23, 1555.

The feeble régime of Julius had made it evident that a pope of another type was necessary if the papal see were to preserve the moral and political influence which it had regained under Paul III. On April 10, 1555, after a conclave which lasted five days, the reform party secured the election of the distinguished Marcellus II. Unfortunately, on May 1, an attack of apoplexy cut short the life of this pope, who seemed peculiarly adapted for the reformation of the Church.

Paul IV.—On May 23, 1555, Gian Pietro Carafa, the strictest of the strict, was elected under the title of Paul IV. (1555–1559). Though already 79 years of age, he was animated by the fiery zeal of youth, and he employed the most drastic methods for executing the necessary reforms and combating the advance of Protestantism. Always an opponent of the Spaniards, Paul IV., in the most violent and impolitic fashion, declared against the Habsburgs. The conflict with the Colonna was soon followed by the war with Spain, which, in spite of the French alliance, ended so disastrously, in 1557, that the pope hencefor-

ward devoted himself exclusively to ecclesiastical affairs. The sequel was the end of the nepotism and the relentless prosecution of reform within the Church. Protestantism was successfully eradicated in Italy; but the pope failed to prevent the secession of England. After his death the rigour of the Inquisition gave rise to an insurrection in Rome. The Venetian ambassador says of Paul IV. that, although all feared his strictness, all venerated his learning and wisdom.

The reaction against the iron administration of Paul IV. explains the fact that, after his decease, a more worldly-minded pope was again elected in the person of Cardinal Giovanni Angelo de' Medici—Pius IV. (1559–1565). In striking contrast to his predecessor he favoured the Habsburgs. A suit was instituted against the Carafa, and Cardinal Carafa was even executed. To his own relatives, however, Pius IV. accorded no great influence, the advancement of his distinguished nephew, Carlo Borromeo (*q.v.*) being singularly fortunate for the Church. The most important act of his reign was the reassembling of the Council of Trent (sessions XVII.–XXV., third period, 1562–63). It was an impressive moment, when, on Dec. 4, 1563, the great oecumenical synod of the Church came to a close. Till the last it was obliged to contend with the most formidable difficulties: yet it succeeded in effecting many notable reforms and in illuminating and crystallizing the distinctive doctrines of Catholicism. The breach with the Protestant Reformation was now final, and all Catholics felt themselves once more brought into intimate connection with the centre of unity at Rome. (*See* TRENT, COUNCIL OF.)

THE GREAT AGE OF CATHOLIC RESTORATION

Three successors of Pius IV. inaugurate the heroic age of the Catholic restoration. All three were of humble extraction, and sprang from the people in the full sense of the phrase. Pius V. (1566–1572), formerly Michele Ghisleri and a member of the Dominican order, observed even as pope the strictest rules of the brotherhood, and was already regarded as a saint by his contemporaries. For Rome, in especial, he completed the task of reform. The Curia, once so corrupt, was completely metamorphosed, and once more became a rallying point for men of stainless character, so that it produced a profound impression even on non-Catholics; while the original methods of St. Philip Neri had a profound influence on the reform of popular morals. In the rest of Italy also Pius V. put into execution the reformatory decrees of Trent. In 1566 he gave publicity to the Tridentine catechism; in 1568 he introduced the amended Roman breviary; everywhere he insisted on strict monastic discipline, and the compulsory residence of bishops within their sees. At the same period Carlo Borromeo made his diocese of Milan the model of a reformed bishopric. The pope supported Mary Stuart with money; his troops assisted Charles IX. of France against the Huguenots; and he lent his aid to Philip II. against the Calvinists of the Netherlands. But his greatest joy was that he succeeded where Pius II. had failed, despite all his efforts, by bringing to a head an enterprise against the Turks—then masters of the Mediterranean. He negotiated an alliance between the Venetians and Spaniards, contributed ships and soldiers, and secured the election of Don John of Austria to the supreme command. He was privileged to survive the victory of the Christians at Lepanto; but on May 1 in the following year he died, as piously as he had lived. The last pope to be canonized, his pontificate marks the zenith of the Catholic reformation.

The renewed vigour which this internal reformation had infused into the Church was now manifest in its external effects; and Pius V., the pope of reform, was followed by the popes of the Catholic restoration. These, without intermitting the work of reformation, endeavoured by every means to further the outward expansion of Catholicism. On the one hand missions were despatched to America, India, China and Japan: on the other, a strenuous attempt was made to reannex the conquests of Protestantism. In a word, the age of the Catholic restoration was beginning—a movement which has been misnamed the counter-Reformation. In this period, the newly created religious orders were the right arm of the papacy, especially the Jesuits and the Capuchins. In place of the earlier supineness, the battle was now joined all along the line. Everywhere, in Germany and France, in Switzerland and the Low Countries, in Poland and Hungary, efforts were made to check the current of Protestantism and to re-establish the orthodox faith. This activity extended to wider and wider areas, and enterprises were even set on foot to regain England, Sweden and Russia for the Church.

Gregory XIII.—This universal outburst of energy which lasted until the middle of the 17th century, found one of its most zealous promotors in Ugo Boncompagni—Pope Gregory XIII. (1572–1585.) (*See* Pastor, *Geschichte der Päpste,* ix., 1923.) Though not of an ascetic nature, he followed unswervingly in the path of his predecessors by consecrating his energies to the translation of the reformatory decrees into practice. At the same time he showed himself anxious to further the cause of ecclesiastical instruction and Catholic science. He created a special congregation to deal with episcopal affairs, and organized the congregation of the index, instituted by Pius V. On behalf of the diffusion of Catholicism throughout the world he spared no efforts; and wherever he was able he supported the great restoration. He was especially active in the erection and encouragement of educational institutions. In Rome he founded the splendid college of the Jesuits; and he patronized the *collegium germanicum* of St. Ignatius; while, at the same time, he found means for the endowment of English and Irish colleges. In fact, his generosity for the cause of education was so unbounded that he found himself in financial difficulties. Gregory did good service, moreover, by his reform of the calendar which bears his name, by his emended edition of the *Corpus iuris canonici* and by the creation of nunciatures.

Sixtus V.—Felice Peretti, cardinal of Montalto, a member of the Franciscan order, succeeded Gregory XIII. on the Apostolic throne as Sixtus V. (April 1585–Aug. 1590). His first task was the extirpation of the bandits and the restoration of order within the papal State. In the course of a year the drastic measures of this born ruler made this State the safest country in Europe. He introduced a strictly ordered administration, encouraged the sciences, and enlarged the Vatican library, housing it in a splendid building erected for the purpose in the Vatican itself. He was an active patron of agriculture and commerce: he even interested himself in the draining of the Pontine marshes. The financial system he almost completely reorganized. With a boldness worthy of Julius II., he devised the most gigantic schemes for the annihilation of the Turkish empire and the conquest of Egypt and Palestine. Elizabeth of England he wished to restore to the Roman obedience either by conversion or by force; but these projects were shattered by the destruction of the Spanish Armada. Down to his death the pope kept a vigilant eye on the troubles in France. Here his great object was to save France for the Catholic religion, and, as far as possible, to secure her position as a power of the first rank.

In Rome itself Sixtus displayed extraordinary activity. The Pincian, the Esquiline, and the south-easterly part of the Caelian hills received essentially their present form by the creation of the via Sistina, Felice, delle Quattro Fontane, di Sta Croce in Gerusalemme, etc.; by the buildings at Sta. Maria Maggiore, the Villa Montalto, the reconstruction of the Lateran, and the aqueduct of the Felice, which partially utilized the Alexandrina and cost upwards of 300,000 scudi. The erection of the obelisks of the Vatican, the Lateran, the Piazza del Popolo and the square behind the tribune of Sta. Maria Maggiore lent a lustre to Rome which no other city in the world could rival. The columns of Trajan and Antoninus were restored and bedecked with gilded statues of the Apostles; nor was this the only case in which the high-minded pope made the monuments of antiquity subservient to Christian ideas. His principal architect was Domenico Fontana, who, with Giovanni Giacoma della Porta, completed the uniquely beautiful cupola of St. Peter's which had already been designed by Michelangelo in a detailed model. In Santa Maria Maggiore the pope erected the noble Sistine chapel, in which he was laid to rest. Indeed, the monumental character of Rome dates from this era. (*See* Pastor, *Geschichte der Päpste, x.* [1926].)

The organizing activity of Sixtus V. was not, however, restricted to the Eternal City, but extended to the whole administration of the Church. The number of cardinals was fixed at 70—six bishops, 50 priests and 14 deacons. In 1588 followed the new regulations with respect to the Roman Congregations, which henceforth were to be 15 in number. Thus the pope laid the foundations of that wonderful and silent engine of universal government by which Rome still rules the Catholics of every land

When we reflect that all this was achieved in a single pontificate of but five years' duration, the energy of Sixtus V appears simply astounding He was, without doubt, by far the most important of the post-Tridentine popes. (L. v. P.)

IV. FROM 1590 TO THE 20th CENTURY

The characteristic features of this period are the splendid progress made by the Catholic Restoration, and the subsequent humiliation of the papacy during the period of absolutism. The influence of the papacy was at a low ebb during the age of enlightenment and the French Revolution. In the 19th century, however, it succeeded, in spite of many obstacles and notwithstanding the loss of the Papal States, in regaining its internal and external strength and authority, while its activities in favour of peace during the World War raised it to a position of great dignity and power.

Urban VII., Gregory XIV., Innocent IX.—The three popes who, in 1590 and 1591, succeeded the great Sixtus V. held office for very short periods. Urban VII. (Castagna) for 13 days, Gregory XIV (Sfondrati) for rather more than ten months, and Innocent IX (Facchinetti) for two months All three were zealous reformers Gregory, who took part in the struggle against Henry of Navarre, was a patron of the great musician Palestrina.

Clement VIII., 1592–1605.—Clement VIII, who was a member of the Florentine family of the Aldobrandini, was of a pious and peaceable disposition, and a hard worker. Following the example of Pius V, he made untiring efforts to increase the internal strength of the Church, to remedy abuses, to reform the religious Orders, and to select worthy candidates for the College of Cardinals and Italian bishoprics. In the interests of purity of doctrine he favoured the Inquisition, re-issued the Index, and had the Clementine Bible printed—although the latter measure was premature He also improved the liturgical books and completed the reform of the breviary The obstinate heretic and apostate Giordano Bruno was burnt in 1600 Clement also prepared the way for the solution which his successors found for the dogmatic dispute between the Dominicans and the Jesuits concerning the efficacy of grace. A great part was played in the revival of Catholicism in Germany by the Jesuit schools which he developed, particularly the Collegium Germanicum in Rome, and by the Capuchin monks. The Counter-Reformation also made great progress in Switzerland, the Spanish Netherlands, Poland and France

FROM "L'ITALIE" (LAROUSSE, ÉDITEUR)
SWISS GUARD IN FULL DRESS UNIFORM

The pope was faced with special difficulties in England, where Queen Elizabeth increased the severity of the legislation against Catholic priests. The help of Spain having proved useless, Clement endeavoured to preserve what remained of Catholic England by the peaceful means of preaching and education Schools for the training of Englishmen abroad were founded in Spain and Flanders, and after the death of Cardinal Allen an arch-priest, who was not consecrated as a bishop, was appointed for England. Seminaries for the training of Scottish and Irish priests were also instituted on the continent, including the Scottish College which was founded in Rome in 1600.

The spread of Christianity made great progress in China, where the gifted Jesuit Matteo Ricci was received by the emperor, and also in Japan, the Philippines, Persia, Abyssinia, West Africa and America. Clement created a special authority for the supervision of missions. His work in averting the Turkish peril recalls the great days of the middle ages The agreement which he reached with Henry IV. of France after the latter's reception into the Catholic Church was one of the turning-points of European history. It prevented the victory of Protestantism in Western and Central Europe, and the Holy See became more independent of Spain and was therefore once more able to mediate between the Powers in the interests of peace as in the middle ages. It was as a result of its recovery of political independence that the papacy was able to act as mediator for the conclusion of peace between France and Spain in 1598. In the Papal States, which were now enlarged by the acquisition of Ferrara, and in which the nobility led an inactive and vicious life, Clement enforced order; it was at this time that Beatrice Cenci suffered the extreme penalty for the murder of her father. Clement was seconded in his work for the encouragement of learning by the great Cardinals Baronius and Bellarmine His name is also connected with that of Torquato Tasso, whose *Gerusalemme Liberata* reflects the renewed vitality of the Church The Jubilee Year of 1600, when over a million pilgrims visited Rome, clearly showed how much of its former vitality the Catholic Church had recovered.

THE 17TH CENTURY

Paul V., 1605–21.—After the brief pontificate (1605) of the Medici Leo XI., whose monument is in St Peter's, Paul V., a member of the Borghese family, became pope Great monuments such as the Villa Borghese still bear witness to the memory of this family in Rome. Paul, like his predecessors, was a nepotist; although he did not carry this practice to the extent of former times, he lost no opportunity of promoting his relatives to wealth and power This weakness, however, enabled him to continue the patronage which so many of the popes had extended to the arts, to beautify the Eternal City and thus to enhance the splendour of the papacy. The Church of St. Peter was completed, an extension was added to Michelangelo's central structure by Carlo Maderno, and the impressive vestibule was constructed. Pope Paul also decorated the Confessio and the subterranean chambers of St. Peter's, and in token of his special veneration for Our Lady he built the Cappella Paolina in S. Maria Maggiore, which is adorned with frescoes by Guido Reni. Paul V is buried in this chapel. The completion of the interior of the Quirinal, the Acqua Paola and other fountains, and the improvement of the streets of Rome are also due to the constructive energy of this pope, under whom the population of Rome increased to over 100,000 In addition, he reformed the administration of justice in Rome and laid the foundation of the new papal secret archives

Paul V, who was a man of great piety and virtue, was also active in the religious sphere. He completed the reform of the liturgical books by the issue of the admirable *Rituale Romanum*, promoted the veneration of saints, and wherever possible carried out reforms on the lines laid down by the Council of Trent At this time the Capuchins were achieving great success as popular preachers In the conflict which was then raging between the Roman theologians and the representatives of the new scientific knowledge which was growing up, the pope showed kindness to Galileo Galilei and comforted him in his misfortunes. He proved himself a vigorous defender of the rights of the Church in his relations with temporal powers, and in particular against the encroachments of Venice, where Paolo Sarpi wished to make the Church dependent on the State. Much was done to promote missionary work in Japan, China, India, Persia, Ethiopia, the Congo and the colonies of the New World

In France, ever since the reconciliation of Henry IV. with the Church, the Catholic revival had made great progress, as also in Germany, Switzerland, Poland and the Spanish Netherlands. In the latter country there was at the same time a great artistic revival, and Rubens and Van Dyck helped by their works to improve the understanding of the Catholic faith. In other countries also, religious art received a new impetus. The baroque style, which is full of vigorous religious feeling, gave expression to the revivified life of Catholicism by the building of wonderful new churches

The position of the pope with regard to the empire was a difficult one owing to the madness of Rudolf II. and the dispute between the Habsburg brothers. He made every endeavour to prevent war breaking out between the Catholics and Protestants in Germany. The course of events, however, compelled him to intervene, and the victory of the Weisse Berg (1620) resulted in the overthrow of the "Calvinist Monarchy" of Prague and the predominance of Catholicism in the Habsburg lands and the Empire.

In England fresh legislation against the Catholics was adopted as a result of the Gunpowder Plot (1605), which was regarded as being due to Catholic teaching. The Catholics were required to take an oath which stigmatized the Catholic Church a sect inimical to the State and to civilization; this oath, which was banned by Paul V., provided James I., who himself entered the lists of theological controversy, with a potent weapon against what remained of Catholicism in England.

Gregory XV., 1621–23.—Gregory XV., who was a member of the Ludovisi family, was exceedingly zealous in his endeavours to promote the victory of the Catholic cause in the war in Germany which followed the Bohemian revolution. The real conduct of affairs was in the hands of his young nephew Lodovico Ludovisi, who did not neglect the temporal interests of his own family. It was he who built the Villa Ludovisi, which became a repository of art treasures. His main energies were, however, devoted to increasing and extending the power of the Church. Subsidies were sent to the emperor and to the League, and the pope supported the transfer of the office of elector of the Palatinate to the Duke of Bavaria, in return for which the latter presented the pope with the valuable Heidelberg library. The Catholic revival was initiated in the Palatinate on the right bank of the Rhine after its conquest; and indeed the revival of the Church everywhere made astonishing progress, and almost reached its zenith, under this energetic pope, whose pontificate in many respects resembled that of Gregory XIII.

The foundation of the *Congregatio de propaganda fide* (1622) focussed the Catholic missionary movement round one centre and enormously increased its strength. Gregory also laid down new rules for the papal elections. He carried on negotiations with the king of England for the marriage of the prince of Wales to a Spanish Infanta, but this attempt at a union between Anglicanism and Catholicism was unsuccessful. He was however able to avert war between France and Spain on the Valtelline question.

Urban VIII., 1623–44.—The long reign of the Barberini Pope Urban VIII. occupied two-thirds of the period of the Thirty Years' War. Urban tried to make peace between the houses of Bourbon and Habsburg so that their combined strength might be used against the Turks and the Protestants. But Richelieu worked against this policy; as the statesman who guided the destinies of France, he made it his principal aim to make France the chief power in Europe in place of the Habsburgs, and to break the power of Spain and Austria by a combined attack. The unscrupulous and Macchiavellian cardinal made alliances with Protestant powers, and even encouraged the Turks to attack the emperor. He succeeded in hoodwinking the pope as to his real aims, and in inducing him to assist the policy of France. Urban was anxious to maintain the papal territories, which had at that time attained their greatest extent by the inclusion of the duchy of Urbino, and thus to secure the independence of the apostolic see. For this reason he felt the territorial predominance of Spain in Italy, and the possibility of any further extension of the power of the Habsburgs there, as intolerable. He therefore tried to find some counterpoise, and, as was shown in connection with the succession question in Mantua, he thus played into the hands of France. He nevertheless protested against the alliance between France and Sweden, which seriously threatened Catholic interests in Germany, and he rejoiced at every success of the imperial forces. He gave financial help to the emperor and the League, although somewhat cautiously and inadequately. He encouraged the alliance between Bavaria and France because he hoped by this means to detach Richelieu from his alliance with the German Protestants. The purely secular policy of Richelieu, which took no account of religious considerations, completed the destruction of the power of the papacy in international politics, which had already suffered severely from the religious schism. From that time onwards the other Catholic Powers also based their policy on purely secular considerations, and the Holy See ceased to be a centre of unity among nations as it had been in the middle ages.

Urban VIII. was more successful in ecclesiastical matters than in international politics. Although the religious revival was paralysed in Germany by the war, it bore fruit in other countries. St. Vincent de Paul in France, and a large number of devoted missionaries in other countries, helped to spread Christianity in Asia, Africa and America. The pope created the Propaganda College and the famous Propaganda Press in order to develop missionary work. He initiated a new arrangement of the calendar of festivals, and conferred the title of "Eminence" on the Cardinals. The condemnation of Galileo (1633), whose discoveries he had celebrated in verse when he was a cardinal, took place during the pontificate of Urban VIII. This regrettable blunder was due to a number of unfortunate influences. The pope, who was an excellent classical scholar, was a patron of literature and published his own verses. He also revised the breviary, but it was to be regretted that the beautiful old hymns were re-written in classical metre. He was a great builder: churches and palaces, and fountains in the streets and squares of Rome, were set up, and the fortifications of the city were improved. The bees which appear on the coat of arms of the Barberini may be seen on an immense number of the public buildings of Rome; and the city is full of monuments by the great baroque architect Bernini, who built the gigantic Confessional in St. Peter's and the mausoleum of the famous Countess Matilda. This proud and self-willed pope was the last to practice nepotism on a grand scale.

Innocent X., 1644–55.—The pontificate of Innocent X., who was a Pamphili by birth, was darkened by the quarrels of his nephews, and by his relation to his ambitious and greedy sister-in-law Donna Olympia, who completely ruled the well-meaning old man and was the most powerful person in the Curia. This regrettable state of affairs, which the Calvinists made a pretext for unjustified aspersions on the morals of the pope, did much to injure his authority. He was exceedingly zealous in maintaining the purity of doctrine. The minds of the faithful had been much exercised by the controversies on the question of grace which had arisen since the Council of Trent; and in 1655 the pope condemned five theses from the *Augustinus* of Cornelius Jansenius, which had originated the Jansenist movement. Innocent X., like his predecessors, refused to recognize the king of the newly founded kingdom of Portugal, out of consideration for Spain. He sent money to the consort of the unhappy King Charles I. of England, and supported the Catholic Irish against the English, as also the Venetians in their struggle with the Turks. The conversion of several Protestant princes of Germany to Catholicism was a matter for great satisfaction. The pope protested against the Peace of Westphalia, 1648 (*q.v.*)—not against the conclusion of peace itself, but against those clauses of the treaty which were contrary to the rights of the Church and the pope. Innocent was buried in the Church of Sant' Agnese, on the Piazza Navona; this church, as well as the fountain by Bernini in the same Piazza, was erected by his order. A portrait of him by Velazquez is to be seen in the Doria Gallery.

Alexander VII., 1655–67.—Fabio Chigi, who had for many years been Nuncio in Cologne, now became pope under the title of Alexander VII. The new pope was adroit, learned and ascetic. Unfortunately he too was not free from the bad custom of nepotism, which was only too closely bound up with the traditions of the Curia; he provided for his relatives from Siena with lands and lucrative offices. He disliked political business, and left it for the most part to his secretary of State, Rospigliosi. He was prudent in the conduct of Church affairs; he was a patron of the Jesuits and was vigilant against the manoeuvres of the Jansenists. He had many difficulties with Portugal, where the king threatened to set up a national Church, and still more with Louis XIV. of France, who, on the pretext that his ambassador had been insulted by the papal guard, broke off relations with Rome and occupied Avignon. The pope was helpless against him, and was

obliged to conclude a humiliating treaty with him in 1664. In view of the growth of Gallicanism, this was a severe blow to his authority. On the other hand, he derived great satisfaction from the fact that Queen Christina of Sweden, the daughter of Gustavus Adolphus, became a convert to the Catholic faith and settled in Rome, where she died in 1689. He commissioned Bernini to build the splendid Scala Regia in the Vatican and the colonnades of the square of St. Peter's. Bernini also built his tomb in St. Peter's.

Clement IX., 1667–69.—Another Tuscan, the former secretary of State Rospigliosi, was now elected to the Holy See under the title of Clement IX. He was a man of affable character and unusual literary culture. Temperate in his own life, he nevertheless did not forget the interests of his relatives. He lightened the taxes of the population of Rome. He settled the dispute with Portugal, and normal ecclesiastical conditions were restored. He also took an active part in the negotiation of the Peace of Aix between France and Spain (1668). He promoted missionary work, and helped the Venetians in their struggle against the Turks; in spite of this, however, it proved impossible to save Candia. The provisional settlement of the Jansenist controversy is also due to Clement IX.

Clement X., 1670–76.—Clement X, the last of the Roman family of the Altieri, was already 80 when he became pope He was a man of pious and charitable character He assisted the Poles in their difficult struggle against the Turks The business of government was carried on by his adopted nephew, the ambitious Cardinal Paluzzi-Altieri, a self-seeker and a man of little political ability It was Clement X who planned the Piazza del Gesù and constructed the second fountain in the square of St. Peter's. His great tomb is to be seen in St Peter's itself

Innocent XI., 1676–89.—The next pope, the Lombard Odescalchi, who took the name of Innocent XI, was one of the most saintly figures in the history of the papacy He was a man of such austere and holy life that he seemed a fit subject for the new procedure of beatification, which was introduced under Clement XI, but not completed He undertook a number of reforms, and was scrupulous in refraining from favouring or enriching his relations, either by open or by covert means He remedied the disorder which prevailed in the finances of the Papal States, limited the expenditure of the papal court, and tried to root out the abuse of the sale of offices. He issued strict regulations in order to raise the moral standard in the Church He instructed the clergy not to indulge in dialectical sophistries in their sermons, but to preach the crucified Christ A sumptuary order was issued with the object of discouraging luxury, and women were forbidden to appear with bare neck and arms The passion for gambling among the Roman nobility was checked by the closing of gaming houses, and the usury of the Jews by the institution of *monti di pietà* The pope also introduced reforms into the educational system Innocent XI. condemned 65 theses from the writings on morality of various Jesuits He was equally severe against Molinos, whose doctrine of quietism, according to which the highest stage of perfection is to be found in complete passiveness, seemed likely to be a source of confusion

Dispute with Louis XIV.—It was inevitable that Innocent XI., who placed the Church above everything, should come into conflict with Louis XIV., who stood for the omnipotence of the State. Their first serious dispute arose in connection with the "regalia," which the king regarded as part of the rights of the Crown and claimed to exercise throughout the territory of France. According to this theory, whenever a bishopric was vacant, the revenues and the right of filling benefices in the diocese belonged to the king The pope refused to recognize this claim, which went beyond what had formerly been customary; and the king called an assembly of the French clergy in 1682 which adopted the so-called "Liberties of the Gallican Church" These four articles maintain that the temporal sovereignty of kings is independent of the pope, that a general council is above the pope, that decisions on matters of faith only become valid by the consent of the Church, and affirm the unalterable validity of the national rights of the Church of France. Rome could not accept these articles, which were intended to affirm the privileges of the Gallican Church. Innocent rejected them, and could not be induced to make concessions even when Louis XIV. began his shameful persecution of the Huguenots. New complications arose when the right of asylum exercised by accredited ambassadors to Rome was abolished. Almost all countries realized that this antiquated rule, which enabled anyone fleeing from justice in Rome to take refuge in the premises of one of the embassies, rendered the proper administration of justice impossible; but Louis XIV. protested against its abolition, and took vigorous measures of reprisal

James II. and William of Orange.—Innocent condemned not only the violent measures which were taken against the Protestants in France, but also the ill-considered and hasty manner in which James II. attempted to restore Catholicism in Protestant England, where the constitution of the Church was closely bound up with that of the State In vain he warned the king, who was under the influence of France, of the danger of a breach with parliament. It is thought that he was aware of the plan to place William of Orange on the throne of England, and that he did not regret James II's fall, which he hoped would destroy the preponderance of Gallican France

Defeat of the Turks.—Missionary work was carried on with great energy during Innocent's pontificate. In order to assist the struggle against the Turks he brought about an alliance between Poland and Austria, and he lived to see the saving of Vienna in 1683, and the liberation of Hungary a year later As a result of the victory over the hereditary enemies of Christianity, the Odescalchi were raised to the dignity of princes of the empire, and received the Hungarian duchy of Sirmium

Alexander VIII., 1689–91.—The Venetian Ottoboni now became pope, with the name of Alexander VIII. Unlike his predecessor, he practised nepotism, and enriched his nephews He purchased the library of Christina of Sweden for the Vatican, condemned a number of heretical doctrines, and was active in charitable works He assisted his native city in its war with the Turks. Partial satisfaction was at this time received from France, which gave up the right of asylum.

Innocent XII., 1691–1700.—Owing to the opposition between the Spanish and Imperial party and the French party in the College of Cardinals, it was only after a five months' conclave that the Neapolitan Pignatelli was elected pope He took the name of Innocent XII. Benevolent, charitable and frugal, he called the poor his relations and put an end to the pernicious practice of nepotism among the popes by his Bull of 1692 Even since that time the families of popes have sometimes been aggrandized, but the system of nepotism was abolished. Innocent also put an end to the abuse of the sale of offices, and made excellent laws for the government and administration of justice in the Papal State He was responsible for the completion of the Monte Citorio (Curia Innocenziana) The Roman nobles were severely punished for all offences against the law, and the pope also endeavoured to improve discipline in monasteries At this time the French clergy revoked the resolutions of 1682, and Louis XIV., who was anxious, in view of the alliance against France, to live at peace with the Church, abolished the obligatory teaching of the Gallican articles. The pope then declared in favour of the French claim in the question of the Spanish succession, but without taking up an attitude of direct opposition to Austria, although the overweening conduct of the imperial ambassador in Rome had given offence, notwithstanding his recall by the Emperor Leopold. The Peace of Ryswick (1697) appointed the pope as arbitrator in the dispute about the succession to the Palatinate; the decision was given by Clement XI in 1702

THE AGE OF "ENLIGHTENMENT"

The 18th century was the period of the greatest difficulty for the papacy. Infidel philosophy, the insincere and superficial "enlightenment" movement, and a spirit of frivolous and mocking scepticism bid against one another for ascendancy over the minds of men. The revolt against authority spread from the religious sphere to morality, politics and science, and the temporal powers encroached more and more on the domain of the Church, with the

aim of subjugating it entirely. All these disintegrating influences led in Catholic countries as well as in others to a slackening in the vitality of the Church.

Clement XI., 1700–21.—The long reign of Clement XI, who was a member of the Albani family, was a period of trouble and difficulty. Clement was extremely active in promoting missionary work, and was a zealous preacher. He adopted a firm attitude towards Jansenism, and in 1713 condemned 101 theses from Quesnel's book. This Bull aroused strong opposition in France. The pope took a number of measures with the object of improving ecclesiastical discipline and public morality, and alleviating the lot of the poor. His relatives did not become powerful until after his death. He set up the Academy of Painting and Architecture in Bologna, and did much in Rome for the restoration of monuments and churches, as well as enriching the Vatican library with oriental manuscripts. He endeavoured to remain neutral in the War of the Spanish Succession (*q.v.*), which created serious disturbances in Italy also; but he appeared to incline to the side of the Bourbons rather than to that of the Habsburgs. The Emperors Leopold I. and Joseph I. made ruthless use of their power, and oppressed the papal State. The claims of the pope were ignored by both sides in the peace negotiations of 1713

The English Pretender, James III., who had left France for Italy in 1717 and had married Maria Clementine Sobieski, was hospitably received by Clement XI. and was given the title of Knight of St. George. It was during the troubled pontificate of Clement XI. that Frederick, Elector of Brandenburg, took the title of king of Prussia (1700), and laid the foundation of a new great Protestant Power. Clement protested, though in vain, against the formation of the new kingdom, since the duchy of Prussia was the property of the Teutonic Order and had not been lawfully transferred.

Innocent XIII., 1721–24.—Innocent XIII. gave help to the Venetians and the Maltese against the Turks. He granted a pension to the Pretender, James III., and promised him subsidies if circumstances should become favourable for him to attempt to regain the throne of England and to re-establish Catholicism there. He invested the Emperor Charles VI. with the kingdom of Sicily, without raising the question of the *Monarchia Sicula;* but he protested when the emperor, disregarding the ancient right of overlordship of the pope, gave the fiefs of Parma and Piacenza to the Spanish Infante Don Carlos.

Benedict XIII., 1724–30.—Benedict XIII, who was a Dominican and a member of the ducal house of Orsini-Gravina, attached much importance to austerity of life, checked the ostentation of the cardinals, and forbade games of chance in Rome. He encouraged scholarship among the clergy He presided in person at the Provincial Council at the Lateran in 1725. He enjoyed the triumph of receiving the submission of Noailles, archbishop of Paris, who had headed the opposition against the Bull of 1713. Others followed the archbishop's example, and Jansenism ceased to be of importance as a heresy. The emperor restored Comachio, which had been taken from the Papal States in 1708. The question of the ecclesiastical privileges of the ruler of Sicily (*Monarchia Sicula*) was settled owing to the conciliatory action of the pope, who also showed his readiness to compromise in connection with the ecclesiastical claims of the king of Sardinia, in whose domains freethinkers were influential. It was owing to his lack of experience in worldly affairs that the pope, who was entirely absorbed in spiritual matters, gave his confidence to a worthless favourite, the hypocritical and avaricious Cardinal Coscia, whose gross maladministration reduced the finances to a state of confusion.

Clement XII., 1730–40.—Clement XII. was a Florentine of the Corsini family. Although he had become blind comparatively early in his reign, his mind continued to be active, and he was a great patron of art and learning. He had a great deal of useful building work done in Rome; churches were restored, the arch of Constantine was repaired, and the museum of the Capitol was enriched with busts and inscriptions and the Vatican with oriental manuscripts.

Clement was active in furthering missionary work, issued new rules for the English College in Rome, and set up two seminaries for the Greeks of Lower Italy and a special seminary intended to promote the union of the Western and the Eastern Church. He forbade Catholics to become members of the secret societies of the Freemasons. He showed much kindness to the English Pretender, James III., and his family. He also gave the emperor considerable subsidies to help him in his war against the Turks. Clement did not have much success in political affairs, for the principle of absolutism, which was warmly supported by the so-called regalists, tended more and more to undermine the authority of the Holy See.

Benedict XIV., 1740–58.—The election of the new pope took six months, owing to the rivalry between the various powers. Finally Lambertini, archbishop of Bologna, was elected and took the name of Benedict XIV. He was a scholar of recognized eminence and a man of excellent character, notable for his constant serenity of temper and kindness of heart, and for his strict and conscientious way of life. He made it a principle that he should be pope first and ruler afterwards. He was the author of a number of books which show him as an excellent canonical scholar. He collected scholars round him and encouraged them to undertake important studies, and he corresponded with foreign writers, including some who were Protestants. He founded learned societies in Rome for the study of Roman and Christian antiquities, canonical law and Church history, and enriched museums and libraries, as well as the academy of his native city, Bologna. He interested himself in the neglected Coliseum, where he erected the Stations of the Cross. He issued important rules for the sacraments of confession and marriage, as well as for the various Eastern rites. He re-issued the Roman Martyrology, and set up a number of new bishoprics in Europe and America. He forbade missionaries to take any part in trading He was much troubled by the exhausted state of the finances of the Papal States, and tried to remedy the situation by introducing a system of economics in all branches of the administration and by encouraging commerce and agriculture. His efforts were however to a large extent rendered useless by the serious damage which the papal territories suffered as a result of the Austrian War of Succession.

In his relations with temporal Powers, the pope showed a peaceable and tolerant disposition and endeavoured to effect a reconciliation between the spirit of the 18th century and the ancient rights of the Church. He dealt with the Courts on moderate and conciliatory lines, and did not attempt to maintain unyieldingly all the mediaeval claims of the papacy. He concluded concordats with Spain, Portugal, Sardinia and Sicily which embodied very far-reaching concessions as regards the dependence of the clergy on the Crown. In various countries the number of religious festivals was reduced, but the pope gave instructions that those which were retained should be celebrated all the more worthily. He also managed to maintain good relations with the German empire. He recognized the kingdom of Prussia, although the state of the Church in Silesia, which had come into the possession of Prussia, was deplorable. The pope also showed wise moderation in his encyclical to the French bishops (1756), in which it was stated that only open and notorious opponents of the Bull of 1713 were to be refused the sacraments. The reign of this pope, who won the respect even of those who were not Catholics, thus passed without serious disputes; but a storm was already brewing against one of the strongest pillars of the Catholic Church, the Order of Jesuits.

Clement XIII., 1758–69: The Expulsion of the Jesuits.—The reign of the Venetian Rezzonico, who took the title of Clement XIII., was an almost uninterrupted series of struggles for the rights of the Church and for the defence of the Society of Jesus, which had earned the bitter hatred of anti-papal circles by its zeal for dogmatic belief and for the principle of authority, especially against Jansenism and Gallicanism. The Order of Jesuits, which possessed great political influence in the various Courts, also had many opponents in the Church itself. Most of the other Orders looked askance at this Order which had outstripped them all. Individual Jesuits had been subjected to papal censure for harmful doctrines put forward in their works on moral questions. They were also accused of abuse of the confessional, disobedience

towards bishops, ambition, avarice, undue acquisitiveness, and other faults, although their accusers did not produce any individual proofs of their allegations. The attack was led by Portugal, where the Jesuits, who had influence at Court, interfered with the attempt of the minister Pombal to introduce a system of unqualified absolutism. Some were imprisoned without trial, others were deported to the Papal States as "a present for St. Peter." This state of affairs led to the breaking off of relations between Portugal and the Holy See. The French *parlement* declared that the rules of the Order were harmful and incompatible with the Gallican liberties; and in 1762 it was decided to suppress the order in France. Spain and Sicily, irritated by the pope's repeated protests, also decided to expel the Jesuits. In Parma, which was ruled by the king of Spain's nephew, a number of laws were adopted which were incompatible with canonical law; Clement, as pope and overlord, sent a *monitorium* to the Duke in 1768, whereupon the Jesuits were also expelled from Parma, and the Bourbon Courts peremptorily demanded that Clement should dissolve the Order He refused to give way, though some of the Cardinals advised him and the secretary of State, Torrigiani, to bow to the storm. Clement, however, who was a man of saintly life and character, thought it better to let the Bourbon Powers occupy part of the papal State rather than to abandon the Jesuits, whom he believed to have been falsely accused.

Another event of the stormy pontificate of Clement was the condemnation of the work of Nicolaus Hontheim, Coadjutor Bishop of Treves (1764). This prelate, who wrote under the name of Febronius, was under the influence of Gallican ideas; he put forward the theory that the bishops acting collectively constituted a higher authority than the pope, that the latter only enjoyed such powers as were necessary to maintain the unity of the Church, and that he must therefore renounce some of his rights of primacy either voluntarily or under pressure from the bishops Clement strongly urged the combatants in the cruel struggle of the Seven Years' War to conclude peace

Clement XIV., 1769–74: The Suppression of the Jesuits.—The conclave of 1769 received an unwonted visit from the young Emperor Joseph II, who told the cardinals that the principles of former days were no longer applicable, and urged that the person to be elected should possess the virtue of wise moderation This quality was in fact possessed by the Franciscan Ganganelli, who became pope under the name of Clement XIV. The new pope followed the example of Benedict XIV, and tried to establish good relations with the "enlightened" Governments He entered into personal correspondence with the various sovereigns, suspended the reading of the Bull *In Coena Domini* (a collection of sentences of excommunication), revoked the *monitorium* to Parma, and re-established relations with Portugal at the cost of a number of concessions He manifested his desire for reconciliation on all hands, hoping by this means to induce the Bourbon cabinets to drop their constant demands for the dissolution of the Order of Jesuits. His hopes were, however, doomed to disappointment. There was already beginning to be talk at the Bourbon Courts of a definite breach with Rome, and the diplomats succeeded in intimidating the pope, who was lacking in courage and who did not allow the cardinals to exercise their influence. He made many attempts at evasion, and suffered bitterly under the pressure exercised on him. Finally, without preliminary canonical procedure, he issued the Brief of 1773, by which the Order was suppressed throughout Christendom in order that peace might be restored.

As ruler of the Papal States, Clement XIV. tried to restore the financial chaos to order and to encourage industry. He was not very successful in this. He was keenly interested in art and learning, and founded the Museum Pio-Clementinum, which was enlarged by his successor. The story that he was poisoned by the Jesuits is an invention.

Pius VI., 1775–99.—The pontificate of Pius VI., whose former name was Braschi, was longer than that of any previous pope. He was a pious, gentle and highly cultivated man, and he regarded what had been done against the Jesuits as the work of irreligious ministers. He therefore secretly favoured the Jesuits, and planned to restore the Order as a bulwark against the rising tide of revolution. He did a great deal for Rome and the Papal States. He undertook the costly work of draining the Pontine marshes, and improved the harbour of Ancona. The Eternal City, which was at that time visited by many sovereigns, was constantly being adorned with new buildings and with treasures of antique art. The Emperor Joseph II. described Rome as "a city of unequalled splendour, where an impulse towards greatness was everywhere visible." The Appian Way was restored, and the sacristy of St. Peter's completed.

The philosophical revolution which preached the destruction of Christianity and the Papacy was now in full swing, and it looked as if Voltaire's cry against the Church, "*Ecrasez l'infâme!*" would be translated into reality. Italy did not escape infection by the new ideas from France, and there were freemasons even among the clergy. The Grand Duke Leopold of Tuscany, the brother of Joseph II, was the most active promoter of the new ideas, but hostile measures against the Church were also taken in Venice and Naples Febronianism gained ground in the Courts of Germany, notwithstanding the fact that it had been condemned by Clement XIII Pius VI. succeeded in inducing the initiator of the movement to recant, but his ideas were taken up by the archbishop electors and the archbishop of Salzburg in the Punctation of Ems (1786), which aimed at increasing their metropolitan rights at the expense of the pope's. Serious disorder seemed on the point of setting in, but the French Revolution broke the power of the three electors of the Rhineland, and the great secularization of ecclesiastical property ensued in 1803.

The Emperor Joseph II.—In Austria the Josephist movement prevailed; Maria Theresa and Joseph II issued a number of decrees which aimed at bringing the Church under the control of the sovereign State The movement contained some just and reasonable elements, mingled with much that was unjust and excessive. There was much talk of the secularization of the property of the Church and the religious Orders, of the appointment of bishops without the intervention of the pope, and of the abolition of Church laws. Joseph II, "Brother Sacristan," as Frederick II. called him, dissolved hundreds of monasteries and relentlessly swept away festivals, processions, confraternities, old customs, and much that made for the splendour of worship While these measures of intolerance were being taken against the Catholic Church, an edict was issued in 1781 proclaiming toleration for all recognized Christian creeds Pius VI, the "holy traveller," undertook the difficult journey to Vienna in 1782 with the object of softening the obduracy of the autocratic emperor, but met with little sympathy either from him or from his minister Kaunitz

In England the position of the Catholics during the 18th century continued to be unfavourable. The spirit of indifference in religious matters which made it possible for Englishmen and Scots not to be members of the national Church brought no relief to the Catholics, while in Ireland they lived poor and despised

THE FRENCH REVOLUTION

The greatest source of trouble and difficulty to Pius VI was the French Revolution, which was a consequence of the revolt against the Church The pope fought courageously against the Terror, when the worship of reason was proclaimed (1793). Napoleon Bonaparte revenged himself for the assistance which the pope had given the Allies against France by attacking the unprotected Papal States. A temporary respite was purchased at the cost of immense sacrifices by the Truce of Bologna (1796) and the Peace of Tolentino (1797). Valuable manuscripts and priceless works of art were taken from Rome and sent to Paris. Jacobin agents had already succeeded in gaining influence over the minds of young people in the Papal States, and the French ambassador's residence in Rome became a focus for revolutionary activities A riot in which the arrogant French General Duphot was shot gave the desired pretext for the entrance of the French troops into Rome and the proclamation of a republic (1798) A statue of the Goddess of Liberty, who was represented trampling on the tiara, was set up outside the Castle of St. Angelo and was intended to symbolise the end of the rule of the pope. The republicans

instituted a reign of disorder and pillage. Pius VI., ill as he was, refused to give up his rights, and was brought as a prisoner to Valence, where death put an end to his sufferings in 1799. Thus the papacy ended the 18th century in exile.

Pius VII., 1800–23: The Concordat of 1801.—The conclave was held in Venice under the protection of Austria, and the Benedictine monk Chiaramonti was elected pope in 1800 under the name of Pius VII. He was assisted in the extraordinarily difficult task which lay before him by the ablest ecclesiastical statesman of the century, Ercole Consalvi, who had received his early training in the College of Cardinal Henry of York at Frascati. Rome was restored to the pope as a result of the political changes which took place, and the condition of the diminished papal State was improved as far as possible by economical administration and the development of agriculture. Napoleon, who had become First Consul in 1799, realized that his power could only be consolidated by the restoration of the Church in France and by a reconciliation with the Holy See. He had need of the pope in order to become emperor. After long negotiations, a Concordat was concluded in 1801; although it made the French clergy entirely dependent on the Government, it nevertheless represented a great improvement, since the Catholic Church was once more firmly established in France. Pius protested, though in vain, against the additions which Napoleon arbitrarily made to the Concordat by the Organic Articles. In the hope of gaining further advantages for the Church, he consented to go to Paris and to anoint Napoleon I. as hereditary emperor of the French (1804).

Napoleon showed more and more clearly that he aimed at universal power. He expected that all Italy should submit to him, and that the Pope should abandon his neutrality and join in the blockade of England. He put forward increasing demands both on political and on ecclesiastical matters, and when they were refused, he occupied Rome in 1808, while in the following year he proclaimed the union of the Papal States with the French empire, and, as the Emperor Frederick I. had once done, declared Rome directly subject to the Emperor. When the pope dared to issue a Bull of excommunication against the "robber of the patrimony of Peter," he was taken as a prisoner first to Savona and subsequently to Fontainebleau. A National Council was called in 1811 with the idea of intimidating the resolute pope, and giving a veneer of legality to the Emperor's ecclesiastical policy. Although Napoleon's star was already beginning to sink in the Russian campaign, he continued to increase his demands, and in Jan. 1813 he had a personal interview with the captive pope, at which he produced the preliminaries of an agreement. These he afterwards published, falsely alleging them to be an arrangement accepted by both parties (Concordat of Fontainebleau). Pius, seeing that he had been tricked, revoked the concessions which he had made; he no doubt suspected that his exile was nearing its end. He recovered his freedom on the fall of Napoleon. His entry into Rome, amid popular rejoicing, on May 24, 1814, was a brilliant triumph for the Church. Napoleon's return to power for the Hundred Days in 1815 meant fresh difficulties for the papal State, and the pope himself was obliged to flee; but this was little in comparison with what had gone before. At the Congress of Vienna (*q.v.*), in 1815, Consalvi exerted all his diplomatic skill in order to obtain the benefit of the principle of legitimacy for the pope as the principal representative of the conservative spirit which the congress embodied. The Holy See recovered all its former possessions with the exception of Avignon and the Venaissin, which remained in the hands of France, and a district on the left bank of the Po, which fell to Austria.

THE 19TH CENTURY

There now began the period of the Restoration, in which the sovereigns of Europe bent their energies towards re-instituting the previous state of affairs. In Rome the reorganization of the Papal States was taken in hand; many of the French innovations were retained, the old municipal and provincial institutions were abolished, and an absolute bureaucracy was set up on the French model. This excessive centralization, which excluded laymen from all high offices, aroused bitter and unceasing complaints against the "rule of the priests."

The pope also had much to do beyond the frontiers of the Papal States in reorganizing ecclesiastical affairs. He was much assisted by the Romantic movement of the day, which regarded the Revolution as a divine punishment for the falling away of the peoples from religion. In all countries there was a revival of Catholicism, which was looked upon as the remedy for the disorders of society, and as the mainstay of the throne. Joseph de Maistre extolled the pope as a mediator standing above the nations and their sovereigns. The Society of Jesus was re-instituted by a Bull of 1814; it set to work again, and made a great contribution to the intellectual and moral revival. Concordats with various countries were concluded or prepared; even Prussia, which had acquired large Catholic territories in the West, concluded an agreement of this kind.

Pius VII. was not neglectful of art and scholarship. He did much to enlarge the Vatican library and art collections, and continued much of the building which had been begun under Napoleon's rule with the object of beautifying Rome. Now that international peace had been restored, Rome became the meeting-place of kings and emperors, and a centre of attraction for artists such as Canova, Thorwaldsen, Cornelius, Overbeck and others. The most magnificent ancient basilica of Rome, S. Paolo, was burnt down during the Pope's last illness. Pius VII.'s tomb, by Thorwaldsen, is to be seen in St. Peter's.

Leo XII., 1823–29.—Count della Genga now became pope with the title of Leo XII. He was a pious man, strict in observing the rules of the Church. He promoted missions, improved the educational system in Rome, and did much for the Irish and German Colleges. He had excavations undertaken which greatly added to what was known of the topography of Rome, and had great buttresses constructed to support the Coliseum. He warned the bishops against the Protestant Bible societies, and also opposed the doctrines of indifferentism, as well as freemasonry. Vigorous efforts were made to root out the revolutionary Carbonari. The Sanfedisti, who were countenanced by the Government, assisted in the persecution of the Carbonari, and there were sanguinary conflicts, especially in the Romagna, where the Legate Rivarola proceeded with excessive severity. The policing of morals was carried out on inquisitorial lines. Leo maintained good relations with the secular Powers, and continued the policy of Concordats, which he extended to the South American republics. The Jubilee Year of 1825 was celebrated as a year of reconciliation and pardon. Leo XII. is buried in St. Peter's.

Pius VIII., 1829–30.—Pius VIII., formerly Francisco Castiglione, gave an indication of the purity of his intentions immediately after his election by forbidding his relations to come to Rome. An important event of this period was the Catholic Emancipation Act of 1829, which was adopted in England after a long struggle, largely owing to the efforts of Daniel O'Connell. This act allowed Catholics to sit in parliament and to hold public office; emancipation was not complete, but Catholics obtained a greater measure of freedom, and increased in numbers. The pope augured much ill from the July Revolution in France. There was much unrest in the Papal States and throughout Italy, and the secret societies became more and more daring.

A new period of revolution now began. It was directed against the absolutist and conservative system of the Restoration, which aimed at a return to the past at a time when men of intellect in all countries were awakening to the idea of the intrinsic value of the nation and were demanding intellectual, political and national liberty. The principles of enlightenment once more began to gain ground, and assumed the form of liberalism and constitutionalism, the guiding principles of the 19th century.

Gregory XVI., 1831–46: Growth of Revolutionary Ideals.—The new Pope Gregory XVI., formerly the Camaldulian monk Mauro Cappelari, was not yet crowned when the Paris Revolution of July 1830 set central Italy ablaze. The revolt raged throughout the Papal State, and could only be suppressed by Austrian bayonets. The pope and his secretary of State Bernetti themselves realized that reforms were needed. The ambassadors of the Powers, including the British representative in Florence, who was not without sympathy for the revolt, presented a memorandum

in 1831 demanding the admission of laymen to a share in the administration and to judicial posts, municipal self-government, provincial councils and a State council to consist of laymen. The pope, who resented the interference of diplomats, agreed to an amnesty, and to a few useful concessions, which were however administrative rather than political in character. A loan was raised from Rothschild on onerous terms in order to meet the financial difficulties to which the prevailing unrest had given rise. Revolution broke out again in 1832 as a result of the influence of the diplomats and the machinations of the rebels; order was restored by the Austrians. This aroused the jealousy of France, which occupied Ancona in order by this means to force the Papal States to adopt liberal reforms. It was not until six years later that the foreign troops were withdrawn, and a period of peace ensued. Much was done at this time to promote the public welfare. The demand for the separation of the ecclesiastical and the civil administration was however not fulfilled. The new secretary of State, Lambruschini, suppressed all aspirations towards political liberty with extreme severity. He was as a matter of fact only doing what was being done in the majority of European countries, where the authorities also tried to suppress the movement towards liberty by force, though by so doing they only strengthened the opposition. The last three years of Gregory's reign were again occupied by rebellions in the Papal States.

Gregory, who even after becoming pope lived according to the strict rule of his Order, was also opposed to the modern spirit in ecclesiastical matters. In the encyclical of 1843 he condemned false enlightenment, indifferentism and the demand for unbounded religious freedom even as the most pernicious errors. He also condemned the doctrines of Lamennais, Bautin and Hermes, as well as the unorthodox practice followed in Prussia in the case of marriages between Catholics and non-Catholics. The ecclesiastical dispute of Cologne ended in favour of the pope. In England the number of Apostolic vicariates was increased to eight, and a Catholic press (*The Tablet*), was founded in order to dispel the prejudice against Catholics. The Catholic Institute in London, various pious associations and the ten theological training colleges which existed in England in 1846 gave good prospects for the progress of Catholicism in England. The pope encouraged missionary work, forbade the slave trade, and settled a number of disputes on ecclesiastical affairs with various countries.

Gregory XVI. showed his interest in scholarship by instituting museums of Egyptian and Etruscan antiquities in the Vatican and a museum of sculpture in the Lateran. He also encouraged excavation and the preservation of Roman remains. Subscriptions were received from all parts of the world for the rebuilding of the church of S. Paolo fuori le mura, which had been burnt down, and a part of the new structure was ready for consecration by 1840. Scholars such as Cesare Cantù, the historian Angelo Mai and the linguist Giuseppe Mezzofanti enjoyed the favour of the pope.

The revolutionary spirit continued to make progress, and men who had been forced to flee from their own countries owing to their revolutionary activities met in Brussels, Paris and London, where they conspired to raise rebellions in their native lands. One of the chief of these agitators was Giuseppe Mazzini, who, with his free-thinking association *La Giovane Italia,* aimed at overthrowing all monarchical Governments in Italy and setting up a united Italian republic. Outside this powerful movement there were a number of Italian nationalists who were influenced by the Romantic movement and wanted the Italy of the future to be founded on religion and the papacy. Rosmini and Gioberti dreamed of a federation of States under the leadership of the pope, and Balbo of a national federation with Piedmont for its sword and Rome for its heart.

Pius IX., 1846–78: The Revolution of 1848.—The new pope, Pius IX., who was of the Mastai-Ferretti family, was believed to hold nationalist views, and when he broke with the rigid system of government of his predecessor, was at once greeted as the "pope of progress." He proclaimed an amnesty for political offences, relaxed the censorship laws, organized the council of ministers, replaced the mercenary troops by a civic guard, and set up a council of State and a municipal council for Rome, admitting laymen to membership of these bodies. He showed his sincere desire to prepare the way for Italian unity by proposing a customs union between the Italian States. The high-minded pope was however ill rewarded for his liberalism when the Revolutionary year of 1848 arrived. The proclamation of the amnesty had attracted Mazzinists, as well as bandits and other revolutionary elements, to the Papal States, and these gradually undermined the foundations of society. Encouraged by the February Revolution in Paris, certain elements in the Italian States peremptorily demanded that constitutions should be granted. The Papal States, on March 14, 1848, received a constitution setting up a two-chamber system. Not long afterwards the once idolized pope was accused of being a traitor to his country because he refused to take part in the nationalist war of Piedmont against the Austrian rulers. In accordance with the duties of his office he put the universal significance of the papacy above national aspirations, and not only declared his neutrality, but stated that he would never place himself at the head of an Italian confederation. By this decision the Holy See placed itself outside the movement for Italian unity, and the formation of Italy took place in opposition to Rome and to the temporal power of the pope. Revolution was already threatening in Rome. The pope was obliged to flee to Gaëta, and Mazzini's Red Republic, which was proclaimed in Rome in 1849, indulged in disgraceful orgies of anti-religious fanaticism. The triumph was however a brief one. Order was restored by foreign Powers, and Pius returned in 1850.

After the stormy years of 1848 and 1849, the former authorities were restored to their position in Italy as in Germany and Austria, and a new reactionary movement everywhere set in. In view of this it is not surprising that Pius IX., after the experiences which he had gone through, also adopted an anti-constitutional attitude. In this he and his secretary of State Antonelli were partly actuated by their conviction that in the Papal States, where all questions of internal and external policy must necessarily be regarded from the standpoint of the Church, the duties of a head of the State acting with a parliament might come into conflict with the duties of the pope as head of the Church, and the freedom and independence of the papacy might accordingly suffer. The 1848 constitution was not restored, but the pope granted provincial and municipal self-administration. Laymen were allowed a share in the administration, but the final decision in all departments remained in the hands of the higher clergy.

Pius IX. governed without severity, founded charitable institutions, and restored order in the finances, where Mazzini had left a deficit. A really amazing amount of work for the public good was accomplished in the peaceful years which now followed. Rome was provided with a good water supply, streets and squares were improved, and the railway to Frascati was constructed. The pope enriched the Vatican collections with new acquisitions, founded the Christian Museum in the Lateran, and encouraged excavations on the Palatine and at Ostia, as well as the important researches of de Rossi in the catacombs. Many churches were restored, the Damascus Court was altered, and the great marble staircase in the Vatican was constructed during this pontificate.

The Union of Italy.—The basis of the temporal power of the pope was however no longer secure. The Italians were subjected to the most intense national and international propaganda. The principal centre of the movement was at this time the little Liberal State of Piedmont, which now stood forward as the chief representative of the idea of unity, and, supported by France, took up arms against Austria in 1859. The independence of Italy was everywhere proclaimed, and one revolt was succeeded by another. The abolition of the Papal States was one of the points in Cavour's programme, and it was faced with dissolution. It was reduced to one-fifth of its previous area in 1860. In the following year Victor Emmanuel was proclaimed king of Italy, and Cavour, the creator of Italian unity, even as he lay dying, spoke in favour of a free Church in a free State (*libera chiesa in libero stato*). This watchword, together with that of *"Roma capitale,"* were everywhere repeated as the dogma of nationalism. The

Franco-Prussian War of 1870 encouraged the nationalists to take the final step. When the news of Sedan was received, and Italy was no longer obliged to consider the wishes of France, the excitement reached its highest pitch. On Sept. 20 the practically undefended city of Rome, the capital of Christianity, which belongs to all Catholic nations, was occupied by Italian troops. Rome became the capital of Italy. The so-called Guarantee Law of May 13, 1871, conferred on the pope the rights and honours of a sovereign, granted him an annual endowment, and recognized the extra-territoriality of the papal palaces, but these were declared the property of the Italian State, and the pope was only allowed the usufruct of them. An international matter was thus settled by an individual State without any other guarantee. Pius IX. persistently refused the offer made to him, and protested against what he called the usurpation. Both he and his successors, who, like him, refused to go outside the Vatican until the settlement that was reached with the Quirinal in 1929, did not cease to join with Catholic Christendom in protesting against a position imposed by force, which did not provide the necessary guarantees for the complete independence of the supreme head of the Church.

Doctrine.—In the midst of all these difficulties, Pius IX. was extremely active in Church affairs. Eminent men of all nations formed part of the College of Cardinals. New seminaries for Americans were set up in Rome, and new bishoprics were created both in America and in other parts of the world. The Latin Patriarchate in Jerusalem was restored. A Congregation of Cardinals was instituted to deal with the affairs of the religious Orders and their reform. The pope held a number of assemblies of bishops, as for instance in 1854, when he proclaimed the dogma of the Immaculate Conception of the Virgin Mary. The encyclical of 1864, with its condemnation of 80 theses (*Syllabus errorum*), was a reply to the violent attacks of liberalism. The pope uttered a warning against compromise in the struggle between God and the world which was an outstanding feature of the times, since compromise could only lead to the confusion of minds. In opposition to modern irreligious philosophy there grew up the new scholasticism, which aimed at a revival of the metaphysical and theological doctrines of St. Thomas Aquinas.

International Relations.—Pius IX. concluded concordats with a number of States. The concordat with Austria (1855) abolished what still remained of Josephism, but it was abrogated in the liberal era which ensued. Since the end of the Cologne disturbances, there had been a Catholic revival in Germany, and religious associations of various kinds took part in the social development of the day. The so-called *Kulturkampf,* which was instituted by Prussia after the creation of the new empire (1871), and the object of which was to give the State complete control of the Church, met with resistance from the bishops and from the leaders of the Centre Party, who were devout Catholics and rallied staunchly round the pope, who also remained steadfast. The Catholic hierarchy was restored in Holland and also in England, where there were 12 bishoprics and the archbishopric of Westminster.

Papal Infallibility.—The most important ecclesiastical event in the lifetime of Pius IX. was the 20th General Council, the summoning of which in 1869 greatly excited the non-Catholic and diplomatic world. The main subject of discussion was the old and vexed question of papal infallibility. Both within and outside the Council there was keen opposition, sometimes on the doctrine itself and sometimes on the expediency of definition. The abundant literature which grew up on the subject shows that it was considered in all its aspects. All the arguments and counter-arguments were fully and freely discussed in the numerous congregations. Finally, on July 18, 1870, all but two of the 535 ecclesiastics present voted in favour of the dogma that the Roman pope, speaking *ex cathedra,* possesses infallibility for decisions on doctrines affecting faith or morals, in virtue of his supreme apostolic power. This was a deathblow to the old doctrines of Gallicanism and Febronianism, and the authority of ecclesiastical doctrine was established on a firmer basis. The strongest opposition to the doctrine of infallibility existed among the followers of Döllinger in Germany, who, notwithstanding the latter's warning against setting up altar against altar, founded the religious society of the Old Catholics.

Leo XIII., 1878–1903.—The so-called Prophecy of Malachi concerning the popes calls Pius IX. *Crux de cruce,* and his successor Leo XIII., whose reign was also a long one, *Lumen de coelo.* Joachim Pecci—for this was his family name—was a man of acute and farseeing mind, who had received a good training in practical affairs, since he had been Nuncio in Belgium at the time when the ecclesiastical and political tension had been at its height, and Bishop of Perugia during the period of reform. Deeply conscious of his duty to instruct the nations, he issued a number of encyclicals, which were masterpieces of Latin composition, and embodied forcibly expressed ideas on all aspects of the life of the peoples. His Easter encyclical of 1878 dealt with the relation between the Church and civilization in general, and a year later he spoke in praise of St. Thomas Aquinas, for the study of whose doctrine an academy was set up, and whom he called the best leader for a renewal of philosophy. The famous encyclical on labour questions (*Rerum novarum*), issued in 1891, still continues to influence the modern world. It lays down a general programme for modern civilization, and points out that the possessing classes, including the employers, have important moral duties to fulfil, and that it is one of the first duties of society in general, in collaboration with the Church, which stands for reconciliation between the classes by virtue of its doctrine and the spirit of charity which inspires it, and with the State, whose duty it is to pass laws for the protection of the workers, to improve the position of the workers.

It was Leo's object to bring about harmonious collaboration between Church and State, without regard to what form of government was adopted. The latter was a matter which did not concern the Church, so long as nothing was done which was not contrary to justice. Other public utterances of this pope dealt with Social Democracy and freemasonry, the duties of the Christian citizen and the family, and religious questions. As a means of combating the rationalistic tendencies of scholarship, he encouraged the study of the Bible, and he founded several colleges for the Eastern clergy in order to promote unity between the churches. One of his main aims was to attain unity among the various Christian religious communities and Rome, and thus to restore the unity of the Christian faith.

Leo XIII. patronised art and learning to an extent which recalls the Renaissance popes. He was a great admirer of Dante, published his own poems, and founded a College of Literature. One of his greatest acts was to open the Vatican archives to students of all nations and denominations (1880), and the Bibliotheca Leonina was founded for the same purpose. The pope was firmly convinced that the Church had nothing to fear from the investigation of truth, and it was his desire that the fullest light should be thrown on every detail of ecclesiastical and world history. Students of all nations, including England, set up historical schools and research institutions in Rome, and have from that time onwards vied with one another in making use of this inexhaustible mine of knowledge for the advancement of learning. Leo encouraged archaeological and scientific studies, and re-instituted the Vatican observatory. On the artistic side, he rebuilt the apse of the Lateran basilica, and restored the Galleria dei Candelabri and the Borgia apartments.

In his relations with the newly established kingdom of Italy, the State which now contained the Vatican, Leo XIII. remained as a matter of principle in the same attitude as his predecessor, and avoided any official relations with the Quirinal, which was the royal residence. Following the example of Pius IX., he forbade Italian Catholics to take part in elections or to stand for the legislature, and demanded the restoration of the temporal sovereignty of the pope as a guarantee for the free exercise of spiritual power. A number of attempts were made to solve the Roman question, as it was called. But Leo XIII. and his secretary of State Rampolla, who were friends of France, never for a moment entertained the idea of attaining their ends by bringing about a war between the Powers and destroying the unity of Italy. They only considered peaceful methods. Negotiations were

undertaken on the basis of the proposal that the popes, while giving up all further claims, should be granted effective sovereignty over a small territory. France, which was at that time an opponent of Italy, was in favour of an agreed solution; Austria and Germany adopted an attitude of reserve, and Italian Liberalism, which was hostile to the pope, and instituted a celebration of the memory of Giordano Bruno in 1889 by way of demonstration, did everything in its power to prevent an agreement being reached.

Leo XIII. was faced in Germany with the legislation which Bismarck had had adopted in Prussia as a result of the *Kulturkampf*. This legislation, with the severe police regulations and other material means of pressure which it instituted, set up a complete system for the suppression of the freedom of the Church. The pope adopted a moderate and conciliatory attitude, and, with the support of the Catholic population of Germany, succeeded in obtaining the repeal of the legislation against the Church. Leo was appointed arbitrator in the dispute between Germany and Spain concerning the possession of the Caroline islands (1885). He also acted as arbitrator in a number of other cases, and thus renewed the former activities of the popes in international relations. Although he was specially friendly to France, his relations with that country were unsatisfactory, since measures were taken to bring about a complete separation of Church and State. A movement arose in England for union between the Anglican and Roman Churches, but Leo decided in the negative in the controversial question of the validity of the consecration of Anglican clergy.

The pope, who had great diplomatic gifts, endeavoured to establish good relations with all countries. He obtained the institution of a Russian embassy to the Vatican, and even established diplomatic relations with Japan. A council of bishops of all the South American States was held in Rome in 1899. The Catholic hierarchy, which now extended over all parts of the world, was increased by nearly 300 dioceses and vicariates. Leo XIII. was a born ruler, and was inspired as a teacher by abundant knowledge of the world and of life.

THE 20TH CENTURY

Pius X., 1903–14.—The new pope, Giuseppe Sarto, who took the name of Pius X., had no diplomatic experience, but was a shining example of the ideal virtues of a shepherd of souls. His motto was *Instaurare omnia in Christo;* and he addressed himself with determination to the task of fortifying the inner life of the Church in every possible way, and filling both clergy and people with the true spirit of the Gospel. While Leo XIII. had been above all the pope of kings, courts and bishops, Piux X. was the pope of the poor and humble, of the minor clergy and of theology and the practical cure of souls. Before he became pope, while he was bishop of Mantua and patriarch of Venice, he had won universal sympathy by his deeply religious nature and his activity in social and charitable affairs. As a result of what had taken place in the last conclave, when Austria had exercised its veto against the candidature of Cardinal Rampolla, he published two constitutions, which prohibited the exercise of the secular veto and reformed the method of papal elections (1904). He reformed the Roman Curia, laid down rules concerning officials in order to check the evil of patronage, and defined the respective spheres of competence of the Congregations and the various other authorities of the Curia, which had become somewhat vague. There was a reduction of the number of fees charged for various purposes. Rome was redivided into parishes. A reduction was made in the excessive number of seminaries for priests in Italy, and Pius instituted a uniform curriculum for the training of the clergy in theology and ascetic discipline. Like his predecessors, he laid stress on the study of St. Thomas Aquinas and the Bible. The Bible Institute was set up in Rome in 1909; it was organized by Fonck on the most modern scientific principles. The Vatican library and archives were developed on the lines adopted by Leo XIII., and the new picture gallery was created. The Italian bishops were given instructions for the care of ecclesiastical archives and the preservation of monuments. Pius also undertook the reform of Church music, and encouraged the use of the old Gregorian chants.

The pope, as bishop of Rome, frequently preached sermons; he recommended frequent communion as a means of developing spiritual life, and suggested that children should be admitted to communion as early as possible. He carried out a number of liturgical reforms, and laid down rules for the secular and regular clergy, who were instructed to interest themselves in social questions. Pius did important work in connection with the codification of ecclesiastical law. Under his instructions, the rules which remained valid for the present day were extracted in a clear and definite form from the chaotic mass of laws which had accumulated in the course of centuries, some of which no longer corresponded to modern requirements. He did not live to see the completion of this work, the new *Codex iuris ecclesiastici*, but certain of its provisions, including those relating to marriage, were put into force during his life-time.

A great stir was created by the pope's manifesto against modernism (1907). In this he condemned all tendencies, whether in Catholic theology or elsewhere, which aimed at the reform of dogma. He demanded that the clergy and teachers of theology should take a special oath disavowing modernism, a movement which had its headquarters in France and Italy and threatened to cause a weakening of the faith in those countries. Pius was not opposed to the modern historical outlook, and recognized the justification of a development of Church doctrine on the basis of incontrovertible researches; but as the guardian of Catholic dogma he could not allow that the supernatural sources of revealed religion should be deprived of their specifically ecclesiastical character by false evolutionism, and that faith and knowledge should be completely separated from one another.

Pius X. was not greatly interested in political affairs, but he had a valuable helper in this respect in his young and congenial secretary of State, Cardinal Merry del Val. As regards relations with official Italy, the Vatican and the Quirinal gradually established a peaceful *modus vivendi,* although the pope had declared immediately after his election that the Church, as the foundation of Christ, must enjoy full and complete liberty. He qualified the absolute prohibition imposed by his predecessors against the participation of Catholics in political elections, and encouraged the non-political organization "Catholic Action" which aimed at educating the social, civic, moral and religious conscience of the Italian nation. He had much difficulty in his relations with France, "the eldest daughter of the Church," which adopted legislation for the separation of Church and State (1905). He took a decisive part in the new settlement of ecclesiastical conditions. The new Republic of Portugal also carried out the separation of Church and State (1911). In Great Britain the Act of 1909 gave Catholics full equality of rights with members of other denominations.

The last circular issued by Pius X. was an appeal for peace addressed to the Catholics of the world on Aug. 2, 1914. He called on Catholics to pray that the flames of war might be extinguished, and that those who guided the destinies of States might cherish thoughts of peace. The "religious pope," as he has been justly called, died in poverty as he had lived, and is buried in a plain sarcophagus in the vaults of St. Peter's. He is revered by the people as a saint.

Benedict XV., 1914–22: The World War.—The archbishop of Bologna, Giacomo della Chiesa, known as Pope Benedict XV., was the great and distinguished priest-diplomatist in whom was brilliantly personified the mediaeval ruler's ideal—"Justitia et Pax" (justice and peace). From his exalted non-party position and with his spiritual authority over all nations, he left no stone unturned in his endeavours to arrest the appalling war spirit. He characterized as the four fundamental evils—and the reason for the severe disturbance of the orderly state of human society—the want of kindly love in the relations of mankind with one another, the contempt of authority, the iniquitous warfare of ranks and classes, the greedy hankering after transitory and perishable possessions. These evils must be uprooted, and only moreover by bringing once more into esteem the fundamental principles of Christianity. This pious pope composed an indi-

vidual prayer for peace, and proposed to the combatant nations a truce for Christmas 1914. Again and again, he exhorted them to desist from this mutual destruction mania, and to realize that nations do not die out, and that therefore rulers should weigh the rights and lawful aspirations of nations by direct or indirect exchange of opinion; for balance of power in the world depends much more on mutual well-wishing and on respect of the rights of others than on the number of men under arms, and on the strength of fortresses. The message of Benedict XV. of Aug. 1, 1917 to the heads of the States of the combatant nations constituted the climax of the papal efforts for peace. In this "as the father of all, who loves all his children with equal affection" he proposed an honourable peace for all, whose durability would be guaranteed if the moral strength of justice were to take the place of the material strength of weapons, and international disputes were submitted to arbitration. At the same time this "pope of peace" accomplished deeds of the sublimest charity. Through his intercession he ameliorated the lot of the prisoners of war, the wounded and the sick; he collected alms throughout the world with the zeal of a Franciscan mendicant friar for the poor and needy, irrespective of nationality and religion. In the midst of the tumult of war, the new book of Church laws, begun under Pius X. was completed (1917), in which the common laws of the Church are lucidly comprised in one. As a supporter of missionary affairs, Benedict emphasized in the great Encyclical Letter of 1919 the common missionary duty of all members of the Catholic Church—of the bishops, of the priests, of the laity, and he established a training centre for the oriental Church in conjunction with the Oriental Institute in Rome, for the education of a home-trained mission clergy. The war situation hindered the pope in free intercourse with the world. Against this ignoble situation, which arose from the want of an individual territorial property, he entered a protest, and demanded a solution of the so-called Roman question, which should guarantee the Holy See complete independence of all temporal power.

Pius XI., 1922.—Pope Pius XI. was born on May 31, 1857 in Desio near Milan and was ordained on Dec. 20, 1879 in the Lateran Basilica in Rome. As head of the Ambrosian Library in Milan and of the Vatican Library, he gained the reputation of a brilliant scientific organizer and of a distinguished scholar, honoured by all the world of culture. In addition to this, he was zealously active in the cure of souls. His love of nature led him in the summer holidays to the mountains where he sought bodily and spiritual refreshment. As apostolic visitor and subsequently papal nuncio in Poland, he gave proof of supreme impartiality and justice in the face of difficult conditions. Appointed cardinal archbishop of Milan in 1921 he managed this most difficult and biggest of Italian dioceses with inspired ability and with wise comprehension of the Church needs of a great modern city. These many-sided gifts, in addition to his eminent knowledge of languages, his clear penetrating discernment, his strong simple character and his high ideal conception of the priesthood, made Achille Ratti appear more suitable than any other to mount the papal throne. His election on Feb. 6, 1922 called forth universal satisfaction.

With the words "Pius is a name of Peace, therefore I will bear it," Pius XI. began his rule, among the signs of the rebuilding of Europe after the prodigious shock of the World War. It is not as yet possible to judge this pontiff conclusively in his world historical significance. He is a specially keen supporter of all scientific movements, and devotes his whole vigorous authority to the drawing together again and reconciliation of the nations. The mighty influx of pilgrims from all the world to Rome in the Holy Year 1925, to whom the pope delivered impressive addresses in the familiar languages of their native countries, showed forcefully what unique prestige, what undisputed moral and cultural weight the papacy has in all States and Nations. This is also demonstrated by the standing of the Diplomatic Corps at the Vatican, which since the beginning of the World War to 1928 has increased from 16 to 28 members.

The year 1929 brought the successful solution of the Roman question, an event of world historical importance, whereby the pope regained his complete liberty as an independent sovereign. (I. P. D.)

The Renewal of Papal Sovereignty.—The aspiration of Pius XI. for "the drawing together again and reconciliation of the nations" bore historic fruit seven years after his holiness first assumed the papal tiara.

Mussolini had, in 1926, expressed the wish that a solution of the conflict between the Italian State and the Vatican should be arrived at, a wish that was communicated to Pius XI., which found a favourable reception in that quarter. Unofficial, semi-official and, eventually, official negotiations followed during the years 1927 and 1929, but were kept strictly secret. The councillor of State, Signor Barone, acted as the Italian representative, Monsignor Borgongini Duca and Signor Pacelli as representatives of the pope. although in the last phase, after Signor Barone's death, the negotiations were conducted by Mussolini and Cardinal Gasparri, with Signor Pacelli as the sole intermediary. It was not until Jan. 1929 that rumours of an imminent solution of the "Roman Question" began to circulate. On Feb. 7 Cardinal Gasparri informed the Diplomatic Corps accredited to the Holy See, expressly summoned by him, that an agreement had been concluded and was about to be signed.

Mussolini's goodwill and powers of translating visions into facts, combined with the pope's definite aspiration for peace and concord at home and abroad, united to bring about a great and historic event, which happened with dramatic suddenness on Feb. 11. At noon on that day a treaty was executed at the palace of the Lateran in Rome by which Pius XI. became sovereign of a newly-created State, "The City of the Vatican." Three documents were signed, respectively, for the high contracting parties by Cardinal Gasparri, papal secretary of State, and Mussolini. The treaty, concordat and financial convention, which had to receive the ratification of the king of Italy and the supreme pontiff within four months from the signature, took effect from the moment of ratification.

The political treaty between Italy and the Holy See consists of a preamble and 27 articles. It recognizes the full property, exclusive dominion and sovereign jurisdiction of the Holy See over the Vatican as at present constituted, and for this purpose "The City of the Vatican" is constituted, in which there can be no interference by the Italian Government. The boundaries of the Vatican city are indicated in the map annexed to the treaty. The Vatican city is endowed by the Italian Government with various public services. Territorial immunities are provided for the patriarchal basilicas, and certain edifices outside the Vatican city in which the Holy See houses its congregations and offices. Also the right of the Holy See to send its own diplomatists to foreign countries, and receive foreign diplomatists according to the general rules of international law, is recognized by Italy.

It is also declared that the Vatican wishes to remain, and will remain, extraneous to the temporal competitions between other States, as well as international congresses convened for this purpose, unless the parties in conflict appeal unanimously to its mission of peace, and reserves the full right, in any case, to the exercise of its moral and spiritual power. In consequence thereof the Vatican territory will always be considered neutral and inviolable.

The following declaration is of supreme importance to future historians:—"The Holy See considers that with the agreements signed to-day it possesses the guarantees necessary to provide due liberty and independence to the spiritual government of the dioceses of Rome and of the Catholic Church in Italy and the whole world. It declares the Roman question definitely and irrevocably settled and therefore eliminated, and recognizes the kingdom of Italy under the dynasty of the house of Savoy with Rome as the capital of the Italian State. Italy on its side recognizes the State of the Vatican city under the sovereignty of the supreme pontiff. The Law of Guarantees and any other law or act contrary to the present treaty is abrogated."

For the article in the Concordat which concerns Italy and the Canon law, and the question of religious instruction, *see* ITALY.

According to the financial convention, the Holy See, as a definite

settlement of all its financial relations with Italy, in consequence of the loss of its temporal power in 1870, accepts 750,000,000 lire (£8,152,000) in cash and 1,000,000,000 lire (£10,869,000) in Italian State bonds bearing interest at 5%. This sum is less than what Italy would have paid if the Holy See had accepted the allowance offered under the Law of Guarantees of May 13, 1871.

On the day following the signing of the treaty, Pius XI. appeared on the balcony of St. Peter's and gave the pontifical blessing, *Urbi et Orbi,* in the presence of some 100,000 people gathered in the square, amidst scenes of unprecedented enthusiasm.

Commenting on this historic event, *The Times* (Feb. 13, 1929) said:—"It is a great fact in the history of the Roman Church and of United Italy, now for the first time invested with a complete religious unity in the minds of all her Catholic citizens. . . . With the signal courage and breadth of view which have led him to carry out this great work of peace, the pope assumes the whole responsibility for his departure from the course followed by his predecessors for almost 60 years. He declares that the only aid he has had during his long study of what until two days since was still the 'Roman Question' has been from the prayers of the faithful of his communion. . . . The credit of the initiative is assigned to Signor Mussolini, but he must have known that in the pope, whose first act was to bless the people from the outer loggia of St. Peter's he would find a ready listener. . . . The pontifical banner and the flag of United Italy flew side by side on St. Peter's yesterday. In the words of the governor of Rome, 'what seemed to be a poet's dream' has indeed 'become a splendid reality.'"

On March 9, the pope received the entire diplomatic corps accredited to the Holy See to receive from them the congratulations of the nations of the world on the settlement of the "Roman Question" by the Lateran Treaty. More than seventy diplomats representing about thirty-five countries assembled before his holiness in the throne room.

In his reply the pope declared that the diplomatists' visit was "truly the greatest and the most important that could be made to us. For behind each one of you, we cannot prevent ourselves from seeing your respective State leaders, kings, presidents, regents, or by whatever other name they are called, and with them your peoples and your countries. . . . The sympathy and union of your countries and peoples at a moment (or, it can be said, a turning point) so important in the history of the Holy See and the Church, are translated into such solemn demonstrations that they have replaced and surpassed without measure all the guarantees which we could have desired." His holiness went on to refer to "another guarantee, which since February 11 has been filling the entire world. That is this great, incomparable (and perhaps up till now unprecedented) plebiscite, not only of Italy, but of all parts of the world. There is no exaggeration in these words: we have received letters and dispatches not only from all the towns and villages of Italy, not only from all the towns and many of the villages of the countries of Europe, but also from the two Americas, from India, from China, from Japan, from Australia, from New Zealand, from Northern, Central and South Africa, from Alaska, from the Mackenzie, from the Hudson, as if it all concerned a local affair. What an impressive event, and one which authorizes us to state, that not only the people, but that the peoples of the entire world are with us; a true plebiscite, not only national, but world-wide. And there is the most imposing guarantee that can be thought of or imagined."

We are too close to the big fact to appreciate it in its full importance and significance, and cannot even guess at its repercussive effects throughout the world. It has been expressly declared that the Vatican city State "will remain extraneous to the temporal competitions between other States," and that "it will only endeavour to fulfil its mission of peace if invited to do so." The Vatican will therefore not apply for admission to the League of Nations, as membership of that body would involve military obligations which a spiritual Power such as the Holy See could not undertake. The temporal power of the Holy See, as the world reckons temporal power, is hardly more than the palpable assertion of a right, when the insignificant size of the new State is considered. All that the pope asked for and received was "what was indispensable to true sovereignty and necessary for his spiritual ministry."

This, taken in conjunction with the statement in the preamble of the treaty, that the two high contracting parties recognize the advisability of eliminating every reason for enmity between them, may be seen to be something more than a magnificent gesture towards international concord. It is the greatest attempt made in the present generation to reinforce the moral health and happiness of the world, because it contains the potentialities by which "the peace of Christ in the Kingdom of Christ" can be forwarded.

(X.)

*List of the Pontiffs of the Roman Church**

Date of Election or Consecration		Date of Death
c. 41	B. PETRUS	29 vi, *c.* 65–67
c. 67	S. Linus	† 23 ix, *c.* 79
c. 79	S. Cletus (*Anencletus*)	† 26 iv, *c.* 91
c. 91	S. Clemens I.	† 23 xi, *c.* 100
*c.*100	S. Evaristus	† 26 x, *c.* 109
*c.*109	S. Alexander	† 3 v, *c.* 119
*c.*119	S. Sixtus (*Xystus*)	† 6 iv, *c.* 126
? 128	S. Telesphorus	† 5 i, 137
*c.*138	S. Hyginus	† 11 i, 142
*c.*142	S. Pius	† 11 vii, *c.* 156
*c.*157	S. Anicetus	† 17 iv, 167
168	S. Soter	† 22 iv, *c.* 176
177	S. Eleutherus	† 26 v, 189
*c.*190	S. Victor I.	† 20 iv, *c.* 202
*c.*202	S. Zephyrinus	† 26 viii, 217
218	S. Calixtus I.	† 14 x, 222
222	S. Urbanus I.	† 25 v, 230
230	S. Pontianus	*res.* 28 ix, 235
235 (21 xi, ord.)	S. Anterus	† 3 i, 236
236	S. Fabianus	† 20 i, 250
251 (iii, el.)	S. Cornelius	† 14 ix, 253
253 el.	S. Lucius	† 5 iii, 254
254 (12 v ?, el.)	S. Stephanus I.	† 2 viii, 257
257 viii	S. Sixtus (*Xystus*) II.	† 6 viii, 258
259 22 vii, el,	S. Dionysius	† 26 xii, 268
269 5 i, el.	S. Felix	† 30 xii, 274
275 *c.* 5 i	S. Eutychianus	† 8 xii, 283
283 17 xii	S. Gaius	† 22 iv, 296
296 30 vi	S. Marcellinus	† (? 25 x), 304
307 el.	S. Marcellus	† 15 i, 309
309 iv, el.	S. Eusebius	† 17 viii, 309
310 2 vii	S. Melchiades (*Miltiades*)	† 11 i, 314
314 31 i	S. Sylvester	† 31 xii, 335
336 18 i	S. Marcus	† 7 x, 336
337 6 ii, el.	S. Julius	† 12 iv, 352
352 22 v	S. Liberius	† 24 ix, 366
366 ix	S. Damasus	† 10 xii, 384
384 xii	S. Siricius	† 26 xi, 398
398 xi-xii	S. Anastasius I.	† *vert. anno* 401–402
402	S. Innocentius I.	† 12 iii, 417
417 18 iii, cs.	S. Zosimus	† 26 xii, 418
418 28 xii	S. Bonifacius I.	† 4 ix, 422
422 *c.* 10 ix	S. Coelestinus I.	† *c.* 26 vii, 432
432 31 vii	S. Sixtus III.	† 18 viii, 440
440 viii, el.	S. Leo I.	† 10 xi, 461
461 12 xi, cs.	S. Hilarus	† 21 ii, 468
468 25 ii, cs.	S. Simplicius	† 2 iii, 483
483	S. Felix III.	† *c.* 25 ii, 492
492 1 iii, cs.	S. Gelasius	† 19 xi, 496
496 *c.* 24 xi. cs.	S. Anastasius II.	† *et sep.* 19 xi, 498
498 22 xi	S. Symmachus	† *et sepult.* 19 vii, 514
514 20 vii, cs.	S. Hormisdas	† *sepult.* 7 viii, 523
523 13 viii	S. Joannes I.	† 18 v, 526
526 12 vii, cs.	S. Felix IV.	† *sepel.* 12 x (?) 530
530 17 ix, el.	Bonifacius II.	† *sepul.* 17 x, 532
532 31 xii, cs.	Joannes II.	† *sepel.* 27 v, 535
535 3 vi, cs.	S. Agapetus I.	† 22 iv, 536
536 8 vi, cs.	S. Silverius, *exul*	† *sepel.* 20 vi, *c.* 538
537 29 iii, cs.	Vigilus	† 7 vi, 555
555 *p.* 7 vi, cs.	Pelagius I.	† 3 iii, 560
560 14 vii, cs.	Joannes III.	† *sepel.* 13 vii, 573
574 3 vi, cs.	Benedictus I.	† 31 vii, 578
578 27 xi, cs.	Pelagius II.	† *sepel.* 6 ii, 590
590 3 ix, cs.	S. Gregorius I.	† *sepel.* 12 iii, 604

*As recorded in the registers of the Roman Church (from P. B. Gams, *Series episcoporum Romanae ecclesiae*).

Date of Election or Consecration		Date of Death	
604 13 ix, cs.	Sabinianus	† 22 ii,	606
607 19 ii, cs.	Bonifacius III.	† *sepel.* 12 xi,	607
608 15 ix, cs.	S. Bonifacius IV.	† *sepel.* 25 v,	615
615 19 x, cs.	S. Deusdedit	† *sepel.* 8 xi,	618
619 23 xii, cs.	Bonifacius V.	† *sepel.* 25 x,	625
625 3 xi, cs.	Honorius	† *sepel.* 12 x,	638
640 28 v, cs.	Severinus	† *sepel.* 2 viii,	640
640 25 xii, cs.	Joannes IV.	† *sepel.* 12 x,	642
642 24 xi, cs.	Theodorus I.	† *sepel.* 14 v,	649
649 vi–vii, cs.	S. Martinus	† *exul* 16 ix,	655
654 10 viii, cs.	S. Eugenius I.	† *sepel.* 3 vi,	657
657 30 vii, cs.	S. Vitalianus	† *sepel.* 27 i,	672
672 11 iv, cs.	Adeodatus	† *sepel.* 16 vi,	676
676 2 xi, cs.	Donus	† *sep.* 11 iv,	678
678 vi–vii, cs.	S. Agatho	† *sep.* 10 i,	681
682 17 viii, cs.	S. Leo II.	† *sep.* 3 vii,	683
684 26 vi, cs.	S. Benedictus II.	† *sep.* 8 v,	685
685 23 vii, cs.	Joannes V.	† 2 viii,	686
686 21 x, cs.	Conon	† *sepel.* 22 ix,	687
687 x–xii, el.	S. Sergius I.	† *sepel.* 8 ix,	701
701 30 x, cs.	Joannes VI.	† *sepel.* 10–11 i,	705
705 1 iii, cs.	Joannes VII.	† *sep.* 18 x,	707
708 18 i (?)	Sisinnius	† *sep.* 7 ii,	708
708 25 iii, cs.	Constantinus I.	† 9 iv,	715
715 19 v, cs.	S. Gregorius II.	† *sepel.* 11 ii.	731
731 11 ii, el.	S. Gregorius III.	† *sep.* 29 xi,	741
741 3 xii, cs.	S. Zacharias	† *sep.* 15 iii,	752
752 iii, el.	Stephanus II.	† *ex.* iii,	752
752 *ex.* iii, el.	Stephanus III.	† *sep.* 26 iv,	757
757 29 v, cs.	S. Paulus I.	† 28 vi,	767
767 5 vii, cs.	Constantinus II.	*depos.* 6 viii,	768
768 7 viii, cs.	Stephanus IV.	† 1 ii,	772
772 1 ii, el.	Hadrianus I.	† 25 xii,	795
795 26 xii, el.	S. Leo III.	† *sep.* 12 vi,	816
816 vi, el.	Stephanus V.	† 24 i,	817
817 25 i, cs.	S. Paschalis I.	† *c.* 14 v,	824
824 v–vi	Eugenius II.	† viii,	827
827	Valentinus	† *ex. ann.*	827
827 *ex. ann.*	Gregorius IV.	† i,	844
844 i	Sergius II.	† 27 i,	847
847 10 iv, cs.	S. Leo IV.	† 17 vii,	855
855 29 ix, cs.	Benedictus III.	† 7 iv,	858
858 24 iv, cs.	S. Nicolaus I.	† 13 xi,	867
867 14 xii, cs.	Hadrianus II.	† *c.* 1 xii,	872
872 14 xii	Joannes VIII.	† 15 xii,	882
882 *c.* xii	Marinus I.	† *c.* v,	884
884 *c.* v, el.	Hadrianus III.	† *c.* viii–ix,	885
885 *c.* ix, el.	Stephanus VI.	† *c.* ix,	891
891 *c.* ix	Formosus	† 23 v,	896
896 *c.* 23 v, el.	Bonifacius VI.	† *c.* 6 vi,	896
896 *a.* 11 vi, intrus	Stephanus VI. (VII.)	*amot.* † vii,	897
897 vii, cs.	Romanus	† *c.* xi,	897
897 *c.* xi	Theodorus II.	† *post* 20 *dies*	
898 *c.* vi, cs.	Joannes IX.	† vii,	900
900 6–26 vii	Benedictus IV.	† viii,	903
903 *c.* viii	Leo V.	† *c.* ix,	903
903 *c.* x	Christophorus	*amot.* i,	904
904 29 i, cs.	Sergius III.	† *p* 4 ix,	911
911 *c.* ix, cs.	Anastasius III.	† *c.* xi,	913
913 *c.* xi, cs.	Lando	† *c.* v,	914
914 15 v, cs.	Joannes X.	† *in carcere*	929
928 *c.* vii, cs.	Leo VI.	† *c.* ii,	929
929 *c.* ii, cs.	Stephanus VIII.	† 15 iii,	931
931 *c.* iii, cs.	Joannes XI.	† i,	936
936 *a.* 9 i, cs.	Leo VI. (VII.)	† vii,	939
939 *a.* 19 vii, cons.	Stephanus IX.	† *c.* x,	942
942 *a.* 11 xi, cons.	Marinus II.	† *c.* iv,	946
946 *c.* iv	Agapetus II.	† *c.* 8 xi,	955
955 *c.* xi, cs.	Joannes XII.	(*amot.* 4 xii, 963) † 14 v,	964
963 4 xii, el.	Leo VIII.	† *c.* iii,	965
964 v, el.	Benedict V.	*exul*	965
965 1 x, cs.	Joannes XIII.	† 6 ix,	972
973 19 i, cs.	Benedict VI.	† *occis.* vii,	974
974 x	Benedictus VII.	† x,	983
983 *ex. ann.*	Joannes XIV.	† *occis.* 20 viii,	984
984	Bonifacius VII.	† vii,	985
985 1 ix, cs.	Joannes XV.	† *in.* iv,	996
996 3 v, cs.	Gregorius V.	† ii,	999
999 *in.* iv, cs.	Sylvester II. (*Gerbert*)	† 12 v,	1003
1003 13 vi, cs.	Joannes XVII. (*Sicco*)	† 7 xii,	1003
1003 25 xii, cs.	Joannes XVIII.	† vi,	1009
1009 *p.* 20 vi, cs.	Sergius IV.	† 16–22 vi,	1012
1012 22 vi, cs.	Benedict VIII.	† 7 iv,	1024
1024 24 vi–15 vii, cs.	Joannes XIX.	† i,	1033
1033 i, cs.	Benedictus IX.	*resignat.* 1 v,	1045
1045 1 v, intr.	Gregorius VI.	*resignat.* 20 xii,	1046
1046 25 xii, cs.	Clemens II.	† 9 x,	1047
1048 17 vii, cs.	Damasus II.	† 9 viii,	1048
1049 12 ii, cs.	S. Leo IX.	† 19 iv,	1054
1055 13 iv, cs.	Victor II.	† 28 vii,	1057
1057 2 viii, el.	Stephanus X.	† 29 iii,	1058
1058 5 iv, el.	Benedict X.	*expuls. c.* i,	1059
1059 24 i, cs.	Nicolaus II.	† 27 vii,	1061
1061 1 x, el.	Alexander II.	† 21 iv,	1073
1073 22 iv, el.	S. Gregorius VII.	† 25 v,	1085
1086 24 v, el.	Victor III.	† 16 ix,	1087
1088 12 iii, el.	Urbanus II.	† 29 vii,	1099
1099 13 viii, el.	Paschalis II.	† 21 i,	1118
1118 24 i, el.	Gelasius II.	† 29 i,	1119
1119 2 ii, el.	Calixtus II.	† 13–14 xii,	1124
1124 15–16 xii, el.	Honorius II.	† 14 ii,	1130
1130 14 ii, el.	Innocentius II.	† 24 ix,	1143
1143 26 ix, el.	Coelestinus II.	† 8 iii,	1144
1144 12 iii, el.	Lucius II.	† 15 ii,	1145
1145 15 ii, el.	Eugenius III.	† 8 vii,	1153
1153 12 vii, cs.	Anastasius IV.	† 3 xii,	1154
1154 4 xii, el.	Hadrianus IV.	† 1 ix,	1159
1159 7 ix, el.	Alexander III.	† 30 viii,	1181
1181 1 ix	Lucius III.	† 25 xi,	1185
1185 25 xi	Urbanus III.	† 20 x,	1187
1187 21 x, el.	Gregorius VIII.	† 17 xii,	1187
1187 19 xii, el.	Clemens III.	† iii,	1191
1191 30 iii, el.	Coelestinus III.	† 8 i,	1198
1198 8 i	Innocentius III.	† 16 vii,	1216
1216 18 vii	Honorius III.	† 18 iii,	1227
1227 19 iii	Gregorius IX.	† 21 viii,	1241
1241 x	Coelestinus IV.	† 17–18 xi,	1241
1243 25 vi	Innocentius IV.	† 13 xii,	1254
1254 25 xii	Alexander IV.	† 25 v,	1261
1261 29 viii	Urbanus IV.	† 2 x,	1264
1265 5 ii	Clemens IV.	† 29 xi,	1268
1271 1 ix	Gregorius X.	† 11 i,	1276
1276 23 ii cs.	Innocentius V.	† 22 vi,	1276
1276 12 vii, el.	Hadrianus V.	† 17 viii,	1276
1276 13 ix	Joannes XXI.	† 16 v,	1277
1277 25 xi	Nicolaus III.	† 22 viii,	1280
1281 22 ii	Martinus IV.	† 28 iii,	1285
1285 2 iv	Honorius IV.	† 3 iv,	1287
1288 15 ii	Nicolaus IV.	† 4 iv,	1292
1294 5 vii	S. Coelestinus V. († 19 v, 1296)	*res.* 13 xii,	1294
1294 24 xii	Bonifacius VIII.	† 11 x,	1303
1303 22 x	Benedictus XI.	† 7 vii,	1304
1305 5 vi	Clemens V.	† 20 iv,	1314
1316 7 viii	Joannes XXII.	† 4 xii,	1334
1334 20 xii	Benedictus XII.	† 25 iv,	1342
1342 7 v, el.	Clemens VI.	† 6 xii,	1352
1352 18 xii	Innocentius VI.	† 12 ix,	1362
1362 28 x	Urbanus V.	† 19 xii,	1370
1370 30 xii	Gregorius XI.	† 27 iii,	1378
1378 8 iv	Urbanus VI.	† 15 x,	1389
[1378 20 ix	Clemens VII. *antipapa Aven.*	† 16 ix,	1394
1394 28 ix	Benedict XIII. (*amot* 26 vii) 1417	† 23 v,	1423]
1389 2 xi	Bonifacius IX.	† 1 x,	1404
1404 17 x	Innocentius VII.	† 6 xi,	1406
1406 2 xii	Gregorius XII. († 1419) *resignat.*	4 vii,	1415
1409 26 vi	Alexander V.	† 3 v,	1410
1410 17 v	Joannes XXIII. († 22 xi, 1419) *amot.*	24 v,	1415
1417 11 xi	Martinus V.	† 20 ii,	1431
1431 3 iii	Eugenius IV.	† 23 ii,	1447
1447 6 iii	Nicolaus V.	† 24 iii,	1455
1455 8 iv	Calixtus III.	† 6 viii,	1458
1458 19 viii	Pius II.	† 15 viii,	1464
1464 31 viii	Paulus II.	† 28 vii,	1471
1471 9 viii	Sixtus IV.	† 12 viii,	1484
1484 24 viii	Innocentius VIII.	† 25 vii,	1492
1492 11 viii	Alexander VI.	† 18 viii,	1503
1503 22 ix	Pius III.	† 18 x,	1503
1503 1 xi	Julius II.	† 21 ii,	1513
1513 15 iii	Leo X.	† 1 xii,	1521
1522 9 i	Hadrianus VI.	† 14 ix,	1523
1523 19 xi	Clemens VII.	† 25 ix,	1534
1534 13 x	Paulus III.	† 10 xi,	1549

Date of Election or Consecration		Date of Death	
1550 8 ii	Julius III.	† 23 iii,	1555
1555 9 iv	Marcellus II.	† 30 iv,	1555
1555 23 v	Paulus IV.	† 18 viii,	1559
1559 25 xii	Pius IV.	† 9 xii,	1565
1566 17 i, cs	S. Pius V.	† 1 v,	1572
1572 26 v	Gregorius XIII.	† 10 iv,	1585
1585 1 v, cs.	Sixtus V.	† 27 viii,	1590
1590 15 ix, el	Urbanus VII.	† 27 ix,	1590
1590 5 xii	Gregorius XIV.	† 15 x,	1591
1591 29 x, el	Innocentius IX.	† 30 xii,	1591
1592 30 i, el	Clemens VIII.	† 5 iii,	1605
1605 1 iv, el.	Leo XI.	† 27 iv.	1605
1605 16 v, el	Paulus V.	† 28 i,	1621
1621 9 ii	Gregorius XV.	† 8 vii,	1623
1623 6 viii, el.	Urbanus VIII.	† 29 vii,	1644
1644 15 ix	Innocentius X.	† 7 i,	1655
1655 7 iv	Alexander VII.	† 22 v,	1667
1667 20 vi	Clemens IX	† 9 xii,	1669
1670 29 iv	Clemens X.	† 22 vii,	1676
1676 21 ix	Innocentius XI.	† 12 viii,	1689
1689 6 x	Alexander VIII.	† 1 ii,	1691
1691 12 vii	Innocentius XII.	† 27 ix,	1700
1700 23 xi, el	Clemens XI.	† 19 iii,	1721
1721 8 v	Innocentius XIII.	† 7 iii,	1724
1724 29 v	Benedictus XIII.	† 21 ii,	1730
1730 12 vii	Clemens XII.	† 6 ii,	1740
1740 17 viii	Benedictus XIV.	† 3 v,	1758
1758 6 vii	Clemens XIII.	† 2 ii,	1769
1769 19 v	Clemens XIV.	† 22 ix,	1774
1775 15 ii	Pius VI.	† 29 viii,	1799
1800 14 iii	Pius VII.	† 20 viii,	1823
1823 28 ix	Leo XII.	† 10 ii,	1829
1829 31 iii	Pius VIII.	† 30 xi,	1830
1831 2 ii	Gregorius XVI.	† 1 vi,	1846
1846 16 vi, el	Pius IX	† 3 vi,	1877
1877 vi, el	Leo XIII	† 20 vii,	1903
1903 4 viii, el	Pius X.	† 20 viii,	1914
1914 3 ix, el	Benedictus XV.	† 22 i,	1922
1922 6 ii, el.	Pius XI.		

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(*c*) From 1198 to 1261 —On the pontificate of Innocent III in general, *see* F von Hurter, *Geschichte Innocenz III.* (3rd and 2nd ed, 4 vols, Hamburg, 1841–44), and A Luchaire, *Innocent III, Rome et l'Italie* (2nd ed, 1905), *Innocent III, la croisade des albigeois* (1905), *Innocent III, la papauté et l'empire* (Paris, 1906), *Innocent III, la question d'orient* (1906), and *Innocent III, les royautés vassales du Saint-Siège* (1908). *Cf* E. Winkelmann, *Philipp von Schwaben und Otto IV. von Braunschweig* (2 vols, Leipzig, 1873–78), W. Norden, *Das Papsttum und Byzanz* (1903), a considerable part of which is devoted to Innocent III, E Gerland, *Geschichte des lateinischen Kaiserreiches von Konstantinopel* (Hamburg, 1905), R Davidsohn, *Philipp II. August von Frankreich und Ingeborg* (Stuttgart, 1888); R Schwemer, *Innocenz III. und die deutsche Kirche wahrend des Thronstreites von 1198–1208* (Strassburg, 1882); Else Gutschow, *Innocenz III. und England* (Munich, 1904); and many other detailed monographs The pontificate of Honorius III. is dealt with by J Clausen in his *Papst Honorius III* (Bonn, 1895), and his registers have been published by P Pressutti (3 vols, Rome, 1884 and 1888–95). On Gregory IX, *see* J Felten, *Papst Gregor IX* (Freiburg-i-B., 1886); P. Balan, *Storia di Gregorio IX e dei suoi tempi* (3 vols, Modena, 1872–73); and J. Marx, *Die vita Gregorii IX.* (1889). The publication of the registers of this pope was begun by L. Auvray in the *Bibliothèque des écoles de Rome et d'Athènes* (Paris, 1890 *et seq*). On Innocent IV., *see* E Berger, *St Louis et Innocent IV.* (1893); E Winkelmann, *Kaiser Friedrich II* (2 vols, Leipzig, 1889–97); P Aldinger, *Die Neubesetzung der deutschen Bistümer unter Papst Innocenz IV.* (Leipzig, 1901); C Rodenberg, *Innocenz IV. und das Konigreich Sizilien* (Halle, 1892), and F. Tenckhoff, *Papst Alexander IV.* (1907). The publication of the registers of Innocent IV. was undertaken by Elie Berger (1881–1919), and those of Alexander IV by J de Loye, A Coulon and C. Bourel de la

Roncière (1895, etc.). As the history of the later Hohenstaufens is intimately bound up with that of the contemporary popes, mention must be made of F. W. Schirrmacher, *Die letzten Hohenstaufen* (Göttingen, 1871); A. Karst, *Geschichte Manfreds vom Ende Friedrichs II. bis zu seiner Krönung* (1897); and K. Hampe, *Geschichte Konradins von Hohenstaufen* (Innsbruck, 1894).

(*d*) From 1261 to 1305:—L. Dorez and J. Guiraud, members of the French school at Rome, began the publication of the registers of Urban IV. (1892, etc.); E. Jordan, those of Clement IV. (1893, etc.); and J. Guiraud and L. Cadier, those of Gregory X. (1892, etc.). On Gregory X., *see* F. Walter, *ie Politik der KDurie unter Gregor X.* (Berlin, 1894). The pontificate of John XXI. has been dealt with by R. Stapper, *Papst Johannes XXI.* (Münster-i.-W., 1898), and that of Nicholas III. by A. Demski, *Papst Nikolaus III.* (Münster-i.-W., 1903), in vol. vi. of the *Kirchengeschichtliche Studien*, edit. by Knöpfler, Schrörs and Sdralek. The publication of the registers of Nicholas III. was undertaken by J. Gay (1898, etc.). Much information on the policy of these popes will be found in the following: R. Sternfield, *Ludwigs des Heiligen Kreuzzug nach Tunis und die Politik Karls I. von Sizilien* (1896); Ch. V. Langlois, *Le Règne de Philippe III. le Hardi* (1887); L. Leclère, *Les Rapports de la papauté et de la France sous Philippe III.* (Brussels, 1889); C. Minieri-Riccio, *Alcuni fatti riguardanti Carlo I. d'Angiò* (Naples, 1874), and *Il Regno di Carlo I. d'Angiò*, in the *Archivio storico italiano* (3rd series, vols. xxii., xxiii., xxiv., xxv., xxvi.: 4th series, vols. ii., iii., iv., v., vii., 1875–81); A. Busson, *Die Idee des deutschen Erbreichs und die ersten Habsburger* (Vienna, 1878); G. del Giudice, *La Famiglia di re Manfredi* (Naples, 1880); and H. Otto, *Die Beziehungen Rudolfs von Habsburg zu Papst Gregor X.* (Innsbruck, 1895). There is a good account of the policy of Martin IV. in O. Cartellieri, *Peter von Aragon und die sizilianische Vesper* (Heidelberg, 1904). On Honorius IV., *see* introduction to the complete edition of his registers by Maurice Prou (1886–88). E. Langlois has published the registers of Nicholas IV. (1886–93), and Otto Schiff deals with his pontificate in his *Studien zur Geschichte Papst Nikolaus IV.* (1897). On Celestine V., *see* H. Schulz, *Peter von Murrhone: Papst Coelestin V.* (1894). The publication of the registers of Boniface VIII. was begun by G. Digard, M. Faucon and A. Thomas (1884). Of the vast literature on this pontificate we must content ourselves with citing: Heinrich Finke, *Aus den Tagen Bonifaz' VIII.* (Münster-i.-W., 1902); Ch. V. Langlois, "St. Louis, Philippe le Bel, Les Derniers capétiens directs" (vol. iii., pt. 2 of Lavisse, *Histoire de France*); Ernest Renan, *Études sur la politique religieuse du règne de Philippe le Bel* (1889); A. Baudrillart, "Des idées qu'on se faisait au XIV^e siècle sur le droit d'intervention du souverain pontife en matière politique," in the *Revue d'histoire et de littérature religieuses* (vol. iii., 1898); and R. Holtzmann, *Wilhelm von Nogaret* (Freiburg-i.-B., 1898). The pontificate of Benedict XI. is dealt with by P. Funke in his *Papst Benedikt XI.* (Münster-i.-W., 1891). *See* Ch. Grandjean, "Recherches sur l'administration financière du pape Benoît XI.," in the *Mélanges d'archéologie et d'histoire* (vol. iii., 1883), published by the French school at Rome. Grandjean has published the registers of Benedict XI. (1883).

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PAPAGO, a tribe in Arizona and Sonora, closely related to the Pima, from whom they differed chiefly in a more scattered mode of life due to a stringently arid habitat. Their chief means of subsistence has always been agriculture. Formerly their chief crops were maize, beans, and cotton, which they cultivated by irrigation, but which have now been replaced by wheat and cotton. More or less under the influence of Jesuit and Franciscan missionaries for over two centuries, they have maintained much of their old life and religion. In 1921 those in southern Arizona numbered 6,100.

PAPAL STATES: *see* States of the Church.

PAPAVERINE, an opium alkaloid still used in medicine to some extent; it was first obtained by Merck in 1848. Papaverine, $C_{20}H_{21}O_4N$, crystallizes in colourless prisms or needles, melts at 147° C, and is optically inactive. It is insoluble in water, but dissolves readily in chloroform or hot alcohol. The hydrochloride, $C_{20}H_{21}O_4N,HCl$, crystallizes in plates and melts at 231° C. On gentle oxidation papaverine is converted into papaveraldine, which is the minor alkaloid *xanthaline* found in opium. Papaverine is an important primary product for the synthesis of alkaloids (*q.v.*). It was first synthesized by Pictet and Gams (1909), and had been converted into laudanosine by Pictet and Athanasescu (1900), from which in turn glaucine was made by Gadamer (1911). The papaverine structure is equally important as a starting point for syntheses in the berberine series.

PAPAW-TREE (*Asimina triloba*), a North American shrub or low tree of the custard-apple family (Anonaceae), native to rich soil from western New York to Nebraska and southward to Florida and Texas. It grows from 10 to 40 ft. high, with large leaves, sometimes 12 in. long and 6 in. wide, and brown to dark red flowers, 1 to 2 in. across. The fleshy, somewhat banana-shaped edible fruit, 2 to 5 in. long, matures in autumn.

PAPAYA (*Carica Papaya*), called also papaw, a small, very soft-wooded tree of the family Caricaceae, native to tropical America and cultivated in most tropical countries. In the United States it thrives in southern Florida below Palm Beach, but it does not succeed well in California, although it is sparingly grown in the hot interior valleys. A rich loamy soil is best. It grows 25 ft. high, without lateral branches, but sometimes divided into several upright stems terminating in clusters of leaves. Most of the plants have either male or female blossoms, only a few have both kinds. The fruits resemble golden yellow melons, are angular, spherical or cylindrical in shape, and attain a weight of 20 pounds. In Florida they ripen from December to June. They are used mostly as a breakfast melon in hot countries, but also as a salad. In some localities the green fruits are cooked and served like summer squash. The milky juice contains papain, a digestive enzyme resembling animal pepsin. This is used as a remedy for dyspepsia.

PAPEETE, capital of Tahiti: *see* Pacific Islands.

PAPEL, a Portuguese Guinea people, related to the Bagnun, Balante, Mandjak and Bola peoples, living on the left bank of the Geba estuary.

See Dr. Maclaud, "Distribution des races sur la Côte Occidentale d'Afrique," *Bulletin Géogr. hist. descript.* (1906).

PAPENBURG, a town in the Prussian province of Hanover, 27 m. by rail S. by E. of Emden, and near the right bank of the Ems, with which it is connected by a canal 3 m. long. Pop. (1925) 9,444. Papenburg, founded in 1675, became a town in 1860.

PAPER, the general name for the substance commonly used for writing upon, or for wrapping things in (Fr. *papier* through Lat. from Gr. *πάπυρος. See* the article Papyrus). The art of making paper from fibrous matter appears to have been practised by the Chinese at a very distant period. Different writers have traced it back to the 2nd century B.C. Paper first became available for the rest of the world in the middle of the 8th century. In 751 the Arabs, who had occupied Samarkand early in the century, were attacked there by Chinese. The invasion was repelled by the Arab governor, who in the pursuit, it is related, captured certain prisoners who were skilled in paper-making and who imparted their knowledge to their new masters. Hence began the Arabian manufacture, which rapidly spread to all parts of the Arab dominions. The extent to which it was adopted for literary purposes is proved by the comparatively large number of early Arabic mss. on paper which have been preserved dating from the 9th century. The material of the Arab paper was apparently substantially linen. It seems that the Arabs, and the skilled Persian workmen whom they employed, at once resorted to flax, which grows abundantly in Khorasan, as their principal material, afterwards also making use of rags, supplemented, as the demand grew, with any vegetable fibre that would serve; and that cotton, if used at all, was used very sparingly. Paper of Oriental manufacture in the middle ages was usually distinguished by its stout substance and glossy surface, and was devoid of water-marks.

Paper was probably first brought into Greece from Asia. There is a record of its use by the empress Irene at about the end of the 11th century, but with one doubtful exception, there are no extant Greek mss. on paper before the middle of the 13th century.

Paper in Europe.—The manufacture of paper in Europe was first established by the Moors in Spain in the middle of the 12th century, the headquarters of the industry being Xativa, Valencia and Toledo. But on the fall of the Moorish power the manufacture, passing into the hands of the less skilled Christians, declined in the quality of its production. In Italy also the art of paper-making was no doubt established through the Arab occupation of Sicily. But the paper which was made both there and in Spain, was in the first instance of the Oriental quality. In the laws of Alphonso of 1263 it is referred to as cloth parchment, a term which well describes its stout substance. The first mention of rag-paper occurs in the tract of Peter, abbot of Cluny (A.D. 1122–1150), *adversus Iudaeos*, cap. 5.

A few words may here be said respecting mss. written in European countries on Oriental paper or paper made in the Oriental fashion. The oldest recorded document on paper was a deed of King Roger of Sicily, of the year 1102; and there are others of Sicilian kings, of the 12th century. A notarial register on paper, at Geneva, dates from 1154. The oldest known imperial deed on the same material is a charter of Frederick II. to the nuns of Goess in Styria, of the year 1228, now at Vienna. In 1231, however, the same emperor forbade further use of paper for public documents, which were in future to be inscribed on vellum. In Venice the *Liber plegiorum*, the entries in which begin with the year 1223, is made of rough paper; and similarly the registers of the Council of Ten, beginning in 1325, and the register of the emperor Henry VII. (1308–1313) preserved at Turin, are also written on a like substance. In the British Museum there is an older example in a ms. (Arundel 268) which contains some astronomical treatises written on an excellent paper in an Italian hand of the first half of the 13th century. In the Public Record Office there is a letter on paper from Raymond, son of Raymond, duke of Narbonne and count of Toulouse, to Henry III. of England, written within the years 1216–1222. The letters addressed from Castile to Edward I., in 1279 and following years (Pauli in *Bericht, Berl. Akad.*, 1854), are instances of Spanish-made paper.

In Italy the first place which appears to have become a great centre of the paper-making industry was Fabriano in the marquisate of Ancona, where mills were first set up in 1276, and which rose into importance on the decline of the manufacture in Spain. The earliest known water-marks in paper from this factory are of the years 1293 and 1294. In 1340 a factory was established at Padua; another arose later at Treviso; and others followed in the territories of Florence, Bologna, Parma, Milan, Venice and other districts. From the factories of northern Italy the wants of southern Germany were supplied as late as the 15th century. But in Germany also factories were rapidly founded. The earliest are said to have been set up between Cologne and Mainz, and in Mainz itself about 1320. At Nuremberg Ulman Stromer established a mill in 1390, with the aid of Italian workmen. Other places of early manufacture were Ratisbon and Augsburg. Western Germany, as well as the Netherlands and England, is said to have obtained paper at first from France and Burgundy through the markets of Bruges, Antwerp and Cologne. France owed the establishment of her first paper-mills to Spain, whence we are told the art of paper-making was introduced, as early as the year 1189, into the district of Hérault.

In the second half of the 14th century the use of paper for all literary purposes had become well established in all western Europe; and in the course of the 15th century it gradually superseded vellum. In mss. of this latter period it is not unusual to find a mixture of vellum and paper, a vellum sheet forming the outer, or the outer and inner, leaves of a quire while the rest are of paper.

Paper in England.—With regard to the early use of paper

in England, there is evidence that at the beginning of the 14th century it was a not uncommon material, particularly for registers and accounts. Under the year 1310, the records of Merton college, Oxford, show that paper was purchased "pro registro." The college register referred to, which was probably used for entering the books that the fellows borrowed from the library, has perished. There is, however, in the British Museum a paper ms. (Add. 31, 223), written in England, of even earlier date than the one recorded in the Merton archives. This is a register of the hustings court of Lyme Regis, the entries in which begin in the year 1309. The paper, of a rough manufacture, is similar to the kind which was used in Spain.

The knowledge, however, which we have of the history of paper-making in England is extremely scanty. The first maker whose name is known is John Tate, who is said to have set up a mill in Hertford early in the 16th century; and Sir John Spilman, Queen Elizabeth's jeweller, erected a paper-mill at Dartford, and in 1589 obtained a licence for ten years to make all sorts of white writing-paper and to gather, for the purpose, all manner of linen rags, scrolls or scraps of parchment, old fishing nets, etc. (Dunkin, *Hist. of Dartford*, 305; Harl ms. 2296, f. 124 *b*). But it is incredible that no paper was made in the country before the time of the Tudors. The comparatively cheap rates at which it was sold in the 15th century in inland towns suggest that there was at that time a native industry in this commodity.

As far as the prices have been observed at which different kinds of paper were sold in England, it has been found that in 1355–1356 the price of a quire of small folio paper was 5d, both in Oxford and London. In the 15th century the average price seems to have ranged from 3d. to 4d. for the quire, and from 3s. 4d. to 4s. for the ream. At the beginning of the 16th century the price fell to 2d. or 3d. the quire, and to 3s. or 3s. 6d. the ream; but in the second half of the century, owing to the debasement of the coinage, it rose, in common with all other commodities, to nearly 4d. the quire, and to rather more than 5s. the ream. The relatively higher price of the ream in this last period, as compared with that of the quire, seems to imply a more extensive use of the material which enabled the trader to dispose of broken bulk more quickly than formerly, and so to sell by the quire at a comparatively cheap rate.

Brown paper appears in entries of 1570–1571, and was sold in bundles at 2s. to 2s. 4d. Blotting paper is apparently of even earlier date, being mentioned under the year 1465. It was a coarse, grey, unsized paper, fragments of which have been found among the leaves of 15th-century accounts, where it had been left after being used for blotting. Early in the 16th century blotting-paper must have been in ordinary use, for it is referred to in W. Horman's *Vulgaria*, 1519 (p. 80 *b*): "Blottyng papyr serveth to dryе weete wryttynge, lest there be made blottis or blurris"; and early in the next century "charta bibula" is mentioned in the *Pinacotheca* (i. 175) of Nicius Erythraeus. It is remarkable that, in spite of the comparatively early date of this invention, sand should have been used so long as an absorbent.

Paper in America.—The early printers of colonial America imported their paper from Europe, chiefly from the Continent. The first paper-mill was built in 1690 at Germantown, Pa., resulting from the combination of the needs of the Philadelphia printer, William Bradford, and the arrival of an ambitious German papermaker, William Rittenhouse. Two other mills were established in Pennsylvania in 1710 and 1729, one in Elizabethtown, N.J., in 1728, and the first in Massachusetts at Milton in the same year. Virginia's first paper-mill was built at Williamsburg in 1744 by its first newspaper publisher, William Parks. The first in New York was built at Hempstead, Long Island in 1768. With imports cut off during the Revolutionary War and increased needs for newspapers, broadsides, pamphlets, records, correspondence, etc., an acute paper famine developed. Under these conditions additional mills sprang into existence and there were probably 80 or 90 when the war ended. Paper manufacturing was protected in the first tariff. In 1810 there were more than 200 mills in operation, making about $2,000,000 worth of products.

For watermarks in paper *see* article WATERMARKS.

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PAPERHANGING: *see* INTERIOR DECORATION.

PAPER MANUFACTURE. The problem of the paper maker is to make a felted web, fabric or tissue of cellulosic fibres and of appropriate uniform thickness, strength, colour and surface. For this purpose the fibres are "beaten" in water, *i.e.*, cut and bruised, so that the cellulose composing them may become more or less "hydrated," by imbibition of water, to form a wet "pulp" (*see* PAPER MATERIALS) of adequate cohesive quality: this wet pulp, as a thin even layer, is then put on to a wire fabric or screen to allow the removal of the superfluous water, and thereafter the wet web of pulp, thus formed, is finished and dried in appropriate manner to produce the paper, in the form in which it comes to the consumer. These operations may be done by hand or by machine: in olden days the beating was actually done by hand process, with a pestle and mortar, but it is nowadays invariably done by machine: the making of the felted web, on the wire, is still done by hand, but only for making the very highest class of so-called "hand made" papers, and it involves a very skilful craftsmanship which attains and maintains its highest development in the "hand made" paper industry.

These are the essentials of the paper making process: but in practice there are also additional auxiliary operations such as tinting, sizing, loading, calendering, etc. The surfacing of paper by the process of "sizing" is sometimes done by hand, in the so-called "tub sizing" process, but otherwise it is done by machine—"engine sizing." The processes of tinting, loading with mineral matter, and calendering (glazing) are also generally machine processes. Paper making, as a whole, is therefore now almost entirely a machine process: the vast output and low prices of the industry would be otherwise, of course, quite impossible.

Half Stuff.—The paper maker has a variety of cellulosic materials available for his "half stuff," *i.e.*, the mixture of say 3–5% of loose fibres suspended in water, from which to make the paper by the paper making process proper. If he starts with a cellulose material fully purified by removal of non-cellulosic substances, and felts it together, with a minimum of further treatment, he obtains a product which is, in effect, of filter paper or blotting paper type: this sort of paper has little strength, it is absorbent, it is uniform in quality from surface to surface, *i.e.*, it has no added surface quality. In order to make paper of this character the half stuff is given a minimum of treatment in the breaker or beater, *i.e.*, the knives are sharp and cut up the fibres quickly into suitable short lengths with only a little compression, bruising and comminution: then, when the wet pulp thus obtained is thrown on to the wire to be made into a sheet it parts with much water very easily, and is said to work very "free." In practice a certain amount of compression, bruising and comminution of the fibres is almost always necessary, or the resulting paper will be uneven in texture and hardly capable of holding together at all. The pulp is therefore, even in this instance, "beaten" to a suitable small extent which makes it slightly cohesive, retain more water, and work just sufficiently wet: the cellulose itself is only to some small extent "hydrated" (*see* CELLULOSE: *Hydrated cellulose*). For a very "free" paper such as filter paper or blotting paper this small amount of light beating and hydrating of the cellulose is as much as is required to give the product its distinctive character. The beating and hydration may, on the other hand, and if required, be continued un-

til finally a very slimy mass is produced in which the fibrous character of the pulp has almost completely disappeared: from it a paper of parchment-like character and considerable strength can then be made. These are the two extreme types obtainable by beating and hydration: intermediate types are also, of course, likewise obtainable proportionately. But a number of other auxiliary treatments are also necessary in order to provide the great varieties of qualities and properties required by modern conditions. Thus, special kinds of surface are required: for writing, the paper must not be too penetrable to moisture and the ink must not spread: the capillaries of the cellulose fibres, for this purpose, are therefore protected against excessive penetration, by "sizing" with more or less water-resistant substances such as rosin, gelatine, with or without auxiliaries such as casein, starch and mineral loadings and thus the felt or web is closed, covered and compacted. The paper can be also tinted, if required, and pressed between "calender" rollers, that can be heated, to give a smooth, glazed surface; or it can be "coated," by the addition to its surface of appropriate mineral matter, and an adhesive, and by treatment with "super calender" rollers.

Breaking and Beating.—The half stuff consists of water and a cellulose material, the fibres of which are separate from one another and in convenient short lengths. In preparing this half stuff it is important that no pulping or beating of the fibre should occur until it is quite clean, or the dirt present will become absorbed in the hydrated cellulose which will be formed and will thereafter remain permanently in the paper produced. The natural fibrous cells may be long, *i.e.*, several millimetres, as they are in cotton, hemp, flax, ramie, and in the operation of preparing half stuff they will have been reduced in length, by cutting under the knives of the breaker: if, on the other hand, the natural fibrous cells are short, *i.e.*, no more than two or three millimetres, as they are in wood and esparto, this cutting becomes superfluous, and breaking of them is therefore omitted. But some degree, at least, of compression bruising and comminution will be required, and hence, beating can never be omitted, except for very low grade products and such special products as cable papers. These operations of breaking and beating, therefore, produce combined effects of separating the fibres from one another, reducing their length in appropriate degree, and of bending, softening, bruising, flattening, and hydrating them, and it is possible to adjust this processing to give any desired combination of these effects and thus to modify the qualities of the resulting paper in any desired degree between the extreme limits of quality, characteristic of a paper of blotting paper type on the one hand, and of a paper of banknote and cigarette paper type on the other hand, in the latter of which the individual or ultimate fibres are beaten out of all recognition under the microscope. The manner of the adjustments required to give such variously proportioned effects is determined not only by the methods of breaking and beating employed, but also by the structural characteristics of the fibres themselves: each fibre has, in fact, its own characteristics, which the skilled paper maker bears in mind in making his adjustments. To make a strong paper it is necessary to subordinate cutting to bruising: in these circumstances the ends of the lengths of fibres, cotton, hemp, flax, ramie, are broken, splayed and tangled, and this increases their felting and strengthening qualities. Sometimes they are split longitudinally into fibrillae; and cotton fibrillae, thus formed, may display an interlacing net or trellis work appearance; the flax and hemp fibre on the other hand, frequently split into bundles of fibrillae to give a paint-brush appearance. The hydration effect, consequent on the bruising action of the beater, which leads to imbibition of water, is more easily produced in some fibres than in others: flax and hemp fibres easily hydrate, then always have a slimy feel, and are easily distinguished, in the hand, from cotton, which has not the same tendency. If the material has been beaten to work wet, which may take as much as twelve hours and more of beating, a considerable quantity of water may be retained by the material on the paper-making wire: the material then undergoes the more shrinkage in drying, and the finished paper has considerable rattle and hardness. The texture is also more closed, less porous and the amount of sizing required to give suitable ink-resistant quality is relatively small.

The breaking and beating effects are contrived by adjustment of the angles of the knives on the bed plate and on the revolving drum: the greater the angle of inclination the more rapid is the cutting effect productive of reduced lengths of fibre: the lower the angle of inclination the greater is the slower bruising action. This is the fundamental distinction between breaking and beating, though in actual practice breaking is frequently part of a combined operation that includes also washing and bleaching: a breaker is for this purpose and is therefore provided also with a drum washer, which is a wire gauze drum, revolving in the channel, and from its interior water can be continuously removed and simultaneously can be replaced by fresh water, fed in just in front of the breaker roll, so as to keep the pulp concentration at the more or less constant value required, which will be usually about 3–5%, otherwise a breaker and a beater are similar.

If half stuff, less or more beaten, is made direct into paper it gives, therefore, a product having qualities which may range from those of blotting paper to those of bank note paper. A number of other finishing operations, additional to breaking and beating, are employed to give special qualities of surface: these operations are those of colouring, sizing, loading and calendering. The substances used in these auxiliary operations are of course selected in relation to their cost and to the effects that can be derived from their use. For sizing, gelatine and rosin, with alum, are the materials much the most commonly used, though very many other substances have been or are used in much smaller degree, such as casein, starch, silicate of soda (the more acid brands are preferred), soaps (with alum), and viscose. For loading, the substances in common use are china clay (kaolin) and "pearl hardening" (calcium sulphate). Other substances have been or are used in lesser degree and for special purposes: *e.g.*, certain magnesian substances such as agalite (nearly pure magnesium silicate, akin to asbestos in composition and properties), French chalk, and soapstone assist the paper in taking a highly finished surface, which is a characteristic effect of using magnesian minerals, probably referable to their "soapy" nature: "heavy spar" (barium sulphate) is used particularly for the surface loading of photographic papers. It is usual, except in making papers of the very highest quality, to add to the pulp in the beater a small quantity of relatively cheap mineral loading material, such as china clay or "pearl hardening." This is not to be regarded as merely an adulteration, since it serves to fill up the pores of the paper and to make a closer texture, more evenly absorbent of printers' ink, and it allows a better surface to be obtained by simple calendering: most important of all, it increases opacity, and thus enables the manufacturer to provide cheap papers that can be satisfactorily inscribed on both sides. If added in large proportion, mineral loading of course greatly diminishes the strength of the paper, and particularly its powers of resisting the wear and tear of folding. The colouring of paper is effected by the addition of pigments or solutions of dyestuffs to the pulp in the beater. (*See* p. 233.) The production of definitely coloured paper is small, but the majority of papers receive some admixture of colouring matter, added with the object of correcting an otherwise objectionable tint. Thus even bleached pulps always retain a residual yellow tint, more or less pronounced, but an apparently good white can be prepared therefrom by the addition of appropriate quantities of red and blue to produce what is really a satisfactorily balanced grey. The successful production, in this way, of an approved illusion of whiteness with such low grade materials as mechanical and unbleached bisulphite wood pulp, containing up to 70% and more of the former, in modern newsprint, is a considerable industrial achievement: the fact that, in newsprint, it is short lived does not diminish the achievement.

The inchoate pulp slurry may be transformed into the cohesive dry sheet, either by hand or by machine, to make the so-called "hand made" or "machine made" paper. Paper making may therefore be divided conveniently into two portions: (*a*) the treatment of the primary raw material as far as the point at which it is in the condition of pulped cellulose half stuff, ready

for the paper making operation proper, and (*b*) the transformation of the pulped cellulose slurry thus formed into paper by the paper making process proper, with the auxiliary optional treatments of colouring, sizing, loading and calendering.

Hand Made Paper.—The expense of making paper by hand is so great that only papers for special purposes and of the highest quality are now "hand made": they are always made from "all rag" pulps of the finest quality, and they are used for such special purposes as artists' water-colour drawing papers, bank ledgers, bank notes, important documents and the highest class of printed books. The pulp from the beater is run into stuff chests from which the vats are supplied, before reaching which it is strained to ensure uniformity and removal of any adventitious ingredient. The sheet of paper is then made on a mould of wire-cloth, which has a removable frame of wood surrounding it, to keep the pulp from running off the edges while the superfluous water is running away through the meshes of the wire cloth: this removable frame is called the "deckel." The craftsman dips the mould, with the deckel in position, into the vat and lifts out enough of the pulp to make just one sheet of paper of the required thickness: as soon as the mould is removed from the vat the water begins to drain away and to leave the fibres on the surface of the wire to form a cohesive sheet: a lateral motion or "shake" given to the mould by the craftsman, assists the "felting" of the fibres and ensures their lying in all directions. The "deckel" is then removed from the mould and the mould is inverted on to and pressed against a felt, whereby the sheet is transferred or "couched" from the wire to the felt. A number of sheets, thus formed, are then piled one above another, with interleaving felts, and submitted to strong pressure to remove water: and after subsequent removal of the felts, the sheets are again pressed and dried, and matured and are then ready for sizing by dipping in a tub of gelatine solution—"tub sizing." Any "watermark" pattern or name required on the sheet is obtained by fastening the wire water-mark design to the surface of the wire mesh, which is thereby embossed to give the design of the water-mark: consequently less pulp lodges there and the paper is by so much the thinner on the lines of the water mark which thus produces in the paper the exact counterpart of the water mark wire pattern. Hand made papers are sometimes made which are extremely hard and water resistant. A high proportion of flax linen, up to 80 per cent, which hydrates very readily, gives thus a hard paper, and its water resistant quality can be further increased by "hard sizing" with gelatine containing a high proportion of alum.

Machine Made Paper.—The invention of the paper machine in 1798 by Louis Robert, a clerk in the employ of Messrs. Didot of the Essonne paper mills in France, gave a great impetus to the industry by first making the process continuous: it allowed paper to be made cheaply and in the roll. The invention was introduced into England by Henry Fourdrinier (1766–1854) after whom the machine is now always named, who owned a mill at Dartford, Kent. He secured the assistance of Bryan Donkin (1768–1855), well known as an engineer, and after much toil and perseverance, with no financial benefit, a machine was erected in 1803, at Frogmore, Hants., which worked fairly well. Dickinson, Causon, Crompton and others brought it to its present high level of perfection. Machine made paper has now completely supplanted hand made paper except for special papers of the highest class.

Paper Making Machine.—The first portion of the paper machine, where the pulp slurry is formed into a wet web, is known as the "wet end" in contradistinction to the other end, devoted to drying and finishing, which is designated the "dry end." The wire is a long endless brass wire-mesh cloth, about 40 to 50 ft. long, 70 to 90 in. commonly, and sometimes up to 240 in. wide, and with 60 to 70 wires to the inch.

The pulp slurry is pumped, at 2–3% concentration of pulp, from a stuff chest to a smaller stuff box at a higher level, is diluted to ·75%–1% with re-used or "white" water, whence it flows on to a sand trap, which is a serpentine channel to settle any heavy particles present, and then through a strainer, to stop any larger particles. From the strainer the pulp passes to the "breast box" which is the same width as the wire of the machine. Then it passes on to the endless wire, moving forwards, on which it is spread evenly by a spreader or slice, and thus a continuous wet sheet or "web," the width of the wire, is gradually formed: the pulp is prevented from flowing off the two edges of the wire, before the water has had time to run away through the wire, by an endless "deckel" strap, each side, made of vulcanized rubber, which moves at the same speed as the wire and in close contact with its corresponding surface. Thence the web passes to the dry end, *i.e.*, to a series of press rolls which remove water and consolidate the web, then to a number of steam heated cylinders to dry it into paper and to a further number of rollers to calender it. The steam heated drying cylinders are usually divided into two or more sets or stacks separated by "nip rolls" or smoothers, the object of which is to flatten and smooth the surface of the paper, while it is yet not quite dry.

The deckel straps serve to guide the paper from the moment the pulped half stuff is spread on to the wire as it issues from the "breast box" and until the web is sufficiently dry to retain its edges: the distance between the two deckel straps can be increased or diminished at will, to determine the width of paper produced. The water that drains through the wire drops into a flat copper or wooden tray along the lines of contact between the wire and a series of tube rolls, which serve to keep the wire in position: this "white" water contains fragments of pulp, and is made to flow into a tank from which it is pumped and the fragments of pulp re-used. At the far end of the wire, the wet web is passed over two or more "suction boxes" for the further removal of water, between them is the "dandy roll," a light skeleton cylinder made of wire cloth to give the water mark and wove or laid markings to the paper. The frame of the machine, from the breast roll support at one end of the wire to the first suction box at the other end, is hung on a pair of strong hinges, and is capable of a slight horizontal to and fro motion, imparted to it by a horizontal connecting rod which is keyed to an adjustable eccentric, in appropriate manner: and thus a "shake" is imparted to the forming web, as is done by hand for the hand made paper.

From the second suction box the damp web of pulp passes between "couch rolls," named by analogy with the couching in the hand made paper process: their purpose is to squeeze out more water and to impart sufficient consistency, thereby, to enable the web to leave the wires. These couch rolls are covered with felt, and the upper one is provided with levers and weights to enable the pressure on the web to be adjusted. Modern machines do not use a top couch, but use a lower couch provided with suction to remove the water. The web is now fully formed into a wet paper, and usually passes through two sets of press rolls to the dry end of the machine. The more gently and more gradually it is dried the better is the final result: rapid drying is not so economic since it is apt to make contraction uneven and excessive, and the paper brittle: the heating surface is therefore made as large as possible, and for this reason and because machines are now driven at high speeds, a large number of drying cylinders is used. All these cylinders, except the first two or three where the greatest amount of evaporation occurs, are encased by continuous, travelling felts, and they are so stacked that each surface of the paper alternates in being in contact with a heating surface. The drying cylinders are generally distributed in two or more sets or stacks with intervening nip rolls to flatten and smooth the paper while it is still moist and responsive. After the drying comes the calendering and there are usually two or more sets or stacks of calendering rolls, according to the grade of surface required. These calenders consist of vertical stacks of chilled iron rolls, generally five in a stack, which revolve on one another and some of which are bored for heating by steam: pressure is applied to them at will, by adjusting levers at the top of each stack. Finally the paper passes to cooling rolls, where the paper can be cooled by water spray if necessary and is then wound on to a reel.

The speed of the machine has to be altered frequently, while in motion, and arrangements are provided whereby the various parts of the machine can be slightly altered in speed relatively to one another, to allow for varying contractions and expansions of the

web, for different thicknesses and different pulp materials. Adjustments are also possible by changing the driving speed of the steam engine governor, and, if necessary, also by changing the driving wheel. Skilful control is obviously required and, in practice, it is found advantageous to have two separate steam engines: the first, at constant speed, drives the strainers, pumps, shake motion, etc., and the second, working the machine, varies in speed according to the rate at which the machine requires to be driven: their combined H.P. will be 40–100 or more. The drying cylinders form convenient and economical condensers for the two engines and it is customary to exhaust one driving engine into the drying cylinders and to utilize the latent heat of the steam for drying the paper, supplementing it, if necessary, by further live steam.

The mills making better class papers commonly use machines up to 90 in. wide, and they make closer and more even sheets than do wider machines: but newsprint sheets are made up to 240 in. wide running up to 1,200 ft. per minute. The former machines will make 20 to 40 tons a week, the latter up to 750 tons.

Tinting and Colouring.—The colouring of paper, including the colour correcting of unfavourable tinges of the pulp, is always effected by adding suitable substances to the pulp in the beater, *i.e.*, before the pulp goes on to the wire. Originally, pigments were practically the only substances available, and many of the pigments used then are still used to-day. Smalts (very finely powdered glass, coloured blue with cobalt) are extremely permanent and are also expensive: they are therefore used for hand made papers only. Ultramarines, of various shades from reddish blues, through pure blue to greenish and yellowish blues are made and they are also much used. They are sensitive to acids and even to solutions of alum, which is slightly acid in reaction, as well as to oxidizing substances such as bleaching agents: hence the colour is apt to be evanescent and care must therefore be taken, especially by effective washing, to ensure that the pulp is free from unfavourable substances. Red pigments in use are rouge, Indian red, Venetian red, etc.: they are natural earths, refined by levigation, and rich in iron oxide to which their redness is due: an artificial red of similar chemical character is also prepared by calcining ordinary green vitriol (iron sulphate, copperas). Chrome yellow (lead chromate) is extensively used for the production of brilliant yellows. It is decolourized by strong acids, dissolved by caustic soda, and blackened by sulphides: it is therefore apt to be discoloured by exposure in cities in the open air, on, *e.g.*, posters. Ochres, which are natural earths containing iron oxide, are used and they give various shades of dull yellow or buff: golden shades are commonly made by using mixtures of ochre and chrome yellow: solutions of iron salts are also used, for the same purpose. Green is usually provided by using chromium oxide and brown by using umbers, which are natural earths containing manganese oxide in addition to iron oxide: the latter are much used as combined colouring and loading agents for brown wrapping papers. There are also some organic pigments and lakes in use, the most important of which is Prussian blue, made by precipitating a soluble ferrocyanide solution with a solution of an iron salt and supplied to the paper maker in paste form. It is sensitive to alkali, which precipitates a brown stain of iron oxide, on paper, when it is present. A number of organic synthetic pigments are valuable by reason of their qualities of permanence: indanthrene blue is very permanent and much used for high grade writing papers: soluble dyes are also largely used.

Briefly the uses of available colouring agents for tinting purposes are as follows. Smalts are the only blueing agents used for the highest grades of papers. For other high grade papers, such as high class all rag machine made papers and high grade sulphite pulp papers, ultramarine is the usual tinting agent: it is practically as permanent as smalt, provided that it is not exposed to the action of acid fumes: indanthrene blue is, however, coming into increasing favour in competition with it. Of lower grade blues there are many water soluble blues, acid coal tar dyestuffs, which are completely precipitated by alum and they are therefore used with sized papers only, usually esparto and chemical wood papers: Prussian blue is also used. For the tinting of the cheapest grades of paper, *e.g.*, newsprint, the very powerful, cheap and light-fugitive, methyl and ethyl violets, blues, greens and reds are used.

Many of the colouring matters now so commonly used are therefore rather sensitive to chemical action: and the commonest active chemical thus to be dealt with, is of course bleaching powder, a solution of which is used in developing the high white colour required in writing and printing papers. Washing will remove the superfluous bleach remaining in the pulp, in time; but time may be saved, frequently with advantage, by using a dilute solution of an "antichlor". Sodium thiosulphate, the "hypo" of photography—has been much used for this purpose: but sodium sulphite is preferred by many paper makers because it has less action on the "wire" of the paper machine, even though about three times as much of it is required for the same effectiveness. These substances react at once with any surplus bleach residues present in the pulp, to form harmless substances. Hydrogen peroxide would be the ideal substance, for this purpose, and it has been used: but its high cost makes its use prohibitive. Whatever antichlor is used, an excess of it must be avoided because they all of them have some slight unfavourable effect on the sizing and to a small extent on some colouring substances. The beater man, in practice, has to add to the pulp the minimum quantity of antichlor that will just prevent the blueing of starch iodide test paper by the pulp: he then knows that there is no free chlorine (or hypochlorite) residue left in the pulp. It is worthy of mention that an excess of antichlor is most objectionable in any paper, such as tissue paper, used for wrapping brass or silver, and in printing papers used for bronze or so-called gold lettering: these antichlors, being compounds containing sulphur, are likely to blacken silver and copper by formation of sulphides, and it is therefore best that such papers should be made without antichlors, and that they should be absolutely condemned for these uses if any antichlor is present, even in the minutest traces. (Ultramarine also contains sulphur, and its presence is similarly objectionable.) The present tendency is to avoid the use of antichlors and to rely on very perfect washing.

Sizing.—The sizing materials used, above all others, are rosin-alum and gelatine-alum. Papers of the filter paper or blotting paper type depend for their characteristic quality on an absence of sizing, though a small quantity of starch, as binder added to the beater, is sometimes used in making them. A great many other papers, certainly all writing and printing papers, are sized. Rosin-alum sizing is always added to the beater, *i.e.*, before the pulp goes on to the wire of the paper making machine, and hence it is called "engine sizing": gelatine-alum sizing is always employed for hand made papers, and these papers are dipped in a tub (originally by hand, now more frequently by machine) containing the sizing solution and hence gelatine sizing, sometimes called "animal sizing" is also commonly known as "tub sizing." The method is also employed for sizing machine-made papers, which is sometimes achieved by intruding a sizing tub between two of the stacks of drying cylinders; more frequently by employing a separate unit. Many attempts have been made to gelatine size paper by adding the size direct to the pulp in the beater, as is done with rosin sizing. This would be the most convenient method, if it were feasible; but as yet no successful method has been evolved capable of giving favourable results proportionate to cost.

Rosin Size.—Rosin, the residue from turpentine distillation, is an acid anhydride or mixture of anhydrides, insoluble in water. It is rapidly dissolved by heating with alkaline solutions, *e.g.*, caustic soda or soda ash, to give sodium salts which are the so-called rosin soaps, so frequently used as ingredients of the yellow soaps of commerce. Ordinarily, neutral rosin soaps are thus obtained containing 100 of rosin to 17 of soda: but, by prolonged heating and stirring, a further large extra quantity of rosin may be brought into solution or suspension to give very "acid" sizes, containing as much as 35 per cent of combined rosin, 24 per cent of free rosin and 3·5 per cent of soda. They give milky emulsions, "size milk," containing suspended globules or droplets of precipitated rosin, on dilution with water. Much care is therefore required in diluting these acid sizes, for addition to the beater,

because there is always the danger present of these precipitated droplets agglomerating together, to form particles of such dimensions as would cause resin specks in the finished paper. The danger is diminished by adding starch to the diluting water. Still more recently, acid sizes containing as much as 45% of free rosin have come into use, and their use requires still more care and skill. They are used with atomiser injectors by means of which the strong size is mixed first with a small proportion of hot water and then with a larger quantity of cold water. The manufacture of these sizes is now a separate industry and the paper maker can purchase concentrated acid sizes, ready made for dilution.

The quantity of acid size usually required is that representing two to three pounds of original rosin per 100 lb. paper: but it depends greatly upon the nature of the fibre and the degree of beating. The sizing operation consists, firstly, in adding the diluted size to the beater after passage through a fine screen or coarse cloth filter bag, and it is usually added when the pulp is one-half to two-thirds beaten: secondly, a solution of alum, or, more commonly, aluminium sulphate, is added to the beater which fixes the rosin in the pulp, by double decomposition between the rosin soap and the aluminium salt, with formation, perhaps, of aluminium rosinate, but more likely of a coagulated colloid absorption complex of rosin-alumina. The optimum quantity of alum is determined by experience and is a good deal higher than the equivalent quantity calculated from the chemical equation. To economize alum it is sometimes desirable to add a proportion of dilute sulphuric acid to the beater with the object of neutralizing the basic ingredients present: *e.g.*, esparto and soda pulps are frequently alkaline in reaction. Experience has shown that the best sizing results obtained with rosin are those given by a finished paper slightly acid to litmus.

Gelatine Size.—Gelatine size is prepared from paper makers' gelatine of good intermediate grade, *i.e.*, of not too high viscosity and proportionately lesser penetrating power, and alum. The gelatine is usually purchased by the paper maker in thin sheets which swell and disperse easily in water and give a clear pale solution, after filtration; the alum solution is then added to it and the viscosity increases up to a point and thereafter diminishes on addition of more alum solution: it is then ready for use as sizing. The proportion of alum is 10 to 15% of the weight of the gelatine: the alum prevents the bacterial decomposition of the gelatine, but its principal purpose is to make the gelatine much more resistant to ink, and the paper therefore less penetrable. A certain proportion of soap is sometimes added, for hand-made papers, which renders the paper capable of taking a high finish by calendering and supercalendering. The soap should be firm and very white, and therefore free from rosin: in presence of the alum it forms insoluble aluminium soap. An acetylated starch named "feculose," made in several grades varying in penetrating power, has been employed as a substitute for gelatine, in tub sizing: it is used without alum and its chief sizing characteristic is that its effect is pronounced on the surface and with little penetration: it is, therefore, economical in use. The use of casein for sizing is limited, because of its relatively high cost: it imparts a certain degree of toughness and a good "handle" to the finished paper. Many attempts have also been made to use viscose as a sizing, which by reversion to cellulose would realize the ideal of sizing cellulose with cellulose: but its technique is difficult, and the action of the sulphur compounds on the metal of the machinery, with the parallel action on minute specks of metal in the paper itself, derivable from beating, is an adverse factor.

Loading.—Loading paper with mineral substances is an important auxiliary treatment, and it should not be considered as an adulteration, pure and simple. To writing and printing paper loading gives opacity: to process papers a highly glazed, compact surface suitable for fine-screen illustration work: to wrapping papers, ochre-brown and other colours. Colour tinting is also, of course, a loading. Other than hand made papers unloaded papers are altogether exceptional. Two to 3% of loading and up to 10% is common and 20 to 30% in specially surfaced papers, anything more than which is certainly an adulteration, greatly weakening the strength of the paper. The larger proportions of loading, particularly for surfacing with supercalenders, are added to the surface with an adhesive, commonly casein or starch, and thereafter the special surface developed by glazing. The cheaper papers are glazed on the paper machine in the calenders as described: the better class of very highly glazed papers and those that are tub sized are also frequently given an additional glazing by supercalendering them or by plate glazing them between plates of zinc or copper. The supercalender, for this purpose, is a stack of rolls alternately of heated cast iron and of compressed cotton or paper so that the paper at each nip is between iron and cotton.

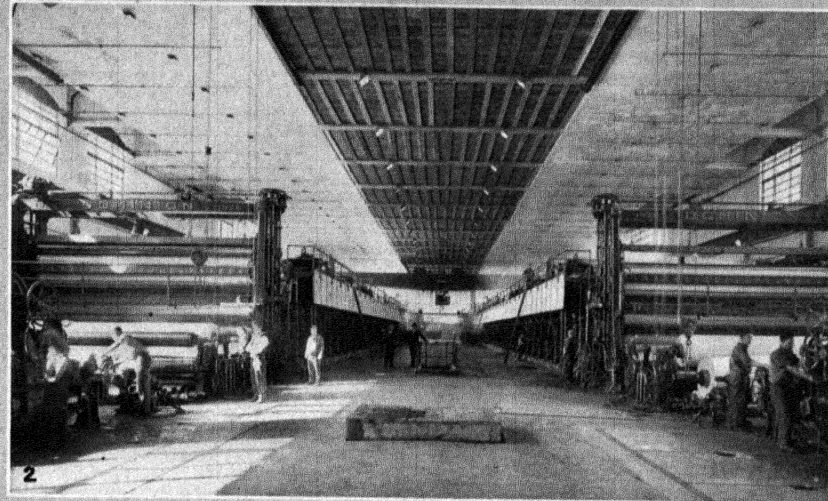
Paper, though made in the roll on the machine, is usually sold in the form of sheets. A number of reels of paper, on their spindles, mounted in a sack, are fed, as a pile of webs, between two rollers: a series of revolving knives slits them longitudinally as they emerge from between the rollers, in effect into strips which are cut again transversely by the scissors action of a movable upper knife, working periodically against a lower fixed knife. The cut sheets fall on to an endless felt for stacking: they are thereafter sorted, usually, into three classes known as "perfect," "retree" (French *retirer*, to discard) and "broke." The retree are sold as second quality and the broke returned to the mill for repulping, as waste paper.

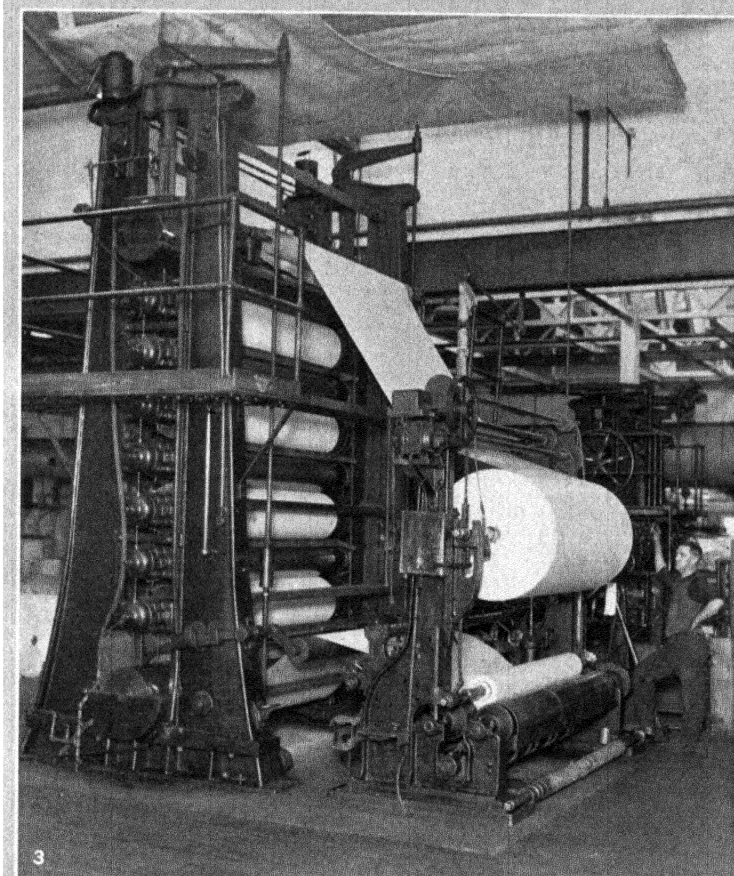
The introduction of esparto and wood pulp has greatly increased the number of grades of paper in use. Paper testing and valuation have therefore become a matter of great importance. The principles of paper testing that have gradually proved themselves of value are partly physical and partly chemical. The physical tests involve determinations of strength, elasticity, stretch or expansion on moistening, resistance to wear and tear by crumpling and folding. Ingenious machines, of various patterns, have been devised for making such tests under strictly comparable standard conditions. In hand made papers the values determined are found to be independent of direction but variable from place to place in the same sheet: in machine made papers the values determined are more independent of locality but they depend always on the direction in the sense that the paper is always weaker longitudinally than it is transversely, and this is referable to the circumstance that at the moment of the formation of the web from the wet pulp, on the wire of the machine, the wire is continuously moving forward. Sizing quality is judged by capillary effects, such as the rise of water up a strip of paper dipping in water, or the spreading of a blot of ink on its surface.

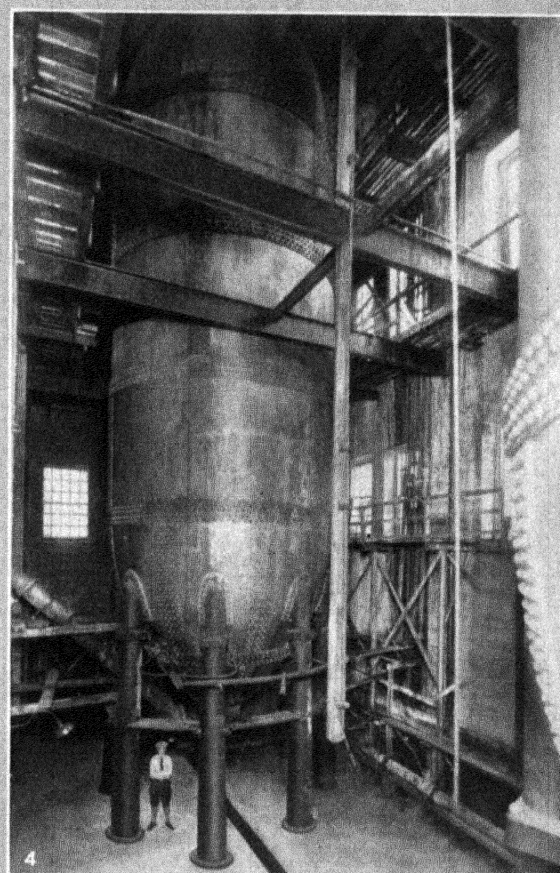
The chemical tests employed are mostly those of moisture content, *i.e.*, loss of weight by drying at 100° C; ash content, by incineration and weighing of the ash remaining: the nature and percentage of sizing, usually gelatine or rosin, the gelatine being identified by extraction of the paper with hot water and testing with tannic acid solution, which gives a gelatinous precipitate with gelatine (it can be estimated quantitatively by Kjeldahl's determination of nitrogen, if required) and rosin being extracted with alcohol, and the loss of weight, thus arising, is taken as equal to the weight of rosin present. Acidity and alkalinity are determined by ordinary indicator dye, colour reactions (litmus, congo red, methyl orange, etc.). The "fibre furnish," *i.e.*, the kinds of fibre present and their approximate percentages are determined by microscopic examination of prepared slides, suitably stained (*see* FIBRES).

Standard Sizes.—Paper is sold in sheets of different sizes and is made up into reams containing from 480 to 516 sheets in Great Britain, 500 in the United States; these sizes correspond to different trade names, as foolscap, demy, royal, etc.; the following are the ordinary British sizes:

Writing Papers	Inches	*Drawing and Book Papers*	Inches	*Printing Papers*	Inches
Pott	12½×15	Demy	15½×20	Demy	17½×22½
Foolscap	13½×16½	Medium	17¼×22½	Double demy	22½×35
Double foolscap	16½×26½	Royal	19×24	Quad demy	35×45
Foolscap and third	13¼×22	Super-royal	19¼×27	Double foolscap	17×27
Foolscap and half	13¼×24¾	Imperial	22×30	Royal	20×25
		Elephant	23×28		
		Double-elephant	26½×40		





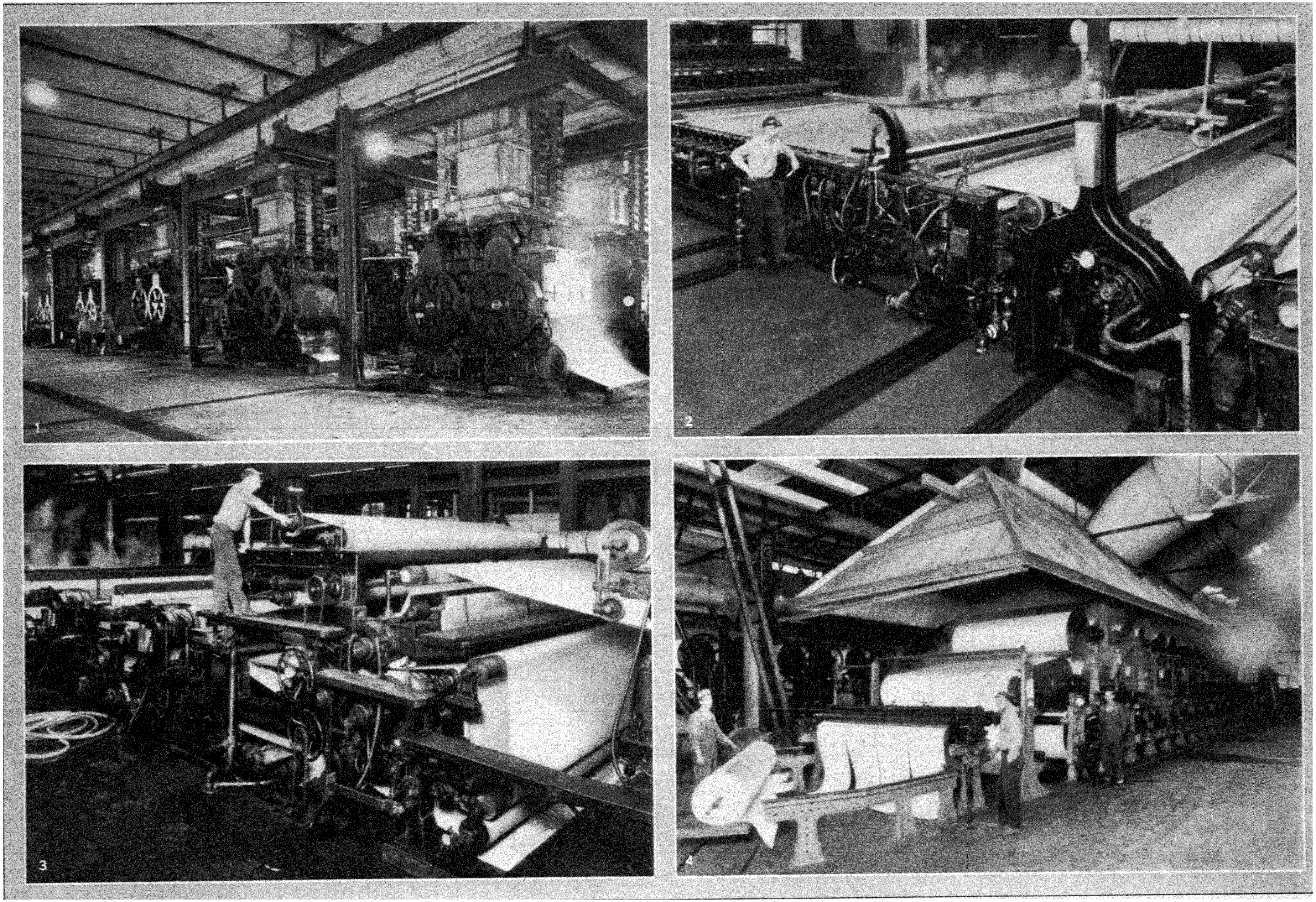


BY COURTESY OF (1, 2, 3) THE INTERNATIONAL PAPER COMPANY, (4) THE CHAMPION COATED PAPER COMPANY

VIEW OF A LARGE NEWSPRINT PAPER MILL AND MACHINERY FOR MAKING PAPER

1. Air view of the world's largest newsprint paper mill at Three Rivers, Canada, situated at the confluence of the St. Lawrence and the St. Maurice Rivers. This mill has a capacity of 700 tons of newsprint paper daily. Every application of power in the mill is electrical
2. Interior of one of the newsprint paper machine rooms in a mill at Gatineau, Canada. The four machines in this mill have aggregate capacity of 600 tons newsprint paper a day. Each machine delivers a sheet of paper over 21 ft. wide at the rate of 20 ft. per second. The mill receives power from Gatineau river
3. Supercalendar stack in a Niagara Falls paper mill. The sheet passes through a series of nine ironing rolls, in the upright portion of the machine at the left, which gives a smooth and glossy finish to book and similar grades of paper
4. Pulp digester in which wood chips are "cooked" in a sulphite solution to reduce them to pulp

PAPER MANUFACTURE



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PULP AND PAPER MACHINERY USED IN MAKING NEWSPRINT AND COATED PAPERS

1. Continuous wood grinders in the Gatineau Newsprint Mill, Quebec
2. Wet-end of the paper line; beginning of the rolling process in the manufacture of paper
3. Centre of paper line where paper is turned over by machine
4. Dry-end of paper line

Writing Papers	Inches	Drawing and Book Papers	Inches	Printing Papers	Inches
Pinched post	14½×18½	Colombier	23½×34½	Double crown	20 ×30
Small post	15¼×19	Atlas	26 ×34	Quad crown	30 ×40
Large post .	16½×21	Antiquarian	31 ×53	Imperial	22 ×30
Medium .	18 ×23				
Standard .	17 ×22	Standard	24 ×36	Standard	25 ×38

The following may be considered as the ordinary sizes in the United States:

Flats and Bonds

14×17	21×32	22×25½	19×26	19×30	21×33
17×28	16×26	26×34	26×38	17×26	30×38
28×34	17×22	19×24	19×28	18×23	20×28
16×21	22×34	24×38	28×38	23×36	28×40
					28×42½

Ledgers

14×17	15×19	21×32	22×34	18×46	24×38
17×28	19×30	16×42	18×23	19×24	20×28
28×34	16×21	17×22	23×36	19×48	28×40

Loose Leaf

16¼×21¼	19¼×28½	22 ×38	22½×34	23 ×24½	24½×28½
17¼×22¾	21½×31½	22½×22½	22¼×25¾	23¼×28½	24½×20
19¼×24¼	22 ×34	22½×28½	22¼×35½	24½×24½	24½×30½
					24½×38½

Book Papers

22×32	26×40	30½×41	34×44	41×61
24×36	28×42	32 ×44	35×45	42×56
25×38	28×44	33 ×44	36×48	44×56
26×29	29×52	33 ×46	38×50	44×64

Classification.—The following list includes the chief papers.

Rag

(1) Hand made, drawing, ledger, and bank-note and book papers

(2) Machine made drawing and other papers, often mixed with high grade sulphite wood pulp

(3) Filter papers

(4) Cigarette papers, heavily beaten, frequently with about 10% chalk as loading the so-called India paper, for printing Bibles, etc., is very similar.

(5) Tissue papers similarly, without loading (suitable for wrapping silver).

(6) Imitation parchment, similarly by heavy beating. This paper is grease-proof but not water-proof.

(7) Wax surfaced wrapping papers requiring some strength in one direction, *e g*, toffee wrappers.

(8) Vegetable parchment The cellulose is hydrated by passing through a bath of 66 per cent sulphuric acid and thereafter very thoroughly washed It is water-proof as well as grease-proof

(9) Vulcanized fibre—the cellulose of the dyed all rag sheets of paper—is hydrated by passing through very concentrated zinc chloride solution, and then very thoroughly washed and several layers welded together under pressure

(10) Willesden paper made similarly with cuprammonium hydroxide solution instead of zinc chloride solution

Esparto

(11) Writing and printing papers, with chemical wood, especially sulphite pulp

(12) Magazine papers frequently contain high percentages of esparto.

(13) Blotting papers, often with soda wood pulp.

Chemical Wood (a) *Bleached*

(14) Sulphite pulp writing and printing papers.

(15) Good grade machine made drawing papers.

(16) Sulphite imitation parchment, by heavy beating (*see* [5] above).

(17) Vegetable parchment from sulphate or sulphite wood pulp (*see* [8] above).

(18) Tissue paper, by beating, from sulphite or sulphate pulp (not suitable for wrapping silver, as a rule).

(19) Ordinary wax covered wrapping papers made from sulphite

(20) Cheque papers, from sulphite, usually with chemical reagents incorporated to prevent falsification.

(*b*) *Unbleached.*

(21) Sulphite, including the incompletely cooked chips screened from fully cooked pulp, is used for so-called "Manila" envelopes, etc.: sometimes also tinted to simulate the colour.

(22) Underboiled sulphate pulp is especially valuable for strong so-called "Kraft" wrapping papers.

Mechanical Wood.

(23) 70 to 80% mechanical wood to 30 to 20% unbleached sulphite pulp, plus about 10% mineral loading, rosin-alum sized, is the material of the modern newspaper: the machines are commonly 160 in. to 240 in. wide and run off the paper at about 550 ft. to 1,200 ft. a minute

(24) Mechanical wood is used for the centres of paper-covered cardboard, *e g*, containers for cigarettes, railway passenger tickets, etc · re-pulped old newspapers are used for the same purposes.

(25) Low grade brown paper, made from paper waste, including old newspapers, heavily loaded with ochres and umbers.

Special Products.

(26) Straw boards and stiff cardboards made from straw boiled with lime (for cheapness)

(27) Cable papers made from strong manila hemp, old rope, usually lime boiled, unbeaten and unbleached.

(28) The yellow cigarette papers, much used on the Continent, frequently contain some hemp.

(29) Imitation art papers usually chemical wood with 20% loading (even more in low grades) heavily calendered to give glossy surface; sometimes supercalendered, which adds to the cost.

(30) True art papers· high content of esparto frequently with chemical wood; loading applied as a surface layer with an adhesive, frequently casein; supercalendered. (C. J. J. F.)

Production.—The output of paper has become enormous The United States produces and uses considerably over one-half the world's production. Of Canada's production in 1926 1,889,208 tons was newsprint paper most of which was exported to the United States Northern Europe is an important producer.

Great Britain imports more than half the paper used and for the paper manufactured most of the raw material is imported. Production statistics for the leading countries follow.—

Country	Year	Tons
United States	1927	10,002,070
Canada	1926	2,266,143
Germany	1927	2,008,000
Great Britain	1927	1,600,000
Japan .	1926	808,140
Russia	1927	641,098
Norway	1926	635,077
Sweden	1926	598,020
Finland	1926	566,950

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PAPER MATERIALS. The supply of rags is insufficient to meet modern demands, and first esparto (about 1860) and then wood (about 1880) accordingly came into use; the use of wood has been greatly advanced, until nowadays it provides by far the largest portion of the world's paper, and it is to wood that the world looks for the somewhat alarming demands of the future The total consumption of wood per annum for paper is at present about 40,000,000 tons of, mostly, coniferous wood, from which about 15,000,000 tons of wood cellulose pulp for the paper industries are obtained. Hitherto the forests of Europe and North America have met a very large proportion of the whole demand, and mainly by a prodigal process amounting to mere extermination, which has left, especially in North America, a legacy of difficult economic problems as possibly permanent factors determining ultimate output

Demand for Pulp Wood.—Nevertheless, even in 1929, the demand for pulp wood amounts to no more than 5% of the total wood cut in North America and Europe, by comparison with 95% used for timber construction work of all sorts, fuel, etc. Extensive systematic afforestation is just beginning and its benefits may be expected to become increasingly important in a generation or two. losses by forest fires, which, *e g.*, in Canada destroy an amount of wood equal to the amount actually cut, may be expected to be brought under control and gradually diminished, and some wasteful uses of wood, *e g*, as fuel, may be partly superseded by the better use of water power and coal.

Even now, when so little has been done to conserve what is available, it is said that annual growth replaces about 80% of the amount cut. Improvements and inventions in the chemistry of pulp making may be expected, when required, to make other plant materials more or less as usable as coniferous woods now are. In some regions, and especially where tariffs are favourable, some local materials are already coming into use, increasingly, to supply local needs. Thus, in India there are now five mills, producing in all 33,000 tons of pulp per annum, mainly from grasses and cereals: other mills are projected and interest is being developed in the use of bamboo, a material first tried by Thomas Routledge (who also introduced and established the use of esparto), the use of which was further elaborated and brought to the level of industrial exploitation by W. Raitt, in recent years. In Burma the paper mulberry, most ancient of paper materials, is beginning to be exploited by plantation methods for the local Indian markets; and similarly in the West Indies, in Brazil, and elsewhere local paper industries are springing up.

It is clearly a gain to the whole world that regional industries should thus spring up to make use of low grade materials for the manufacture of cheap products which will not stand high freights. The supplying of local demands for cheap grades in this sort of way will stimulate a subsequent demand for better grades, which will be met by the supplies from the industrially more organized countries of Europe and North America, as has happened already in the textile industries. There is a very large amount of waste cereal material in the several countries of the world which is used for fodder, fuel, and so on: a good deal of this would be available for paper material if and when required, and some of it is even now thus used, to a minor extent, for straw boards and some grades of paper to which it gives a hard, brittle quality. The quantity available, both of natural grown and cultivated cereals and grasses, could doubtless be greatly increased. Esparto is already thus cultivated, though the output of it is relatively small, and most of it is derived from the littoral, natural grass lands of the Mediterranean. Actually about 2,000 species of plants, among those already studied and described, are known to be possible sources of fibrous raw materials, only a very small number of which have been actually used industrially, except of course by native craftsmen. And when it is considered how the quality and the output of such plants as cotton, wheat, and rubber, have been favourably modified by systematic thorough-breeding and cross-breeding, it appears certain that there must be important undeveloped utilities latent in many of these 2,000 species, which it will be possible to develop by systematic cultivation in due course.

The Outlook.—A consideration of the problem of raw material supplies is, therefore, on the whole reassuring. Difficult and complex as many of the issues undoubtedly are, and likely as they are to cause anxiety from time to time, all the indications appear to confirm the belief that the world is, on the whole, alert to them, and that future requirements will be met.

In the industrially more advanced countries of Europe and North America it appears likely that the raw materials at present in use will continue to be available and will have to be relied upon to meet future requirements. New materials are, however, continually being suggested and tried in these markets, but they do not displace or compete with those already in use. The fact is that the materials thus in use to-day are in use because of certain optimum combinations of ultimate fibre length, cellulose percentage, adequate market supplies of standard quality, suitability for economic manipulation in the factory, and so on, realizable by using them and not as obviously realizable by using other materials suggested from time to time. And the paper industry is one of severe competition at hard cut prices, and it is therefore not easy for a new material to establish itself in use. The conditions are undoubtedly very exacting, and to stand any chance of success at all the material must satisfy a number of simultaneous conditions, and do it fairly obviously, otherwise the manufacturer will not feel free to take the risk of adjusting his mill procedure to the adoption of it as a raw material. And thus, in spite of continuously rising prices, no new material of any real importance has appeared since esparto and wood first came into use about 1860 and 1880 respectively.

Classification of Material.—In the modern sense, paper may be regarded as a tissue of fibrous cellulosic material, the individual fibres of the original raw material from which it was made having been first separated from one another by mechanical or chemical action, and thereafter felted together to form the tissue. The fibrous cellulosic materials available to the practical paper manufacturer may be broadly catalogued as follows:—

For whites, writings and printings—rags, esparto, woodpulp.

For browns, wrappings and boards—wood, hemp, jute, straw, waste paper.

For the better grades the cellulosic materials should be pure cellulose, that is, freed from the incrustants with which cellulose is so frequently associated in the plant: for other grades it is frequently preferable to remove the incrustants only partially or not at all. Ordinarily the elongated cells known as fibres are the portions of the plant which are of value for paper, but the ordinary short plant cells are also sometimes of value.

Pure cellulose fibres, free from incrustants, are easily obtained from cotton, since the plant forms the cotton fibres without incrustants (other than slight traces of resinous substance easily removed by treatment with a dilute solution of soda ash), and without any short cells adhering to them. In flax, hemp and jute, the plant forms typically massive bundles of fibres in which the fibres adhere to one another more firmly than they do to the cellular matter surrounding them, and from which they are freed, industrially, by a variety of processes such as retting, scutching and so on. In wood, esparto and straw the fibres are most intimately associated with incrustants (lignone or pectin, with which they form the so-called "compound celluloses"), from which the pure cellulose fibres can be separated only by a drastic chemical treatment that, in effect, resolves the material, dissolves away the incrustant and leaves the cellulose proper undissolved. Cotton, flax and hemp, thus processed, give high yields of cellulose having considerable resistance to chemical treatment, and amounting to 75% and upwards of the original fibre weight. Wood, esparto, jute, straw, bamboo, etc., give a lower yield of cellulose (40 to 60%) which is less resistant to chemical action.

(1) **Rags.**—Rags, as they come to the rag boiler, vary greatly in regard to material, cleanliness, colour and strength, and they are graded and valued accordingly. They may contain new linen and cotton cuttings, fine white linens and cottons and inferior similar materials, coloured rags, gunny, rope, sailcloth, canvas, hemp, flax waste, manila, bagging and so on. Cotton, linen, sailcloth and canvas are made into high class hand made and machine made writing papers: rope, gunny, bagging and textile wastes of all sorts are made into wrappers and boards. Rags reach the mill in bales; they are first dusted to remove as much dirt as possible, and are then sorted into grades and such foreign matters as buttons, hooks, leather, rubber, etc., likely to diminish the value of the final paper are removed. The rags are then cut up into small pieces a few inches square, either by hand for the highest grades of papers or by machines for the lower grades. The cutting machines consist of pairs of revolving cylinders carrying one set of knives to cut the rags into strips and another set to cut the strips transversely into short pieces. The pieces are then dusted and shredded in a machine known as a "willow," consisting of an iron drum, bristling externally with iron spikes, revolving inside a box armed internally with similar spikes: a wire grating in the base of the box allows dirt to fall through. The rags are then boiled with solutions of chemicals to remove fatty and greasy matter and sizing materials which may be present: caustic soda ash or lime, sometimes 100% of either and sometimes mixtures of both varying in proportion with the grade made or mill practice, is used for this purpose, in quantity about 5 to 8 per cent of the weight of rags treated, dissolved in an appropriate quantity of water. For the highest grades of material this treatment is made the gentlest: water alone or lime water being sometimes used, if feasible: by gentle treatment only can the best qualities of cellulose be fully conserved. The time of boiling is about three to seven hours, at steam pressures

about 15 to 30 lb. to the square inch, and a charge of two to three tons, in a cylindrical or spherical boiler mounted on suitable trunnions to allow slow solution, is common practice.

When the boiling is judged complete the rags are discharged from the boiler, varying in colour from light brown to black, into a "breaker," which is an oval shaped vessel divided down the centre by a "midfeather" or partition which is placed along the major axis of the vessel, without extending to its ends. In the bottom, at one point of the channel thus formed, is a bed plate containing fixed steel knives against which play similar knives on the periphery of a heavy cast-iron roller, suitably mounted on bearings and rotating in the channel, like a paddle wheel. Its motion circulates the mixture of rags and water round and round the circuit of the channel, disintegrating the rags all the while: the water is continuously renewed, and the rags thus washed, the quantity of water thus consumed being very large. Eventually clean rag pulp is obtained, which is then bleached up to the white colour required, by a chloride of lime (bleaching powder) solution, which is previously freed from turbidity by settlement and decantation: the bleaching is commonly done in the breaker, or after partial bleaching in the breaker the half bleached pulp may be tipped out into a tank and the bleaching process left to continue until complete. The material is then known as half stuff, and, after thorough washing, it is ready for making up into paper. For this purpose it is passed through the beater and thence to the wet end of the paper making machine.

(2) **"Chemical" and "Mechanical" Pulp.**—The principles of this procedure are followed for the manufacture of half stuff from compound celluloses, *e.g.*, wood and esparto, after, however, such previous chemical action as is necessary to remove the incrustants. Wood cellulose, thus prepared as a pulp free from incrustants, is called "chemical wood" to distinguish it from "mechanical wood." Mechanical wood is prepared as a pulp by grinding wood wet against a grindstone, without removal of incrustants, and it is therefore a material of very inferior grade, suitable only for the manufacture of low grade products. In recent years a highly refined spruce bleached ground wood has been developed that is satisfactory for high grade box papers where opacity and a superior printing surface is desired. Chemical wood pulp and mechanical wood pulp are prepared in mills adjoining the forests of the wood growing countries, and thence exported to papermakers all over the world, in air dry condition: the papermaker uses this pulp, plus water, in much the same way, *mutatis mutandis,* as he uses the rag half stuff, the preparation of which has been described above.

Esparto grass is derived from the littoral lands of the Mediterranean, whence it is imported almost entirely into Great Britain, and mainly Scotland, in fairly constant amount, of value about £750,000 per annum. It is shipped in bales which contain roots, weeds and other impurities. It is cleaned and boiled with 15–18% caustic soda at 4–5% strength and at 40–50 lb. steam pressure: the boiler used is almost invariably stationary and of the type known as Sinclair's patent esparto boiler which commonly takes between 2½ or 3 tons of grass. The boiler is charged through an opening at the top and when the cooking has been judged completed, which may be in about three hours, the boiled material is taken from a false bottom through a door at the side: the liquor drains from the false bottom and is removed through vomit pipes. To get rid of the roots, weeds and other impurities, the pulp, after washing and bleaching, is pumped from storage chests over a settling table or "sand table," made of wood and fitted with divisions or "weirs" behind which the heavy impurities collect, fall to the bottom and are removed. The yield of cellulose is about 40–50% on the dry weight of the grass, and the cellulose is of not very permanent quality: its fibre is short and therefore incapable of giving strength to paper made from it, but it gives a certain soft bulkiness which is esteemed for some purposes, *e.g.*, magazine papers, and it is much used in all sorts of combinations with other fibres, especially bisulphite wood pulp. Straw is treated in much the same sort of way but it requires higher boiling temperatures, gives a lower yield and consumes more bleach: it is used to a small extent as an ingredient for papers, to which it gives a hard, brittle quality; but it is used much more for making straw boards, for which purpose it is boiled with lime which is cheaper than caustic soda.

There are three processes in use for the chemical removal of incrustants from wood, with formation of "chemical wood pulp," *i.e.*, wood cellulose prepared from wood by removal of incrustants by chemical action. These are the so-called soda, sulphate and bisulphite or sulphite processes. The woods employed in Europe are mainly those of the Scotch fir (*Pinus sylvestris*), the Norway spruce (*Picea excelsa*), the poplar (*Populus alba*), the aspen (*Populus tremula*) and, in America, the black spruce (*Picea mariana*), the red spruce (*Picea rubra*), the hemlock (*Tsuga canadensis*), the balsam fir (*Abies balsamea*), the poplar (*Populus grandidentata*) and the aspen (*Populus tremuloides*). The wood is cut up into logs, de-barked and then converted into chips, ½ or ¾ inch in size, by revolving cutters: afterwards the chips are bruised by passing between rollers to enable the boiling solution, later on, to penetrate them the more easily. In the soda process the wood chips are boiled in much the same way as esparto is boiled: and with about the same proportions of caustic soda. The boiler is sometimes a rotating boiler, however, and the time of boiling longer (5–8 hours) and the steam pressure higher (90–150 lb.). The soda is recovered and used again, in this as in the esparto industry, by evaporating down the liquor to dryness and igniting the residue obtained, which is then recausticized by treatment with lime and used over again.

The sulphate process is really a derivative of the soda process, sodium sulphate being used instead of the caustic soda. The action is much gentler, the yield greater, and the fibre stronger, but the pulp is not capable of giving so high a white colour as soda pulp: it is much used for strength and when colour is not of first importance. New processes are being developed to bleach this fibre to a bright white, making it available for high grade purposes. The bisulphite process is based on the use of a solution of sulphur dioxide (sulphurous acid gas), to which lime or magnesia is added in quantity insufficient for complete neutralization. The process has been developed greatly, with a number of modifications, since its first successful industrial introduction by Tilghman, Ekman and Mitscherlich. In the early days the liquor thus used contained 2·5–4·0 per cent of total sulphur dioxide of which rather less than half was neutralized by lime or magnesia: indirect heating by steam coils at 80–110 lb. steam pressure was used, and the time of cook was 16–48 hours. Ritter and Kellner raised the sulphur dioxide concentration and the cooking temperature and introduced the use of live steam for heating: this procedure has been developed still further and the modern "quick cook" at still higher concentrations is now sometimes completed in 8–16 hours, and temperatures of 150°–160° C are reached. In general terms the gentlest treatment gives the largest yield and the strongest pulp which may be, however, relatively difficult to bleach. The boilers for this process are always stationary, vertical and brick lined with litharge cement mortar. They are commonly of enormous size and capable of taking 30 tons or more of wood chips in one charge.

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(C. J. J. F.)

PAPER MONEY. In strict definition, paper money consists of the banknotes authorized by law as legal tender and usually engraved with great care on watermarked paper to prevent forgery. Such notes may be "convertible" or "inconvertible." Convertible paper money is exchangeable into gold, and really amounts to gold certificates, being therefore, as in the case of a Bank of England note, always acceptable at its face value. Inconvertible paper money is not exchangeable into gold, and its value, therefore, depends not upon its nominal figure but upon the quantity printed and put into circulation. (*See* further Money and Currency.)

In a wider sense, the expression paper money covers all printed or written documents which are promises to pay money either on demand or at a future date. Thus defined, it covers not only banknotes, but cheques (which have become the common currency of British and American trade), bills of exchange, postal and money orders, etc. (*see* QUANTITY THEORY OF MONEY; ASSIGNATS; BANKING AND CREDIT; PRICES; CHEQUE; BILL OF EXCHANGE).

PAPHLAGONIA, a district of Asia Minor, situated on the Euxine Sea between Bithynia and Pontus, separated from Galatia by a prolongation to the east of the Bithynian Olympus. Although the Paphlagonians play scarcely any part in history, they were one of the most ancient nations of Asia Minor (*Iliad,* ii. 851). They were among the races conquered by Croesus (Herod. i. 28), and they sent a contingent to the army of Xerxes in 480 B.C. Paphlagonia passed under the Macedonian kings, and after the death of Alexander the Great it was assigned to Eumenes. It continued, however, to be governed by native princes until it was absorbed by the encroaching power of Pontus. The rulers of that dynasty became masters of the greater part of Paphlagonia as early as the reign of Mithridates III. (302–266 B.C.), but it was not till that of Pharnaces I. that Sinope fell into their hands (183 B.C.). From this time the whole province was incorporated with the kingdom of Pontus until the fall of the great Mithradates (*q.v.*) in 65 B.C. Pompey united the coast districts of Paphlagonia with the province of Bithynia, but left the interior of the country under the native princes, until the dynasty became extinct and the whole country was incorporated in the Roman empire. All these rulers appear to have borne the name of Pylaemenes, as a token that they claimed descent from the chieftain of that name who figures in the *Iliad* as leader of the Paphlagonians. Under the Roman empire Paphlagonia with the greater part of Pontus, was united into one province with Bithynia.

Paphlagonia is a rugged mountainous country, but it contains fertile valleys, and produces great abundance of fruit. The mountains are clothed with dense forests, which are conspicuous for the quantity of boxwood which they furnish. The coasts were from an early period occupied by Greek colonies among which the flourishing city of Sinope, founded from Miletus about 630 B.C., stood pre-eminent. The most considerable towns of the interior were Gangra, in ancient times the capital of the Paphlagonian kings, afterwards called Germanicopolis, situated near the frontier of Galatia, and Pompeiopolis, in the valley of the Amnias (a tributary of the Halys), near which were extensive mines of the mineral called by Strabo *sandarake* (red sulphuret of arsenic), which was largely exported from Sinope.

See W. M. Ramsay, *Hist. Geog. of Asia Minor* (1890); *Cambridge Ancient History,* vol. iii. (with useful bibliography).

PAPHOS, an ancient city and sanctuary on the west coast of Cyprus. The sanctuary and older town (Palaepaphos) lie at Kouklia, about 20 m. west of Limasol, about a mile inland on the left bank of the Diorizo river (anc. Bocarus). New Paphos (Papho or Baffo), which had already superseded Old Paphos in Roman times, lies 10 m. farther west, and 1 m. south of modern Ktima, at the other end of a fertile coast-plain. Paphos was believed to have been founded either by the Arcadian Agapenor, returning from the Trojan War (*c.* 1180 B.C.), or by his reputed contemporary Cinyras, whose clan retained royal privileges down to the Ptolemaic conquest of Cyprus in 295 B.C., and held the Paphian priesthood till the Roman occupation in 58 B.C. The town certainly dates back to the close of the Bronze age (*c.* 1200 B.C.) and had a king Eteandros among the allies of Assur-bani-pal of Assyria in 668 B.C. In Hellenic times the kingdom of Paphos was only second to Salamis in extent and influence.

Paphos owes its ancient fame to the cult of the "Paphian goddess (ἡ Παφία ἄνασσα, or ἡ Παφία, in inscriptions, or simply ἡ θεά), a nature-worship like that of Phoenician Astarte. The Greeks identified both this and a similar cult at Ascalon with their own worship of Aphrodite (*q.v.*) and localized at Paphos the legend of her birth from the sea foam, accumulated here in masses on certain winds which also cause remarkable jets of spray. Her grave also was shown in this city. She was worshipped, under the form of a conical stone, in an open-air sanctuary not unlike those of Mycenaean Greece, the general form of which is known from late gems, and Roman coins; its ground plan was discovered by excavations in 1888. It suffered repeatedly from earthquakes, and was rebuilt more than once; in Roman times it consisted of an open court, with porticos and chambers on three sides, and a gateway through them on the east.

After the foundation of New Paphos and the extinction of the Cinyrad and Ptolemaic dynasties, the importance of the Old Town declined rapidly. Though restored by Augustus and renamed Sebasté, after the great earthquake of 15 B.C., and visited in state by Titus before his Jewish War in A.D. 70, it was ruinous and desolate by Jerome's time; but the prestige of its priest-kings partly lingers in the exceptional privileges of the patriarch of the Cypriote Church (*see* CYPRUS, CHURCH OF).

New Paphos became the administrative capital of the whole island in Ptolemaic and Roman days, as well as the head of one of the four Roman districts; it was also a flourishing commercial city famous for olive oil, and for "diamonds" of medicinal power. In A.D. 960 it was attacked and destroyed by the Saracens. The site shows a Roman theatre, amphitheatre, temple and other ruins and rock tombs, part of the city wall, the moles of the Roman harbour, and a ruined Greek cathedral. (*See* also CYPRUS.)

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PAPIAS, of Hierapolis in Phrygia, one of the "Apostolic Fathers" (*q.v.*). His *Exposition of the Lord's Oracles,* the prime early authority as to the Gospels of Matthew and Mark (*see* GOSPELS), is known only through fragments in later writers, chiefly Eusebius of Caesarea (*H.E.* iii. 39). The latter had a bias against Papias on account of the influence which his work had in perpetuating, through Irenaeus and others, belief in a millennial reign of Christ upon earth.

About his date, which is important in connection with his witness, there is some doubt. Setting aside the exploded tradition that he was martyred along with Polycarp (*c.* A.D. 155), we have the witness of Irenaeus that he was "a companion (ἑταῖρος) of Polycarp," who was born not later than A.D. 69. We may waive his other statement that Papias was "a hearer of John," owing to the possibility of a false inference in this case. But the fact that Irenaeus thought of him as Polycarp's contemporary and "a man of the old time" (ἀρχαῖος ἀνήρ) together with the affinity between the religious tendencies described in Papias's Preface (as quoted by Eusebius) and those reflected in the Epistles of Polycarp and Ignatius, all point to his having flourished in the first quarter of the 2nd century. Indeed, Eusebius, who deals with him along with Clement and Ignatius (rather than Polycarp) under the reign of Trajan, and before referring at all to Hadrian's reign (A.D. 117–138), suggests that he wrote about A.D. 115. It has been usual, however, to assign to his work a date *c.* 130–140, or even later. No fact is known inconsistent with *c.* 60–135 as the period of Papias's life. Eusebius (iii. 36) calls him "bishop" of Hierapolis, but whether with good ground is uncertain.

Papias uses the term "the Elders," or Fathers of the Christian community, to describe the original witnesses to Christ's teaching, *i.e.,* his personal disciples in particular. It was their traditions as to the purport of that teaching which he was concerned to preserve. But to Irenaeus the term came to mean the primitive custodians of tradition derived from these, such as Papias and his contemporaries, whose traditions Papias committed to writing. Not a few such traditions Irenaeus has embodied in his work *Against Heresies,* so preserving in some cases the substance of Papias's *Exposition.* (*See* Lightfoot, *Apostolic Fathers,* 1891, for these, as for all texts bearing on Papias.)

See articles in the *Dict. of Christian Biog., Dict. of Christ and the Gospels,* and Herzog-Hauck's *Realencyklopädie,* xiv., in all of which further references will be found; also Lightfoot, *Essays on Supernatural Religion* (1889).

PAPIER MÂCHÉ, a term embracing numerous manufactures in which paper pulp is employed, pressed and moulded into various shapes. The art has long been practised in the East. About the middle of the 18th century papier mâché work came into prominence in Europe in the form of trays, boxes and other small domestic articles. In 1772 Henry Clay of Birmingham patented a method of preparing this material for coach-building, for door and other panels and for furniture. In 1845 the application of the material to internal architectural decoration was patented by C. F. Bielefeld of London, and for this purpose it has come into extensive use. Under the name of carton pierre a substance which is essentially papier mâché is also largely employed as a substitute for plaster in the moulded ornaments of roofs and walls. Under the name of ceramic papier mâché, architectural enrichments are also made of a composition derived from paper pulp, resin, glue, a drying oil and acetate of lead. Masks, dolls' heads and other toys, lay figures, milliners' and clothiers' blocks, mirror and picture-frames, etc., are also made from it.

The materials for the commoner classes of work are old waste and scrap paper, repulped and mixed with a strong size of glue and paste. To this very often are added large quantities of ground chalk, clay and fine sand, so that the preparation is little more than a plaster held together by the fibrous pulp. For the finest work Clay's original method is retained. It consists of soaking several sheets of a specially made paper in a strong size of paste and glue, pasting these together, and pressing them in the mould of the article to be made. The moulded mass is dried in a stove and hardened by dipping in oil. For very delicate relief ornaments, a pulp of scrap paper is prepared, which after drying is ground to powder mixed with paste and a proportion of potash.

See L. E. Andés, *Die Fabrikation der Papiermaché- und Papierstoff-Waaren* (Vienna, 1900); A. Winzer, *Die Bereitung und Benützung der Papiermaché und ahnlicher Kompositionen* (4th ed. Weimar, 1907).

PAPIN, DENIS (1647–*c.* 1712), French physicist, one of the inventors of the steam-engine, was born at Blois on Aug. 22, 1647. Papin acted as assistant to Huygens (*q.v.*) in his experiments with the air pump. Later he came to London and assisted Boyle. He introduced a number of improvements in the air pump and invented the condensing-pump. In 1679 he invented his famous "steam digester," a vessel with a tightly fitting lid which prevented the steam (from water heated in it) escaping, and thus a high pressure was generated and the boiling point of the water considerably raised. A safety valve guarded against excessive rise of pressure. In 1684 Papin received from the Royal Society an appointment as "temporary curator of experiments," with a small salary. In this capacity he carried on numerous and varied investigations in hydraulics (*Phil. Trans.*, 1685, etc.). In Nov. 1687 he was appointed to the chair of mathematics in the University of Marburg, and here he remained until 1696, when he removed to Cassel. In 1705 Leibnitz sent him a sketch of Savery's engine for raising water, and this stimulated him to further exertions, which resulted two years afterwards in the publication of the *Ars nova ad aquam ignis adminiculo efficacissime elevandam* (Cassel, 1707). (*See* STEAM ENGINE.) In 1707 Papin returned to London where he died in obscurity, probably early in 1712.

Many of Papin's writings were collected by himself into a *Fasciculus dissertationum* (Marburg, 1695), of which he published also a translation into French, *Recueil de diverses pièces touchant quelques nouvelles machines* (Cassel, 1695). His correspondence with Leibnitz and Huygens, along with a biography, was published by Dr. Ernst Gerland, *Leibnizens und Huygens Briefwechsel mit Papin, nebst der Biographie Papins* (1881). *See* also L. de la Saussaye and E. Péan, *La Vie et les ouvrages de Denis Papin* (1869); and Baron Ernout, *Denis Papin, sa vie et ses ouvrages* (4th ed., 1888).

PAPINEAU, LOUIS JOSEPH (1786–1871), Canadian rebel and politician, son of Joseph Papineau, royal notary and member of the house of Assembly of Lower Canada, was born at Montreal on Oct. 7, 1786. He was educated at the seminary of Quebec, where he developed the gift of declamatory and persuasive oratory. He was called to the bar of Lower Canada on May 19, 1810. On June 18, 1808 he was elected a member of the House of Assembly of the province of Lower Canada, for the county of Kent. In 1815 he became speaker of the house, being already recognized as the leader of the French Canadian party. At this time there were many grievances in the country demanding redress. In Dec. 1820 Lord Dalhousie, governor of Lower Canada, appointed Papineau a member of the executive council; but Papineau, finding himself without real influence on the council, resigned in Jan. 1823. In that year he went to England to protest on behalf of the French Canadians against the projected union of Upper and Lower Canada, a mission in which he was successful. Nevertheless, his opposition to the government became more and more pronounced, till in 1827 Lord Dalhousie refused to confirm his appointment to the speakership, and resigned his governorship when the house persisted in its choice. The aim of the French Canadian opposition at this time was to obtain financial and also constitutional reforms. Matters came to a head when the legislative assembly of Lower Canada refused supplies and Papineau arranged for concerted action with William Lyon Mackenzie, the leader of the reform party in Upper Canada. In 1835 Lord Gosford, the new governor of Lower Canada, was instructed by the cabinet in London to inquire into the alleged grievances of the French Canadians. But the attitude of the opposition remained no less hostile than before, and in March 1837 the governor was authorized to reject the demand for constitutional reform and to apply public funds in his control to the purposes of government. In June a warning proclamation by the governor was answered by a series of violent speeches by Papineau, who in August was deprived of his commission in the militia.

Papineau had formerly professed a deep reverence for British institutions, but as party strife became more bitter and real issues were lost sight of Papineau, falling in with the views of one O'Callaghan, who distrusted everything British, became an annexationist. On Oct. 23, 1837 a meeting of delegates from the six counties of Lower Canada was held at St. Charles, at which resistance to the Government by force of arms was decided upon, and in which Papineau took part. In November preparations were made for a general stampede at Montreal, and on the 7th Papineau's house was sacked and a fight took place between the "constitutionals" and the "sons of liberty." Towards the middle of November Colonel Gore was instructed to arrest Papineau and his principal adherents on a charge of high treason. A few hundred armed men had assembled at Saint Denis to resist the troops, and on Nov. 22 hostilities occurred, which resulted in many casualties. On the eve of the fray Papineau sought safety in the United States. On Dec. 1, 1837 a proclamation was issued, declaring Papineau a rebel, and placing a price upon his head.

From 1839 till 1847 Papineau lived in Paris. In 1847 a general amnesty was granted; and, although in June 1838 Lord Durham had issued a proclamation threatening Papineau with death if he returned to Canada, he was now admitted to the benefit of the amnesty. On his return to Canada, when the two provinces were now united, he became a member of the lower house and continued to take part in public life, demanding "the independence of Canada, for the Canadians need never expect justice from England, and to submit to her would be an eternal disgrace." He unsuccessfully agitated for the re-division of Upper and Lower Canada, and in 1854 retired into private life. He died at Montebello, in the province of Quebec, on Sept. 24, 1871.

See L. O. David, *Les Deux Papineau;* Fennings Taylor, *Louis Joseph Papineau* (Montreal, 1865); Alfred De Celles, *Papineau-Cartier* (Toronto, 1906); H. J. Morgan, *Sketches of Celebrated Canadians* (Quebec, 1862); Rose's *Cyclopaedia of Canadian Biography Annual Register* (1836–37); Sir Spencer Walpole, *History of England* (5 vols., London, 1878–86), vol. iii.

PAPINI, GIOVANNI (1881–), Italian author, was born in Florence on Jan. 9, 1881. He founded the reviews, *Leonardo* (1902) and *Lacerba* (1913), and was also joint editor of *La Voce* in 1912. Professedly an iconoclast, in a volume entitled *Stroncature* (1917) he demolished many established reputations. Among his many works are several volumes of essays and criticism—*La paga del Sabato, L'uomo Carducci* (1918), *Il crepuscolo dei filosofi* (1906), and two novels *Un uomo finito* (1922) and *Parole e Sangue* (1921). His poems include *Cento pagine di poesia* (1920), *Opera prima, Giorni di festa* (1920). In his *Storia di Cristo* (1921), a book which achieved immense success, he sud-

denly abandoned his caustic and sceptical attitude in favour of mysticism.

See E. Fabri, *Papini come scrittore* (1921) and R. Fondi, *Un Construttore: Papini* (1922).

PAPINIAN (AEMILIUS PAPINIANUS), Roman jurist, was *magister libellorum* and afterwards praetorian prefect under Septimius Severus. He was an intimate friend of the emperor, whom he accompanied to Britain, and before his death Severus commended his two sons to his charge. Papinian tried to keep peace between them, but only excited the hatred of Caracalla, to which he fell a victim in the general slaughter of Geta's friends which followed the fratricide of A.D. 212. (*See* ROMAN LAW.)

PAPPENHEIM, GOTTFRIED HEINRICH, COUNT OF (1594–1632), imperial field marshal in the Thirty Years' War, was born on May 29, 1594, at the little town of Pappenheim on the Altmühl, now in Bavaria, the seat of a free lordship of the empire, of an ancient family established there. He was educated at Altdorf and at Tübingen. At the outbreak of the war he abandoned the legal and diplomatic career on which he had embarked, and took service in Poland under the Catholic League. He displayed brilliant courage at the battle of the White Hill near Prague (Nov. 8, 1620), where he was left for dead on the field. In the following year he fought against Mansfeld in western Germany, and in 1623 became colonel of a regiment of cuirassiers, afterwards the famous "Pappenheimers." In the same year, as an ardent friend of Spain, the ally of his sovereign and the champion of his faith, he raised troops for the Italian war and served with the Spaniards in Lombardy and the Grisons. His long and heroic defence of the post of Riva on the Lake of Garda made his name. In 1626 Maximilian of Bavaria, the head of the League, recalled him to Germany to suppress an insurrection in Upper Austria. In a few weeks Pappenheim crushed the rebellion with ruthless severity (actions of Efferdingen, Gmünden, Vöcklabruck and Wolfsegg, Nov. 15–30, 1626). After this he served with Tilly against King Christian IV. of Denmark, and besieged and took Wolfenbüttel. His hope of obtaining the sovereignty and possessions of the evicted prince was, after a long intrigue, definitely disappointed. In 1628 he was made a count of the empire. The siege and storm of Magdeburg followed, and Pappenheim, like Tilly, has been accused of the most savage cruelty in this transaction. After the battle of Breitenfeld, he covered the retreat of the imperialists from the lost field with care and skill, and won glory by his operations on the lower Rhine and the Weser in rear of the victorious Swedish army. Being now a field marshal in the imperial service, he was recalled to join Wallenstein, and assisted the generalissimo in Saxony against the Swedes; but was again despatched towards Cologne and the lower Rhine. In his absence a great battle became imminent, and Pappenheim was hurriedly recalled. He appeared with his horsemen in the midst of the battle of Lützen (Nov. 6th–16th, 1632). His furious attack was for the moment successful. But at about the same time as Gustavus was killed, Pappenheim also was mortally wounded. He died next day in the Pleissenburg at Leipzig.

See *Kriegsschriften von baierischen Offizieren* I. II. V. (Munich, 1820); Hess, *Gottfried Heinrich Graf zu Pappenheim* (Leipzig, 1855); Ersch and Grüber, *Allgem. Encyklopädie*, III. 11 (Leipzig, 1838); Wittich, in *Allgem. deutsche Biographie*, Band 25 (Leipzig, 1887), and works there quoted.

PAPPUS OF ALEXANDRIA, Greek geometer, flourished about the end of the 3rd century A.D. In a period of general stagnation in mathematical studies, he stands out as a remarkable exception. How far he was above his contemporaries, how little appreciated or understood by them, is shown by the absence of references to him by other Greek writers, and by the fact that his work had no effect in arresting the decay of mathematical science. In this respect the fate of Pappus strikingly resembles that of Diophantus. In his *Collection*, Pappus gives no indication of the date of the authors cited or of the time at which he himself wrote. Since he frequently quotes Ptolemy the astronomer (*fl.*, say, A.D. 140), he can hardly have been earlier than the end of the 2nd century. A marginal note to a 10th century ms. states, in connection with the reign of Diocletian (A.D. 284–305) that Pappus wrote during that period; and in the absence of better testimony it seems best to accept this indication. Suidas, it is true, makes him contemporary with Theon of Alexandria (4th century), who wrote a commentary on Ptolemy's *Syntaxis;* but, as Pappus also wrote a commentary (doubtless largely assimilated by Theon), Suidas perhaps failed to disconnect the two, and so assigned the same date to both.

The great work of Pappus, in eight books and entitled *συναγωγή* or *Collection,* we possess only in an incomplete form, the first book being lost, and the rest having suffered considerably. Suidas enumerates other works of Pappus as follows: *Χωρογραφία οἰκουμενική, εἰς τὰ τέσσαρα βιβλία τῆς Πτολεμαίου μεγάλης συντάξεως ὑπόμνημα, ποτάμους τοὺς ἐν Λιβύῃ, ὀνειροκριτικά.* He also wrote commentaries on the *Analemma* of Diodorus, on Ptolemy's *Planispherium* and *Harmonica,* and on Euclid's *Elements.* Citations from the commentary on the *Elements* are made by Proclus and others, while fragments of the portion relating to book x. survive in the Arabic.

The characteristics of Pappus's *Collection* are that it contains an account, systematically arranged, of the most important results obtained by his predecessors; and, secondly, notes explanatory of, or extending, previous discoveries. These discoveries form, in fact, a text upon which Pappus enlarges discursively. Very valuable are the systematic introductions to the various books, which set forth clearly in outline the contents and the general scope of the subjects to be treated. From these introductions we are able to judge of the style of Pappus's writing, which is excellent and even elegant the moment he is free from the shackles of mathematical terminology.

We can only conjecture that the lost book i., as well as book ii., was concerned with arithmetic, book iii. being clearly introduced as beginning a new subject.

The whole of book ii. (the former part of which is lost, the existing fragment beginning in the middle of the 14th proposition) related to a system of continued multiplication coupled with the expression of large numbers in terms of "tetrads" (powers of 10,000), due to Apollonius of Perga.

Book iii. contains geometrical problems, plane and solid. It may be divided into five sections: (1) On the famous problem of finding two mean proportionals between two given lines, to which Hippocrates of Chios had reduced the problem of duplicating the cube. Pappus gives several solutions of this problem, including his own, and also a method of approximating continually to a solution, the significance of which he apparently failed to appreciate. (2) On the arithmetic, geometric and harmonic means between two straight lines, and the problem of representing all three in one and the same geometrical figure. This serves as an introduction to a general theory of means, of which Pappus distinguishes ten kinds with examples. (3) On a curious problem suggested by Eucl. i. 21. (4) On the inscribing of each of the five regular polyhedra in a sphere.

Of book iv. the title and preface have been lost, so that the programme has to be gathered from the book itself. At the beginning is the well-known generalization of Eucl. i. 47, then follow various theorems on the circle, leading up to the problem of the construction of a circle which shall circumscribe three given circles touching each other two and two. This and several other propositions on contact, *e.g.,* cases of circles touching one another and inscribed in the figure made of three semi-circles and known as *ἄρβηλος* (*shoemaker's knife*), form the first division of the book. Pappus turns then to a consideration of certain properties of Archimedes's spiral, the conchoid of Nicomedes, and the curve discovered by Hippias of Elis about 420 B.C., and known by the name *ἡ τετραγωνίζουσα*, or *quadratrix.* Proposition 30 describes the construction of a curve of double curvature called by Pappus the helix on a sphere, a construction analogous to that of Archimedes's spiral in a plane. The area of the surface included between this curve and its base is found by the classical method of "exhaustion" equivalent to integration. The rest of the book treats of the trisection of any angle, and the solution of more general problems of the same kind by means of the quadratrix and spiral. In one solution of the former problem is the first recorded use of the property of a conic (a hyperbola) with reference to the focus

and directrix.

In book v., after an interesting preface concerning regular polygons, and containing remarks upon the hexagonal form of the cells of honeycombs, Pappus addresses himself to the comparison of the areas of different plane figures which all have the same perimeter (following Zenodorus's treatise on this subject), and of the volumes of different solid figures which all have the same superficial area; and, lastly, a comparison of the five regular solids. Incidentally Pappus describes the 13 other polyhedra bounded by equilateral and equiangular but not similar polygons, discovered by Archimedes, and finds, by a method recalling that of Archimedes, the surface and volume of a sphere.

According to the preface, book vi is intended to resolve difficulties occurring in the so-called *μικρὸς ἀστρονούμενος*. It accordingly comments on the *Sphaerica* of Theodosius, the *Moving Sphere* of Autolycus, Theodosius's book *On Days and Nights*, the treatise of Aristarchus, *On the Sizes and Distances of the Sun and Moon,* and Euclid's *Optics* and *Phaenomena.*

The preface of book vii. explains the terms analysis and synthesis, and the distinction between theorem and problem. Pappus then enumerates works of Euclid, Apollonius, Aristaeus and Eratosthenes, 33 books in all, the scope of which he intends to describe, with the lemmas necessary for their elucidation With the mention of the *Porisms* of Euclid we have an account of the relation of porism to theorem and problem In the same preface are included (*a*) the famous problem known as "Pappus's Problem," which formed, so to say, the "text" of Descartes's *Géométrie;* (*b*) the theorems which were rediscovered by and named after Paul Guldin, but appear to have been discovered by Pappus himself. Book vii. contains also (1), under the head of the *de determinata sectione* of Apollonius, lemmas which, closely examined, are seen to be cases of the involution of six points; (2) important lemmas on the *Porisms* of Euclid (*see* PORISM); (3) a lemma upon the *Surface-Loci* of Euclid which gives a complete proof of the focus-directrix property of the three conic sections.

Lastly, book viii. treats principally of mechanics, the properties of the centre of gravity, and some mechanical powers. Interspersed are some questions of pure geometry Proposition 14 shows how to draw an ellipse through five given points.

BIBLIOGRAPHY.—Of the whole work of Pappus the best edition is that of Hultsch, bearing the title *Pappi Alexandrini collectionis quae supersunt e libris manuscriptis edidit latina interpretatione et commentariis instruxit Fridericus Hultsch* (Berlin, 1876–78). Previously the entire collection had been published only in the Latin translation (with commentary) by Commandinus (Pesaro, 1588, etc). For a detailed account of Pappus's work *see* G. Loria, *Le scienze esatte nell' antica Grecia,* 1914, esp pp. 656–703; T. L. Heath, *History of Greek Mathematics* vol. ii. pp 355–439. (T L H)

PAPUA, a name for the whole island of New Guinea, also used for British New Guinea, and known as Territory of Papua. (*See* NEW GUINEA.)

PAPUAN LANGUAGES. Papuan languages are spoken in New Guinea and the adjacent islands, and in the Solomon group. The Halmaheran languages of Indonesia are included with them. The definition of the languages is essentially negative, and they are described as those languages of the Melanesian and Indonesian regions which differ entirely in grammar, and very largely in vocabulary, from the Austronesian. The Papuan languages are not members of a single linguistic stock, but differ from one another in word-formation, in grammatical categories and expressions, and in syntax. The variations in vocabulary are extreme, and villages only a short distance apart use languages without a single common feature.

Geographical Distribution.—In the British portion of New Guinea there is an unbroken succession of Papuan forms of speech from the Netherlands boundary to the St. Joseph and Vanapa rivers on the south coast, and to Collingwood bay on the north coast. East of these places Papuan languages are spoken on the hills inland and in the upper river valleys, and reach the coast only between Keakalo and Orangerie bays. East of Collingwood and Orangerie bays and in the islands off the south-eastern end of New Guinea, no Papuan languages appear, except doubtfully in Rossel island in the Louisiade archipelago. In British territory more than sixty Papuan languages have been partially recorded, but only fifteen are known by grammars. These are:—

1. Kunini on the coast west of the Fly delta
2. Miriam in the eastern islands of Torres straits.
3. Kiwai on the islands of the Fly delta, with many variations in vocabulary.
4. Tirio on the western shore of the Fly delta
5. Goaribari or Kerewa at the mouth of the Bamu river
6. Namau in the villages of the Purari delta.
7. Orokolo on the Papuan gulf.
8. Toaripi or Motumotu, at the eastern end of the Papuan gulf.
9. Binandele, in the basins of the Mamba, Gira and Ope rivers in the north-west of the possession
10. Ambo or Afoa (Tauata) inland from Hall sound and around Mount Yule.
11. Fuyuge or Mafulu in the mountains inland from Galley reach
12. Koiari, inland from Port Moresby, and Koita in the Motu villages.
13. Mulaha (now extinct), on the south-east coast
14. Kwale, inland from Kapakapa
15. Magi or Mailu, in coast villages from Cheshunt bay to Toulon island.

In the mandated territory the languages are Papuan, except in a few small districts on the coast, opposite islands where Melanesian dialects are spoken A large number of short word-lists are recorded, and six languages are represented by grammars.

1. Kate, inland from Finschhafen
2. Bongu, inland from Astrolabe bay
3. Bogajim, inland from Astrolabe bay
4. Monumbo, on the coast at Potsdamhafen, opposite Vulcan island.
5. Kavu, opposite Muschu island.
6. Valman, east of Berlinhafen.

In Netherlands territory there are many languages which are definitely non-Indonesian and non-Melanesian and are therefore included with the Papuan. But very little is known of the grammar and the uncertain classification depends almost entirely on vocabulary. One language of this region, the Nufōr or Mefor, is represented by a grammar, but is essentially a mixed language. The best known of the Papuan languages are

On the north coast:

1. Seka and Sentani, Lake Sentani
2. Pauwi, on the lower Mamberamo river
3. Angadi, Goredu and Nagramadu in the neighbourhood of Lake Jamur.

On the south coast:

4. Mimika, inland from Mimika river.
5. Merauke or Marind-anim, on the coast, between the Kumbe river and the British boundary.

West of New Guinea in Halmahera, the northern part of the island of Gilolo, the languages differ from the Indonesian They are well known by comparative grammars and word-lists, and are conveniently grouped with the Papuan

In New Britain several Papuan languages are recorded Those known by grammars are:

1. Baining, in the mountains inland of Gazelle peninsula.
2. Sulka, on the coast near Cape Orford.

In New Ireland several Papuan languages are named but exact information is wanting

In the Solomon islands at least seven Papuan languages are known.

1. Nasioi, on north coast of south-east Bougainville island.
2. Koromira, adjacent to Nasioi
3. Telei or Buin, in south of Bougainville island.
4. Bilua in Vella Lavella island.
5. Baniata in Randuvu (Rendova) island
6. Laumbe, in Russell (or Cape Marsh) island.
7. Savo, in Savo island west of Florida.

Classification.—A complete survey of the Papuan languages is not yet possible and classification based on grammar is premature. At present no two Papuan languages show sufficient likeness in grammar to establish genealogical relationship and each name in the foregoing list represents an independent linguistic stock.

Grammar.—Some of the Papuan languages are less complex than others, but all are difficult to acquire Where Papuans and

Melanesians are in contact the Melanesian language is used by both. Many Papuan languages were unknown until about thirty-five years ago, and our present knowledge of them is mainly due to missionary studies in translating the Scriptures.

The pronouns of the various languages have no common basis. They often indicate the dual, and rarely a trial number by suffixes which may or may not be derived from the numerals "two" and "three." Sometimes entirely distinct words are used. Very few Papuan languages have two forms of the first dual and plural personal pronouns; one indicating the inclusion, the other the exclusion of the person addressed, so that "we" means either "you and I" or "he and I" (in the plural "they and I"). In some languages the possessive pronoun does not differ from the personal, but in others a suffix is used. There are many irregularities and omissions, and some languages use more than one method. A different pronoun or different method is sometimes used to indicate a special kind of possession, and these pronouns may sometimes be used without the noun.

In most of the Papuan languages there is no indication of grammatical gender and the pronouns of the third person rarely distinguish sex. In a few languages there is a classification of nouns with a special pronoun for each class, and the classification is not sexual.

In Nasioi the classification is as varied as the Bantu of Africa. The classes are distinguished by a suffixed article, and the numerals, possessive, interrogative and demonstrative pronouns and adjectives take endings in concord with the noun.

The genitive usually precedes, sometimes with a particle, sometimes with a pronoun, between the governed and governing words.

In a few Papuan languages the subject and object of the verb are shown only by separate nouns or pronouns, the verb itself undergoing no change. In most of the languages the objective pronoun is combined with the verb as prefix, infix or suffix. Some languages indicate the subject by a change in the verbal ending. This often varies according to tense. Other languages indicate both subject and object by distinct particles or by syllables meaning I-thee, I-him, you-me, etc., in which separate pronouns do not appear. Some of the Papuan verbs only indicate two persons, an inclusive person, used with the pronouns I and we, and an exclusive person used for all others, but in some languages the inclusive person is used with I, we and you, and the exclusive for he and they.

Most Papuan languages have only the numerals "one" and "two," and three is rarely found. In some places Melanesian expressions are imitated. It is a Papuan custom to recall the number of objects by using parts of the body as tallies.

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PAPUANS (Malay *papúwah* or *puwah-puwah*, "frizzled," "woolly-haired," in reference to their characteristic hair-dressing), the name given to the people of New Guinea and the other islands of Melanesia. The pure Papuan is found in most parts of New Guinea and is an element in Melanesia. Papuan elements formerly existed in Australia, and the Tasmanian race may be akin to the Papuan. The typical Papuan is woolly haired, long headed, dark skinned, broad nosed. The nose is often prominent and convex.

Their culture is very diverse, and in parts has been affected by contact with other peoples. Modern research (Armstrong and Laudtman) has added much to our knowledge of the Papuans, and further investigations are being undertaken from Australia, which controls the area by mandate.

Social Order.—Custom regulates the duties in life, but where cases of doubt or difficulty arise, the old men—with more of social importance and individuality—discuss and decide the issue. Here and there are chiefs, or head men, and patrilineal succession is found in certain districts. The exogamic clans are local groups, totemic, and generally patrilineal, though kinship systems are "classifactory." Marriages are often regulated more by kinship, reckoned by genealogical methods, than by clanship. Exchange marriages are frequent. In Rossel Island—a mixed culture—a class system in decay was found by Armstrong. Once naked and unashamed, the people often suffer now from extreme prudishness. Polygamy was once prevalent. The initiation rites included lessons in morals. Pre-nuptial chastity was rare. Individual ownership of land was recognized. Children generally divided their father's property equally, but bequests (verbal) were respected.

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A PAPUAN NATIVE OF DUTCH NEW GUINEA

Magical practices were common, but the training of a magician was unpleasant and rigorous, the methods employed being of the ordinary type. (*See* MAGIC: PRIMITIVE.) Ceremonies—of a magico-religious nature—were performed in connection with fishing and cultivation, close connection between sexual activity and agricultural success finding expression in rites of a peculiar nature.

There is a belief in a class of powerful beings, most of which are mischievous but stupid, though some are good. Beliefs are vague. That of transmigration into animals has been recorded. Another is that the soul leaves the body at death and goes to an unknown island in the west. Some return and even marry mortals. Various forms of divination were employed. Spirits appeared in dreams; hero cults are recorded and of the Western Islands it is stated that they "had no deities or conception of a Supreme God." Ancestors are believed to control the food supply, and if customs are broken, withhold their favour.

Products.—Yams, taro and sweet potatoes constitute in some districts the main food of the people, while in others sago is the staple diet. Forest fruits and vegetables are also eaten. Maize and rice—which are not indigenous—are eagerly sought after. The Papuan varies his vegetable diet with the flesh of the wild pig, wallabi and other small animals, which are hunted with dogs. Birds are snared or limed. Fish abound at many parts of the coast, and are taken by lines, or speared at night by torch-light, or netted, or a river is dammed and the fish stupefied with the root of a milletia. Turtle and dugong are caught. The kima, a great mussel weighing (without shell) 20 to 30 lb., and other shellfish, are eaten, as are also dogs, flying foxes, lizards, beetles and all kinds of insects. Food is cooked in various ways. Cooking-pots, made at various parts of the coast, form one of the great exchanges for sago; but where such vessels do not reach, food is cooked by the women on the embers, done up in leaves, or in holes in the ground over heated stones. The sexes eat apart. In the interior salt is difficult to get, and sea-water, which is carried inland in hollow bamboos, is used in cooking in place of it. Salt, too, is obtained from the ashes of wood saturated by sea-water. In the Fly River region, kava, prepared from *Piper methysticum,* is drunk without any of the ceremonial importance associated with it in Polynesia. As a rule the Papuans have no intoxicating drink and do not know the art of fermenting palm-sap or cane-juice. Tobacco is indigenous in some parts, and is smoked everywhere, except on the north-east coast and on the islands.

Clothing and Ornaments.—The Papuan's chief home-made ornaments are necklaces, armlets and ear-rings of shells, teeth or fibre, and cassowary, cockatoo, or bird of paradise feathers—the last two, or a flower, are worn through the septum of the nose. With his head encircled by a coronet of dogs' teeth, and covered with a network cap or piece of bark-cloth, the septum of the nose transfixed by a pencil of bone or shell, and perhaps a shell or

fibre armlet or two, the Papuan is in complete everyday attire. On festal occasions he decks his well-forked-out and dyed hair with feathers and flowers, and sticks others in his ear-lobe holes and under his armlets; while a warrior will have *ovula* shells and various bones of his victims dangling from ringlets of his hair, or fixed to his armbands or girdle. The Papuan comb is a long piece of bamboo split at one end into prongs, while the other projects beyond the forehead sometimes two feet or more, and into it are stuck the bright feathers of parrots and other birds. The fairer tribes at the east end tattoo. Men are not tattooed till they have killed some one. Raised cicatrices usually take the place of tattooing with the darker races.

The Papuans build excellent canoes and other boats, and in some districts there are professional boat-builders of great skill, though in others this is now a lost art These boats are either plain dug-outs, with or without outriggers, or regularly built by planks tightly laced and well caulked to an excavated keel. The "lakatoi" is composed of several capacious dug-outs, each nearly 50 ft. long, which are strongly lashed together to a width of some 24 ft., decked and fitted with two masts, each carrying a huge mat sail picturesquely fashioned. On the deck high crates are built for the reception of pottery for conveyance annually to the Fly River district to exchange for sago

Papuans use Pan-pipes, a Jew's harp of the Papuans' own fabrication, and the flute; on occasions of ceremony the drum only is used—this instrument being always open at one end and tapped by the fingers. To the accompaniment of the drum, dancing almost invariably goes, but rarely singing All sorts of jingling sounds also are music to the ear, especially the clattering in time of strings of beans in their dry shells

Nearly all Papuan houses are built on piles, and this not only on the coast but on the hillsides In the north, the east and south-west of the island immense communal houses (*morong*) are met with. Some of these are between 500 and 700 ft in length, with a rounded, boat-shaped roof thatched with palm-branches, and looking inside, when undivided, like dark tunnels. In some districts the natives live together in one of these giant structures, which are divided into compartments. As a rule elsewhere each family has its independent dwelling On the north coast the houses are not built on piles; the walls, of bamboo or palm branches, are very low, and the projecting roof nearly reaches the ground; a barrier at the entrance keeps out pigs and dogs. A sort of table or bench stands outside, used by the men only, for meals and for the subsequent siesta In east New Guinea sometimes the houses are two-storeyed, the lower part being used for stores. The ordinary house is 60 to 70 ft. long, with a passage down the centre, and stands on a platform or veranda raised on piles, with the ridge-pole projecting considerably at the gables so that the roof may cover it at each end Inland villages are often situated on hills or on top of steep-faced rocks as difficult of access as possible, whence a clear view all round can be had, or the village is protected by high palisades and by fighting platforms on trees commanding its approaches The "dobbos" are tree-houses, built in high trees On the north-east coast many of the villages are tastefully kept, their whole area being clean swept, nicely sanded, and planted with ornamental shrubs, and have in their centre little square palaver places laid with flat stones, each with an erect stone pillar as a back-rest. Excellent suspension bridges span some of the larger rivers

Weapons and Tools.—Papuan weapons are the bow and arrow (in the Fly River region, the north and north-east coasts); a knife of a sharp segment of bamboo; a shafted stone club—rayed, disc-shaped or ball-headed (in use all over the island); spears of various forms, pointed and barbed; the spear-thrower (on the Finsch coast), and hardwood clubs and shields, widely differing in pattern and ornamentation with the district of their manufacture. The Papuan bow is rather short, the arrows barbed and tipped with cassowary or human bone. The Papuans were mostly ignorant of iron, but work skilfully with axes of stone or tridacna shell and bone chisels, cutting down trees 20 in. in diameter. Two men working on a tree trunk, one making a cut with the adze lengthwise and the other chopping off the piece across, will soon hollow out a large canoe. Every man has a stone axe, each village generally owning a large one. Their knives are of bamboo hardened by fire In digging they use the pointed stick. In British New Guinea alone is the man-catcher (a rattan loop at the end of a handle with a pith spike projecting into it) met with. For war the men smear themselves in grotesque fashion with lime or ochres, and in some parts hold in their teeth against the chin a face-like mask, supposed to strike terror into the foe, against whom they advance warily (if not timidly), yelling and blowing their war-trumpets The war canoe (which is a long, narrow dug-out outrigger, capable of holding 28 men) is only a transport, for they never fight in it. The conch-shell is the trumpet of alarm and call to arms.

See B Hagen, *Unter den Papuas* (Wiesbaden, 1899); A B Meyer and R Parkinson, *Album von Papúa Typen* (Dresden, 1894), F S. A de Clercq, *Ethnographische Beschrijving van de West-en Noordkust van N N G.* (Leyden, 1893); A C Haddon, *Decorative Art of British New Guinea* (1894), *Reports* of the Cambridge Anthropological expedition to the Torres Straits (1904); *Annual Reports on Papua* (1920–21), W E. Armstrong, *Rossel Island* (1928); G. Laudtman, *Papuans of Kuoni.*

PAPYROLOGY. Papyrology means the science or study of papyri, but as commonly understood the scope of this study is narrowed on one side and widened on another The papyri found in Egypt—which country, except for the charred rolls of Herculaneum, has hitherto been their only source—are written in a variety of scripts and languages: ancient Egyptian in its progressive stages of Hieroglyphic, Hieratic, Demotic and Coptic in Hebrew and Aramaic, in Syriac, Persian and Arabic, as well as in Greek and Latin. Papyrology, however, and its foreign equivalents, Papyrologie, Papirologia, Pápyrusforschung, etc., have come to be associated with papyri written in the two classical languages, especially Greek, which is far commoner than Latin, and limit themselves to the Graeco-Roman period of Egyptian history On the death of Alexander the Great, who had occupied Egypt in 332 B C, Ptolemy Soter I, the founder of the Ptolemaic dynasty, became satrap and subsequently king Thenceforward, till the Arab invasion in the middle of the seventh century, Greek was the official language of the country Under the earlier Ptolemies Greek-speaking settlers were introduced in considerable numbers, and by degrees the Greek language and literature became so widely diffused and firmly rooted that their predominance remained unchallenged when Egypt was incorporated in the empire of Rome Literary fragments in Latin are rare, and for documentary purposes that language was little used except in military and legal business and in private correspondence between Roman officials themselves. After the Arab conquest Greek continued for a while to be officially employed side by side with Arabic, and then gradually died out Greek, then, is the language with which the papyrologist is primarily concerned. He will not of course neglect the evidence derived from contemporary documents in Demotic, Coptic, or Arabic, but the decipherment and interpretation of oriental scripts are left to specialists in those tongues Though thus circumscribed, however, on the one hand, on the other the term papyrology is somewhat loosely allowed to comprehend those analogous Greek or Latin texts which are found in Egypt inscribed on substances other than papyrus—parchment, leather, wood, bone, fragments of limestone and especially broken pottery or ostraca, which were very often used for short receipts and similar purposes Inscriptions on stone are excluded, these form the material of the kindred science of epigraphy. The first professorship of papyrology was established in 1908 at Oxford

HISTORY OF THE DISCOVERY OF PAPYRI

18th Century.—Herculaneum.—The first discovery of Greek papyri, of which we have record, was made at Herculaneum, where in 1752 the charred remains of a library were found, consisting almost entirely of philosophical works, mostly by Philodemus, an Epicurean contemporary of Cicero, others by Epicurus himself or writers of his school Copies of some of these were edited by Walter Scott (*Fragmenta Herculanensia*, 1885), others have been published in Italy. That find is as yet an isolated event

In Egypt Greek papyri first made an appearance in 1778, when a European merchant bought one of a number of rolls said to have been unearthed at Gizeh. The rest were torn up by the native finders and burned for the sake of their aromatic smell. Such is the picturesque but not very convincing story. That the home of the discoverers was Gizeh no one familiar with that village will doubt. As the place of discovery, however, the Fayûm (the ancient Arsinoite nome), is plainly indicated by the contents of the single surviving roll.

Early 19th Century.—About 1820 further appreciable finds began to be made. In the decade from 1815 to 1825 several groups of documents, many of the second century B.C., were unearthed, chiefly at Memphis and Thebes, and for the most part found their way to the museums of London, Paris, Turin, Vienna and Leyden. The Turin section was edited by Amadeo Peyron in 1826, and the others were brought out in more or less successful form during the next forty years. The first literary papyrus obtained from Egypt was a roll containing Book XXIV. of the *Iliad,* bought by William Bankes in 1821 and passed on by him to the British Museum. That institution also acquired in 1847 the papyrus of a lost classic which contains three orations of Hyperides, and subsequently the Funeral Oration of the same orator, which followed in 1856.

Late 19th Century.—The sporadic finds just described, though important, were relatively sparse, and it was only in the last quarter of the century that the great possibilities of Egypt as a source of papyri became fully apparent. The second period in the history of papyrus discovery began in 1877 and lasted for rather less than twenty years. It was marked by very large finds made in the ruins of Arsinoë and other places in the Arsinoite nome, and of Heracleopolis and Hermopolis, farther south in the Nile valley. Many of these finds were the accidental fruits of digging in the ancient mounds for *sebakh, i.e.,* nitrous earth which is extensively used by the natives as a fertilizer. The *fellahin* had gradually awakened to the fact that papyrus was a marketable commodity, so that what formerly passed unheeded came to be more or less carefully preserved and handed on to dealers in antiquities. Other discoveries were the outcome of work undertaken by the dealers themselves, or by mere plunderers. The united result was a copious and fairly constant stream which flowed mainly to London, Berlin and Vienna. During this period, in the winter of 1889, Prof. (now Sir Flinders) Petrie, excavating at Gurob in the Fayûm, came upon some mummies of the early Ptolemaic age, in the cartonnages of which papyrus had been used in place of cloth (*see* below). About the same time the British Museum purchased a most important group of literary papyri, including Aristotle's treatise on the Constitution of Athens, the Mimes of Herondas, and part of the oration of Hyperides against Philippides, while another speech of Hyperides, that against Athenogenes, was acquired by the Louvre.

Scientific Excavations.—The earlier discoveries outlined above proceeded almost entirely from the unskilled work, sometimes authorized but often illicit, of natives, whose desultory methods involved much damage and loss. Those of the latest period, now in progress, have largely been the product of systematic exploration superintended by properly qualified Europeans. In the winter of 1895–96 the first expedition of such a kind, definitely undertaken for the discovery of papyri, was conducted on behalf of the Egypt Exploration Fund (now Society) by Drs. D. G. Hogarth, B. P. Grenfell and A. S. Hunt in the north of the Fayûm. Its results, subsequently published in *Fayûm Towns and their Papyri,* justified further efforts, and in the following season an enormous find was made by Grenfell and Hunt in the mounds of Behnesa, the ancient Oxyrhynchus, once the capital of a province. Among their earliest discoveries there was a leaf containing new sayings of Jesus, which were published in a brochure under the title of *Logia* in 1897. Prompted by this success the Society founded in that year a Graeco-Roman branch with a view to systematic publication of what had already been secured as well as to further exploration. Work was carried on by the same pair at various sites in the Fayûm, at El Hibeh in the Nile valley, and for five more seasons at Behnesa, and subsequently by Mr. John Johnson on the sites of Heracleopolis, Aphroditopolis and Antinoë. French scholars conducted excavations in the Fayûm and middle Egypt (1901–4); Germans at Heracleopolis (1898–99), Elephantine, Hermopolis, Abusîr at the entrance to the Fayûm, and in the Fayûm itself; Italians at Hermopolis (1903) and later at Oxyrhynchus, while at Aphroditopolis a representative of the Cairo Museum made one of the most notable of recent discoveries, remains of a papyrus book containing comedies of Menander (1905). Meanwhile native digging, though overshadowed, was not suspended, and papyri from that source continued to be offered for sale. A most important literary acquisition, the Bacchylides papyrus, came in this way to the British Museum at the end of 1896. Another highly valuable find of a different character occurred in 1915, consisting of a very extensive group of documents known as the archives of Zenon, in which the central figure is an official of the third century B.C. The lion's share of this was obtained by the Museum of Cairo, but large sections have gone also to the British Museum and Florence, and a sprinkling to the United States. Since the interruption caused by the World War little in the way of scientific excavation has been attempted, except by an American expedition from Michigan university which has worked for several winters in the Fayûm on the site of the ancient Karanis, and discoveries by natives, either in the course of their agricultural operations or by less legitimate means, have again become the chief source of supply. Of the material recently placed on the market much has been secured by institutions in the United States, whose active participation both in field work and purchases marks a new departure in papyrology.

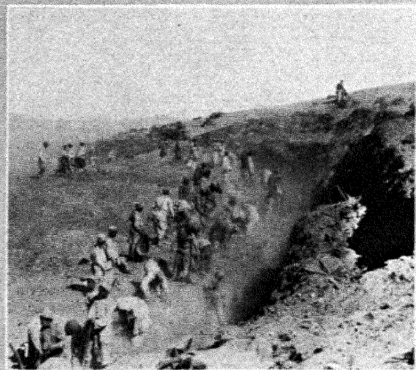
CONDITIONS OF DISCOVERY

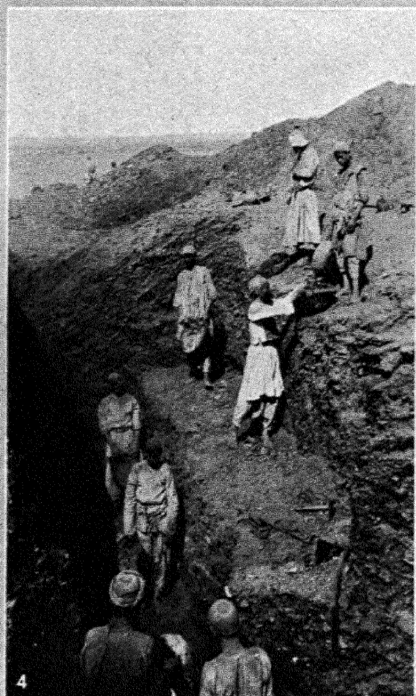
Ancient Houses and Rubbish Mounds.—Of the papyri recovered hitherto, the bulk has proceeded from the ruins of ancient towns and villages. They may be found in deserted houses, where useless or forgotten papers were left lying about or perhaps put by for safety in a pot or other receptacle. Such conditions have been exemplified in sites on the edge of the Fayûm desert. Papyri are to be found, again, in mere rubbish heaps, where waste paper was thrown away along with other house refuse. These piles of ancient rubbish may be the growth of several centuries, and may rise to a height of some 30 feet.

Cemeteries.—A second principal source is tombs. Books or papers were occasionally buried with their dead owners, and valuable literary finds have sometimes been made in this way, *e.g.,* the *Persae* of Timotheus, which was found by German excavators at Abusîr. Moreover, in the Ptolemaic period waste papyrus was often employed in the process of mummification. It was the fashion to decorate human mummies with pieces of painted cartonnage, in the composition of which papyrus was a common ingredient. By removing the overlying plaster and paint and separating the layers the documents used may be recovered in a more or less legible condition. The Petrie Papyri, as mentioned above, and many others since, were so obtained. Sometimes, too, waste paper was utilized in the mummification of crocodiles and other sacred animals. The discovery of papyri in mummified crocodiles was first made by Grenfell and Hunt in the Fayûm when working for the University of California; over 250 texts derived from this source were published in *Tebtunis Papyri,* vol. i.

COLLECTIONS AND CLASSES OF PAPYRI

As a result of the large production during the past generation papyri are now widely distributed, and very many museums and libraries possess at least a few specimens. The chief repositories are the British Museum, Oxford (the Bodleian library and Queen's college), Paris, Berlin, Vienna and Cairo. In Europe more or less extensive and valuable collections are to be found in the Rylands library at Manchester, in Cambridge, Aberdeen, Trinity college at Dublin, Strasbourg, Leyden, Heidelberg, Leipzig, Hamburg, Bremen, Giessen, Frankfurt, Halle, Wurzburg, Munich, Graz, Geneva, Basle, Florence, Turin and Oslo. In the United States the Universities of California and Michigan are especially prominent, and collections exist also at Princeton, Cornell, Columbia, Wisconsin and elsewhere. In Egypt besides the large accumu-





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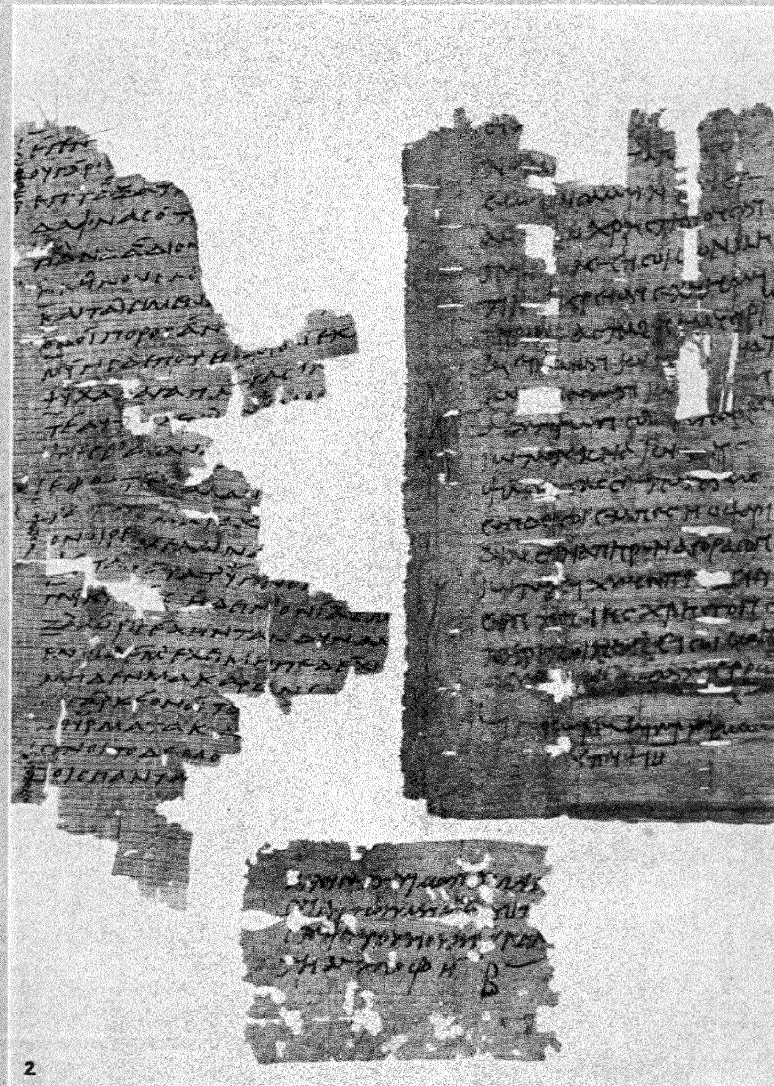

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EXCAVATIONS IN EGYPT AND SPECIMENS OF PAPYRI FOUND

1. Digging for papyri at Behnesa (the ancient Oxyrhynchus), Egypt, showing a trench at the foot of a mound. In 1897 a great find of papyri was made on this site by Drs. Grenfell and Hunt, among their earliest discoveries being a leaf containing new sayings of Christ

2. *Left:* transliteration of fragment of a roll containing poems of Sappho (Oxyrh. Pap: 1787) 3rd century; this column gives remains of three poems, marked off by a *coronis* in the margin. *Right:* part of a letter "to my brother Heracleides" written in the 13th year of Tiberius A.D. 27 (Oxyrh. Pap: 2148). *Below:* A formal invitation. 3rd century. "Eudaemon invites you to dine at the Gymnasium in celebration of the crowning (i.e., entry upon some civic office) of his son on the 1st at the 8th hour." (Oxyrh. Pap. 2147) (Reduced facsimiles)

3. Natives searching for papyri among the debris of a rubbish mound. The natives appreciate the market value of papyri and illicit digging for specimens is sometimes carried on. The finds are all sold to antique dealers

4. Late stage of trench in a rubbish heap. The piles, formed of the accumulated refuse of centuries, are sometimes over 30 feet high and require careful trenching and sifting in the search for papyri

5. Head pieces and breast pieces of painted mummy cartonnage made of waste papyrus excavated in the Fayum, Egypt. In the Ptolemaic period (4th century B.C. and later) papyrus was often employed in mummification

lation at Cairo there are some papyri in the museum at Alexandria.

In a classification of papyri the main line of demarcation is between literary and non-literary. Sometimes indeed a doubt arises as to which class a text belongs, *e.g.*, a medical recipe may be an extract from a book or a private formula. Sometimes, again, a group, though including elements falling in both the above categories is homogeneous enough to be most suitably treated as a whole. Such a group is formed by the magical papyri.

I. Literary Papyri: Recovery of Lost Works.—The literary section falls in turn into two main groups, the new and the extant, and within these a number of subdivisions are conveniently made. Of the new contributions to literature the following may be regarded as the most important. In the sphere of theology the chief items are the Cairo fragments on vellum of the Gospel and Apocalypse of Peter (edited with facsimile by G. v. Gebhardt, 1893) and the two series of Sayings of Jesus, found at Oxyrhynchus and published in 1897 and 1904. In classical literature, lyric poetry has been decidedly fortunate. Besides Bacchylides (first edited by F. G. Kenyon, 1897) there are new poems of Pindar (Oxyrh. Pap. 659, 841), numerous fragments of Sappho and Alcaeus (Oxyrh. Pap. 7, 1231–4, 1787–9, *Berl. Klassikertexte* V. 12–13), and substantial pieces of Alcman, Ibycus and Corinna (Pap. du Louvre 71, Oxyrh. Pap. 1790, *Berl. Klassikertexte* V. 14). Drama can count three notable acquisitions, the greater part of the *Ichneutae* of Sophocles (Oxyrh. Pap. 1174), which for the first time affords a fair idea of a Sophoclean Satyr-play, extensive remains of the *Hypsipyle* of Euripides (Oxyrh. Pap. 852), and large portions of several plays of Menander (ed. 1 by G. Lefèbvre, 1907). Among later poets, important additions have been made to the remains of Callimachus and to the few extant specimens of the Greek mime through the discovery of the Mimes of Herondas. The Mimiambi of Cercidas (Oxyrh. Pap. 1082) and the *Persae* of Timotheus also deserve notice; the latter has the distinction of being probably the most ancient Greek literary manuscript yet known. In history, Aristotle's *Athenian Constitution* (ed. 1 by F. G. Kenyon, 1891) is an authority of the first rank, and perhaps the chief prize brought by the papyri so far. A second acquisition of much value though of smaller compass is the so-called *Hellenica Oxyrhynchia* (Oxyrh. Pap. 842), the author of which is not determined with certainty but not improbably was Ephorus. In any case the fragment is of importance not only for the new information which it contains but also for its bearing on the work of Diodorus Siculus. A life of Euripides by Satyrus (Oxyrh. Pap. 1176), written in the form of a dialogue, is an interesting specimen of popular biography. An epitome of some of the lost books of Livy (Oxyrh. Pap. 668) constitutes the chief literary find in Latin. In the department of oratory, the six surviving speeches, or remains of speeches, of Hyperides, have all been found in Egypt.

Long Survival and Wide Dissemination of Greek Literature.—The multifarious literary remnants preserved in the papyri are a striking testimony to the popularity and diffusion of the Greek classics in Egypt. Not till a comparatively late period does their decline become marked—a decline traceable partly to material decay and waning culture, partly, too, to the spread of Christianity, which tended to divert attention to theological writings. Down to about the end of the third century the loss of great works does not seem to have gone very far. This consideration should lead to increased respect for tradition. If the materials available continued to be so large, statements of fact are not to be lightly dismissed even when they come from comparatively late writers. To invent where information lay ready to hand would be ridiculous. Some signal examples of the futility of a certain kind of scepticism may be seen in the papyri. For instance, the late Latin treatise on the Fall of Troy attributed to Dictys Cretensis begins with a statement that the book was a translation from Greek. A recent editor, rejecting that plain affirmation, decided that the Greek original was mythical. A good-sized piece of this original has since been found.

Extant Literature: (a) Biblical.—A second principal class of literary papyri consists of those representing works already extant. Of the Greek Bible there are numerous early fragments, and both for the Old and the New Testament the oldest manuscripts known are among the papyri. And they are not always mere fragments. From Egypt has lately come a well preserved book in the ancient binding containing a copy (on vellum), written probably in the fifth century, of the four Gospels (edited by H. A. Sanders, 1912). This is known as the Freer manuscript, from the name of the purchaser, and is now in Washington. It differs from all others in the last chapter of St. Mark, where it gives a passage otherwise known only from a partial quotation in Latin by Jerome. Another Freer manuscript of considerable compass, a papyrus book, perhaps of the early fourth century, containing most of the Minor Prophets, was edited by the same scholar in 1927 along with a Berlin papyrus covering the greater part of Genesis and probably still earlier in date.

(b) Classical Authors.—Of the more familiar Greek classical writers not very many now remain quite unrepresented; the Latin authors are comparatively rare, but fragments of Virgil, Cicero, Livy, Sallust, Gaius and other jurists have been recovered. Valuable textual evidence, often many centuries older than that which was previously available, has thus been obtained. Here again a general confirmation of tradition is a primary and satisfactory result. The papyri bring a certain number of minor improvements of reading, but prove that no serious deterioration occurred during the middle ages, and that the classical texts have been handed down to us substantially as they stood in the first centuries of the Christian era. Secondly, the earlier papyri commonly show what has been termed an eclectic type of text, that is to say, they are seldom found to support at all consistently a single ms. or group of mss. but instead agree now with one, now another. An editor should therefore beware of attaching too much weight to one ms. or family; readings are to be judged on their own merits rather than on the general qualities of their source. Thirdly, the methods of the best modern scholarship have received from the papyri encouraging support.

II. Non-literary Papyri.—The non-literary or documentary papyri naturally form an overwhelming proportion of the entire mass. A rough computation made at the end of 1927 put the total of published documents, including ostraca, in the neighbourhood of 12,000, and large numbers which have been found have yet to be edited. The earliest dated Greek papyrus so far known is a marriage-contract of the year 311 B.C., and each century from the third B.C. to the eighth A.D. is now more or less copiously represented. A documentary material is here presented which for extent and variety is unmatched in any other archaeological department. Considered according to their subject-matter these papyri fall into two main classes, the official and the private, each of them including numerous subordinate groups. Under the former head come copies of laws, rescripts, edicts, records of official acts, reports of judicial proceedings and other kinds of public business, correspondence, assessments and receipts of taxes, inventories, accounts and the like. In this class also are most conveniently placed documents which though emanating from private persons were addressed to officials, such as petitions, etc.

Subjects Illustrated: (1) History.—The historian may reap a rich harvest in several directions. For the Ptolemaic dynasty valuable evidence is forthcoming, and fresh light has also been thrown on the chronology of some of the Roman emperors. Other direct contributions to political history, though not frequent, are occasionally made; for instance, a recently published letter of the emperor Claudius to the people of Alexandria (H. I. Bell, *Jews and Christians in Egypt*, 1926), in which he states his views about the attribution to himself of divine honours, shows that at the beginning of his reign, at any rate, Claudius was as much averse from extravagant pretensions as any of his predecessors. In an Oxyrhynchus papyrus, again, is preserved the proclamation which announced to the locality the decease of this same emperor, Claudius, and the accession of Nero.

Local Administration, etc.—But it is in the less prominent sphere of internal administration and economic, industrial and social conditions that the historical import of these business papers is especially striking. Here they are a prime source of information; and their significance is by no means limited to Egypt,

though of course local evidence must be applied with caution to other parts of the Graeco-Roman world. Sometimes individual documents may prove particularly instructive, as for instance the so-called Revenue Papyrus (edited by B. P. Grenfell, 1896), which reveals the highly complicated details of the working of an important State monopoly in the third century B.C.; or a document of the same period from Hibeh, in which is exhibited the elaborate organization of the official postal service.

Social Life, etc.—With regard to the material conditions in which people lived, their culture, education, religion, habits and amusements, the papyri are a mine of information. This is one of their more immediately attractive sides, and nowhere are their peculiar qualities and significance more evident. Much private correspondence is found, and in this and the equally numerous petitions, contracts, accounts, etc., may be seen an almost endless variety of intimate and unposed scenes of common life. In one letter a person in financial difficulties is warned to beware of moneylenders; in another, a father describes how, egged on by his wife and daughter, he got his son transferred from the infantry into the cavalry; in another a prodigal confesses that he had brought himself to destitution and begs for forgiveness. There are formal invitations, couched, like those of to-day, in the third person, to dinner; lists of viands; contracts with musicians and other artistes who were engaged to perform on festive occasions; an order for an inquest on a slave who had fallen from a house in an endeavour to get a good view of some dancing-girls; athletic diplomas; a list of articles in pawn; a question addressed to the local oracle about a man's matrimonial prospects; the complaint of an outraged wife that her husband had locked her out of doors: these are a few samples of a material from which a realistic picture may be made.

(2) **Law.**—The legal side of the papyri is also of much importance. Both Greek law, which came to Egypt with the Ptolemaic dynasty, and Roman law, which was afterwards engrafted upon the earlier system, obtain in them valuable evidence and illustration. As in the department of history, single texts of special interest sometimes occur, *e.g.*, a papyrus at Halle which preserves in eleven columns a number of ordinances in force at Alexandria in the third century B.C. (*Dikaiomata*, 1913), or a still larger text of the Roman period at Berlin, which is a kind of manual for the guidance of the minister of finance (*Gnomon des Idios Logos*, 1919). But here again much is to be gleaned from the multifarious edicts, reports of judicial proceedings, petitions, wills, contracts and other such papers.

(3) **Philology.**—Another subject having a considerable debt to acknowledge is philology. In the new edition of Liddell and Scott's Greek lexicon, now in course of publication, there are many references to the papyri; and they figure prominently in every page of Moulton and Milligan's *Vocabulary of the New Testament*. It is indeed in its bearing upon what has been miscalled "Biblical Greek" that the linguistic evidence of the documents has proved to be especially illuminating. They have shown that the supposed peculiarities of the Greek of the New Testament were illusory; its vocabulary and syntax reappear in the documentary papyri, where are found many of the words and constructions formerly explained as due to Semitic influence. In short, the New Testament, like the papyri, merely reflects the vernacular of the day.

Numismatics and Metrology are also subjects which find valuable data in the papyri, where, naturally, money matters are a constantly recurring topic, and references to weights and measures are frequent. Occasionally tables drawn up for purposes of reference or for committing to memory are found.

Palaeography.—The palaeography of papyri, both literary and documentary, is dealt with elsewhere (*see* PALAEOGRAPHY: *Greek*). For the history of Greek writing they are of course highly important. In the literary and cursive hands of the papyri is to be found the origin of the uncial and minuscule scripts of the vellum codices, and the date and source of the older of these have sometimes to be revised in the light of the papyrus evidence. A useful contribution is made also to Latin palaeography.

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(A. S. H.)

PAPYRUS (păp-ī′rŭs), the paper reed, the *Cyperus Papyrus* (Linn.) in ancient times cultivated in the Delta of Egypt, where it was used for various purposes, and especially as a writing material. The plant is now extinct in Lower Egypt, but is found in the Upper Nile regions and in Abyssinia. The first accurate description of the plant is given by Theophrastus, from whom we learn that it grew in shallows of 2 cubits (about 3 ft.) or less, its main root being of the thickness of a man's wrist and 10 cubits in length. From this root, which lay horizontally, smaller roots pushed down into the mud, and the stem of the plant sprang up to the height of 4 cubits, being triangular and tapering in form.

The various uses to which the papyrus plant was applied are

also enumerated by Theophrastus. Of the head nothing could be made but garlands for the shrines of the gods; but the wood of the root was employed in the manufacture of different utensils as well as for fuel. Of the stem of the plant were made boats, sails, mats, cloth, cords, and, above all, writing materials. Its pith was also a common article of food, and was eaten both cooked and in its natural state. Herodotus, too, notices its consumption as food, and incidentally mentions that it provided the material of which the priests' sandals were made. He likewise refers to its use as tow for caulking the seams of ships. That the plant was itself used also as the principal material in the construction of light skiffs suitable for the navigation of the pools and shallows of the Nile, and even of the river itself, is shown by sculptures of the fourth dynasty, in which men are represented building a boat with stems cut from a neighbouring plantation of papyrus. It is to boats of this description that Isaiah (xviii. 2) probably refers in the "vessels of bulrushes upon the waters."

FROM (PLANT) CONSTANTIN, "MERVEILLES DE LA NATURE" (BAILLIÈRE & SON), (A & B) BAILLON, "HISTOIRE DES PLANTES" (H. BONNAIRE)

PAPYRUS (CYPERUS PAPYRUS), SHOWING RIVERSIDE PLANT WITH SHOOTS 3–12 FT. HIGH

A. Single flower showing 3 stamens and trifid stigma. B. Single floral spike. (A and B enlarged)

The widespread use throughout the ancient world of the writing material manufactured from the papyrus plant is attested by early writers, and by documents and sculptures. Papyrus rolls are represented in ancient Egyptian wall-paintings; and extant examples of the rolls themselves are sufficiently numerous. The early use of papyrus among the Greeks is proved by the reference of Herodotus to its introduction among the Ionian Greeks, who gave it the name of διφθέραι, "skins," the material to which they had already been accustomed. In Athens it was doubtless in use for literary as well as for other purposes as early as the 5th century B.C. An inscription relating to the rebuilding of the Erechtheum in 407 B.C. records the purchase of two papyrus rolls.

Papyrus also made its way into Italy, but at how early a period there is nothing to show. It may be presumed, however, that from the very first it was employed as the vehicle for Roman literature. Under the Empire its use must have been extensive, for not only was it required for the production of books, but it was universally employed for domestic purposes, correspondence and legal documents.

The account which Pliny (*N.H.* xiii. 11–13) has transmitted to us of the manufacture of the writing material from the papyrus plant should be taken strictly to refer to the process followed in his own time; but, with some differences in details, the same general method of treatment had doubtlessly been practised from time immemorial. His text, however, is so confused, both from obscurity of style and from corruptions in the mss., that there is much difference of opinion as to the meaning of many words and phrases employed in his narrative, and their application in particular points of detail. In one important particular, however, affecting the primary construction of the material, there can no longer be any doubt. The old idea that it was made from layers growing between the rind and a central stalk has been abandoned, as it has been proved that the plant, like other reeds, contains only a cellular pith within the rind. The stem was in fact cut into longitudinal strips, those from the centre of the plant being the broadest and most valuable. The strips (*inae, philyrae*) were laid side by side to the required width, thus forming a layer (*scheda*), across which another layer of shorter strips was laid at right angles. The two layers thus "woven"—Pliny uses the word *texere* in describing this part of the process—formed a sheet (*plagula* or net), which was then soaked in water of the Nile.

The mention of a particular water has caused trouble to the commentators. Some have supposed that certain chemical properties of which the Nile water was possessed acted as a glue or cement to cause the two layers to adhere; others, with more reason, that glutinous matter contained in the material itself was solved by the action of water, whether from the Nile or any other source; and others again read in Pliny's words an implication that a paste was actually used. The sheet was finally hammered and dried in the sun. Any roughness was levelled by polishing with ivory or a smooth shell. But the material was also subject to other defects, such as moisture lurking between the layers, which might be detected by strokes of the mallet; spots or stains; and spongy strips (*taeniae*), in which the ink would run and spoil the sheet. When such faults occurred, the papyrus must be re-made. To form a roll the several sheets were joined together with paste (glue being too hard), but not more than twenty sheets in a roll (*scapus*). As, however, there are still extant rolls consisting of more than the prescribed number of sheets, either the reading of *vicenae* is corrupt, or the number was not constant in all times. The *scapus* seems to have been a standard length of papyrus, as sold by the stationers. The best sheet formed the first or outside sheet of the roll, and the others were joined on in order of quality, so that the worst sheets were in the centre of the roll.

The different kinds of papyrus writing material and their dimensions are also enumerated by Pliny. The best quality, formed from the middle, and broadest strips of the plant, was originally named *hieratica*, but afterwards, in flattery of the emperor Augustus, it was called, after him, *Augusta*; and the *charta Livia*, or second quality, was so named in honour of his wife. The *hieratica* thus descended to the third rank. The first two were 13 digiti, or about $9\frac{1}{2}$ in. in width; the *hieratica*, 11 digiti or 8 in. Next came the *charta amphitheatrica*, named after the principal place of its manufacture, the amphitheatre of Alexandria, of 9 digiti or $6\frac{1}{2}$ in. wide. The *charta Fanniana* appears to have been a kind of papyrus worked up from the *amphitheatrica*, which by flattening and other methods was increased in width by an inch, in the factory of a certain Fannius at Rome. The *Saitica*, which took its name from the city of Sais, and was probably of 8 digiti or $5\frac{3}{8}$ in., was of a common description. The *Taeniotica*, named apparently from the place of its manufacture, a tongue of land (ταινία) near Alexandria, was sold by weight, and was of uncertain width, perhaps from $4\frac{3}{8}$ to 5 in. And lastly there was the common packing-paper, the *charta emporetica*, of 6 digiti or $4\frac{3}{8}$ in. Isidore (*Etymol.* vi. 10) mentions yet another kind, the *Corneliana*, first made under C. Cornelius Gallus, prefect of Egypt, which, however, may have been the same as the *amphitheatrica* or *Fanniana*. In the reign of Claudius another kind was introduced and entitled *Claudia*. The *charta Augusta* was, from its fineness and porous nature, ill suited for literary use; it was accordingly reserved for correspondence only, and for other purposes was replaced by the new paper.

The *charta Claudia* was made from a composition of the first and second qualities, the *Augusta* and the *Livia*, a layer of the former being backed with one of the latter; and the sheet was increased to nearly a foot in width. The largest of all, however, was the *macrocollon*, probably of good quality and equal to the hieratic, and a cubit or nearly 18 in. wide. It was used by Cicero (*Ep. ad Attic.* xiii. 25, xvi. 3). The width, however, proved inconvenient and the broad sheet was liable to injury by tearing. An examination of extant papyri has had the result of proving that sheets of large size, measuring about 12 in., were sometimes used A large class of examples run to 10 in., others to 8 in., while the smaller sizes range from 4 to 6 in. It has been observed that the width of extant rolls of papyrus does not tally satisfactorily with Pliny's measurements. It is possible that the breadth (not the height) of the individual rolls was referred to.

The first sheet of a roll was named πρωτόκολλον; the last, ἐσχατοκόλλιον. Under the Romans, the former bore the name of the *comes largitionum*, who had control of the manufacture, with the date and name of place. It was the practice to cut away the

portion thus marked; but in case of legal documents this mutilation was forbidden by the laws of Justinian. On the Arab conquest of Egypt in the 7th century, the manufacture was continued, and the protocols were marked at first, as it appears, with inscriptions in both Greek and Arabic, and later in the latter language alone. There are several examples extant, some being in the British Museum, ranging between the years 670 and 715. The Arab inscriptions are accompanied by curious scrawls on each side, which may be imitated from words used in the Latin inscriptions of the Roman period.

Papyrus was cultivated and manufactured for writing material by the Arabs in Egypt down to the time when the growing industry of paper in the 8th and 9th centuries rendered it no longer a necessity. (*See* PAPER.) It seems to have entirely given place to paper in the 10th century. Varro's statement, repeated by Pliny, that papyrus was first made in Alexander's time, should probably be taken to mean that its manufacture, which till then had been a government monopoly, was relieved from all restrictions. It is not probable, however, that it was ever manufactured from the native plant anywhere but in Egypt. At Rome there was certainly some kind of industry in papyrus, the *charta Fanniana,* already referred to, being an instance in illustration. But it seems probable that this industry was confined to the re-making of material imported into Italy, as in the case of the *charta Claudia.* This second manufacture, however, is thought to have been detrimental to the papyrus, as it would then have been in a dried condition requiring artificial aids, such as a more liberal use of gum or paste, in the process. The more brittle condition of the Latin papyri found at Herculaneum has been instanced as the evil result of this re-making of the material.

As to cultivation of the plant in Europe, according to Strabo the Romans obtained the papyrus plant from Lake Trasimene and other lakes of Etruria, but this statement is unsupported by any other ancient authority. At a later period, however, a papyrus was cultivated in Sicily, which has been identified by Parlatore with the Syrian variety (*Cyperus syriacus*), far exceeding in height the Egyptian plant, and having a more drooping head. But in the 13th century it began to fail, and in 1591 the drying up of the Papireto caused the extinction of the plant in that district. It is still to be seen at Syracuse, but it was probably transplanted thither at a later time, and reared only as a curiosity, as there is no notice of it to be found previous to 1674.

Even after the introduction of vellum as the ordinary vehicle for literature papyrus still continued to some extent in use outside Egypt, and was not entirely superseded until a late date. It ceased, however, to be used for books sooner than for documents. In the 5th century St. Augustine apologizes for sending a letter written on vellum instead of the more usual substance, papyrus (*Ep.* xv.); and Cassiodorus (*Varr.* xi. 38), writing in the 6th century, indulges in a high-flown panegyric on the plant and its value. Of mediaeval literary Greek papyri very few relics have survived, but of documents coming down to the 8th and 9th centuries many are being brought to light among the discoveries in Egypt.

Mediaeval Latin mss. on papyrus in book form are still extant in different libraries of Europe, viz.: the Homilies of St. Avitus, of the 6th century, at Paris; Sermons and Epistles of St. Augustine, of the 6th or 7th century, at Paris and Geneva; works of Hilary, of the 6th century, at Vienna; fragments of the Digests, of the 6th century, at Pommersfeld; the Antiquities of Josephus, of the 7th century, at Milan; Isidore, *De contemptu mundi,* of the 7th century, at St. Gall; and the Register of the Church of Ravenna, of the 10th century, at Munich. The employment of this material in Italy for legal purposes is sufficiently illustrated by the large number of documents in Latin which were preserved at Ravenna, and date from the 5th to the 10th century. In the papal chancery it was used at an early date and in the 10th century papyrus was used, to the exclusion of other materials, in papal deeds. In France it was a common writing substance in the 6th century (Gregory of Tours, *Hist. Franc.* v. 5). Of the Merovingian period there are still extant several papyrus deeds, the earliest of the year 625, the latest of 692. Under Charlemagne and his successors it was not used. By the 12th century the manufacture of papyrus had entirely ceased, as appears from a note by Eustathius in his commentary on the *Odyssey,* xxi. 390.

See Melch. Guilandino's commentary on the chapters of Pliny relating to papyrus, *Papyrus, hoc est commentarius,* etc. (Venice, 1572); Montfaucon, "Dissertation sur la plante appellée Papyrus," in the *Mémoires de l'académie des inscriptions* (1729), pp. 592–608; T. C. Tychsen, "De chartae papyraceae in Europa per medium aevum usu," in the *Comment. Soc. Reg. Scient. Gottingensis* (1820), pp. 141–208; Dureau de la Malle, "Mémoire sur le papyrus," in the *Mém. de l'institut* (1851), pp. 140–183; P. Parlatore, "Mémoire sur le papyrus des anciens," in the *Mém. à l'acad. des sciences* (1854), pp. 469–502; Blumner, *Technologie und Terminologie der Gewerbe und Künste bei Griechen und Römern,* i. 308–327 (Leipzig, 1875); C. Paoli, *Del Papiro* (Florence, 1878); G. Cosentino, "La Carta di papiro," in *Archivio storico siciliano* (1889), pp. 134–164. *See* also W. Wattenbach, *Das Schriftwesen im Mittelalter* (Leipzig, 1896); T. Birt, *Das antike Buchwesen* (Berlin, 1882); F. G. Kenyon, *The Palaeography of Greek Papyri* (Oxford, 1899); and W. Schubart, *Das Buch bei den Griechen und Römern* (Berlin, 1907). (E. M. T.)

PAR, technically, a commercial and banking term. When stocks, shares, etc., are purchasable at the price originally paid for them or at their nominal or face value they are said to be *at par.* When the purchase price is higher than the face value, they are *above par,* or *at a premium;* when below face value, they are *below par,* or *at a discount. Par of exchange* is the amount of money in the currency of one country which is equivalent to the same amount in the terms of another, both currencies being of the same metal and of a fixed standard of weight and purity. (*See* EXCHANGE.)

PARÁ or GRÃO PARÁ, a northern state of Brazil, bounded on the north by the three Guianas and the Atlantic, east by the Atlantic and the states of Maranhão and Goyaz, south by Goyaz and Matto Grosso and west by Amazonas. It is the third largest state of the republic, having an area of 443,922sq.m.; pop. (1890), 328,455 (1920) 983,507. The Amazon valley has its outlet to the ocean through the central part of the state, the outlet, or neck, being comparatively narrow and the territory on both sides rising to the level of the ancient plateau that covered this part of the continent. In the north is the Guiana plateau, sometimes called Brazilian Guiana. In the south the country rises in forested terraces and is broken by escarpments caused by the erosion of the northern slope of the great central plateau of Brazil. With the exception of the Guiana highlands, and some grassy plains on the island of Marajó and in some other places, the state is densely forested, and its lowest levels are covered with a network of rivers, lakes and connecting channels.

The rivers of the state may be grouped under three general systems: the Amazon and its tributaries, the Tocantins and its tributaries and the rivers flowing direct to the Atlantic. The Amazon crosses the state in a general E.N E. direction for about 500 miles. Its channels, tributaries, *furos* (arms), *igarapés* (creeks, or literally, "canoe paths"), by-channels and reservoir lakes form an extremely complicated hydrographic system. From the south two great tributaries are received—the Tapajos and Xingú—both having their sources outside the state (*see* AMAZON). The Pará estuary, usually called the Pará river, belongs to the Tocantins, although popularly described as a mouth of the Amazon. Very little Amazon water passes through it except in times of flood. It is connected with the Amazon by navigable tidal *furos,* in which the current is hardly perceptible.

Lying across the mouth of the Amazon and dividing it into three channels are the islands of Caviana and Mexiana, the first 47m. and the second 27m. in length, north-west to south-east, both traversed by the Equator, and both devoted to cattle-raising. Somewhat different in character is the island of Marajó, or Joannes, which lies between the Amazon and Pará estuary. It is 162m. long by 99m. wide, and its area is about 15,000sq.m. This island is only partly alluvial in character, a considerable area on its eastern and southern sides having the same geological formation as the neighbouring mainland. The larger part, the north-western, belongs to the flood-plains of the Amazon, being covered with swamps, forests and open meadows, and subject to annual inundations. There are several towns and villages on the island, and stock-raising has long been its principal industry. Of interest to archaeologists is the largest of its several lakes, called

Arary, in the centre of which is a small island celebrated for its Indian antiquities, chiefly pottery.

Pará is crossed by the Equator, and its climate is wholly tropical, but there is a wide variation in temperature and rainfall. In general, it is hot and dry on the Guiana plateau, and hot and humid throughout the forested region. In the latter, there are two recognized seasons, wet and dry, which differ only in the amount of rainfall, a strictly dry season being unknown. The trade winds, which blow up the Amazon with much force, moderate the heat and make healthy most of the settlements on the great river itself; but the settlements along its tributaries, which are not swept by these winds, are afflicted with malaria. The population is concentrated at widely separated points on the coast and navigable rivers, except on Marajó island, where open country and pastoral pursuits have opened up inland districts. The principal occupation is the collecting and marketing of forest products such as rubber (from *Hevea brasiliensis*), gutta-percha or *balata* (*Mimusops elata*), Brazil nuts (*Bertholetia excelsis*), sarsaparilla (*Smilax*), *cumaru* or tonka beans (*Dipterix odorata*), copaiba (*Copaifera officinarum*), *guaraná* (*Paulinia sorbilis*), *cravo* (an aromatic bark of *Dicypellium caryophillatum*) and many others. In earlier days cotton, sugar-cane, rice, tobacco, cacao and even coffee were cultivated, but the demand for rubber caused their abandonment in most places. Cacao (*Theobroma cacao*) is still cultivated, as also *mandioca* (*Manihot utilissima*) in some localities. Pará produces many kinds of fruits—the orange, banana, *abrico, cajú, abacate* (alligator pear), mango, *sapotilha, fructa de Conde*, grape, etc., besides a large number hardly known beyond the Amazon valley. The pastoral industries were once important in Pará, especially on the islands of Marajó, Caviana and Mexiana, and included the rearing of horses, cattle and sheep. At present little is done in these industries, and the people depend upon importation for draft animals and fresh meat.

Transportation depends largely on river craft, the Pará and Bragança, and its branches being the only railway lines. The capital of the state is Pará, or Belem do Pará, and its history is largely that of this city. Other important towns are Alemaquer (pop. of the municipio [1920] 75,873), on a by-channel of the Amazon; Breves (mun. [1920] 22,678), a river port in the south-west part of Marajó, on a channel connecting the Amazon with the Pará estuary; Bragança (mun. [1920] 44,486), a small town in one of the few agricultural districts of the state, 147m. by rail north-east of Pará, on the river Caeté, near the coast; Obidos (mun. [1920] 26,812), on the north bank of the Amazon at a point called the Pauxis narrows, a little over 1m. wide, attractively situated on a hillside in a healthful locality; and Santarem (1920, 41,546), on the right bank of the Tapajos, 2½m. from the Amazon, dating from 1661, and the most prosperous and populous town between Pará and Manáos.

PARÁ (officially BELEM; sometimes BELEM DO PARÁ), a city and port of Brazil, capital of the State of Pará, and the see of a bishop, on a point of land formed by the entrance of the Guamá river into the Pará (86 m. from the Atlantic), in lat. 1° 28′ S., long. 48° 20′ west of Greenwich. Population of the city and rural districts of the municipality (1920) 236,402. There is a large Portuguese contingent in the population, and the foreign element, engaged in trade and transportation, is also important. The Indian admixture is strongly apparent in the Amazon valley and is noticeable in Pará. A railway, built by the State, runs north-eastward to Bragança (160 m.), on the sea-coast. The Guamá river is enlarged at its mouth to form an estuary called the bay of Guajará, partially shut off from the Pará by several islands and forming the anchorage of the port. The Pará, the estuary mouth of the Tocantins river, is about 20 m. wide here.

The city is built on an alluvial forested plain only a few feet above the level of the river. The climate is hot, but the annual and diurnal changes are remarkably small. The rainfall is about 100 in., well distributed through the year. The plan of the city is regular and, owing to the density of the forest, it has no outlying suburbs. The streets are usually narrow, straight and well paved and most of them end abruptly at the margin of the forest. There are many public squares and gardens, the largest being the Praça Caetano Brandão. The public buildings and institutions are in great part relics of an older régime. The great cruciform cathedral, on the Praça Caetano Brandão, dates from the middle of the 18th century. In the vicinity are the Government and municipal palaces—built by order of Pombal (*c.* 1766), when Portugal contemplated the creation of a great empire on the Amazon.

One of the most notable buildings of the city is the Theatro da Paz (Peace Theatre), which faces upon the Praça da Republica and was built by the Government during the second empire. Other noteworthy buildings are the Caridade hospital, the Misericordia hospital (known as the "Santa Casa"), the military barracks occupying an old convent, and Castello fort, which is a relic of colonial days.

Pará is the entrepôt for the Amazon valley and the principal commercial city of northern Brazil. It is the headquarters of the Amazon Navigation Company, which owns a fleet of 40 river steamers, of 500 to 900 tons, and sends them up the Amazon to the Peruvian frontier, and up all the large tributaries where trading settlements have been established. Transatlantic lines afford regular communication with Lisbon, Liverpool, Hamburg and New York. The port is accessible to large steamers, but only those of light draught can lie alongside the quays. Extensive port improvements have been undertaken.

Pará was founded in 1615 by Francisco Caldeira de Castello-Branco, who commanded a small expedition from Maranhão sent thither to secure possession of the country for Portugal and drive out the Dutch and English traders. The settlement, which he named Nossa Senhora de Belém (Our Lady of Bethlehem), grew to be one of the most turbulent and ungovernable towns of Brazil. Rivalry with Maranhão, the capital of the Amazon dependencies, slave-hunting, and bitter controversies with the Jesuits who sought to protect the Indians from this traffic, combined to cause agitation. In 1641 it had a population of only 400, but it had four monasteries and was already largely interested in the Indian slave traffic. In 1652 the Pará territory was made a separate *capitania*, with the town of Pará as the capital, but it was reannexed to Maranhão in 1654. The final separation occurred in 1772, and Pará again became the capital. The bishopric of Pará dates from 1723.

The popular movement in Portugal in 1820 in favour of a constitution and parliament (Cortes) had its echo in Pará, where in 1821 the populace and garrison joined in creating a government of their own and in sending a deputation to Lisbon. The declaration of Brazilian independence of 1822 and creation of an empire under Dom Pedro I. was not accepted by Pará, partly because of its influential Portuguese population, and partly through jealousy of Rio de Janeiro as the centre of political power.

In 1823 a naval expedition under Lord Cochrane, then in the service of Brazil, took possession of Maranhão, from which place the small brig "Dom Miguel" under the command of Captain John Grenfell was sent to Pará. This officer conveyed the impression that the whole fleet was behind him, and on Aug. 15 the *junta governativa* organized in the preceding year surrendered its authority and Pará became part of the newly created Brazilian empire. An uprising against the new Government soon occurred, which resulted in the arrest of the insurgents, the execution of their leaders, and the incarceration of 253 prisoners in the hold of a small vessel, where all but four died from suffocation.

Conspiracies and revolts followed, and in 1835 an outbreak of the worst elements, made up chiefly of Indians and half-breeds, occurred, known as the "Revolução da Cabanagem," which was chiefly directed against the Portuguese, and then against the Freemasons. All whites were compelled to leave the city and take refuge on neighbouring islands. The Indians and half-breeds obtained the mastery, under the leadership of Antonio and Francisco Vinagres and Eduardo Angelim, and plunged the city and neighbouring towns into a state of anarchy, the population being reduced from 25,000 to 15,000. The revolt was overcome in 1836. The opening of the Amazon to foreign trade in 1867 increased the importance of the city, and its growth went forward steadily as the rubber forests of the Amazon were exploited. With the decline of this industry, however, after the development of plan-

tation rubber in the East Indies, its prosperity has been checked. (A. J. L.)

PARABOLA, in mathematics, a section of a circular cone made by a plane parallel to an element or generatrix. The name was given by Apollonius (*c.* 220 B.C.) to denote the areal equivalence expressed in the modern equation $y^2=4px$. The curve was conceived earlier, probably by Menaechmus (*c.* 350 B.C.), as a section of a right-angled circular cone made by a plane perpendicular to one cone-element, and hence parallel to the opposite element. As thus parallel the plane cannot cut across the cone (as in the ellipse), but extends alongside to infinity (∞). Hence the parabola reaches to ∞, symmetric as to its axis or principal diameter perpendicular to a cone-element at the vertex O. Hence, projectively, the parabola is the conic tangent to the line at ∞ (*See* CONIC SECTION and PROJECTIVE GEOMETRY.)

The curve may be treated in several ways. One regards it as the *common limit* of both the ellipse (*q.v.*) and hyperbola (*q.v.*), as implied in the foregoing. Hence the positional (not magnitudinal) properties of the ellipse and the hyperbola coalesce and reappear in the parabola. Thus the eccentricities of the two are

$$e=\sqrt{(1\mp b^2/a^2)},$$

which become 1 for b^2/a^2 vanishing, b^2/a held finite while a increases to ∞. Hence the usual definition of the parabola—a conic whose *eccentricity* is 1. This e in all conic sections is the fixed ratio between the distances from any point of the curve to a fixed point (*focus, F*) and a fixed line (*directrix, DR*). In both the ellipse and the hyperbola there are two such pairs: (F, DR) and (F', $D'R'$), and the curve is symmetric as to a centre C; but in the parabola the second pair (F', $D'R'$) along with C withdraw along the axis to ∞; all parallels to the axis are diameters, central and focal chords (as will be seen) through C' and F'. Also, the common equations of the ellipse and hyperbola ($x^2/a^2\pm y^2/b^2=1$), on pushing the origin O from the centre C to the vertex V at the left of the curve, become $y^2=2b^2/a\cdot x\mp b^2/a^2\cdot x^2$. Here $2b^2/a$ is a finite length called *parameter,* a focal chord perpendicular to the axis; hence b^2/a^2 vanishes for $a=\infty$. When this parameter is conveniently written $4p$, the equation of the parabola referred to its axis and the vertical tangent as coordinate axes is

$$y^2=4px.$$

Focal and Other Properties.—For $y=2p$, $x=p$. Hence F is the point (p, 0). Also, since $e=1$, the directrix DR is the vertical $x=-p$. By the general law the tangent at $P(x', y')$ is

$$yy'=2p(x+x')$$

Hence for $y=0$, $x+x'=0$ or $x=-x'$; i.e., *the vertex O bisects the subtangent ST* (fig. 1). By exchanging the direction-coefficient

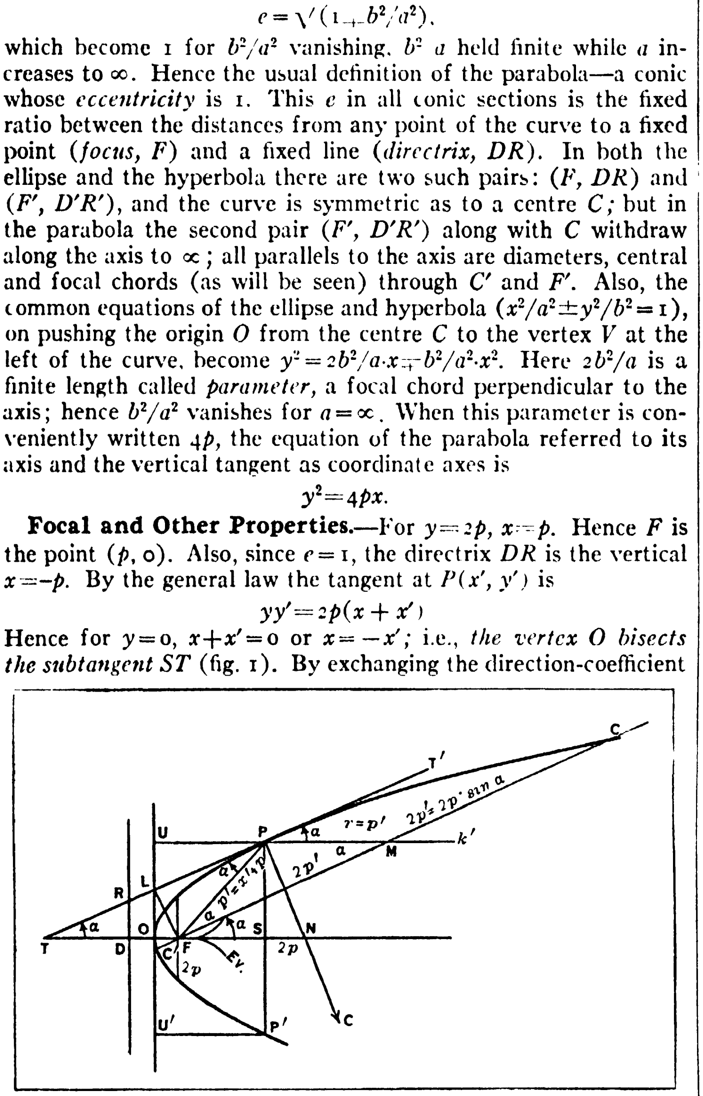


FIG. 1

$2p/y'$ for $-y'/2p$, the normal is found to be $2p(y-y')+y'(x-x')=0$. Whence for $y=0$, $x-x'=2p$ or $x=x'+2p$, i.e., *the subnormal SN=2p, a constant,* the half-parameter. Hence F (p, 0) bisects the hypotenuse TN of the right Δ TPN in the circle about F with radius $FP=x'+p$. Plainly also, both vertical tangent and focal perpendicular on any tangent bisect the tangent-length PT. The Δ TFP being isosceles, axis and focal ray (FP) are like-sloped to the tangent PT, which thus bisects the angle between the focal ray PF and the diameter PF' (the second focal ray, parallel to the axis, to the second focus F' at ∞). So also, in both the ellipse and the hyperbola, the tangent at P bisects the angle between the focal rays FP, $F'P$. Again, TFP being isosceles, the angle PFN (2α) is twice the angle PTN (α); so, too, for any other tangent (at Q) and focal ray FQ, the angles being β and 2β; hence the angle PFQ ($2\alpha-2\beta$) between the focal rays is twice that ($\alpha-\beta$) between the tangents. Now two opposite focal rays FC, FC', forming one focal chord CFC', diverge by 180°; hence tangents at the ends C, C' of the focal chord diverge by 90°, at a right-angle. They also meet on DR; for (since $\alpha=FTP=FLO$, $OL=p/\tan\alpha=p/m$) their equations are $y=mx+p/m$, $y=x/m-mp$; on subtracting, $(1+1/m)(x+p)=0$

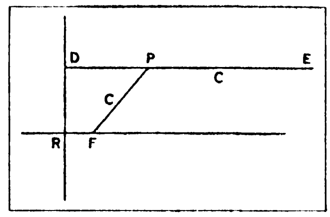


FIG. 2

or $x+p=0$, the directrix, the polar of the pole F. For $m=0$, or $\alpha=0$, the tangent becomes the line at ∞. Clearly, the normal $PN=\sqrt{(y^2+4p^2)}=2\sqrt{p(x+p)}=$ twice the geometric mean of FN and FO.

That the second focal ray PF' is really a diameter appears on transforming $y^2=4px$ to oblique axes PF' and PT; for the transformed equation readily reduces to $y^2=4p'x$. Hence to any value of x correspond two equal and opposite values of y, *i.e.*, the second focal ray PF' bisects all chords parallel to the tangent PT. The constant $4p'$ is easily shown to be the focal chord among these parallels, and $p'=x'+p=$ focal ray of the new origin $P(x',y')$.

By an improved method of exhaustion, suggesting modern integration, Archimedes (287–212 B.C.) proved the half-segment $OSP=\frac{2}{3}OSPU$; hence the whole segment $POP'=\frac{2}{3}PP'U'U$. So too for any oblique segment, since the form of the equation is the same and the areal elements parallel to the tangent are all sloped at the same angle (α) to the axis. Less simple, though readily proved, are such properties as that the circle circumscribing the triangle of any three tangents to the parabola passes through the focus F. More important, in the parabola as in all conics the radius (ρ) of curvature equals the cubed normal divided by the squared half-parameter; i.e., $PC=\rho=N^3/4p^2=(y^2+4p^2)^{\frac{3}{2}}/4p^2$, or $\rho : N=N^2 : 4p^2$. The locus of this centre of curvature C is the *semi-cubical* or *cuspidal parabola* $27py^2=4(x-2p)^3$, remarkable as the first curve rectified (by W. Neil, 1657, and H. Van Haureat, 1659), unless slightly antedated by the cycloid (fig. 1).

The parabola is perhaps best known as the path of a projectile through an unresisting medium under constant like-directed acceleration. However, air resists and the acceleration of gravity is neither quite constant nor fixed in direction; hence, especially in long high flights, the trajectory deviates much from a parabola, which is uniform (since $e=1$), the curves differing only in size, with F the centre of similitude for coaxial confocals. The parabola appears in many other physical problems and connections.

Construction and Analysis.—The curve may be drawn by fastening an inextensible cord C at a fixed point F and at one end E of a rigid ruler $ED=C$, sliding at right angles along a fixed line DR. A pencil P, holding the cord taut against ED, traces a parabola (fig. 2). To find points of a parabola, given the focus F and the directrix DR, draw the axis through F upright on DR at D, and bisect FD; this determines the vertex O, and $OF=p$. About F as centre draw any circle cutting the axis at T and N; from N lay off (toward F) $NS=2p$ and through S draw a circle-chord PP' upright on the axis; then P and P' are points of P.

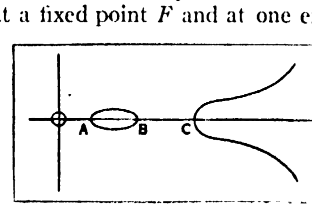


FIG. 3

To find F and DR of a parabola, draw two mutually perpendicular pairs of parallel chords, and also the bisectors (or diameters) of the pairs meeting the parabola at P and Q. Draw the tangents at P and Q (parallel to the bisected chords); being at right angles, they meet on the directrix, as at R; draw DR perpendicular to the diameters. Through P and Q draw chords

sloped to the tangents as the tangents are to the diameters; these chords meet in the focus F, the diameter through F is the axis, the segment FD is $2p$, its mid-point O is the vertex.

The name parabola is applied loosely to many other curves, especially of the equational form $y^{m+n}=a^m x^n$, besides the Apollonian or quadratic $y^2=4px$ For example, the cubic $y^3=a^2x$, the biquadratic $y^4=a^3x$, the semicubic parabola $y^3=ax^2$, all having been subjects of early study (Descartes, Newton, *et al.*)

There is also the cubic parabola $xy=ax^3+bx^2+cx+d$, called the *cartesian parabola* from its use by Descartes to solve sextic equations by its intersections with a circle. There are also the

divergent parabolas, $my^2=(x-a)\ (x-b)\ (x-c)$,

which vary widely with varying $a<b<c$. For all three real, with $+m$, the curve is an oval (shrinking to a conjugate point for $a=b$), followed after an interval ($b<x<c$) by a parabola-like branch (fig. 3). The two parts look little alike, yet depict the same law of algebraic form; also, during the interval the geometric law of form loses all real content—the curve-points are imaginary, the geometric depiction vanishes, to reappear for $x=c$—which may have philosophic significance

See T. H Eagles, *Plane Curves* (1885) (W. B. SM)

PARABOLOID, in geometry, a non-centric open surface of the second degree. Its vertical axial equation is either

$$x^2/a+y^2/b=4z, \quad \text{or} \quad x^2/a-y^2/=4z$$

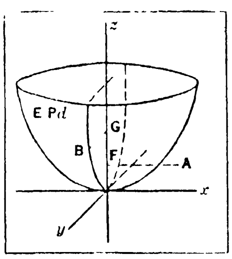


FIG 1

The first form, the elliptic paraboloid, meets the X-Z and Y-Z planes in the parabolas $x^2=4az$ and $y^2=4bz$ respectively, and is traced by an ellipse moving parallel to XY, its centre on Z, its vertices on these two parabolas, with parameters $4a$, $4b$ For $a=b$, this elliptic paraboloid becomes the "revolute," $x^2+y^2=4az$, of $y^2=4az$ round Z; conversely, on shortening all its y's in the ratio b/a, the "revolute" becomes the elliptic paraboloid (fig 1). A plane parallel to XY cuts the surface in the moving ellipse $ay^2+bx^2=4abz$; on turning this plane round the major axis of the ellipse through the angle θ, the minor axis grows indefinitely; at some angle θ ($\cos\theta=\sqrt{b/a}$) it equals the major axis, and the ellipse becomes a circle. Parallel planes make similar sections; clearly there are two such plane-directions, two sets of circles and two *cyclic points* of tangency The right lines lying on the surface are unreal

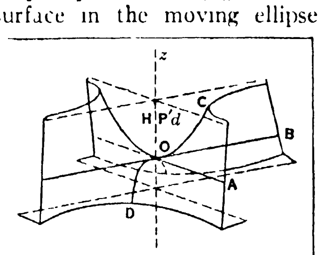


FIG 2

The second paraboloid is *hyperbolic* [$x^2/a-y^2/b=4z$] Clearly XY cuts it in the pair of lines $bx^2-ay^2=0$; all parallel cuts are hyperbolas or an hyperbola and its conjugate according as z is positive or negative Sections made by YZ and ZX are the parabolas (fig. 2), $y^2=-4bz$ and $x^2=4az$ *respectively*. The paraboloid is the path of an hyperbola always parallel to XY, moving with its vertices on one of these parabolas, and with its asymptotes always parallel to $bx^2-ay^2=0$ At XY the moving hyperbola passes through this asymptote-form over into the conjugate hyperbola, its vertices passing over from one parabola on to the other. At any stage $+z$ and $-z$ yield an hyperbola and its conjugate, respectively. The surface is saddle-like, $4a$ and $4b$ are the parameters. O is the vertex, Z is the axis, and its cyclic planes and points are unreal. However, similarly to the simple hyperboloid (*q v.*), it contains two systems of real right lines, each line of each system cutting all lines of the other system, but none of its own (fig 3) Each such pair of intersectors fixes a tangent-plane cutting the surface, which is not developable, but is *skew* or a *scroll*. (*See* MATHEMATICAL MODELS.)

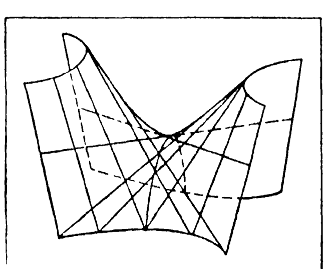


FIG. 3

(W. B SM)

PARACELSUS, THEOPHRASTUS BOMBAST VON HOHENHEIM (*c.* 1490–1541), great German physician, born near Einsiedeln in the canton Schwyz. His father was also a physician and his mother was, before her marriage, superintendent of the hospital at Einsiedeln. The son's epithet, Paracelsus, was probably his own invention, and was meant to denote his superiority to Celsus

Paracelsus, for a short time, studied at the University of Basel and then with Trithemius, abbot of Sponheim, under whom he prosecuted chemical researches, but he soon departed to the mines in Tirol where he became absorbed in the mechanical difficulties of mining, in the nature of minerals and in the diseases of miners.

On his return to Basel in 1526, Paracelsus became town physician and lecturer on medicine at the university The lectures, in German and not Latin, were preceded by a solemn burning of the works of Galen and Avicenna; they discredited past and contemporary medicine and set forth the lecturer's own theories and methods of treating disease Gradually, however, the novelty of the doctrines of Paracelsus began to wear off, and his bombastic and quarrelsome nature became more intolerable. His opponents reacted by pointing out both that he possessed no degree and that there were serious defects in his system Finally things came to a crisis through a dispute about fees with Canon Cornelius von Lichtenfels. In 1529, Paracelsus resumed his wanderings, practising in succession at Colmar, Nuremberg, Appenzell, Zurich, Pfaffers, Augsburg, Villach, Meran, Middelheim and other places. At last in 1541, Archbishop Ernst invited him to settle at Salzburg under his protection There after a few months of rest, he died on Sept 24 The cause of his death, like most other details in his history, is uncertain His enemies asserted that he died in consequence of a drunken debauch, but others maintain that he was thrown down a steep incline by emissaries of jealous physicians and apothecaries He was buried in the churchyard of St Sebastian. In 1752 a monument was erected to his memory.

In his works written during his wanderings, Paracelsus shows a genuine desire to promote the progress of medicine, but his powers were not adequate for his desires Indeed, it has been said that it is questionable whether he introduced a single new truth into medicine He advocates a simplicity in practice, but his prescriptions are extremely complicated; he exalts observation and experience, but he rejects dissection and all operations other than lithotomy, and, at the same time, introduces a number of new theories Fundamentally, his system is based on a visionary Neo-Platonic philosophy in which the life of man is regarded as inseparable from that of the universe. For him, the scriptural "limus terrae" from which the body of man is created is in reality an extract of all beings previously created. It is primarily a compound of "salt," "sulphur" and "mercury," the separation of these mystic elements in man being the cause of sickness The separation is due to the failure of the Archaeus, an occult vital force which is situated in the stomach, to perform its function of separating the useful from the poisonous. For the treatment of disease, Paracelsus introduced mineral baths, made opium, mercury, lead, sulphur, iron, arsenic, copper sulphate a part of the pharmacopoeia, and popularized tinctures and alcoholic extracts Since man contains all elements and requires them for the curing of his diseases, the physician must know the physical sciences and alchemy; he must also know astronomy, for not only do the stars influence disease, but man, like all terrestrial beings, is penetrated by the astral spirit. Thirdly, the physician must know theology, since, in addition to body and spirit, man has a third factor, the soul, which was created by God, and to which the spirit serves as a kind of body With Paracelsus' lofty views of the true scope of medicine it is impossible to reconcile his ignorance, his superstition and his erroneous observations

BIBLIOGRAPHY —The first book by Paracelsus, *Practica D Theophrasti Paracelsi, gemacht auf Europen*, was printed at Augsburg in 1529. The first and best collected edition, which probably

includes many non-genuine writings, was made by John Huser and printed at Basel in 1589–91. The first collected Latin edition (the works were originally composed in Swiss-German) was produced in 1603 by Palthenius, but the best Latin edition is that edited by Bitiskius in 1658. Some of the works, including the *Chirurgia magna,* were translated into French, English, and other languages during the 17th century. *See* Hartmann, *Life of Paracelsus* (1887); Schubert und Sudhoff, *Paracelsus-Forschungen* (Frankfurt a.M. 1887); Sudhoff, *Kersuch einer Kritik der Echtheit der paracelsischen Schriften* (Berlin, 1894); Waite, *The Hermetic and Alchemical Writings of Paracelsus* (1894); J. K. Proksch, *Paracelsus als medizinischer Schriftsteller* (Vienna, 1911); A. M. Stoddart, *The Life of Paracelsus* (1915); and J. M. Stillman, *Theophrastus Bombast von Hohenheim* (Chicago, 1920). *See* MEDICINE.

PARACHOR, a term introduced by S. Sugden (*J. Chem. Soc.,* 1924) to denote the value of the function $M\gamma^{\frac{1}{4}}/(D-d)$, where M is the molecular weight of a specified liquid, γ is its surface tension at a particular temperature, D is its density, and d is the density of its vapour. Since the molecular volume is M/D, the parachor is the molecular volume corrected (to some extent empirically) for surface-tension effects, and hence the name (Gr. *παρά,* by the side of; *χώρα,* space). Sugden and his collaborators have made many interesting applications of this function to the determination of chemical constitution, since the parachor is an additive function of atomic and structural constants and is nearly independent of temperature. (*See* CHEMISTRY, *Physical.*)

PARACHUTE, an instrument more or less resembling a large umbrella, which by the resistance it offers to the air enables a person or an object attached to it to descend safely from a balloon or flying machine in the air. In 1783 Sébastien Lenormand practically demonstrated the efficiency of a parachute by descending from the tower of Montpellier observatory; but he merely regarded it as a useful means whereby to escape from fire. To J. P. Blanchard (1753–1809) is due the idea of using it as an adjunct to the balloon. As early as 1785 he had constructed a parachute to which was attached a basket. In this he placed a dog, which descended safely to the ground when the parachute was released from a balloon at a considerable elevation. It is stated that he descended himself from a balloon in a parachute in 1793; but, owing to some defect in its construction he fell too rapidly, and broke his leg.

The First Parachute Descent from a Balloon.—André Jacques Garnerin (1769–1823) was the first person who successfully descended from a balloon in a parachute, and he repeated this experiment so often that he may be said to have first demonstrated the practicability of using the machine. His first public experiment was made on Oct. 22, 1797. He ascended from the park of Monceau, at Paris, and at the height of 2,236 feet he released the parachute, which was attached to the balloon in place of a car; the balloon, relieved suddenly of so great a weight rose very rapidly till it burst, while the parachute descended very fast, making violent oscillations all the way. Garnerin, however, reached the earth in safety. He repeated his parachute experiment in England on Sept. 21, 1802. The parachute was dome-shaped, and bore a resemblance to a large umbrella. The case or dome was made of white canvas, and was 23 ft. in diameter. At the top was a truck or round piece of wood 10 in. in diameter, with a hole in its centre, fastened to the canvas by 32 short pieces of tape. The parachute was suspended from a hoop attached to the netting of the balloon, and below it was placed a cylindrical basket, 4 ft. high and $2\frac{1}{4}$ ft. in diameter, which contained the aeronaut. The ascent took place at about six o'clock from North Audley street, London; and at a height of about (it is believed) 8,000 ft. Garnerin separated the parachute from the balloon. He was hurt a little by the violence with which the basket containing him struck the earth; but a few cuts and a slight nausea represented all the ill effects of his fall. A few years later, Jordaki Kuparento, a Polish aeronaut, made real use of a parachute. He ascended from Warsaw on July 24, 1808, in a fire-balloon, which, at a considerable elevation, took fire, but he was able to effect his descent in safety by means of his parachute.

BY COURTESY OF THE U.S NAVY

FIG. 1.—A PARACHUTE HARNESS AND PACK READY FOR SERVICE

The next experiment made with a parachute resulted in the death of Robert Cocking. The great defect of Garnerin's umbrella-shaped parachute had been its violent oscillation during descent, and Cocking considered that if the parachute were made of a conical form (vertex downwards) the whole of this oscillation would be avoided; and if it were made of sufficient size there would be resistance sufficient to check too rapid a descent. He therefore constructed a parachute on this principle, the radius of which at its widest part was about 17 feet. On July 24, 1837, Cocking rose in the Nassau balloon from Vauxhall Gardens, London, hoping to reach a height of 8,000 ft.; but when the balloon reached 5,000 ft. it was found to be impossible to ascend to the requisite height if the parachute was to descend in daylight. Cocking accordingly let slip the catch which was to liberate him from the balloon. The parachute for a few seconds descended very rapidly, but still evenly, until suddenly the upper rim seemed to give way and the whole apparatus collapsed (taking a form resembling an umbrella turned inside out, and nearly closed), and the machine descended with great rapidity, oscillating very much. When about 200 or 300 ft. from the ground the basket became disengaged from the remnant of the parachute, and Cocking was found in a field at Lee, dashed to pieces.

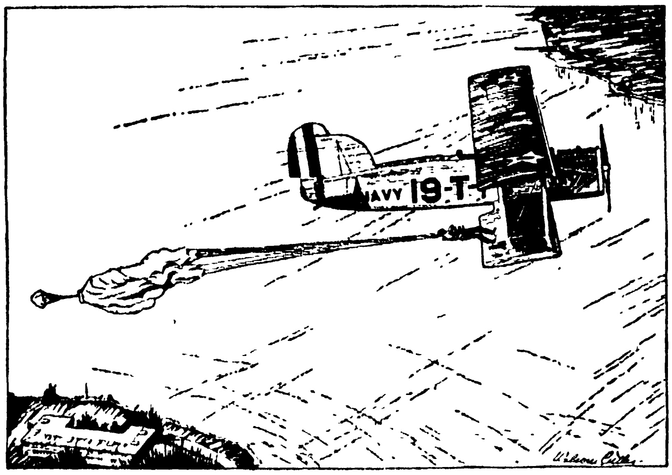
FIG. 2.—TRAINING PARACHUTE
Showing the way it is worn in an aeroplane

Many objections were made to the form of Cocking's parachute; but there is little doubt that had it been constructed of sufficient strength, and perhaps of somewhat larger size, it would have answered its purpose. John Wise (1808–79), the American aeronaut, made some experiments on parachutes of both forms (Garnerin's and Cocking's), and found that the latter always were much more steady, descending generally in a spiral curve.

The Modern Parachute.—In modern aviation, parachutes are recognized as a part of the standard flying equipment for use with aeroplanes. In 1912 Capt. Berry made the first descent from an aeroplane at St. Louis, Mo. He used a medium sized parachute, folded and stuffed into a conical cylinder tied under the front end of the aeroplane skid. During the last days of the World War in 1918, German aviators frequently used them; but after the war little was done to complete the use of parachutes until about the year 1921. At this time British and American aviators began working upon a parachute that could be carried conveniently by a pilot. It was obvious that the old style balloon parachutes were too cumbersome to carry in aeroplanes.

The Seat Pack and Lap Pack.—In 1918 the U.S. Army Air Service experimented with a "seat pack" type of parachute and in 1919 the type was generally recognized as standard and extremely efficient. More than 1,500 experimental jumps were made in achieving perfection. The "seat pack" is used as a seat cushion, thus removing all weight and bulk from the person of the aviator, and is the type in most general use for pilots. The "lap pack" has been developed for the use of machine gunners and photographers, or where it is not desirable to use a "seat pack." It will be readily understood that an aerial machine gunner usually has the most room directly in front of him and below the waist line. There is also the pack which is strapped on the back and which is used for special cases.

The standard seat pack aeroplane parachute is folded into a compact pack about the size of an ordinary chair cushion, but about twice as thick. It is worn strapped upon the body with the pack in place beneath the buttock of the wearer and it becomes the cushion when the aviator takes his seat in an aeroplane. Thus, the regular cushion in aeroplane cockpits is generally omitted. The equipment weighs approximately 18 lb. The sail of the parachute is made of carefully chosen untreated silk, because untreated silk does not become creased so easily as the finished material. When spread open, the parachute is 22, 24 or 28 ft. in diameter, 24 ft. being standard. The shroud lines are made from high-grade thrown silk and consist of not less than 32 threads of three-ply, each with a breaking strength of not less than 400 pounds. The main parachute is pulled from its case by a smaller "pilot chute," about 3 ft. in diameter, which operates by spring when the aviator pulls the "rip cord" that holds the pack closed. When open the parachute descends at the rate of 16 to 24 ft. per second, depending upon the weight of the wearer and density of the air. Each parachute is tested by an actual drop from an aircraft using a dummy or weight.



BY COURTESY OF THE UNITED STATES NAVY

FIG. 3.—THE "LIFT OFF" JUMP WITH A PARACHUTE FROM AN AEROPLANE

The lowest height at which a parachute will open is probably not less than 150 ft., although a few forced jumps have been made at slightly lower altitudes. The lowest altitude considered safe is 250 ft., although the higher the jumper is, the better are his chances, because sometimes delayed openings occur. Jumps have been made from aeroplanes as high as 25,000 ft.

Use of Parachute.—There are two general ways to leave an aircraft with a free-type manually-operated parachute; one is by the "lift off" method, and the other by the "free fall" method. In making a lift off jump, the jumper gets on one of the wings where there are no projections or obstructions of any kind directly behind, and pulls the rip cord, which opens the parachute and pulls the jumper from the aircraft. In case of jumps made for training purposes, this method eliminates unnecessary hazards and gives the student a better chance to become familiar with parachute operation. In making a free fall, the jumper clears the aircraft at any point, free of obstruction, that is convenient to him. After falling clear, a jerk on the rip cord releases the parachute. Where there is plenty of altitude, a long "free fall" is not dangerous. Actual jumps have disproven the theory that a man falling free through space becomes confused and forgets to pull the rip cord. Several cases are on record where men have fallen 3,000 to 4,000 ft. without pulling the rip cord and yet retained perfect control of their senses. When the parachute is opened and descending at its normal rate, the jumper's position in the harness is as though he were sitting in a swing. The rate of descent is between 16 and 24 ft. per second depending on the weight of the wearer, the size of the parachute and the density of the air. The impact on landing at these speeds is equivalent to that obtained from a free jump from heights of 4 to 9 ft. respectively. In the descent any tendency to oscillate should be checked as soon as possible. This can be done by pulling down vigorously on the shroud lines on the high side of the parachute as the body swings in that direction. The instant the body starts on the return swing, the shroud lines should be released and the swing met by pulling down on the opposite shroud lines. At the same time the jumper should try to face the line of flight, as a much better and safer landing can be effected in that position. This can be done by grasping a handfull of shroud lines, and giving a vigorous swing on them, not down, but as much in a circle as possible. This tends to "spin" the parachute around. During descent, if it is seen that there is danger of striking some building or other obstructions, it is possible to change the gliding angle by pulling down on the shroud lines. This tends to spill air from under the parachute on the higher side, and results in an appreciable angle of glide toward the lower side. This should never be attempted when near the ground, except in an emergency, as it results in an increased rate of descent.

If it should be seen that the parachute is going to "under shoot" the place where it is desired to make the landing—that is, the parachute in its normal flight is gliding toward a desired landing place, but its rate of descent is such that it evidently will reach the ground before this spot is reached—nothing can be gained by trying to "side slip" in this direction for the parachute will travel further in a horizontal direction if it is kept stable. Upon nearing the ground the best method of relieving the shock of impact is to grasp the harness webbing over the head, retaining the sitting position in the harness—but with the knees slightly lower than the hips, with feet together and lifted slightly up and forward—relaxing the muscles as in jumping off a low platform. The body should be lifted up into the harness by pulling on the harness webbing just before the moment of striking. If the parachute has a tendency to "fill out" and drag the body along the ground on landing, it can be collapsed by pulling the top shroud lines toward the body, which tends to straighten the parachute out in the form of a sheet. Pulling on the lower shroud lines will have a tendency to keep the parachute "filled out." In case it is seen that a landing is going to be made in a body of water, it is best to settle well back into the harness and unsnap the leg straps; when close to water (about 12 ft) unsnap the breast snap; and when 4 or 5 ft. from the water, drop out of the harness.

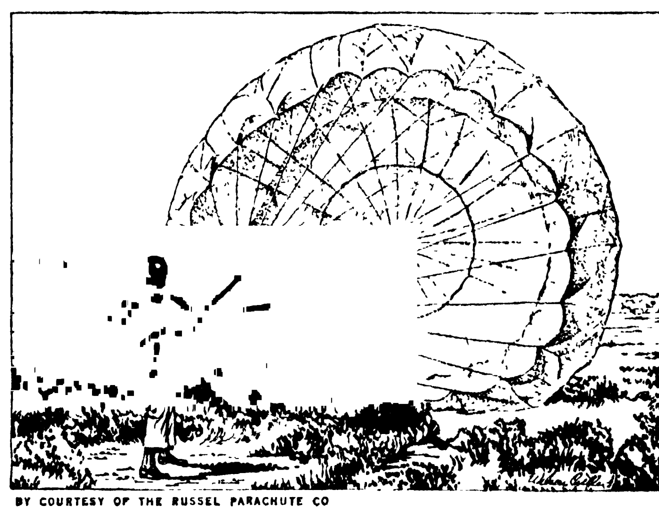

BY COURTESY OF THE RUSSEL PARACHUTE CO

FIG. 4.—A LANDED JUMPER ABOUT TO SPILL THE AIR FROM THE LOBE OF HIS PARACHUTE

Parachute Flare.—A parachute flare contains illuminating chemicals attached to a small parachute, which, when ignited and dropped from an aircraft, will descend slowly and light up the countryside for many miles. Parachute flares are used for military purposes to discover night movements of enemy troops by aerial observers; by aviators to locate landing fields at night, guide the approach to the earth and to take night photographs.

PARADISE. A Persian word, meaning a royal park or enclosed pleasure garden, found in three late passages of the Hebrew Old Testament, Neh. ii. 8, Cant. iv. 13, Eccles. ii. 5, in much

the same sense. The Greek Old Testament uses it much more freely, especially as a name for the Garden of Eden in Genesis, and in other passages where the Hebrew has "garden of God" or simply "garden." The name has thus passed into use as the title of the happy garden in which our first parents lived. Other forms of the myth may be traced in the Old Testament. Behind the dirge of Ezekiel on the king of Tyre (Ezek. xxviii.) lies a myth which pictures the primeval man as dwelling in the garden of God, situate not in a desert plain but on the mountain of God. He wears glorious apparel, studded with gems. He is originally blameless, but sins, and is banished from the mountain, which, like the garden in Genesis, is the dwelling-place of God. These myths are not of Hebrew origin, but belong to the common stock of Semitic tradition.

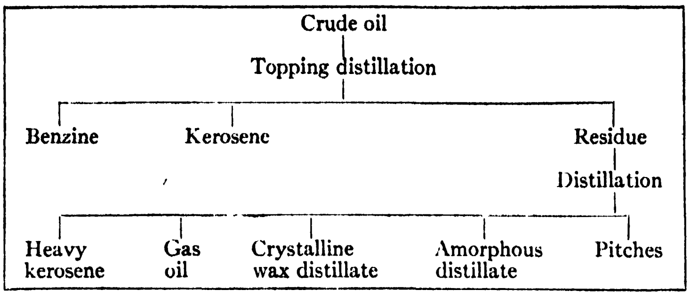
Among the Sumerians there were myths about the Paradise in which man had lived before the Flood, and his loss of this primitive bliss. While certain features of the Babylonian myths are found in the Hebrew stories no close parallel to the latter has yet been discovered in cuneiform, and it is unlikely that they were borrowed directly from Babylon. Many peoples had myths telling of a golden age when men dwelt happily with the gods in some fair isle or happy garden: sometimes this Paradise was thought still to exist. If only the way to it might be re-discovered! So Gilgamesh, the hero of the Babylonian epic, travelled a perilous journey to the island where Utnapishtim, the Babylonian Noah, dwelt with the gods; there he indeed obtained the plant which conferred immortal life, but a serpent stole it from him as he returned. But though man might not in this life find the road to Paradise might not the dead return there? The Semites generally, and the Hebrews in particular, thought of the dead as maintaining a shadowy existence in a gloomy cavern of the underworld. When, however, the hope of a Messianic kingdom upon earth dawned there was developed also the idea that the righteous dead might be raised to share its bliss. It is noteworthy that the Messianic kingdom renews on earth some of the felicities of the Garden of Eden: the land becomes miraculously fertile, even the desert blossoming as the rose, and the beasts live in idyllic amity. The conception is developed by the Jewish apocalyptic writers, especially the author of *Enoch,* who wrote in the early second century B.C.

Later this Paradise of hope becomes more supernatural, and is situated not on earth but in heaven. The book of *Enoch* (*q.v.*) divides the underworld into four parts, tenanted severally by the wicked, the moderately wicked, the moderately good, and the supremely good; the good even there enjoy some measure of felicity ere they are raised to share the happiness of the Messianic kingdom. Paul gives the name Paradise to the third of the seven heavens recognized by the Rabbinic schools. In Rev. ii. 7 Paradise would seem to be the final state of bliss attained by the saints. The visions of the New Jerusalem coming down out of heaven to the earth (Rev. xxi., xxii.) recall in several features the Paradise from which the earliest man was driven: in it are miraculous trees, giving food and healing; through it flows the river of water of life; and there, free from sorrow, pain and death, dwell the saints in the presence of God.

See EDEN, and particularly the articles *Blest, Abode of the* in the *Encyclopaedia of Religion and Ethics.* (W. L. W.)

PARAFFIN, the term given to a mineral wax and also used as a generic name for a particular series of hydrocarbons. Refined commercial paraffin is a white, translucent, waxy solid devoid of taste and smell and characterized by chemical indifference. The industry owes its origin to Dr. James Young, who in 1850 applied for his patent "to obtain . . . paraffin from bituminous shales" by slow distillation. To-day, paraffin is obtained from the many crude petroleums that are designated "paraffin-base oils" because of their wax content. The wax-bearing crudes of America contain on the average less than 5%, those of Galicia about 6%, the oils of Burma 10% and Scottish shale oil about 13% of merchantable wax.

Manufacture.—The manufacture of paraffin by modern methods falls under two heads. Firstly the distillation of the crude oil and secondly the extraction of wax from the distillate. A process that has become almost conventional starts with crude oil and brings about by continuous distillation the removal of petrol and kerosene, leaving what may be called a "topped" oil.



In the majority of cases this topped oil contains heavy oil, such as gas oil, that is used for enriching water-gas in the gasworks, lubricating oils, wax and pitch, as is clearly shown in the above diagram. This residue oil is again distilled continuously and run down to heavy kerosene, gas oil, wax distillates and pitch. In more recent practice the distillation is carried out in a pipe-still through which the oil passes at high velocity under pressure and is discharged as vapour into a fractionating column. From the top of the column may be easily obtained an overhead distillate, *e.g.,* petrol, and at various "decks" or trays at different distances from the top may be withdrawn fractions of higher and higher boiling point. But, in the majority of cases the wax distillates are of two kinds, known as crystalline or pressable and amorphous or non-pressable. As will be seen later, this difference is probably a function of the crystal size.

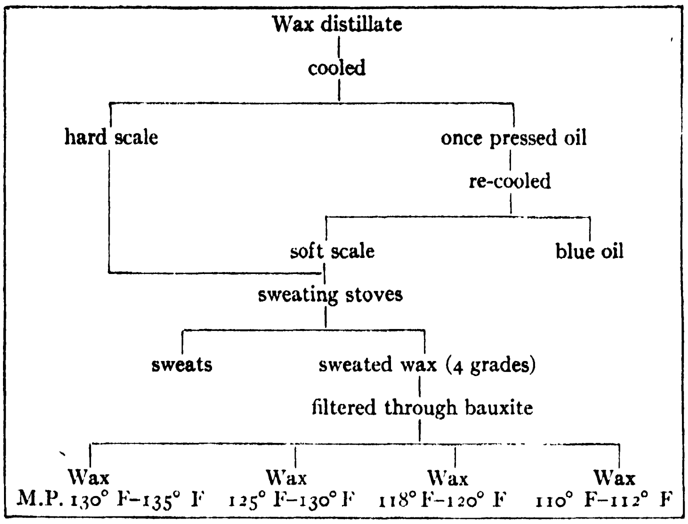
Crystalline (or Pressable) Wax Distillate.—This material in effect is a mixture of crude lubricating oils and crystalline paraffin hydrocarbons that possess no lubricating power whatever. It is necessary to remove the wax firstly because of this lack of ability for lubrication and secondly because the high melting point of wax would render the lubricating oils solid or semi-solid at ordinary temperatures, and thirdly because of the market value of the wax. This wax distillate, then, is passed on to the paraffin sheds, as the extraction plant is usually termed, and is allowed to repose in tanks to promote thorough settling and the maximum reduction in temperature. It is then transferred to plant in which it can be cooled artificially to any particular temperature required. The refrigerating plants that achieve this cooling usually depend for their effect on the expansion of liquid ammonia or liquid carbonic acid gas. In modern practice heat exchangers are used so that the cold filtrate from the filter-presses can be employed further to chill the incoming wax distillate to the refrigerators. It is frequently convenient to cool the wax distillate in two stages, but this procedure depends largely on the content of wax and its nature. There have been devised many types of cooling apparatus of which that patented by James Bryson of Scottish Oils Ltd., is typical. This type consists of an inner cylinder in which the wax distillate passes and which is provided with a scraper. The cylinder is surrounded by a concentric casing through which cold brine is circulated after having been chilled by contact with pipes in which the refrigerant is being evaporated. The plant designed by A. C. Thompson uses direct cooling in preference to brine cooling and the oil is pumped over the vessel that contains the expanding ammonia or other cooling agent.

A more recent type is the Allen-Moore, in which the oil to be cooled passes into thin cells provided with scrapers and cooled by contact with the refrigerant. Broadly speaking it is advisable to cool the wax distillate slowly. In this way large crystals are produced from which the adherent oil easily drains.

The frozen mass containing the crystallized paraffin is now pumped through filter-presses under high pressure, *e.g.,* 500 lb. per sq.in. The filter-presses are kept in sheds which are well insulated from outside conditions and chilled to the necessary temperature by radiators in which cooled brine is circulated. When the filter-press is fully charged with wax, it is opened and the contents are discharged into a trough situated below the press and conveyed by a screw conveyor into the refining section. If a

second cooling is necessary, the expressed oil, commonly called the "blue oil," is re-cooled to a lower temperature in similar plant and filter-pressed again.

Example of Treatment of Wax Distillate



A modern filter-press consists of a series of thin circular steel plates fitted with steel gauze on each side and provided with a circular opening in the centre to permit oil to be fed into each chamber. Heavy canvas is cut to fit the plates and is either sewn or firmly clamped round the hole in the centre. Spacing rings are placed between each pair of plates, thereby forming chambers in which the wax cakes form. The series of plates and rings are assembled on the press frame and the whole closed under a pressure of about 700 lb. per sq.in. by means of a hydraulic ram. This type is built to hold up to 400 or 500 plates 48 in. in diam. and to work up to 500 lb. pressure. The spacing rings used to form the chambers vary in thickness from ⅜ in. to 1 in., enabling the thickness of the wax scale cakes to be altered according to the quality of the oil being pressed. For instance, should the oil contain an easily pressable crystalline wax scale a thick cake would be desired in order to work the press at its maximum capacity by reducing the number of plates in use, but should the oil contain a soft wax it might be advantageous to reduce the thickness of the cake.

Pressing.—The oil is pumped by means of low-pressure pumps through the chillers into a tank kept at the exact temperature required and thence by means of a high-pressure pump into the main line feeding the presses, any oil over the amount taken by the presses being returned to the tank through a relief valve set at the maximum pressure required. This allows perfect control to be exercised over the temperature and pressure of the oil.

The paraffin distillate from the stills, usually having a settling point of from 70° F to 80° F, and a recoverable wax content ranging between 5% and 10%, is chilled to the temperature which will give a pressed oil having the desired set point and then fed into the presses. The oil is let into the presses very gently and when the pressure starts to rise the rate of increase is kept slow and constant. When the pressure has reached its maximum the press is allowed to remain under pressure until it is required to be emptied ready for a new charge and this permits the wax scale to become as free from oil as possible.

The Refining of the Crude Paraffin.—The original wax distillate is now separated into blue oil and crude scale; the latter still contains a little adherent oil and this must be removed and the crude wax chemically treated to remove colouring matter and odorous impurities.

The process that follows achieves the removal of low melting waxes and adherent oil and is called the "sweating process," first developed by Price's Candle Company. There are innumerable modifications of the sweating process, which may be regarded as a fractional melting operation, and perhaps the simplest to understand is that devised by N. Henderson. In this there is a frame on which are set nine shallow trays one above the other. In each tray wire gauze is stretched 2 in. from the bottom. The frames can be set in rooms or stoves provided with heating and cooling arrangements. The trays are first set level and water is run in to the depth of the gauze. Then the melted wax is run on to the water surface and is allowed to solidify. After solidification the trays are tilted and the water run off. The temperature inside the stove is gradually raised and fractional melting goes on until the material on the gauze is of the correct melting point. The "sweats" are run off and may be again put through the process. After drawing off the sweats the temperature is still further raised and the sweated wax is melted and run to the next stage of the process.

The oil and soft wax that sweats out during the process are divided into fractions, graded according to their setting points.

The first runnings from the trays up to a set point of about 90° F, termed "light foots oil," is in the ordinary process used as works fuel; it has no other commercial value and the wax it contains is of too low a melting point to justify repressing or further redistillation.

The next fraction sweating out, from a set point of 90° to 110° F, termed "heavy foots oil," is generally pumped back for incorporation with the wax distillate cut from the crude oil.

Wax that sweats out above this point till the end of the operations is reached is re-sweated to give a wax of a lower grade, or if only one grade of finished wax is being made it is mixed with the scale from the filter-presses to make up the next sweating chamber charge.

The setting points and fractions obtained are, of course, purely arbitrary and are governed by the number of the grades of finished wax being made, as well as by the method and temperatures used in processing the wax. It still contains colouring matter and therefore must be decolorized.

The Finishing Treatment.—In many refineries the wax is melted and run into agitators, where it is treated with successive amounts of strong sulphuric acid. The agitators are lead-lined and steam-jacketed and the mixture of acid and wax is violently stirred up by air agitation. The agitation is carried on for 30 min., and then an hour is allowed for settling. At the end of this time the acid sludge is drawn off and the melted wax is run into another agitator, in which it is washed with hot water and then with caustic soda and finally with a hot water spray. After removing all traces of water by long settling, the wax is dried finally by blowing air through it. Alternatively the use of caustic soda may be dispensed with by following up the acid treatment with agitation in the presence of finely divided absorbent clay. Even at this stage the wax is not entirely colourless and odourless and it is necessary to filter it through ignited fuller's earth.

Another method of treatment that has been found very effective and that dispenses with the acid treatment altogether is achieved by filtering the wax-scale through recently ignited bauxite. This mineral is essentially a mixture of alumina and ferric oxide and has a very porous structure. To prepare it for use, the crude rock is ground and sieved to form coarse particles that pass through a 10-mesh sieve and are retained on a 90-mesh sieve. The bauxite is then passed through a furnace at about 600° C, where it is ignited and becomes substantially free from water. The bauxite is now put into filters that are jacketed and the melted wax is allowed to flow through, samples being tested to see that the colour of the effluent wax is up to standard. The wax is run to trays, allowed to solidify, and packed in bags; each cake of wax is about 12 in.×18 in.×1½ in. in dimensions and weighs about 10½ lb.

Refined wax is always passed through a filter-press equipped with double sheets of filter paper before final caking. The wax should be entirely odourless and a cake of wax freshly broken should possess no smell at the plane of fracture. It should be colourless, stable to heat and light, and of the correct melting point. It should be free from opaque blemishes ("mottling") and should not be crumbly or flaky. It is sold commercially in terms of melting point, *e.g.*, hard wax in the grade that melts between 130° F and 135° F.

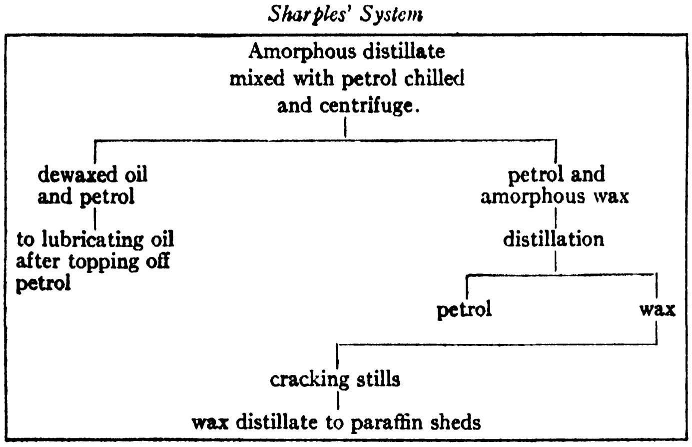
It has been found in the case of certain sulphurous oils that a preliminary treatment with alkaline hypochlorite before filtration materially assists in the production of a non-odorous wax.

Amorphous Wax—Non-pressable.—After the pressable wax has been distilled off from the crude oil residue there appears a fraction containing wax, the crystal size of which is very much smaller than that of the preceding fraction; this is the so-called *amorphous distillate*.

Until recent times fractions and residues of petroleum containing this material that could not be handled in filter-presses were allowed to stand, well diluted with petrol, in tanks at a low temperature and for a long period of time. The slow imperceptible action of gravity gradually precipitated the slightly heavier wax out of the slightly lighter solution. There was left at the bottom of the tank a soft salve-like mass and above it a petrol solution of de-waxed oil. In many cases the precipitate was so amorphous that it could be worked up for petroleum jelly and this was particularly the case when a residue was being treated.

A revolutionary idea has changed this procedure. It is to the credit of Sharples, who had successfully separated cream from milk by means of high speed centrifuges to apply this method to the separation of amorphous wax from its accompanying oil.

Sharples' System



Sharples' Process.—The amorphous distillate is diluted with approximately an equal bulk of petrol or a fraction of petrol from which the more volatile part has been distilled off. The mixture is now very slowly cooled till it reaches a temperature of about 10° F throughout a period of 20–30 hours. It is then conveyed into the bowl of a centrifuge rotating at 30,000 revolutions per minute when the slightly heavier wax is flung outward against the periphery whilst the slightly lighter solution occupies the middle of the bowl, by natural law. The centrifuge runs continuously and there are consequently ejected from spouts at the top, (a) amorphous wax that is melted by suitable heating means and (b) a petrol solution of de-waxed oil. These run away to separate tanks. The wax obtained after removing some of the solvent that is conveyed with it is in the micro-crystalline state and it is converted into macro-crystalline wax by a redistillation under cracking conditions, that is to say, by distilling at a relatively high temperature, thus permitting a re-adjustment of the molecules. The distillate from the amorphous wax contains oil and crystalline wax and may be put through the sheds along with the pressable wax distillate.

Uses of Paraffin.—Although paraffin wax may be regarded as a by-product of petroleum distillation, the world's supply is very considerable, amounting to approximately 200,000 tons a year. It finds its chief use in replacing and as a substitute for certain expensive natural waxes such as beeswax. It enters largely into the composition of floor polishes; it is used for filling leather and as an insulator in the electrical trades. A very large amount is also used for water-proofing paper and cardboard, and thus is an essential component of water-proof receptacles for packing; during the World War, for example, jam pots were made of stout paper rendered air-tight and water-proof by means of paraffin. In a similar way it may be applied for water-proofing fibres before weaving, and very large amounts of water-proofed textiles are now manufactured. The softer paraffins are used in the manufacture of ointments and salves, and a large amount is applied in rendering match sticks water-proof and flammable.

The above uses, however, are only minor when compared with the vast quantities used in the manufacture of tapers, candles and night lights. In making candles it is not usual to employ pure paraffin, because it has a tendency to stick to the moulds and, moreover, may soften too easily in service, so the paraffin is mixed with stearic acid and palmitic acid that are obtained by the decomposition of many natural fats. The effect of the stearic acid is to give a less plastic composition, one that is stiffer and not so likely to bend in warm weather.

The earlier candles were usually made of tallow, were very soft and the wick required constant snuffing, but in the modern wax candle the wick is so woven that it tends to bend over during burning and so be consumed in the hot edge of the flame as fast as the burning proceeds. (A. E. D.)

PARAFFIN, CHEMISTRY OF. Paraffin is the generic name given to the saturated hydrocarbons of the general formula C_nH_{2n+2}. Many of these hydrocarbons exist as naturally occurring products, the lower (gaseous) members of the series being met with as exhalations from decaying organic matter (marsh gas) or issuing from fissures in the earth, or in the gases from coal mines; the higher members occur in petroleum and ozokerite.

The principal members of the series are shown in the following table:—

Formula	Name	Melting point	Boiling point	Specific gravity
CH_4	Methane	−186°	−160°	0·415 at b.p.
C_2H_6	Ethane	−172°	−93°	0·446 at 0°
C_3H_8	Propane	..	−45°	0·536 at 0°
C_4H_{10}	Butane	..	+1°	0·600 at 0°
C_5H_{12}	Pentane	..	36·3°	0·627 at 14°
C_6H_{14}	Hexane	..	69°	0·658 at 20°
C_7H_{16}	Heptane	..	98°	0·683 at 20°
C_8H_{18}	Octane	..	125·8°	0·702 at 20°
C_9H_{20}	Nonane	−51°	150°	0·718 at 20°
$C_{10}H_{22}$	Decane	−31°	173°	0·730 at 20°
$C_{11}H_{24}$	Undecane	−26°	195°	0·774 at m.p.
$C_{12}H_{26}$	Dodecane	−12°	214°	0·773 at m.p.
$C_{14}H_{30}$	Tetradecane	+4°	252°	0·775 at m.p.
$C_{16}H_{34}$	Hexadecane	18°	287°	0·775 at m.p.
$C_{20}H_{42}$	Eicosane	37°	205°*	0·778 at m.p.
$C_{21}H_{44}$	Heneicosane	40°	215°*	0·778 at m.p.
$C_{23}H_{48}$	Tricosane	48°	234°*	0·779 at m.p.
$C_{31}H_{64}$	Hentriacontane	68°	302°*	0·781 at m.p.
$C_{35}H_{72}$	Pentatriacontane	75°	331°*	0·782 at m.p.
$C_{60}H_{122}$	Hexacontane	101°	..	..

*Under 15 mm. pressure.

The lowest members of the series are gases at ordinary temperature; those of carbon content C_5 to C_{15} are colourless liquids, and the higher members from C_{16} onwards are crystalline solids. The highest members only volatilize without decomposition when distilled under diminished pressure. They are not soluble in water, although the lower and middle members of the series are readily soluble in alcohol and ether; the solubility, however, decreases with increase of molecular weight, so that the highest members of the series are almost insoluble in these solvents. The specific gravity increases with the molecular weight but always remains below that of water. The liquid paraffins have a characteristic smell, more pronounced in the case of the branched chain members. The paraffin may be synthesized by reducing the alkyl halides (preferably the iodides) with nascent hydrogen, using either sodium amalgam, zinc and hydrochloric acid, concentrated hydriodic acid (Berthelot, Jour. prak. Chem. 1868, 104, p. 103), aluminium amalgam (H. Wislicenus, *ibid.*, 1896 [2], 54) or the zinc-copper couple (J. H. Gladstone and A. Tribe, Ber., 1873, 6, p. 202 *seq.*) as reducing agents.

They may also be derived from alkyl halides by heating to 120–140° C with aluminium chloride in the proportion of three molecules of alkyl halide to one molecule of aluminium chloride (B. Kohn, Ber., 1883, 16, p. 560); by heating with zinc and water

to 150–160° C. (E. Frankland, Ann., 1849, 71, p. 203; 1850, 74 p. 41), $2RI+2Zn+2H_2O=2RH+ZnI_2+Zn(OH)_2$; by conversion into zinc alkyls, which are then decomposed by water, $ZnR_2+2H_2O=2RH+Zn(OH)_2$; by conversion into the Grignard reagent with metallic magnesium and decomposition of this either by water, dilute acids or preferably ammonium chloride (J. Houben, Ber., 1905, 38, p. 3019), $RMgI+H_2O=RH+MgI(OH)$; by the action of potassium hydride (H. Moissan, Comptes rendus, 1902, 134, p. 389) and by the action of sodium in absolute ether solution (A. Wurtz, Ann. chim. phys., 1855 [3], 44, p. 275), $2RI+2Na=R{\cdot}R+2NaI$. They may also be obtained by the reduction of the higher fatty acids with hydriodic acid (F Krafft, Ber., 1882, 15, pp. 1687–1711),

$$C_nH_{2n}O_2+6HI=C_nH_{2n+2}+2H_2O+3I_2;$$

by the reaction of unsaturated hydrocarbons with hydrogen in the presence of a "catalyst" such, for example, as reduced nickel, copper, iron or cobalt (P. Sabatier and J B. Senderens, Ann chim. phys., 1905 [8], 4, pp. 310, 433); by the elimination of carbon dioxide from the fatty acids on heating their salts with soda-lime or baryta, $CH_3SO_2Na+NaOH=CH_4+Na_2CO_3$, or by heating their barium salts with sodium methylate in vacua (I. Mai, Ber., 1889, 22, p. 2133); by the electrolysis of the fatty acids (H. Kolbe, Ann., 1849, 69, p 257), $2C_2H_4O_2=C_2H_6+2CO_2+H_2O$; and by the action of the zinc alkyls on the ketone chlorides, $(CH_3)_2CCl_2+Zn(CH_3)_2=C_5H_{12}+ZnCl_2$. The paraffins are characterized by their great inertness towards most chemical reagents. Fuming sulphuric acid converts the middle and higher members of the series into sulphonic acids and dissolves the lower members (R. A Worstall, Amer Chem. Journ, 1898, 20, p. 664)

Dilute nitric acid, when heated with the paraffins in a tube, converts them into secondary and tertiary nitro-derivatives (M Konowalow, Ber., 1895, 28, p. 1852), whilst long boiling with strong nitric acid or nitro-sulphuric acid converts the middle and higher members of the series partly into primary mono- and di-nitro compounds and partly oxidizes them to carbonic, acetic, oxalic and succinic acids (Worstall, *ibid*, 20, p. 202; 21, p. 211). Fuming nitric acid only reacts slowly with the normal paraffins at ordinary temperature, but with those containing a tertiary carbon atom the reaction is very energetic, oxidation products (fatty acids and dibasic acids) and a small quantity of polynitro compounds being obtained (W. Markownikow, Centralblatt, 1899, 1, p. 1064; Ber., 1899, 32, p. 1441). Chlorine and bromine react with the paraffins, readily substituting hydrogen. Isomeric hydrocarbons in this series first appear with butane, the number increasing rapidly as the complexity of the molecule increases. Isomerism in the paraffin series is due to the variety of linking between the carbon atoms

Thus C—C—C—C—C is the arrangement of atoms in normal pentane but $\begin{matrix}C\\ \\C\end{matrix}\!\!>\!C—C—C$ represents the *secondary* or *iso* pentan and $\begin{matrix} & C & \\ & | & \\ C— & C & —C \\ & | & \\ & C & \end{matrix}$ is the arrangement in *tertiary* pentane Ethane C_2H_6, occurs in the natural gas associated with petroleum together with *propane* C_3H_8 and *butane* C_4H_{10}; *pentane* and higher members up to *decane* are present in petrol, probably as isomers Solid paraffin wax contains the higher members. (For methane *see* MARSH GAS.) (A. E. D)

PARAFFIN OIL, a term widely used in the United Kingdom to connote burning oil or illuminating oil for use in lamps. The corresponding American expression is kerosene and this also is commonly used in the industry. Kerosene is the distillate from any crude mineral oil (including shale oil) that boils between the approximate limits of 150° C and 300° C Legally it is defined as an oil that possesses a flash point above 73° F when observed in the standard Abel instrument. In early days paraffin oil was very liable to possess a low flash point and consequently many accidents occurred, owing to the fact that the oil gave off an inflammable vapour at moderate temperatures; to-day the flash point is usually above 100° F, because refiners are much more concerned with obtaining the maximum yield of petrol or gasolene from their crude oil, and therefore the illuminating oil coming on the market is practically free from low boiling, volatile and dangerous inflammable components. The chief criterion of a good illuminating oil is its capacity to burn with a steady highly luminous flame. This calls for great care throughout the refining operations.

The crude oil is first distilled in continuous stills arranged in benches and able to deal with upwards of 1,000 tons of oil a day. It is thus separated into naphtha and a heavy residue. This operation is called "topping" and the residue is a high flash oil that can be used as fuel or as a source of lubricating oil and waxes and pitch The naphtha is redistilled and there is obtained from it a light petrol fraction and a heavier kerosene. In the most modern plant redistillation is avoided, the crude oil is pumped through a tubular still under pressure and discharged into a tall fractionating column that is provided with a series of perforated decks, the perforations being covered by serrated cast iron hemispherical caps. This arrangement brings about intimate contact between the vapours ascending and the condensed liquid descending. The vapour of the gasolene issues from the top of the tower, which may be over 70 ft. high, whilst from a deck lower down the column may be taken kerosene. At various decks still lower down gas oil and lubricating oil are drawn and finally residue is taken from the bottom The crude kerosene distillate thus obtained although of correct flash point and boiling range, usually requires chemical treatments, to remove first colour and secondly objectionable compounds of sulphur that produce an unpleasant smell and poor burning qualities.

There is a variety of methods by which crude kerosene can be decolorised and deodorised A widely used one is to agitate the crude oil with strong sulphuric acid, which dissolves out sulphur derivatives and the coloured impurities If the mixture after thorough agitation is allowed to stand, there falls to the bottom of the agitator a heavy tar above which is the supernatant treated oil. The heavy tar is run off through a valve and the oil is washed several times with water, then with weak caustic soda and finally with water again The oil thus purified is run to storage This conventional method has many drawbacks and attempts are constantly being made to improve upon it Thus the Rumanian chemist, Edeleanu, agitates the oil with liquid sulphur dioxide, thus separating from the oil by means of their greater solubility those bodies that cause inferior burning The sulphur dioxide can be recovered and repeatedly used again Other processes aim at removing objectionable materials by filtration through fuller's earth or ignited bauxite or other adsorptive materials, whilst again a common deodorising treatment is brought about by agitation with a solution of litharge in caustic soda. (A. E. D.)

PARAGOULD, a city of north-eastern Arkansas, U.S.A, near the St. Francis river, on the Missouri Pacific and the St. Louis Southwestern railways; county seat of Greene county. Pop. (1920) 6,306 (99% native white); estimated locally at 10,000 in 1928. It has large stave factories and is an important shipping point for lumber The city was founded in 1881 and incorporated in 1884.

PARAGUAY, an inland republic of South America, bounded on the north-west by Bolivia, north and east by Brazil, south-east, south and west by Argentina. Pop. (1926 estimate) 798,969; the area of Paraguay proper is about 61,647 square miles. Sovereignty over the Chaco territory west of the Paraguay river and north of the Pilcomayo, comprising some 100,000 sq m., is disputed with Bolivia.

Physical Features.—Paraguay proper, or the country between the Paraguay and the Paraná is traversed from north to south by a broad irregular belt of highlands, which are known as the Cordillera Ambaya, Cordillera Urucury, etc., but partake rather of the character of plateaux, and form a continuation and outwork of the great interior plateau of Brazil The elevation nowhere much exceeds 2,200 feet. On the western side these

highlands terminate with a more or less sharply defined edge, the country sloping gradually up to their bases in gentle undulations with open, ill-defined valleys; on the eastern side they send out broad spurs enclosing deep-cut valleys, and the whole country retains more of an upland character. The streams that flow westward to the Paraguay are consequently to some extent navigable, while those that run eastward to the Paraná are interrupted by rapids and falls, often of a formidable description. From the Asunción plateau southwards, near the confluence of the Paraguay and Paraná, there is a vast stretch of marshy country, draining partly into the Ypoa lagoon, and smaller tracts of the same character are found in other parts of the lowlands, especially in the valley of the Paraguay. Many parts of the country sloping to the Paraná are nearly covered with dense forest, and have been left in possession of the scattered native tribes. The country sloping to the Paraguay, and comprising the greater part of the settled districts, is grassy and open, though the hills are usually covered with forest and clumps of trees are frequent in the lowlands. The soil is mostly dry, porous and sandy. (X.)

Geology.—The Paraná plateau of southern Brazil extends into eastern Paraguay, where it occupies about half the area of the country east of Paraguay river. It is a table-land formed of nearly horizontal beds of Triassic sandstone capped by late Triassic basalt and dissected by the gorges of the Paraná and its tributaries. West of the plateau is a lower foot-hill zone composed of almost horizontal Devonian and Permian beds, a southward continuation of the Palaeozoic beds exposed at the foot of the Matto Grosso plateau. The surface of the broad lowland, known west of Paraguay river as the Chaco, so far as known, is formed of Tertiary and Quaternary beds, through which protrudes, in its northern part, a low range of ancient gneiss, the Sierra de Quince Puntas. (G. McL. Wo.)

Minerals.—The gold mines said to have been concealed by the Jesuits may have had no existence; and though iron was worked by F. S. López at Ibicuy (70 m. S.E. of Asunción), and native copper, oxide of manganese, marble, lime and salt have been found, the real wealth of the country consists rather in the variety and value of its vegetable products.

Climate and Fauna.—December, January and February are generally the hottest months, and May, June, July and August the coldest. The mean temperature for the year seems to be about 74° F; for summer 81°, for winter 64°. The annual rainfall is about 62 in. at Asunción fairly well distributed throughout the year. The most common winds are from the north or south. The south wind is dry, cool and invigorating, and banishes mosquitoes for a time; the north wind is hot, moist and relaxing.

The fauna of Paraguay proper is practically the same as that of Brazil. Caymans, water-hogs (*capinchos*), several kinds of deer (*Cervus paludosus,* the largest), ounces, opossums, armadillos, vampires, the American ostrich, the ibis, the jabiru, various species popularly called partridges, the *pato real* or royal duck, the *Palamedea cornuta,* parrots and parakeets, are among the more notable forms. Insect life is especially abundant; the red stump-like ant-hills are a feature in every landscape.

Population.—The great majority of the inhabitants are of Indian (Guaraní) descent, with very slight traces of foreign blood. Civilization has not made much progress, and the habits of the people are more primitive than those in the more advanced neighbouring republics. As a general rule the Paraguayans are indolent, especially the men. Climate conditions obviate the necessity of heavy clothing. A cotton chemise, and white *manta* wrapped in Moorish fashion over head and body, constitute the dress of the women; a cotton shirt and trousers that of the men. Boots and shoes are worn only by the upper classes. Goitre and leprosy are the only endemic diseases; but the natives, being underfed, are prone to diarrhoea and dyspepsia. The common language of the country is Guaraní, although in a few districts Tupi is spoken. The country people as a rule understand a little Spanish, if living near any trading centre. Immigration is on a small scale, but tends to increase; it is encouraged by the Government, which seeks to divert to Paraguay some portion of the Italian labour immigration into Brazil and Argentina.

The principal towns with the 1926 estimate of their populations (including in each case the municipal district) are Asunción, the capital (113,684), Villa Rica (26,000), Luque (13,000), Carapegua (12,000), Paraguarí (10,000), Concepción (11,000) and Villa del Pilar (6,000); these are described in separate articles. Encarnación (7,500) on the Paraná has a large transit trade.

Government.—The constitution of the republic was voted by a constituent assembly on Nov. 25, 1870. Legislative power is vested in a Congress consisting of a Senate and a Chamber of Deputies, elected by universal manhood suffrage in the proportion of one senator for every 12,000 inhabitants and one deputy for every 6,000. Every member of Congress receives a salary of about £200. The head of the executive is the president, chosen by an electoral college for four years, and only re-eligible after eight consecutive years. He is aided by a cabinet of five ministers, responsible to Congress. The vice president is similarly elected, and is *ex officio* chairman of the Senate. The highest judicial authority is the Supreme Court, which is empowered to decide upon the constitutional validity of acts passed by Congress; its three members are appointed for four years by Congress, subject to the approval of the president. There are five courts of appeal, and inferior tribunals in all the large towns. The civil and criminal codes of Argentina have been adopted, almost without change. For purposes of local administration the republic is divided into 12 departments, subdivided into 104 counties (*partidos*).

Religion and Instruction.—Roman Catholicism is the established religion, but the Constitution guarantees full liberty to all other creeds. Asunción, the only bishopric in the State, is in the archi-episcopal province of Buenos Aires. Education is backward and was long neglected. By law it is free and compulsory, but in some districts the attendance of many children is impossible owing to lack of schools, and at least 60% of the inhabitants are illiterate. An attempt at educational progress was made by President Franco in 1916–19. In 1926 there were 90,133 pupils enrolled in 576 Government primary schools, while 3,201 pupils were attending the 21 private schools, and 800 the three national colleges at Asunción, Pilar and Villa Rica. The Colegio Internacional, an American missionary institution and the largest educational establishment in Paraguay, was opened at Asunción in 1920. There is a National university with 369 students in 1926, and 6 normal schools with 482 students.

Defence.—In 1926 the standing army numbered about 2,285 men; and there were three small armed river steamers.

Finance.—The financial situation of Paraguay has been a source of anxiety for many years. In 1885, after interest had been unpaid for 11 years on bonds amounting to £1,505,400, an agreement was made for the issue of new scrip to the value of £850,000 in quittance of all claims for capital and arrears of interest, certain public lands being also ceded to the bondholders as compensation. In 1895 an arrangement was made for a reduction of the rate of interest, for the funding of the arrears and for the creation of a sinking fund. The Government was unable to meet their obligations during a number of years and the public debt was further increased by the revolution of 1911–12, but in 1924 a new arrangement was made with the creditors for the service of this foreign debt, and the authorities have been able regularly to meet these obligations. The total outstanding debt on June 30, 1927 was 6,665,733 pesos gold and 26,804,494 pesos paper, equal to about £1,459,000. Besides this debt, there are other claims on Paraguay, including about £1,950,000 due to Brazil and about £2,500,000 due to Argentina, as a result of the war against López. These latter claims Paraguay does not recognize.

The revenue is derived from import duties, and the most important branches of expenditure are the salaries of public officials, the army, public instruction and debt. The estimated revenue for the year 1926–27 was 260,039,984 paper pesos (213·5 paper pesos to the £1) and the expenditures, 260,033,684.

Industry.—The principal industries are the cultivation and preparation of *mate* (Paraguayan tea), cotton, sugar, cattle-farming, fruit-growing, tobacco-planting and timber-cutting. The majority of the *yerbales* (tea plantations) were formerly the property of the Government, but have been acquired by private

enterprise. Cotton-growing has increased in recent years, its acreage in 1924 being 30,380. About 11,000 ac. are devoted to sugar, and there are many sugar mills largely engaged in the production of spirits.

The cattle industry is of great importance. The number of animals was estimated at 5,000,000 in 1928. The animals are small, but Durham and Hereford bulls have been introduced from Argentina to improve the breed. The increase in the herds has caused the owners of *saladero* establishments in Argentina and Uruguay to try the working of factories in Paraguay for the preparation of *tasajo* (jerked beef) and the manufacture of extracts of beef There are meat-packing plants in several cities.

Oranges, pineapples and other fruits are widely grown, mainly for local use. Tobacco, although of inferior quality, is grown to a considerable extent The staple diet is maize and mandioca (the chief ingredient in the *chipa* or Paraguayan bread).

The forests abound in such timber as quebracho, cedar, curupey, lapacho and urundey Some of these, such as the lapacho and quebracho, are of rare excellence and durability, as is shown by the wonderful state of preservation in which the woodwork of early Jesuit churches still remains The quebracho forests of the Paraguayan Chaco yield large quantities of tannin, the extracting of this having become one of the important industries of the country. Fifteen plants are known to furnish dyes, and eight are sources of fibre—the caraguatay especially being employed in the manufacture of the exquisite *nanduty* or spider-web lace of the natives Bricks, leather and furniture are manufactured also

Commerce.—The commercial situation of Paraguay has improved in consequence of the investment of foreign capital in industrial enterprise. The principal articles imported are textiles, hardware, wines, rice, canned goods and general provisions; the exports are *yerba mate*, hides, hair, meat, quebracho logs and extract, oranges and tobacco Most of the export trade is with Argentina, a large part of this being for re-shipment at Buenos Aires The values for the years 1925, 1926 and 1927 were.—

	1925	1926	1927
Imports	£3,530,550	£2,441,056	£2,395,550
Exports	3,133,235	3,099,500	2,856,400

Communications.—Numerous ocean-going liners, most of which fly the Brazilian or the Argentine flag, ply on the Paraguay and the Paraná, smaller vessels ascend the tributary streams, which are also utilized for floating lumber down to the ports. During the year 1923, 2,046 steam vessels of an aggregate tonnage of 221,488 tons entered the port of Asunción; during the same year 2,061 steam vessels of an aggregate tonnage of 226,020 tons were cleared from the port The most important railway in the republic is the Paraguay Central between Asunción and Encarnación, on the upper Paraná, a train-ferry across the Paraná affording connection with Posadas, thus shortening the journey between Buenos Aires and Asunción from five days to about 48 hours. A few other short lines bring the total railway mileage to 517. There are a few fairly good wagon roads, but most of the roads are in very poor condition.

Post and Telegraph.—Paraguay entered the Universal Postal Union in 1881. Telegraph lines connect Asunción with other towns, and two lines put the republic in communication with the rest of the world by way of Corrientes and Posadas. Wireless stations have been erected at the capital, at Concepción and at Paraguarí.

Money and Credit.—The principal banks in Paraguay are the Banco de la República, with a total authorized capital of $4,000,000, the Bank of London and South America, Ltd., the German Bank of South America, and the Banco Agrícola. The Conversion Office (Oficina de Cambios), which is authorized to sell or lend gold, was organized for the administration of the public debt. The gold and silver coinage of Paraguay are legally standardized as identical with those of Argentina (5 gold dollars or pesos=£1); but paper money is about the only circulating medium.

Weights and Measures.—The metric system is officially adopted, but the weights in common use are the *tonelada* (2,025 lb.), the *quintal* (101·4 lb.), the *arroba* (25·35 lb), the *libra* (1·014 lb.) and the *onza* (·0616 lb.). The unit for liquid measure is the *cuarta* (·1665 gal.); for dry measure the *almud* (·66 bu.) and *fanega* (1½ bu.). The land measures are the *legua* (2·689 m.), the *sino* (69⅛ sq.yd), and the *legua cuadrada* (12½ sq m.).

History.—The Indians whom the Spaniards found in Paraguay belonged to many tribes, but possessed a common language, the Guaraní. They were chiefly agriculturists and continued to live side by side with their conquerors, the culture of the country being still distinctly Indian. In 1527 Sebastian Cabot reached Paraguay and built a fort called Santo Espíritu Asunción was founded on Aug 15, 1535 by Juan de Ayolas From this centre Spanish adventurers pushed east to La Guayra, beyond the Paraná, and west into the Gran Chaco; and before long vast numbers of the less warlike natives were reduced to serfdom The name Paraguay was applied not only to the country between the Paraguay and the Paraná, but to the whole Spanish territory, which now comprises parts of Brazil, Uruguay and the Argentine provinces of Buenos Aires, Entre Ríos, Corrientes, Misiones and part of Santa Fe It was not till 1620 that Paraguay proper and Río de la Plata or Buenos Aires were separated as distinct Governments, and they were both dependent on the vice-royalty of Peru till 1776, when Buenos Aires was erected into a vice-royalty, and Paraguay placed under its jurisdiction The first Christian missions were established by the Franciscans between 1542 and 1560; but neither they nor the first Jesuit missionaries were allowed to make their enterprise a permanent success. This fell to the lot of the second band of Jesuits, Cataldino, Mazeta and Lorenzana, who began work in 1605 They succeeded in establishing a kind of *imperium in imperio*, and for a century and a half the history of Paraguay is the history of the Jesuit missions In 1750, however, Ferdinand VI of Spain ceded to the Portuguese, in exchange for the fortified village of Colonia del Sacramento (Uruguay), a part of this territory. The Jesuits resisted the transference, and it was only after several engagements that they were defeated by the combined forces of Spain and Portugal. The missions never recovered their prosperity, and the Jesuits were finally expelled in 1769 In 1811 Paraguay declared itself independent of Spain; by 1814 it was a despotism in the hands of Dr J G R Francia (*q v.*). On Francia's death, in 1840, the chief power passed to his nephew, Carlos Antonio López (*q v.*), who in 1862 was succeeded by his son Francisco Solano López In 1864 a dispute arose between the younger López and the Brazilian Government, and López marched an army through Argentine territory to invade southern Brazil. This act induced the Governments of Brazil, Uruguay and Argentina to combine for the purpose of suppressing López The invasion of Paraguay then took place, and a struggle involving an enormous sacrifice of life and treasure lasted for five years, only coming to a close when the Paraguayan forces were totally defeated and López was killed at the battle of Aquidaban on March 1, 1870 During this warfare every male Paraguayan capable of bearing arms was forced to fight, whole regiments being formed of boys from 12 to 15 years of age. Even women were used as beasts of burden to carry ammunition and stores, and when no longer capable of work were left to die by the roadside or murdered to avoid any ill consequences occurring from their capture When the war broke out the population of Paraguay was 1,337,439; when hostilities ceased it consisted of 28,746 men, 106,254 women above 15 years of age, and 86,079 children

After the death of López the Government was administered by a triumvirate consisting of Cirilo Rivarola, Carlos Loizaga and José Díaz de Bedoza, until, in Nov. 1870, the present Constitution was formulated The policy of Brazil was for a time directed towards the annexation of Paraguay; the debt due to Brazil on account of the war was assessed at £40,000,000, a sum which Paraguay could never hope to pay; and it was not until 1876 that the Brazilian army of occupation was wholly withdrawn. But the rivalry between Brazil and Argentina, and the necessity of maintaining the balance of power among the South American republics, enabled Paraguay to remain independent. No violent constitutional change took place after 1870, though there have been spasmodic outbreaks of revolution, as in 1881, in 1894, in 1898, in 1904, in 1908 and in 1909. None of these disturbances deeply or permanently affected the welfare of the republic, nor

were all of them accompanied by bloodshed. Under the presidency of J. B. Egusquiza (1894–98) the boundary dispute with Bolivia became acute; but war was averted, largely owing to the success of the revolution, which forced the president to resign. The main interest of recent Paraguayan history is economic rather than political. In that history the gradual development of commerce, the financial reforms in 1895, and the extension of the Paraguay Central railway were events of far greater importance than any political movement which took place between 1870 and 1910. In 1911 a series of revolutions forced Dr. Manuel Gondra (recently inaugurated) out of the presidency and brought into office four provisional presidents in rapid succession during that and the following year. In 1912, however, a peaceful succession took place and Dr. Eduardo Schaerer was allowed to complete his full term, 1912–16. During his administration the country recovered somewhat from the effects of its unfortunate disturbances. He was followed by Dr. Manuel Franco, under whose direction the condition of the country improved still further. Upon his death (1919) the remainder of the term was filled by Dr. José P. Montero, after which Gondra was elected for a second time. The latter, however was forced to resign in 1921 under pressure of threatened revolts and the administration of his successor, Eusebio Ayala (provisional president), was no less turbulent. This situation terminated in 1923 when Elijio Ayala was elected for the term, 1924–28, a period which has been one of the most peaceful and prosperous in the history of Paraguay. In April 1928, Don José P. Gugguiari was elected president.

During the World War Paraguay remained neutral but toward the latter part of the conflict she displayed a decided pro-Ally attitude, and dismissed some of her German employees. In 1919 she joined the League of Nations. Her boundary dispute with Bolivia became acute in 1926, but the following year the two countries signed a protocol creating an international boundary commission and agreed to arbitrate the question in case of failure to arrive at a direct solution. In spite of this agreement, actual armed clashes took place along the disputed border late in 1928. In 1927 there began an immigration of Mennonites into Paraguay, and by the middle of 1928 at least 2,000 of them had arrived.

(G. M. McB.)

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PARAHYBA (Parahiba or Parahyba do Norte), a State of north-eastern Brazil, bounded north by Rio Grande do Norte, east by the Atlantic, south by Pernambuco and west by Ceará. Pop. (1920), 961,106. Area, 21,585 sq. miles. It consists of a narrow coastal zone, 30 to 40 m. wide, along the seaboard, behind which the country rises sharply to a highland region forming part of the great central plateau of Brazil. The long dry season (April to October), together with occasional devastating droughts (*séccas*) lasting two or more years, prevents the development of forests and damages the agricultural and pastoral industries of the State. There is only one river of importance, the Parahyba do Norte, which crosses the southern part of the State from west to east with a course of about 240 miles. In the lowlands and some of the river valleys agriculture is the chief occupation of the people; cotton and sugar are extensively produced and some tobacco is grown. The exports include hides, skins, cotton, sugar and tobacco. Rubber of the Ceará type is also found and forms an item among the smaller exports. The eastern extremity of the State is served by a railway originally called the Conde d'Eu railway but now forming part of the Great Western of Brazil system. The capital is Parahyba (*q.v.*). Other important towns are: Bananeiras, Campina Grande, Guarabira, Pombal, and Souza.

Parahyba formed part of the original grant, known as the *capitania* of Itamaracá, from the Portuguese Crown to Pero Lopes de Souza. It was not settled until 1584, when a fort was erected near the present port of Cabedello under the name of São Filippe.

PARAHYBA (PARAHYBA DO NORTE), a city and port of Brazil, capital of Parahyba State, on the right bank of the Parahyba do Norte river, 11 m. above its mouth and 65 m. N. of Recife. Pop., including the municipal district (1920), 52,990. Parahyba is the starting-point of the Conde d'Eu railway, now a part of the Great Western of Brazil system. Its port is Cabedello, with which it is connected by rail. The entrance to the Parahyba do Norte river being obstructed by a stone reef and sand bars, only vessels drawing less than 14 ft. can effect an entrance. The "Varadouro," as the lower part of the city is called, is built on the margin of the river and is devoted principally to commerce. Behind this is a low hill on whose northern slope and broad summit the upper city is built, and a tramway line runs to the suburb of Trincheira. There are some good public buildings, including the parish church (*matriz*) of N.S. das Neves, the old Franciscan convent and church, the government palace, and the Treasury. There are a normal school, a lyceum, a national gymnasium, and a school for marine apprentices. Parahyba was founded in 1585. It was called Frederickstadt by the Dutch, and Felippéa after the Spanish king when the Dutch were expelled.

PARAHYBA DO SUL, a river of Brazil, having its source on the *campos* of Bocaina, on the northern slope of the Serra do Mar in the western part of the state of São Paulo, and flowing at first south-westerly and then after a horse-shoe curve in the vicinity of Jacarehy in a general east-north-east direction to the Atlantic in lat. 21° 38′ S. Its upper course for a distance of 80m., or to the confluence of the Parahybuna, is known as the Parahytinga. The navigable channel from São Fidelis to the Atlantic is 54m. long, and the total length of the river, including the Parahytinga, is 540m. Its source is about 4,920ft. above sea-level. The Parahyba passes through a fertile, long-settled country, a part of which was long the chief coffee-producing region of Brazil.

PARAKEET: *see* Parrot.

PARALDEHYDE (para-acetaldehyde, paraldehydum in British and U.S. *Pharmacopoeia; see* also Aldehydes), a colourless liquid of characteristic odour and soluble in ten parts of water. It boils at 124° C (m.p. 12·5° C). Paraldehyde is a powerful hypnotic without depressing effect on the heart, and, being largely excreted by the lungs, is beneficial in bronchial asthma. Used intravenously, it acts as an anaesthetic and hypnotic. It is produced by polymerizing acetaldehyde with a trace of sulphuric acid; with the concentrated acid this reaction is accompanied by considerable generation of heat. The resulting liquid is neutralized with calcium carbonate and purified by fractional distillation. Paraldehyde has the same molecular formula $(CH_3{\cdot}CHO)_3$ both in the gaseous phase and in solution.

PARALLAX (παράλλαξις) is the difference in direction of a body caused by a change in the position of the observer. For members of the solar system the word is more specifically used to mean the difference in direction as seen from the observer and from the earth's centre. It is used in this sense by Ptolemy. In fig. 1, let O be the observer, E the centre of the earth, and M the position of the moon, planet or sun, then the angle OME is the parallax. This varies with the altitude and is greatest when the body is on the horizon. At zenith distance z $\sin p = \frac{a}{r} \sin z$. When $z = 90°$, $\sin p = \frac{a}{r}$ and this value of p is called the horizontal parallax or briefly the parallax. For all bodies but the moon, p is so small that it does not differ appreciably from $\sin p$, and is usually expressed in sexagesimal measure. A further refinement is required owing to the spheroidal figure of the earth and the numerical values generally given are those of the *Equatorial horizontal parallax.*

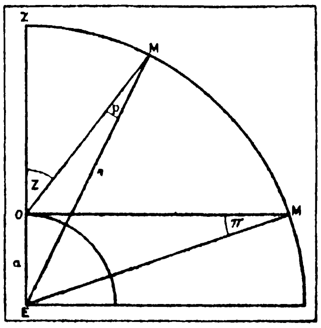


FIG. 1.—CHANGE OF PARALLACTIC ANGLE WITH ALTITUDE

Lunar Parallax.—The moon being by far the nearest of the celestial bodies was the first to have its parallax determined. Hipparchus showed that the sum of the parallaxes of the sun and moon was equal to the sum of the angular radii of the sun and of the shadow of the earth thrown on the moon in a lunar eclipse. If the parallax of the sun be considered as inappreciable compared with that of the moon, the moon's parallax is found to be 58′.

Parallax of the moon is directly determined from observations of declination made at two places like Greenwich and the Cape which are nearly on the same meridian. The theory of the observations will be readily grasped from fig. 2.

The angles z_1 and z_2 are observed and other data are obtained from the latitude of the observatories and the known size and shape of the earth. In practice, stars are observed in positions near the moon in order to eliminate uncertainties of refraction and instrumental errors. In this way Henderson obtained a value of 57′2″·3 for the moon's equatorial horizontal parallax in 1837. From a series of observations of a small lunar crater in the years 1905–10 the value 57′2″·5 was found.

A second method rests on a comparison of the force of gravity at the earth's surface with its value at the moon. If M and m be

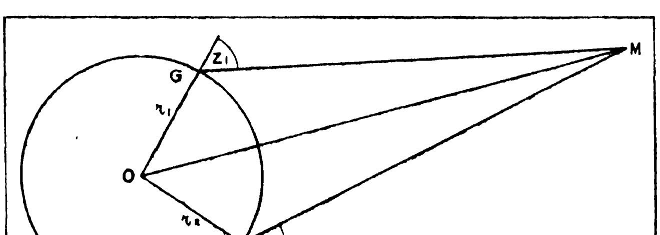


FIG 2—MEASUREMENT OF PARALLAX BY OBSERVATIONS FROM A NORTHERN AND A SOUTHERN OBSERVATORY
If the angles Z_1 and Z_2 are accurately observed at Greenwich and the Cape, and the form of the earth and the positions of these places on it are accurately known, a diagram drawn to the scale will give the moon's distance

the masses of the earth and moon, r the mean distance, and P the sidereal period of revolution of the moon about the earth $M+m = 4\pi^2 r^3/P^2$ where $\pi = 3{\cdot}14$. Also, g, the value of gravity at the earth's surface, determined accurately from pendulum observations $= M/a^2$. Hence $\left(\frac{a}{r}\right)^3 = 4\pi^2 \frac{M}{M+m} \cdot \frac{a}{gP^2}$. As the quantities on the right hand side are known with great accuracy, $\frac{a}{r}$ is accurately determined as 57′2″·7

Solar Parallax. Trigonometrical Methods.—In accordance with the law of gravitation the relative distances of the planets are known, and tables of their positions and movements take the distance of the sun from the earth as unit of length. To determine the value of this unit, it is only necessary to obtain the distance or parallax of one of the planets at a time when it is nearest the earth. The first accurate determination of the sun's parallax was obtained in 1672 from a series of observations of Mars when in opposition made in South America and Paris, from which a value of 9″·5 was obtained. The utilization of the transit of Venus for this purpose was advocated by Halley, and at the transit of 1769, the times of ingress and egress of the planet on the sun's disk were observed by astronomers dispatched to various parts of the globe, including Capt. Cook in Otaheite. From these observations a value of 8″·6 was obtained. The transits of 1874 and 1882 were widely observed for the same purpose, but the results were disappointing owing to the impossibility of precise determination of the times of ingress and egress In 1877 Gill made an expedition to the island of Ascension and observed the opposition of Mars, using a heliometer to measure the distance of the planet from neighbouring stars. He made his observations after sunset and before sunrise, the parallactic displacement of the planet from its calculated position as seen from the centre of the earth being in opposite senses and of largest amount at these times. A value of 8″·78 was deduced. The successful result of this series of observations led Gill to make a very elaborate series of heliometer observations of the small planets Victoria, Iris and Sappho, in 1888 and 1889, when they were in opposition. The resulting value of the solar parallax was 8″·80.

In 1898 De Witt discovered the small planet Eros which at its nearest approach comes to within 15 million miles or one-sixth of the sun's distance The opposition of 1900 was extensively observed visually and photographically at many observatories. The collection and discussion of the extensive series of observations was made by Mr. Hinks who obtained the value for the solar parallax 8″·804±″·004. A still nearer approach of this planet to the earth will occur in 1931

Methods Depending on Velocity of Light.—The value of the velocity of light has been determined by Michelson with great precision and may be utilized in several different ways. A direct method is the converse of the procedure of Römer in the discovery of the velocity of light; *i e*, to use the light equation, or time taken by the light to reach us at the varying distances of Jupiter Great accuracy is hardly obtainable in this way A second method is by means of the constant of aberration which gives the ratio of the velocity of the earth in its orbit to the velocity of light As aberration produces an annual term of amplitude 20″ in the positions of all stars its amount has been determined in numerous ways One of the latest determinations—that made at Greenwich in the years 1911 to 1918 gave the value 20″·445±″·013 leading to the value 8″·810±″·006 for solar parallax. This method is not free from the suspicion of systematic error.

The velocities of stars towards or from the earth are determined from spectroscopic observations. By choosing times when the orbital motion of the earth is carrying it towards or from a star the velocity of the earth in its orbit may be obtained. In this way the solar parallax was found from observations at the Cape of Good Hope to be 8″·802±″·004.

Gravitational Methods.—(1) In the theory of the moon there is a term of period one month known as the parallactic inequality. The coefficient of the term contains the ratio of the parallaxes of the sun and moon as a factor. The large size of this coefficient makes it of value. From the discussion of occultations of stars at the Cape observatory, Jones finds the value 125″·15±″·06 for this term giving for the solar parallax 8″8·805±″·004.

(2) The ratio of the mass of the earth+moon to that of the sun may be determined from the disturbing action of the earth+moon on the elliptic motion of the planets. The ratio of the moon's mass to that of the earth is 1 81·53, and thus the ratio of the earth's mass to that of the sun is found In a manner similar to that described above for the moon's parallax the solar parallax is then derived. From an exhaustive discussion of the perturbations of the planet Eros Noteboom has made a very accurate

determination of the solar parallax as 8″·799.

There is thus a general agreement of different methods that the solar parallax is not far from 8″·804. This corresponds to a mean distance of the sun of 149,500,000 kilometres or 92,900,000 miles.

Stellar Parallax.—The stars are too distant for any difference of position to be perceptible from two places on the earth's surface; but as the earth is 93 million miles from the sun, stars are seen from widely different view points in the course of the year. The effect on their positions is called *annual parallax,* defined as the difference in position of a star as seen from the earth and sun. Its amount and direction varies with the time of year, and its maximum is a/r where a is the radius of the earth's orbit and r the distance of the star. The quantity is very small and never reaches 1/206,265 in radian or 1″ in sexagesimal measure. Unsuccessful attempts to measure the parallax of a star were made continuously after the acceptance of the Copernican system, including one by Bradley which led to the discovery of aberration (*see* ABERRATION OF LIGHT) and by Herschel which led to the discovery of binary stars. The first successful results were obtained in 1838 when the parallax of α Centauri was announced by Henderson, α Lyrae by Struve and 61 Cygni by Bessel. For his observations Bessel used the heliometer, an instrument constructed by Fraunhofer, in which the object glass is cut in two, and so mounted that the whole can be rotated, and the separate halves made to slide relatively to one another and their movement measured with great precision. In this way the distance between two stars is measured by the separation of the two halves required to make the images of the two stars coincident. Bessel found small movements of 61 Cygni relative to two neighbouring stars which from their magnitude and want of proper motion were judged to be so distant that no parallactic effect could be perceived. With instruments of this kind having small object glasses of not more than 4 or 6in. and focal lengths of a few feet, research on stellar parallax was carried on to the end of the 19th century and the parallaxes determined of approximately 100 of the brightest stars and those showing the largest proper motion. The introduction of photography simplified the problem, and after the researches of Hinks and Russell at Cambridge, and still more of Schlesinger at Yerkes, a number of observatories have engaged in the work and have determined the parallaxes of many stars with great accuracy. Two observational conditions have to be fulfilled (1) The telescope must be in the same position for observations at different times of the year. (2) By some means, *e.g.*, a rotating shutter with a suitable slit—the photographic image of the star observed must be made equal to that of the stars with whose position it is compared. In practice, a few photographs are taken when the star is on the meridian shortly after sunset at one period of the year and shortly before sunrise at another period. As the stars' positions change owing to their proper motion, a minimum of three epochs is required but the possibility of systematic errors make it desirable to extend the observations over a larger number of epochs. With 25 photographs spread over five epochs, the parallax of a star is obtained with a probable error of less than ±0″·010, although the diameter of the photographic disk of the star is seldom less than 2″·0. The concerted action of the observatories of Allegheny, McCormick, Swarthmore, Dearborn, Yerkes, Mount Wilson and Greenwich has resulted in the determination of the parallaxes of 1,800 stars, 1,600 north and 200 south of the Equator. The determination of parallaxes of stars in the Southern hemisphere has been commenced at the Yale Observatory at Johannesburg and the Royal Observatory at the Cape, and will in a few years correct this large disparity. In the Northern hemisphere the parallaxes have been measured of 191 of the 207 stars brighter than $4^{m}0.381$ of 1,041 stars between $4^{m}0$ and $5^{m}5$ and of many stars whose comparative nearness is suggested by their large proper motions. Rather more than one half of the stars have parallaxes greater than 0″·02 or are within 50 parsecs of us, a parsec being defined as the distance of a star whose parallax is 1″ and equal to 206,265 times the earth's distance from the sun or approximately 19 million million miles.

Between the distances of 1 and 5 parsecs, 23 stars have been found, of which seven are double stars. These include the bright stars α Centauri, Sirius and Procyon and three stars below the 10th magnitude.

(2) If a star is moving at an inclination i to the tangent plane of the celestial sphere, its angular velocity $\frac{V}{r}\cos i$ can be compared with its linear velocity $V \sin i$ in the line of sight obtained from spectroscopic observations. For some double stars and for several open clusters of stars i is known and accurate values of the parallax have been determined for Capella, the Taurus and the Great Bear clusters.

(3) For the more distant stars, trigonometrical methods are inapplicable, but the parallax can be derived from the apparent magnitude of the star, if there are any means of knowing the absolute magnitude of the star; *i.e.*, the magnitude the star would have at the standard distance of 10 parsecs. For Cepheid Variables this can be inferred with considerable accuracy from their periods, and for many stars a reasonable guess can be made from the spectral type and proper motion. The formula connecting absolute magnitude and apparent magnitude with parallax is $M = m + 5 + 5\log \pi$ and expresses the condition that the light received from a star varies inversely as the square of the distance.

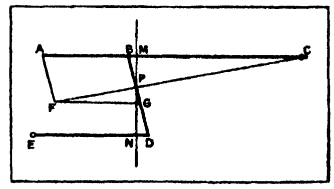
(4) **Spectroscopic Parallaxes.**—Stellar spectra are arranged in a sequence which represents the effective temperatures of the stars. In 1914 Adams and Kohlschütter found differences in the intensities of certain lines in stars of the same type of spectrum, dependent on the absolute luminosities of the stars, or slight difference in the spectra of great and small stars of the same surface temperature. By photometric comparison of neighbouring lines, one invariable, and the other varying with the size of the star, the absolute magnitude of a star is determinable, and the parallax by means of the formula given above. This method has been applied extensively to most of the brighter stars in the Northern hemisphere, using stars of known parallax as standards.

Average Parallaxes.—The solar system is moving through space with a velocity of 19·5 km./sec., carrying it four times the earth's distance from the sun in one year. This produces a general drift in the angular movement of the stars away from the apex or point in the sky to which the movement is directed. Were the stars at rest, this would give a ready means of determining their individual distances. As the stars are all moving, the method gives the average distance of a group of stars examined, on the assumption that their peculiar motions are eliminated. In this way the mean parallaxes of stars of successive apparent magnitudes of different galactic latitudes and of different spectral types are obtained. Thus the mean parallax of 5th magnitude stars: *i.e.*, of stars just visible to the naked eye—is ″·018; and of the 10th magnitude stars; i.e. of stars giving $\frac{1}{100}$ of their light—is ″·0027.

As spectroscopic observations have given the mean peculiar velocities of stars of different types, the average proper motions perpendicular to the direction of the solar motion may also be used as a criterion of parallax. There is a very great diversity in the parallaxes of individual stars included in these mean values.

(F. D.)

PARALLEL MOTION, an arrangement of links, invented by James Watt, and used in the older types of steam-engines (*see* STEAM-ENGINE) to connect the head of the piston rod, moving up and down in a vertical path, with the end of the beam, moving in the arc of a circle. An ordinary form is shown diagrammatically in the figure. MN is the path in which the piston-rod head is to be guided. ABC is the middle line of half the beam, C being the fixed centre about which the beam oscillates. A link BD connects a point in the beam with a radius link ED, which oscillates about a fixed centre at E. A point P in BD, taken so that BP:DP::EN:CM, moves in a path which coincides very closely with the straight line MPN. Any other point F in the line CP or CP produced is made to copy this motion by means of the links AF and FG, parallel to BD and AC. In the ordinary application of parallel motion, a point such as F is the point of attachment



of the piston-rod, and P is used to drive a pump-rod. Other points in the line CP produced are occasionally made use of by adding other links parallel to AC and BD. Watt's linkage gives no more than an approximation to straight-line motion, but in a well-designed example the amount of deviation need not exceed one four-thousandth of the length of stroke. It was for long believed that the production of an exact straight-line motion by pure linkage was impossible, until the problem was solved by the invention of the Peaucellier cell (*See* also MECHANICS)

PARALYSIS or **PALSY,** a medical term usually implying the loss or impairment of voluntary muscular power Paralysis is rather a symptom than a disease *per se;* it may arise (1) from injury or disease of nervous and muscular structures (*organic paralysis*), or (2) from purely dynamic disturbances in the nervous structures of the brain which preside over voluntary movement. The latter is *functional motor paralysis,* a symptom common in certain neuroses, especially hysteria For *general paralysis of the insane, see* INSANITY.

Whether the loss of motor power be functional or organic, it may be generalized in all the muscles of the body, or localized to one or many The different forms of paralysis which may arise from organic disease can be understood by a consideration of the motor path of voluntary impulses from brain to muscle There are two neural segments in this path, an upper cerebral and a lower spinal; the former has its departure platform in the brain and its terminus in the whole of the anterior grey matter of the spinal cord, whence issues the lower spinal segment of the motor path to the muscles The nerve fibres of the upper cerebral segment are prolongations of the large psycho-motor cells; the nerve fibres of the lower segment are prolongations by the anterior roots and motor nerves of the large cells in the grey matter of the cord Disease or destruction of any part of the upper cerebral segment will give rise to loss of voluntary power, for the influence of the mind on the muscles is removed in proportion to the destruction of this efferent path Disease or destruction of the lower spinal segment causes not only loss of voluntary power but an atrophy of the muscles themselves

Paralysis may therefore be divided into three great groups: (1) loss of voluntary power without muscular wasting except from disuse, and without electrical changes in the muscles due to injury or disease in the upper cerebral segment, (2) loss of muscular power with wasting and electrical changes in the muscles due to disease or injury in some part of the lower spinal segment; (3) primary wasting of the muscles

The more common forms of paralysis will now be described.

Hemiplegia, or paralysis affecting one side of the body, is a frequent result of apoplexy (*q v.*); there is loss of motion of the tongue, face, trunk and extremities on the side of the body opposite the lesion in the brain In complete hemiplegia both arm and leg are powerless; the face is paralysed chiefly in the lower part, while the upper part moves almost as well as on the unparalysed side, and the eye can be shut at will, unlike peripheral facial paralysis (Bell's palsy). The tongue when protruded deviates towards the paralysed side, and the muscles of mastication contract equally in ordinary action, although difficulty arises in eating, from food accumulating between the cheek and gums on the paralysed side Speech is thick and indistinct, and when there is right-sided hemiplegia in a right-handed person, there may be associated various forms of aphasia (*q.v*), because the speech centres are in the left hemisphere of the brain. Some muscles are completely paralysed, others are merely weakened, while others, *e.g.,* the trunk muscles, are *apparently* unaffected

In many cases of even complete hemiplegia, improvement, especially in children, takes place after a few weeks or months, and is generally first indicated by return of movement in the muscles which are habitually associated in their action with those of the opposite unparalysed side; thus, movement of the leg returns first at the hip and knee joints, and of the arm at the shoulder and elbow, although the hand may remain motionless. The recovery, however, in the majority of cases is only partial, and the sufferer is left with a permanent weakness of one side of the body, often associated with contracture and rigidity, giving rise to a characteristic gait and attitude.

According to the part of the brain damaged variations of paralytic symptoms may arise; thus occasionally the paralysis may be limited more or less to the face, the arm or the leg In such case it is termed a *monoplegia,* a condition sometimes arising from cerebral tumour. Occasionally the face is paralysed on one side and the arm and leg on the other (*alternate hemiplegia*); this is because the disease has damaged the motor path from the brain to the leg and arm before it has crossed over to the opposite side, whereas the path to the face muscles is damaged after it has crossed In rare cases both leg, arm and face on one side may be paralysed—*triplegia;* or all four limbs—*bilateral hemiplegia* Infantile spastic paralysis, *infantile diplegia,* is a *birth palsy* caused by injury from protracted labour, the use of forceps or other causes The symptoms are generally not observed until long after birth. Convulsions are common, and the child is unable to sit up or walk long after the age at which it should do so

Paraplegia implies paralysis of the lower extremities; in the great majority of instances it arises from a local or general disease or injury of the spinal cord A localized transverse myelitis will interrupt the motor and sensory paths which connect the brain with the spinal grey matter below the lesion; thus fracture, dislocation and disease of the spinal column (*e g* , tubercular caries, syphilitic disease of the membranes, localized tumours and haemorrhages) may cause compression and inflammatory softening, and the result is paralysis of the voluntary muscles, loss of sensation, loss of control over the bowel and bladder, and a great tendency to the development of bedsores The muscles do not waste except from disuse, nor undergo electrical changes unless the disease affects extensively the spinal grey matter or roots as well as the cerebral path When it does so, as in the case of *acute spreading myelitis,* the symptoms are usually more severe and the outlook is more grave.

In *focal myelitis* from injury or disease, a good measure of recovery may take place by keeping the patient on his back in bed, daily practising massage and passive movements, and so managing the case as to avoid bedsores and septic inflammation of the bladder

Paralysis may also result from acute inflammatory affections of the spinal cord involving the grey and white matter—*myelitis* (*see* NEUROPATHOLOGY)

Infantile or Essential Paralysis.—This is a form of spinal paralysis occurring with frequency in young children; in Scandinavian countries the disease is prevalent and sometimes assumes an epidemic form The names *infantile* and *essential* paralysis were given before the true nature of the disease in the spinal cord was known; the same affection may occur, however, in adults The medical name is *acute anterior poliomyelitis,* because the anterior grey matter of the spinal cord is the seat of acute inflammation, and destruction of the spinal motor nerve path to the muscles. The term *atrophic spinal paralysis* is sometimes employed as indicating the wasting of muscles that results

Infantile paralysis often commences suddenly, and the paralysis may not be observed until a few days have elapsed; the earliest symptoms are fever, convulsions and sometimes vomiting; and, if the child is old enough, it may complain of pains or numbness or tingling in the limb or limbs which are subsequently found to be paralysed It is characteristic, however, of the disease that there is no loss of sensation in the paralysed limb. The whole of the limb is not necessarily paralysed, often it is only a group of muscles, and even if the paralysis affects both legs or the arm and leg on one side, it generally fails in the uniform distribution of paraplegia or hemiplegia The affected muscles rapidly waste and become flaccid, the electrical reactions change, and finally the muscles may cease to respond to electrical stimulation altogether In the less severe cases (and they are the most common) only a group of muscles undergo complete paralysis and atrophy, and there is always hope of some return of power in a paralysed limb Associated with the withered condition of the limb due to the muscular atrophy is an enfeebled circulation, rendering the limb cold, blue and livid; the nutrition of the bones and other parts is involved, so that a limb paralysed in early infancy does

not grow and is shorter than its fellow. Deformities arise, some the result of failing muscular support; others due to permanent changes in the position of the limbs, for example clubfoot. There is absence of bladder and bowel troubles, and bedsores do not occur; the disease itself is rarely, if ever, fatal. About a month after onset of the disease every effort should be made by massage, by suitable positions and passive movements to promote the circulation and prevent deformities in the affected limbs. Should these measures fail, surgical aid should be sought.

Wasting Palsy.—This is a chronic disease characterized by slow and insidious weakness and wasting of groups of muscles from disease of the anterior spinal grey matter. It begins mostly between 25 and 45 years of age, and affects males more than females. Usually it commences in the upper limbs, and the small muscles of the hand are especially liable to be affected. The muscles next most liable to atrophy are those of the shoulder and upper arm, and the atrophy may thence spread to the neck and trunk, and the intercostals and even the diaphragm may be affected, causing serious difficulties of respiration. The lower extremities are less often and later affected. This disease generally runs a slow and progressive course. A characteristic feature is fibrillary twitching of the wasting muscles. The electrical excitability of the muscles is diminished rather than changed, except where the wasting is extreme, when a partial reaction of degeneration may be obtained. Sensation is unaffected. There is no affection of the bowel or bladder. Death usually occurs from intercurrent diseases, *e.g.*, bronchitis, pneumonia or broncho-pneumonia. Some patients die owing to failure of the respiratory muscles; others from the disease spreading to the medulla oblongata (the bulb of the brain) and causing bulbar paralysis. The destruction of spinal motor cells which is the essential pathological feature of this disease is generally accompanied, and sometimes preceded, by degeneration of the path of voluntary impulses from the brain. It is then called *amyotrophic lateral sclerosis,* a rapid form of progressive muscular atrophy.

Bulbar Paralysis.—Various morbid conditions may give rise to a group of symptoms, the principal features of which are paralysis of the muscles concerned in speech, swallowing, phonation and mastication. These symptoms may arise suddenly from vascular lesions or inflammatory processes, which involve the nuclei of origin of the cranial nerves supplying the muscles of the tongue, lips, pharynx and larynx. But there is also a slow degenerative insidious *progressive bulbar paralysis* affecting both sexes pretty equally; it comes on between 40 and 60 years of age, and the cause is unknown. Slight indistinctness of speech is usually the first symptom. Later, owing to paralysis of the soft palate, the speech becomes nasal in character. Sooner or later there is a difficulty of swallowing, and liquids are apt to regurgitate through the nostrils. As the disease proceeds, the laryngeal muscles become affected; the pitch of the voice is lowered and the glottis is imperfectly closed during deglutition; there is consequently a tendency for liquids and food to pass into the larynx and set up fits of coughing. Later the muscles of mastication are affected and the disease may extend to the respiratory centre. The intellectual faculties are as a rule unimpaired, although the facial expression and the curious emotional mobility of the countenance, would suggest weak-mindedness. Whilst the lower half of the face is strikingly affected, the upper half retains its normal expression and power of movement. This disease is usually rapidly fatal.

Bulbar Paralysis Without Anatomical Change.—This condition is also termed "myasthenia gravis"; it differs from acute and chronic bulbar disease by the absence of muscular atrophy, normal electrical excitability of the muscles, marked development of the paralysis by fatigue, and considerable remissions of the symptoms. The bulbar symptoms are the most prominent, but all voluntary muscles are more or less affected.

Paralysis may result further from disease or injury of the motor path to the muscles in the peripheral nervous system.

Neuritis.—Paralysis may arise in a muscle, a group of muscles, a whole limb, the lower extremities, or there may be a generalized paralysis of voluntary muscles as a result of neuritis. A typical example of neuritis giving rise to paralysis owing to inflammatory swelling and compression is afforded by the facial nerve; this purely motor nerve as it passes out of the skull through a narrow bony passage is easily compressed and its function interfered with, causing a paralysis of the whole of one side of the face and *Bell's Palsy.* Exposure to a cold draught in a person with rheumatic diathesis is a frequent cause.

Lead poisoning (*q.v.*) may give rise to a localized neuritis affecting the posterior inter-osseous nerve, especially in painters and in those whose occupations necessitate excessive use of the extensors of the forearm; the result is *wrist drop* or *lead palsy.*

Sciatica and Multiple Neuritis.—*Sciatica* is a painful inflammatory condition of the sciatic nerve, in which there may be weakness of the muscles; but inability to move the limb is more on account of the pain it causes than on account of paralysis of the muscles. Exposure to cold and wet, *e.g.*, sitting on a damp seat, may lead to sciatica in a gouty or rheumatic person.

Multiple neuritis (*see* NEURITIS) is a painful generalized inflammation of the peripheral nervous system and arises in many toxic conditions of the blood; among the most important are lead, arsenic and chronic alcohol poisoning. It also occurs in diabetes, diphtheria and beri-beri (*see* NEUROPATHOLOGY).

Paralysis—termed medically muscular dystrophies—may arise from a primary atrophy of muscle apparently independent of any discoverable change in the nervous system, but due to a *congenital* developmental defect of the muscles. Heredity plays an important part in the incidence of these diseases. There may be a tendency in a family to the affection of one sex and not the other; on the other hand, children of both sexes may suffer in the same family. It is curious that the majority of cases are males, and that it is transmitted by women who are not themselves its subjects.

The muscular dystrophies may be divided into two groups according to the period of life in which the malady manifests itself: (1) Those occurring in childhood; (2) those occurring in youth or adult life. In the first group the muscles may be atrophied or *apparently* hypertrophied. In the latter instance the child looks like an infant Hercules, with abnormally large calves and buttocks, yet it stands with its feet widely separated; waddles along rather than walks; falls easily and rises with difficulty, having to use the hands to push against the floor; it then rests one hand on the knee, and then the other hand on the other knee, and climbs, as it were, up its own thighs in order to assume the erect posture. In this pseudo-hypertrophic form of paralysis, there is little hope of the patient reaching adult life.

Paralysis Agitans, otherwise known as *Shaking Palsy* or *Parkinson's Disease,* this is a chronic progressive disease of the nervous system occurring late in life, and characterized by weakness, tremors and stiffness of the muscles associated with a peculiar attitude and gait. The first sign of the disease is weakness followed by tremor of one hand; this consists of continuous movements of the thumb and forefinger as in rolling a pill, or of movements of the hand like beating a tom-tom; then the other hand is affected, and later there is tremor at the ankle. In some cases there is a continual nodding movement of the head. These tremors are at the rate of five per second and cease during sleep. The attitude and gait are very characteristic; the head is bent forward, and the patient in beginning to walk takes slow steps, which soon become short and quick. The intellect is clear and in marked contrast to the mask-like expression. This disease lasts for years, and but little can be done in the way of treatment.

Treatment.—There are certain principles in the treatment of all forms of paralysis which may be summarized as follows.

1. Rest in bed and attention to the vital functions of the body, the heart's action, the respiratory functions, nutrition and excretion. The pulse is the best guide to the administration of drugs and stimulants. As regards the respiratory function, one of the dangers of paralysis is an intercurrent pneumonia—sometimes unavoidable, often due, however, to attempts to give nourishment to a patient in an insensible state, with the result that some of the fluid enters the bronchial tubes, when either the reflex protective coughing is not excited or is ineffectual. Attention to the

bowels and bladder is most important. A purge at the onset of paralysis is indicated when the pulse is full and of high tension, and the regular action of the bowels is necessary in all conditions. Retention of urine should be carefully avoided, if necessary by the passing of a catheter, but too much emphasis cannot be laid upon the importance of adopting aseptic precautions to avoid infection of the bladder. Daily inspection of the back should be made of all paralysed patients, and precautions taken to keep the skin of all parts exposed to pressure clean; the back should be laved with eau-de-Cologne or spirit to harden the skin. Any sign of a red spot on the back or buttock of the paralysed side should be a warning note of the possibility of a bedsore; zinc powder or ointment should be applied and the effect of pressure on the part be removed if possible by change of posture and by the use of a water-bed. It is important to cover all warm bottles with flannel, for owing to insensibility large blisters, which heal with difficulty, may result. In cases of paraplegia the legs should be covered with warm woollen hand-knitted stockings, and a cradle employed to protect the feet from the continuous weight of the bed-clothes, a fruitful source of foot drop

2. As soon as the acute symptoms have passed off passive movement and massage may be employed with advantage; in some cases electrical treatment is indicated; but as a rule, especially in children, electrical treatment offers the disadvantage of being painful and not accomplishing more than can be effected by massage and passive movements. When the passive movements are being made the patient should be instructed by the operator to will the movement which he is performing, and thus try to re-establish the connection of the brain with the muscles through the point of interruption or by a new path if that is not possible. (F. W. Mo.)

For bibliography *see* Thomas L Houlton, "General Paralysis" (*Archives of Neurology and Psychiatry*), 1927.

PARAMARIBO, the capital of Dutch Guiana or Surinam (*see* GUIANA), in 5° 44′ 30″ N, 55° 12′ 54″ W, 20 m. from the sea on the right bank of the Surinam, here a tidal river nearly a mile broad and 18 ft. deep Pop. (1925), 38,191. Built on a plateau about 16 ft. above low-water level, Paramaribo is well drained, clean and in general healthy. The straight canals, the broad, tree-planted streets, the spacious squares, and the solid public buildings recall Holland.

The Indian village of Paramaribo became the site of a French settlement probably in 1640, and in 1650 it was made the capital of the colony by Lord Willoughby of Parham The town was partly burned down in 1821, and again in 1832

PARAMECIUM (often misspelt Paramaecium, Paramoecium), the slipper animalcule, a genus of aspirotrochous ciliate Infusoria (*q v.*), characterized by its slipper-like shape, common in infusions, especially when they contain a little animal matter. It has two dorsal contractile vacuoles, each receiving the mouths of five radiating canals from the inner layer of the ectosarc, and a large ovid meganucleus, and one or two micronuclei. From its abundance, the ease with which it can be cultivated and observed, its simple structure and large size ($\frac{1}{125}$ in), it is frequently selected for elementary study and demonstration, as well as for research. *P. bursaria* is green, owing to the presence of symbiotic algae.

PARANÁ, a State of southern Brazil, on the Atlantic coast, with the Paraná river as its western boundary line Area, 77,160 sq.m.; pop. (1920) 685,711. It includes two dissimilar regions—a narrow coastal zone, thickly wooded, swampy, and semi-tropical and a plateau (2,500 to 3,000 ft) whose precipitous, deeply eroded eastern escarpments are known as the Serra do Mar, or Serra do Cubatão. The southern part of the State is densely forested and has large tracts of Paraguay tea (*Ilex paraguayensis*), known in Brazil as *herva maté*, or *matte*. The plateau slopes westward to the Paraná river, is well watered and moderately fertile, and has a remarkably uniform climate of a mild temperate character. The larger rivers of the State comprise the Paranapanema and its tributaries the Cinza and Tibagy, the Ivahy, Piquiry, Jejuy-guassú, and the Iguassú with its principal tributary the Rio Negro. Twenty miles above the mouth of the Iguassú are the Iguassú falls, 215 ft. high. The plateau is undulating and the greater part is adapted to agriculture and pastoral purposes. There are two railway systems in the State—the Paranaguá to Curityba (69 m.) with an extension to Ponta Grossa (118 m.) and branches to Rio Negro (55 m.), Porto Amazonas (6 m.) and Antonina (10 m); and the São Paulo and Rio Grande, which crosses the State from north-east to south-west from Porto União da Victoria, on the Iguassú, to a junction with the Sorocabana line of São Paulo at Itarare. The upper Paraná is navigable between the Guayrá, or Sete Quedas, and the Urubu-punga Falls. The chief export of Paraná is Paraguay tea.

There is a large foreign element in the population owing to immigrant colonies on the uplands, and progress has been made in small farming Besides the capital, which is Curityba, the principal towns (with the population of their municipal districts for 1920) are Paranaguá (18,998); Antonina, at the head of the bay of Paranaguá (10,105); Campo Largo, 20 m W of Curityba (19,149); Castro, north-north-west of the capital on the São Paulo and Rio Grande line (18,949); and Ponta Grossa (20,171), at the junction of the two railway systems of the State

Paraná was settled by gold prospectors from São Paulo and formed part of that captaincy and province down to 1853, when it was made an independent province. The first missions of the Jesuits on the Paraná were situated just above the Guayrá Falls in this State and had reached a highly prosperous condition when the Indian slave hunters of São Paulo (called Mamelucos) compelled them to leave their settlements and emigrate in mass to what is now the Argentine territory of Misiones.

PARANÁ, a city and port of Argentina, capital of the province of Entre Ríos, and the see of a bishopric, situated on the left bank of the Paraná river, 410 m. by navigable channels (about 240 m. direct) N W of Buenos Aires Pop. (1914) 36,089 The city occupies a gently rolling site 120 ft above the river and about 2 m from its riverside port of Bajada Grande, with which it is connected by railway, tramway and highway. It is classed as a seaport, and ocean-going vessels of not over 12 ft draught can ascend to Bajada. There is also a daily ferry service across the river to Santa Fé (7 m. distant), which is connected by railway with Rosario and Buenos Aires. Paraná is also the western terminus of a provincial railway system, which connects with Concepción and Concordia, on the Uruguay river, and with other important towns of the province. The mean annual temperature is about 66° F and the climate is bracing and healthful Its port of Bajada Grande, on the river shore below the bluffs, has the custom-house and a fine wharf for the accommodation of the Entre Ríos railway and river craft. Paraná was founded in 1730 by colonists from Santa Fé and was at first known as Bajada. It was made the capital of the province by Gen. Mansilla in 1821, but in 1861 Gen. Urquiza restored the seat of government to Concepción, where it remained until 1882, when Paraná again became the capital. Paraná was also the capital of the Argentine from 1852 to 1861.

PARANAGUÁ, a seaport of the State of Paraná, Brazil, on the southern shore of the Bay of Paranaguá, about 9 m from the bar of the main channel. Pop. of the municipality (1920) 18,998 Paranaguá is the principal port of the State, and is a port of call for steamers in the coastwise trade It is the coastal terminus of a railway running to Curityba, the capital (69 m.), with an extension to the line that connects São Paulo with Uruguay, and a branch to Antonina, 10½ m W of Paranaguá Its exports consist chiefly of *maté*, or Paraguay tea The town was founded in 1560

The Bay of Paranaguá opens into the Atlantic in lat 25° 32′ S through three channels and extends westward from the bar about 19 miles It is irregular in outline, and comparatively shallow Light-draught steamers can ascend to Antonina at the head of the bay. The broad entrance to the bay, which is the gateway to the State of Paraná, is nearly filled by the large Ilha do Mel (Honey island) an old fort commanding the only practicable channel.

PARAÑAQUE, a municipality (with 7 *barrios* or districts) of the province of Rizal, Luzon, Philippine Islands, on Manila bay about 8 m south of Manila. Pop. (1918), 22,121, of whom 16,851 were males (the great disparity between the sexes arising from the soldiers stationed at Camp Tomás Claudio) It has long been famous for its embroidery. In 1918 it had 43 manufacturing

establishments with output valued at 205,800 pesos. Of the seven schools, five were public. The language spoken is Tagalog.

PARANOIA, a chronic mental disease, of which systematized delusions with or without hallucinations of the senses are the prominent characteristics. The delusions may take the form of ideas of persecution or of grandeur and ambition. The disease may begin during adolescence, but the great majority of the subjects manifest no symptoms of the affection until full adult life.

The prominent and distinguishing symptom of paranoia is the delusion which is gradually organized out of a mass of original but erroneous beliefs or convictions until it forms an integral part of the ordinary mental processes of the subject and becomes fused with his personality. This process is known as "systematization."

It is necessary to point out that there is, undoubtedly, what may be called a paranoiac mental constitution, in which delusions may appear without becoming fixed or in which they may never appear. The characteristics of this type of mind are credulity, a tendency to mysticism and a certain aloofness from reality, combined, as the case may be, with timidity and suspicion, or with vanity and pride. On such a soil, given the necessary circumstances, a systematized delusional insanity may develop.

The term paranoia appears to have been first applied by R. von Krafft-Ebing in 1879 to all forms of systematized delusional insanity. The rapid development of clinical study has now resulted in the isolation of a comparatively small group of diseases to which the term is applied and the relegation of other groups resembling it to their proper categories.

Attempts have been made to base a differential diagnosis of paranoia upon the presence or absence of a morbid emotional element in the mind of the subjects, with the object of referring to the group only such cases as manifest a purely intellectual disorder of mind. Though in some cases of the disease the mental symptoms may, at the time of observation, be of a purely intellectual nature, the further back the history of any case is traced, the greater is the evidence of the influence of preceding emotional disturbances in moulding the intellectual peculiarities. Indeed, it may be said that the fundamental emotions of vanity or pride and of fear or suspicion are the groundwork of the disease. It is frequently ascertained that the patients have always been regarded as "queer."

Paranoia is classified for clinical purposes according to the form of delusion which the patients exhibit. Thus there are the Persecutory, the Litigious, the Ambitious and the Amatory types.

1. **Persecutory Paranoia.**—This form is characterized by delusions of persecution with hallucinations of a painful and distressing character. In predisposed persons there is often observed an anomaly of character dating from early life. The subjects are of a retiring disposition, generally studious, though not brilliant or successful workers. They prefer solitude to the society of their fellows, and are apt to be introspective, self-analytical, or given to unusual modes of thought or literary pursuits. Towards the commencement of the insanity the patients become gloomy, preoccupied and irritable. Suspicions regarding the attitude of others take possession of their minds, and they ultimately come to suspect the conduct of their nearest relatives. The conversations of friends are supposed by the patient to be interlarded with phrases which, on examination, he believes to contain hidden meanings, and the newspapers appear to abound in veiled references to him. A stray word, a look, a gesture, a smile, a cough, a shrug of the shoulders on the part of a stranger are apt to be misinterpreted and brooded over. The extraordinary prevalence of this imagined conspiracy may lead the patient to regard himself as a person of great importance, and may result in the formation of delusions of ambition which may wholly supplant the persecutory insanity.

Hallucinations may begin to appear. These, in the great majority of instances, are auditory, and usually commence with indefinite noises in the ears, such as ringing sounds, hissing or whistling. Gradually they assume a more definite form, until isolated words and ultimately formed sentences are distinctly heard. A not uncommon form of verbal hallucination is formulated in the complaint of the patients that "all their thoughts are read and proclaimed aloud." Though some of the subjects do not develop any other form of hallucination, others suffer from hallucinations of taste, smell or touch. The misinterpretation of subjective sensations in these sense organs leads to the formulation of delusions of poisoning or of being subjected to the influence of noxious gases or powders.

During the course of a disease so distressing in its symptoms the patient's suspicions as to the authors of his persecution vary much in indefiniteness. He often never fixes the direct blame upon any individual, but refers to his persecutors as "they" or a "society," or some corporate body such as "lawyers," "priests" or "freemasons." It not infrequently happens that suspicions gradually converge upon some individual, or that from an early stage of the disease the patient has fixed the origin of his trouble upon one or two persons. When this takes place the matter is always serious from the point of view of physical danger to the inculpated person.

The persecutory type of the disease may persist for an indefinite period—even for 20 or 30 years—without any change except for the important fact that remissions in the intensity of the symptoms occur from time to time. These remissions may be so marked as to give rise to the belief that the patient has recovered, but in true paranoia this is hardly ever the case.

2. **Ambitious Paranoia.**—After a long period of persecution a change in the symptoms may set in, in some cases, and the intensity of the hallucinations may become modified. At the same time delusions of grandeur begin to appear, at first faintly, but gradually they increase in force until they ultimately supplant the delusions of persecution. At the same time the hallucinations of a disagreeable nature fade away and are replaced by auditory hallucinations conformable to the new delusions of grandeur.

The emotional basis of ambitious paranoia is pride, and every phase of human vanity and aspiration is represented in the delusions of the patients. There is, moreover, considerably less logical acumen displayed in the explanations of their beliefs by such patients than in the case of the subjects of persecution. Many of them affect to be the descendants of historical personages without any regard for accurate genealogical detail. They have no compunction in disowning their natural parents or explaining that they have been "changed in their cradles," in order to account for the fact that they are of exalted or even of royal birth. The sphere of religion affords an endless field for the ambitious paranoiacs, and some of them may even aspire to Divine authority.

A not uncommon form of paranoia, combining both ambition and persecution, is where the subject believes that he is a man of unbounded wealth or power, of the rights to which he is, however, deprived by the machinations of his enemies. They are often so troublesome, threatening and persistent in their determination to obtain redress for their imagined wrongs, that they have to be forcibly detained in asylums in the public interest.

On the whole, however, the ambitious paranoiac is not troublesome, but calm, dignified, self-possessed, and reserved on the subject of his delusions. He is usually capable of reasoning as correctly and of performing work as efficiently as ordinary people.

3. **Amatory Paranoia.**—A distinguishing feature of this form of paranoia is that the subjects are chivalrous and idealistic in their love. Some of them believe that they have been "mystically" married to a person of the opposite sex, usually in a prominent social position. The fact that they may have never spoken to or, perhaps, never seen the person in question is immaterial. The conviction that their love is reciprocated and the relationship understood by the other party is unshakeable, and is usually based upon suppositions that to a normal mind would appear either trivial or wholly unreal. The object of affection, if not mythical or of too exalted a position to be approached, is not infrequently persecuted by the admirer, who takes every opportunity of obtruding the evidences of an ardent adoration.

Closely allied, if not identical with, amatory paranoia, is the form in which jealousy forms the basis of morbid suspicions with or without definite delusions. The subjects are extraordinarily assiduous in watching the objects of their jealousy.

Their conduct is fertile in producing domestic unhappiness, and in the case of unmarried persons in creating complicated or delicate situations.

4. **Litigious Paranoia** (*paranoia querulans*).—The clinical form of litigious paranoia presents uniform characteristic features which are recognized in every civilized community. It is important to observe that the rights such people lay claim to, or the wrongs they complain of, may not necessarily be imaginary. But, whether imaginary or real, the statement of their case is always made to rest upon some foundation of fact, and is, moreover, presented, if not with ability, at any rate with forensic skill and plausibility. As the litigants are persons of one idea, and only capable of seeing one side of the case—their own—and as they are actuated by convictions which preclude feelings of delicacy or diffidence, they ultimately succeed in obtaining a hearing in a court of law under circumstances which would have discouraged any normal individual. Neither the loss of the case nor the payment of heavy expenses has any effect in disheartening the litigant, who carries his suit from court to court until the methods of legal appeal are exhausted. After dissipating his means and, perhaps, those of his family, and finding himself unable to continue to litigate to the same advantage as formerly, delusions of persecution begin to establish themselves. He accuses the judges of corruption, the lawyers of being in the pay of his enemies, and imagines a conspiracy to prevent him from obtaining justice.

Paranoia is generally a hopeless affection from the point of view of recovery. From what has been stated regarding its genesis and slow development it is apparent that no form of ordinary medical treatment can be of the least avail in modifying its symptoms The best that can be done in the interests of the patients is to place them in surroundings where they can be shielded from influences which aggravate their delusions and to make their lot as pleasant and as easy to endure as possible.

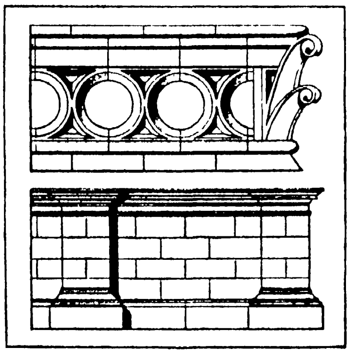
As has been frequently stated, the subjects of most forms of paranoia are liable to commit crime, usually of violence, which may lead to their being tried for assault or murder The question of their responsibility before the law is therefore one of the first importance (*see* also INSANITY: *Law*) The famous case of McNaghten, tried in 1843 for the murder of Drummond, private secretary to Sir Robert Peel, is, in this connection, highly important, for McNaghten was a typical paranoiac and his case formed the basis of the famous deliverance of the judges in the House of Lords in the same year, on the general question of criminal responsibility in insanity in which it was held that such an offender might be regarded as sane, save on one subject, and should, therefore, be held accountable for his acts—a conclusion quite at variance with that of modern medical science

The true paranoiac is a person of an anomalous mental constitution apart from his insanity; although he may, to outward appearances, be able, on occasion, to converse or to act rationally, the moment he is dominated by his delusions he becomes, not partially, but wholly insane; when, in addition, his mind is distracted by ideas of persecution or hallucinations, or both, he becomes potentially capable of committing crime, not because of any inherent vicious propensity but in virtue of his insanity. There is, therefore, no middle course in respect to the criminal responsibility of paranoiacs; they are all insane wholly, not partially, and should only be dealt with as persons of unsound mind

See Bianchi, *Textbook of Insanity* (Eng. trans., 1906); Clouston, *Mental Diseases;* Krafft-Ebing, *Textbook of Insanity* (American trans., 1904), Kraepelin, *Psychiatrie* (Leipzig, 1899); Magnan, *Le Délire chronique* (Paris, 1890); Stewart Paton, *Psychiatry* (Philadelphia, 1905); Percy Smith, "Paranoia," in *Journ of Mental Science*, p. 607 (1904), O. Kant, *Beitrage z Paranoiaforschung*, etc *vergleichende Analyse u forensischer Ausblick,* Ztschr f d ges Neurol u Psychiat., 110, 558, bibl. (1927); J. Levy-Valensi, *La constitution paranoiaque*, Progrès méd., 42, 549 (1927); Genil-Perrin, *Les paranoiaques*, bibl. (Paris, 1926); M Nathan, *Des idées actuelles sur la paranoia*, Presse méd., 33, 1,653, bibl. (1925); E. Rétif, *Remarks on the Psychology of Paranoia*, Inter. Clin. (1925); P. Nayrac, *La démence paranoiae*, bibl (Paris, 1924); E Kraepeter, *Manic-depressive Insanity and Paranoia*, bibl (Edinburgh, 1921). (J Mn.)

PARANTHELIA, an image in the parhelic circle situated from 90° to 140° of parhelic arc from the sun. *See* also HALO

PARAPET, a dwarf wall or heavy railing around the edge of a roof, balcony, terrace, stairway, etc., either to prevent those behind it from falling over, or to shelter them from attack from the outside. Thus battlements (*q.v.*) are merely one form of defensive parapet arranged to allow those within to discharge missiles without exposing themselves. In many cases roof and terrace parapets are only continuations of the wall below, but in some instances they are projected forward beyond the face of the wall and carried upon brackets or a moulded cornice Parapets, during the classic ages, were often formed of large slabs of marble pierced with holes, forming a pattern of squares and diagonals; an example still exists in the ruins of the palace of Tiberius on the Palatine hill at Rome. Parapets with fish-scale patterns were also used and are indicated in extant wall paintings in Pompeii. English late Gothic parapets frequently adopt the battlement form During the Renaissance, the use of the balustrade largely superseded the parapet, but in north Europe, the transitional early Renaissance styles offer many examples of fantastically scrolled and pierced parapets



TOP· FRENCH GOTHIC, 13TH CENTURY: BOTTOM RENAISSANCE

PARASELENAE or **MOCK MOON,** a bright spot on a lunar halo resembling the moon A number of these reflections of the moon appear at the intersection of the inner halo and the parhelic circle. *See* also HALO.

PARASITIC DISEASES. It has long been recognized that various specific pathological conditions are due to the presence and action of parasites (*see* PARASITISM) in the human body, and during the last 50 years the part played in the causation of the so-called infective diseases by various members of the schizomycetes or fission fungi has been widely and thoroughly investigated. During the past 20 years many diseases have been ascribed to filter passing viruses. Below are given lists of the principal morbid conditions ascribed to these two groups of causes:

A.—Morbid conditions affecting man due to vegetable parasites: Suppuration, septicaemia, infective endocarditis, erysipelas, gonorrhoea, soft chancre, nasal catarrh, pneumonia, acute rheumatism (?), cholera, typhoid fever, paratyphoid fevers, epidemic diarrhoea, bacillary dysentery, malta fever, plague, diphtheria, tetanus, anthrax, influenza (?), tuberculosis, glanders, leprosy, epidemic cerebro-spinal meningitis, dental caries, tularaemia, actinomycosis and other streptothricoses, aspergillosis, favus and other skin diseases, whooping cough

B.—Morbid conditions affecting man due to filter-passing viruses. yellow fever, rabies, vaccinia, variola, dengue, sandfly fever, trachoma, poliomyelitis, measles (?), typhus fever, trench fever, mumps (?), herpes labialis, influenza (?), common colds

Discussion of the general relation of vegetable parasites to disease is contained in articles on BACTERIA; IMMUNITY; VACCINE THERAPY; and of filter-passing viruses in FILTER-PASSING VIRUSES In this article the part played by protozoal and other animal causes of disease is considered

MORBID CONDITIONS DUE TO ANIMAL PARASITES

Introductory.—Animal parasites are invertebrate animals which have abandoned their free-range life and have taken up their abode in or upon the living bodies of other animals or plants Freedom has been exchanged for a more constant and usually richer supply of food and a greater measure of protection

The term "parasite" connotes habitat rather than zoological grouping (*see* PARASITISM; PARASITOLOGY). Several of the main subdivisions of the animal kingdom contain both free-living and parasitic forms but with the specialised parasitic method of living certain physiological and morphological adaptations have often resulted which have rendered a free existence no longer possible. All gradations exist from the raiders which are parasitic only

which cannot now survive if separated from their "host." Many forms which as adults are obligatory parasites still have a free-living larval phase in an invertebrate during the free larval development. The animal in which the adult stage of a parasite is attained is termed the "definitive host." That in which an immature or "larval" stage develops is called the "intermediate host." Some parasites have no free stage or intermediate host. Some have a free stage without intermediate host and others have two successive intermediate hosts through which they must pass before reaching adult life in the definitive host. A knowledge of these developmental phases is obviously of great importance in preventive medicine, for the control of a disease in a community may be attained more readily by destroying the essential intermediate hosts than by stamping out the disease in the members of the community. Climatic conditions limit the spread of parasites by acting upon the free-living stages, *e.g.*, hookworm development is controlled by temperature and only occurs in warm climates. The effect may be indirect by action upon the intermediate host.

The vast majority of internal parasites inhabit the alimentary canal or ducts leading thereto. This indicates probably the original as well as the present route of invasion of most parasites. Oral infection is from food, seldom from water. But in a few striking cases infection enters not by the mouth but by penetrating the skin, as in Bilharziasis (*q.v.*). In some instances penetration follows injection by some insect which has previously sucked up an earlier stage of larval development from another animal.

Animal parasites belong either to the unicellular Protozoa or to the multicellular (metazoan) invertebrates. Protozoan parasites can multiply in their definitive hosts and produce enormous numbers but in the metazoan parasites successive generations do not follow the attainment of sexual maturity in the definitive host. Here the progeny (eggs or embryos) must leave the host body and undergo some part of their larval development outside, or in an intermediate host, before the infective stage is reached when the definitive host can again be parasitized. As the majority of the Metazoa live in the gut, the eggs appear most frequently in the bowel discharges. Microscopical examination of the stools has become therefore an important routine in the detection of infection with animal parasites. Intestinal infections with protozoal forms can be diagnosed similarly from the passage of free or encysted stages of these organisms.

Animal parasites affect their hosts by absorbing nourishment, by feeding upon the living tissues or cells, by mechanical injury or obstruction, and by the poisonous effect of their excretions and secretions. Different species affect their hosts in varying degree. In some cases the effect is so slight that the parasite appears to be almost a commensal. Parasitism differs from commensalism in that the host does not benefit, in turn, from the presence of the parasite. But it should be noted that it is not in the interests of a parasite that great harm should result to the host from its presence. A certain amount of tolerance, *i.e.*, of acquired immunity, develops in the host.

Within the definitive host the normal habitat of each parasite is usually strictly limited to some special organ or tissue. The malaria parasites for instance invade the red blood corpuscles. The trypanosomes live in the fluid of the blood. Some species of fluke live in the gut, others in the bile ducts (Plate fig. 10) and others again in the lung (Plate fig. 11). Adult tape worms almost without exception are inhabitants of the gut while in their larval stages they infest the solid tissues of the body. Round worms are mainly intestinal in habitat but some live in the tissues, producing tumours, others in the lymphatic and haemal systems, while one of the largest invades the kidney. (Plate fig. 7.)

PARASITIC PROTOZOA

The Protozoa (*q.v.*) are classified in four main groups based on the method of locomotion adopted by the organism. The first group, Sarcodina, move by means of pseudopodia, or extrusions of the body-wall, towards and into which the remainder of the body flows, e.g., *Amoeba*. The second group, the Flagellata, which possess a more definite body-shape, move by means of one or more long, very slender lash-like organs, which, by their rapid movement, drag the body through the surrounding medium, e.g., Trypanosomes. Thirdly the Ciliata possess a fur-like coating of short, very fine out-growths, the cilia, which, by their rhythmical wave-like motion, propel the body. The fourth group, the Sporozoa, form a heterogeneous group of organisms, all of which are parasitic. The adult stages possess no means of locomotion and they reproduce by spore-formation. In many of the Sporozoa the developmental forms have some power of movement, which may be effected by pseudopodia or by flagella, indication that the loss of movement is due to the parasitic mode of life.

This form of classification is beset with many difficulties, as, for example, that some of the Protozoa adopt different means of locomotion at different periods of their existence. Owing to the diversity present in the group and in the primary divisions or classes, numerous subdivisions have been formed within each class.

Protozoa of the Alimentary Canal.—The pathogenic Protozoa inhabiting the alimentary canal of man and other vertebrates include representatives of all four groups. Of the Sarcodina *Entamoeba histolytica,* the causative organism of amoebic dysentery is the most important. Infection is caused by the ingestion of faeces containing cysts of the amoeba. These hatch and liberate the amoebae into the intestine where they penetrate the walls, breaking down and consuming the tissue, and cause ulcers. Occasionally they may be carried in the blood-stream to the brain or liver, causing the formation of abscesses. Some of the amoebae round up, secrete a resistant wall and pass out of the body in the faeces, ready, if reingested, to create a new infection. *Entamoeba gingivalis* is parasitic in the human mouth and has been associated with tonsilitis and pyorrhoea but is probably entirely harmless. Cysts are not known but the mode of transmission is probably contaminative.

Of the intestinal Flagellata only one species appears to be pathogenic. *Giardia intestinalis,* frequently associated with diarrhoea, is an eight-flagellated organism, which is also provided with a large sucker by which it clings to the intestinal epithelium. It passes out of the body in the form of cysts and is transmitted by the contamination of food with faeces.

The only ciliate pathogenic to man is *Balantidium coli,* which, like *Entamoeba histolytica,* penetrates the walls of the intestine causing ulceration and giving rise to dysenteric conditions. This form also produces cysts which are passed out of the intestine.

The most important sporozoan parasites of the alimentary canal of vertebrates are the Coccidia. These form a widely distributed group of parasites which attack almost all mammals and many of the lower vertebrates and invertebrates. Most species cause denudation of the intestinal epithelium, while a few invade the epithelium of the bile-ducts causing functional disturbance of the liver. Only one species, *Isospora hominis,* is parasitic in man, and this has a very limited distribution and is not of great pathogenicity. *Eimeria zurnii* is the cause of epidemics of red dysentery in cattle. *E. faurei* and *E. arloingi* infect sheep and goats respectively. Dogs and cats harbour other species of *Eimeria* and the allied genus *Isospora.* Two species of *Eimeria* infect the rabbit. Poultry and game birds are also attacked.

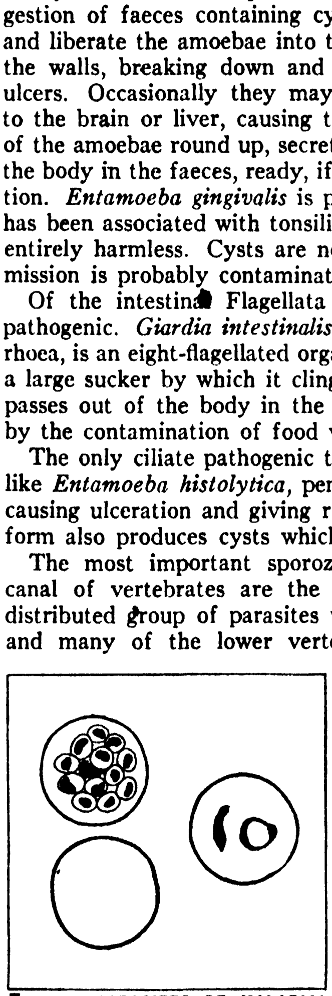


FIG. 1.—PARASITES OF MALARIAL FEVER IN PERIPHERAL BLOOD

The parasites are transmitted by resistant stages, the oocysts. These when mature contain sporozoites which hatch out on entering the intestine and make their way into the epithelial cells or travel up the bile-duct. Within the cells they multiply rapidly by an asexual process, producing merozoites. At the same time sexual forms are developed, the females after fertilization being passed out of the body in the form of resistant oocysts. Outside the body development proceeds, resulting in the formation of sporozoites within the oocysts. When this development is completed the oocysts are infective if ingested by a new host.

Protozoa Inhabiting the Blood and Tissues.—These are both numerous and important. Only a few can be dealt with.

Malaria.—Plasmodium, the causative organism of malaria (*q.v.*), is represented by three species parasitic in man. Several other varieties are known to attack other mammals. The parasites live in the red blood corpuscles, where they grow, form a pigment, and finally divide up into a number of small bodies which are liberated by the breaking down of the containing corpuscle. These small bodies, the merozoites, then penetrate other blood-corpuscles and again grow and divide, thus repeating the asexual cycle indefinitely. Since each cycle takes a definite time for its completion, the pigment formed by the parasite is liberated into the blood at regular intervals, and by its toxic action fever is set up. Some of the merozoites develop into sexual forms which circulate in the bloodstream without further development until they are ingested by a female anopheline mosquito. Fusion of the sexual elements takes place in the stomach of the mosquito and the resultant organism passes into the body-cavity where it forms a cyst. Within this cyst numerous small, spore-like bodies (sporozoites) develop. These make their way into the salivary glands of the mosquito, and, at the next feed are injected into the wound creating a fresh infection. The three species of *Plasmodium* causing human malaria are distinguishable by microscopic examination in all their stages. Further, while *P. vivax* and *P. falciparum* complete the asexual cycle in 48 hours, causing tertian fever, *i.e*, fever recurring every third day, *P. malariae* develops more slowly and produces quartan fever, *i e.*, fever recurring every fourth day.

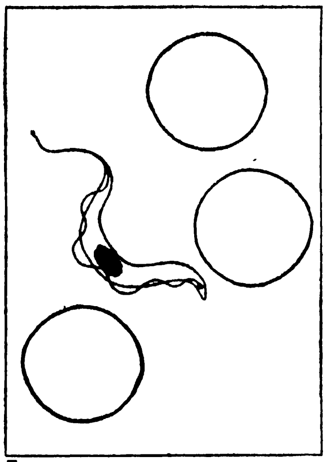


FIG 2 —PARASITE OF SLEEPING SICKNESS IN PERIPHERAL BLOOD

Trypanosomes and Sleeping Sickness.—Trypanosomes, the causative organisms of sleeping sickness (*q.v*) in man and similar diseases in cattle and game in Africa, are flagellate parasites which inhabit chiefly the liquid portion of the blood. They consist of an elongated, flattened, binucleate body, one edge of which forms an undulating membrane, the outer margin of which is supported by a flagellum which either becomes free at the anterior end or terminates with the membrane.

The life-cycle is passed partly in the mammalian host and partly in the gut of a blood-sucking insect, the transmittor. In African sleeping sickness the trypanosome, *T. gambiense* or *T. brucei,* is injected into the blood-stream of the definitive host, where it multiplies with great rapidity, by the bite of a tse-tse fly. Some of the trypanosomes eventually make their way into the cerebro-spinal fluid, where they produce the symptoms of the disease The ingested trypanosomes pass into the mid-gut of the fly where multiplication takes place and the resulting flagellates, the infective forms, pass forward into the salivary glands from which they are ejected at the next feed to recommence the cycle in the definitive host. Other species of African trypanosomes differ slightly in their life cycle and mode of transmission

Chagas's disease, prevalent among children in South America, is transmitted by certain bugs, the faeces of which are infective when rubbed under the skin. The trypanosomes multiply in the tissues of the body where non-flagellate stages occur.

Leishmania Donovani and Leishmania Tropica.—Kála-ázar, a disease widely distributed in India, China, Russia, Africa and the Mediterranean littoral, is caused by a flagellate parasite, *Leishmania donovani,* which has recently been shown to be transmitted by a species of sand-fly. The disease attacks chiefly children and young adults and is caused by the parasites invading the cells constituting the walls of the capillary blood-vessels in the bone-marrow and glands of the body. The parasite as seen in the definitive host is a minute, rounded, non-flagellate body, containing two nuclei which differ from one another in form, one being rod-shaped, the other rounded. These bodies multiply by fission within the host-cells which become packed with parasites. The organisms then escape and enter other cells in which reproduction is continued. Many find their way into the white blood corpuscles and circulate in the peripheral blood, with which they are taken up by bloodsucking insects In the sand-fly they become flagellated. The body elongates and a single long flagellum, arising from the neighbourhood of the rod-shaped nucleus, extends anteriorly, free of the body. Within the intestine and pharynx these flagellates reproduce by longitudinal fission and give rise to forms infective to man

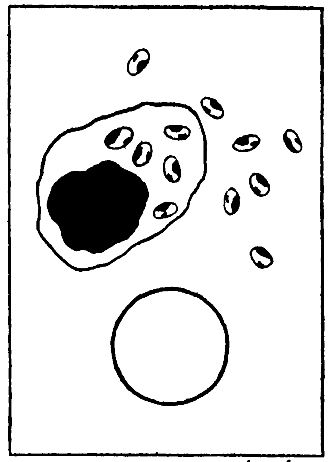


FIG. 3.—PARASITE OF KÁLA-ÁZAR IN SPLEEN SMEAR

L. tropica, while being morphologically identical with *L. donovani,* produces an infection that is limited to the skin and the mucosa of the nose, throat and mouth, where it produces ulcerating sores. This parasite occurs in the New as well as the Old World It also is probably transmitted by a species of sand-fly.

The Spirochaetes —The spirochaetes are microscopic organisms with slender, thread-like, spirally twisted bodies. Movement is effected by wave-like motions of the flexible body, often accompanied by rotation. Their inclusion among the Protozoa is of doubtful validity, for, although they exhibit some protozoal characters, they seem more closely allied to the Bacteria

Spirochaetes occur in the intestines and blood of man and most domestic animals In the latter they are usually non-pathogenic, but in man, when they invade the blood-stream and internal organs, they give rise to various diseases *Treponema recurrentis,* the parasite of relapsing fever (*q v.*), prevalent in Africa, Asia and America, is transmitted by lice and ticks to the human bloodstream *Treponema pallidum,* the causative organism of syphilis (*see* VENEREAL DISEASES), is a tissue parasite, as also are the spirochaetes associated with yaws and acute infective jaundice The latter is thought to be transmitted by water contaminated by the urine of naturally infected rats Rat-bite fever, a disease following the bite of rats, or other small mammals, is due to an organism, *Spirillum minus,* which occurs in the mouths of these animals

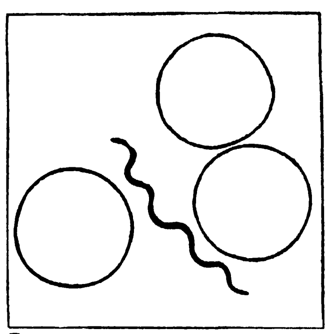


FIG. 4.—PARASITE OF RELAPSING FEVER IN PERIPHERAL BLOOD

PARASITIC METAZOA

If we omit the insects which as occasional raiders for food act unwittingly as vectors of animal parasites (*see* ENTOMOLOGY, MEDICAL) and other arthropods, which are more permanent parasites of the skin, inducing irritation diseases such as pediculosis and scabies, the chief metazoan parasites are those commonly termed "parasitic worms." It should be noted, however, that the term "worm" is used very loosely for a large variety of animals which are, zoologically, unrelated: the "blind-worm" or "slow-worm," "glow-worm," "round-worm," "wire-worm," "tape-worm" and "earth-worm" belong to different subdivisions of the animal kingdom The parasitic worms found in animals belong either to the phylum Nemathelminthes or to the phylum Platyhelminthes (*qq.v.*).

Nemathelmia.—The phylum Nemathelmia (round-worms) contains three classes:—(*a*) Nematoda (*q v*) (round-worms with a well developed gut), (*b*) Nematomorpha (*q v*) (round-worms

with gut which atrophies in the adult) and (*c*) Acanthocephala (*q.v.*, thorn-headed round-worms in which the gut is entirely absent). Of these the class Nematomorpha contains relatively unimportant forms which parasitise arthropods. The Acanthocephala are mainly intestinal parasites of birds and fishes. A few species infest mammals.

Nematodes and Disease.—The class Nematoda is, however, by far the most important division of the Nemathelmia. It contains many thousand species of which a considerable proportion are free-living in the soil and decaying organic matter. Specialized species are found in malt vinegar and paper-hangers' paste. All these forms are of microscopic size. Closely allied to them is a small group which is parasitic in many cultivated plants (Plate, fig. 4), *e.g.*, potato, tomato, clover, wheat, oats, tulip, onion, etc., and cause considerable economic losses in Great Britain. On the European continent the sugar-beet is severely attacked, while in the Tropics coffee, bananas, oranges, rice and tobacco are frequently infested by allied "nemas" or "eel-worms."

Nematodes occur in practically all vertebrate animals. These round-worms are usually of larger size than those found free-living or in the cultivated plants and may attain a length of two to three feet, *e.g.*, *Dracunculus medinensis*, the Guinea worm (*q.v.*). The nematodes are unisexual, *i.e.*, there are separate males and females. The eggs are simple and such yolk as may be present is incorporated as globules in the protoplasm of the ovum. Larval development in the various species is essentially the same and proceeds by a series of metamorphoses marked by ecdyses. Some of these changes occur during the period of delay outside the body after the passage of the egg or embryo from the definitive host. The remainder occur after reinfection. In some cases the extra-corporeal phase is undergone within the thick egg-shell as in the round-worms of dogs, cats, pigs and man. Infection results from the swallowing of these embryonated eggs as contaminations of food. In numerous other cases, however, as in the large group of so-called "bursate" nematodes (which include the hookworm of man and the red-worms of horses) the egg-shell is thin and the developing embryo emerges therefrom. After a short period outside the body, the hatched worm undergoes its further metamorphosis into the infective stage as a microscopical form in the soil, to re-enter its host later by the mouth. In a few instances reinfection of the definitive host is accomplished by the penetration of the skin as in hookworm disease (*q.v.*).

In a third group of nematodes, viz., those which live in the tissues of the body and are commonly called filarial worms, the embryos are discharged into the lymph or blood and are sucked up by biting insects. In the bodies of these insects the same essential metamorphosis takes place and the infection subsequently re-enters another definitive host through insect bites.

In a fourth group larval development takes place in an intermediate host eaten by the definitive host, *e.g.*, *Trichinosis* (*q.v.*).

After gaining entry into the definitive host either by the mouth or through the skin, the larval nematodes in some cases, not in all, undergo strange migrations through the blood stream to reach their final habitat and during the course of these wanderings they may give rise to serious damage. Heavy losses are incurred in young pigs as result of pneumonia set up by the migration through the lungs of the young stages of the common round-worm *Ascaris suilla*. There is a similar migration on the part of young hookworms *en route* from the skin to the bowel, but there is relatively less damage as the number passing at a time is usually small and the associated symptoms are merely a transient cough. Similarly urticarial irritation is induced when large numbers of hookworm larvae penetrate the skin at the same time.

For detailed technical information concerning the morphology and classification of the parasitic nematodes reference should be made to the well illustrated volume by Warrington Yorke, *The Nematode Parasites of Vertebrates.* Mention can only be made here of a few forms which are associated with disease in man and the lower animals. One of the most interesting of these is the *Filaria bancrofti*, a delicate thread-like worm which lives in the lymphatic vessels and is reputed to be the cause of a number of different diseases in man which have been grouped together under the term filariasis (*q.v.*). Some of these diseases are due to the damage done by the worm to the lymphatic wall, others are attributable to secondary invasion of these damaged lymphatics by streptococcic germs. The young of this parasite appear in large numbers in the peripheral blood stream at night and disappear during the day time. Manson showed that this rhythmic appearance was associated with the habits of the intermediate host—a night-biting mosquito—*culex fatigans*, in the thoracic muscles of which the essential larval development takes place. An allied filarial worm *Dirofilaria immitis* inhabits the right side of the heart of the dog (Plate, fig. 8). This parasite is especially common in China but occurs also in Italy and South America and is spread by a mosquito. In natives of West Africa worms frequently cause conjunctivitis. They belong to the species *Loa loa* and are transmitted from man to man by a day-biting insect of the genus *Chrysops.* In this case the young worms appear periodically in the blood, but during the day only, in strange compliance with the day-biting habits of the insect vector. Closely allied to the filarial worms are the nodule worms of the genus *Onchocerca.* These worms produce tumours sometimes of the size of a walnut in the tendinous attachments of muscles. Such tumours are common in man in certain parts of tropical Africa, especially in the Congo. The young of these worms congregate in the deeper layers of the skin whence they are sucked up by midges of the genus *Simulium.*

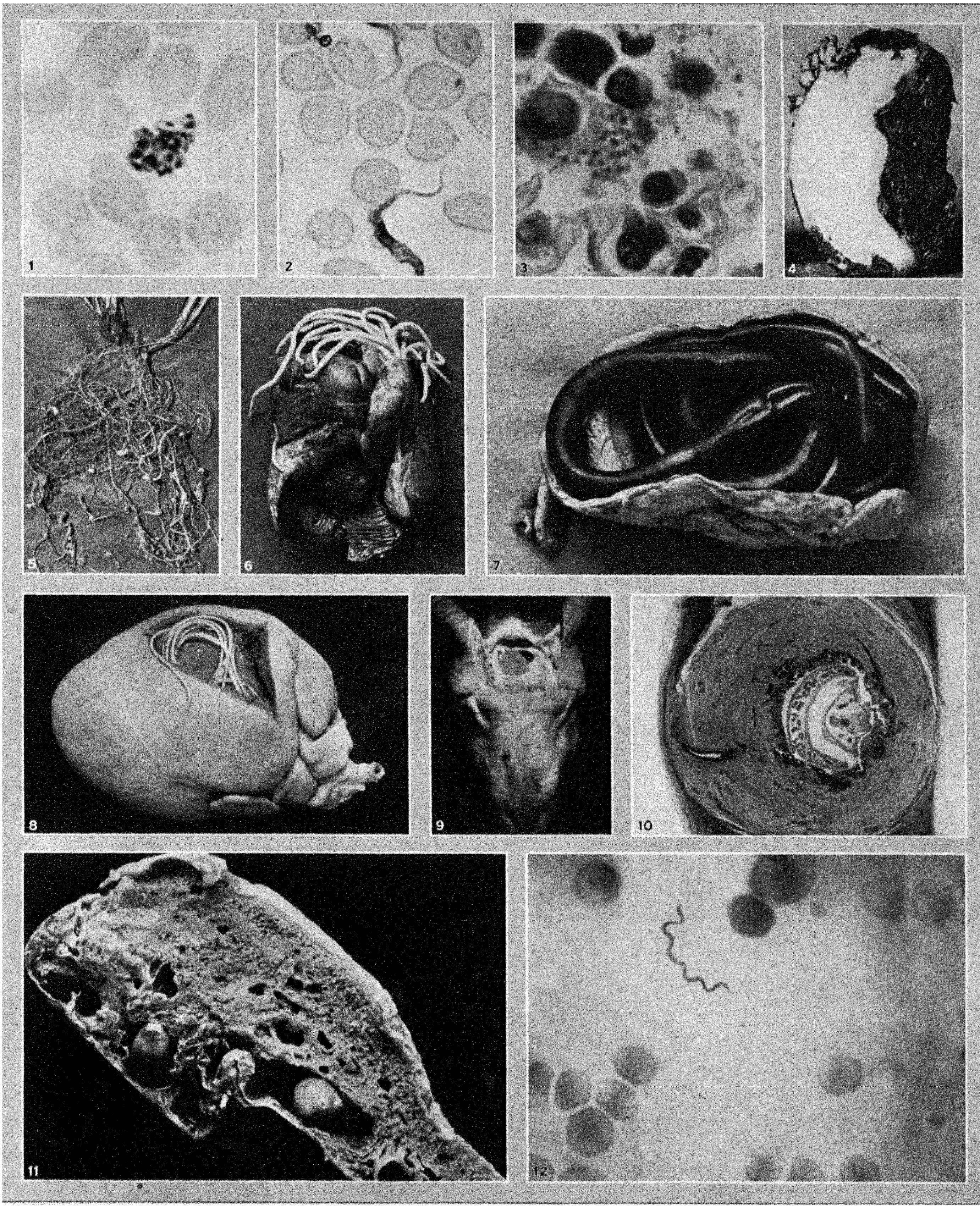
The hookworms of man, of which there are two species, are relatively short nematodes measuring about half an inch in length. They inhabit the small intestine, usually the jejunum, and attach themselves by means of teeth or cutting oral plates. The bites of these worms result in a considerable loss of blood and when numerous worms are present anaemia may result. It has been estimated that 90% of the inhabitants in many tropical countries are infested by hookworm. Many of these, however, show few symptoms of disease owing to an acquired tolerance. Related to the hookworm is the gape-worm of poultry. *Syngamus trachealis* lives, as its name indicates, in the wind-pipe. It is a common cause of death in young chickens and pheasants, partly through the obstruction of the air passage, partly from the abstraction of blood upon which the worms feed. Adult birds practically never harbour the worms. Turkeys and starlings are frequently infected by this parasite without suffering to any extent. It is suspected that they are the chief reservoirs of the infection.

Many different species of round-worms, somewhat more distantly related to the hookworm, live in the gut and lungs of sheep, goats, cattle and horses. Many of these probably do little harm but the results of massive infection with several species show themselves in general loss of condition and of body weight and in increased susceptibility to bacterial disease.

Platyhelmia.—The Platyhelmia (or flat-worms) contain three classes:—(*a*) Turbellaria (*q.v.*), *i.e.*, planarians; usually free living forms but a few species are parasitic in molluscs. (*b*) Trematoda (*q.v.*), or flukes, parasitic in or upon vertebrates, and (*c*) Cestoda (tape-worms, *q.v.*), parasitic in vertebrates.

The Platyhelmia are hermaphrodite, are leaf-like or pear shaped, and, in the case of the Cestoda, tape-like in outline. Turbellaria are distinguished morphologically by the presence of numerous cilia on the surface of the body. They probably provided the ancestor of the trematodes, but are otherwise of little interest in relation to animal parasites and disease. A few parasitize molluscs. The Trematoda and Cestoda are covered with a cuticular skin which may or may not be clothed with spines of similar material. The Trematoda are distinguished morphologically from the Cestoda by the presence of a gut which ends blindly. The Cestoda have derived from the Trematoda and may be regarded as a degenerate branch.

Trematoda and Disease.—The trematodes generally inhabit the alimentary canal. A few forms occur in the bile ducts and in some of the birds an occasional species has adapted itself to live in the conjunctival sac and the generative passages. The highly specialized group of flukes to which the bilharzial worms belong live in the blood stream. Other small groups inhabit the mouth, lung and air passages. The flukes give rise to composite eggs containing within the shell masses of yolk-cells in addition to the ovum.



EXAMPLES OF PARASITES OCCURRING IN ANIMALS AND VEGETABLES

1. Tertian malaria rosette in peripheral blood. 2. Causative organism of sleeping sickness (*Trypanosoma gambreuse*) shown in peripheral blood. 3. Kala-azar spleen smear showing the parasite *Leishmania donovani* which causes the disease characterized by enlargement of the spleen, anemia and leukopenia. 4. Potato showing rot associated with eelworm. 5. Root-knot due to eelworm. 6. Gall bladder of a pig showing Ascaris parasite. 7. A round worm (*Eustrongylus gigas*) in a kidney. 8. Heart of a dog showing invasion of *Dirofilaria immitis*. 9. Tape worm cyst (*Coenurus cerebralius*) in head of a sheep. 10. Section of liver of a sheep showing liver flukes, a classification of flat worms. 11. Section of lung of tiger showing Asiatic fluke (*Paragonimus westermanni*). 12. *Spirochaeta duttoni*, organism causing relapsing fever

The vast majority of flukes, including all those of medical importance, require for their larval development a mollusc as intermediate host. The egg, when discharged from the definitive host, usually takes several days or weeks in water to hatch. A ciliated larva emerges which proceeds to its further development by attacking a specific mollusc. Within this mollusc, larval development proceeds. By asexual multiplication large numbers of infective larvae, technically called cercariae, are produced. These cercariae are discharged from the mollusc into water whence they reach the definitive host either (*a*) by direct penetration of the skin, as in the case of *Bilharzia,* (*b*) by encystment on plants which are edible, as in the case of the liver fluke of the sheep, or (*c*) by penetration and subsequent encystment in edible fishes, in crabs, or in mosquito or other insect larvae, or in other molluscs.

For a discussion of the intricacies of trematode morphology and classification the reader should refer to the recent monograph by Poche, *Das System der Platoden* and to the somewhat earlier writings of Looss and Odhner. Of greatest economic importance is *Fasciola hepatica* which infects the bile-ducts of sheep, cattle, horses and rabbits. The presence of these parasites causes marked thickening of the walls of the bile-ducts and subsequent hepatic insufficiency. In tropical countries the lining of the intestinal wall of sheep, cattle, horses and elephants is frequently eroded by vast numbers of clinging amphistome flukes. A third group calling for specific reference here is that of the schistosomes or bilharzia worms (*see* BILHARZIOSIS). Unlike most flukes these are unisexual and live in the portal system. The eggs are laid by the female in its finer ramifications on the walls of the lower bowel and bladder through which they ultimately work their way to be discharged in faeces and urine. *Bilharzia,* various species of which parasitize man, dog, sheep, cattle, goats and camels, develop like other flukes in molluscan intermediary hosts. The infective young or cercariae invade man and other definitive hosts by piercing the skin. Preventive measures against fluke diseases are of two kinds: (*a*) the adult flukes in the definitive hosts and the mollusc carriers of the larval stages can be destroyed by appropriate chemicals. (*b*) Infection can be avoided by the heat sterilization of food containing encysted forms and by avoidance of exposure of the skin to infected water.

Tapeworms and Disease.—Tapeworms infest all classes of vertebrates but the number occurring in reptiles and amphibians is relatively low. Excellent monographs on the cestodes of mammals have recently been published by Meggitt and Jean Baer and on cestodes of birds by Fuhrmann and Ransom. Southwell and Linton have given special attention to the parasites of fishes.

Adult tapeworms normally inhabit the bowel. In sheep, however, there is a species which lives in the bile ducts. Considering their size, these parasites produce relatively little serious harm. Their presence causes considerable local irritation and diarrhoea. Large numbers may produce obstruction and intussusception (*see* INTESTINAL OBSTRUCTION) in young animals. Owing to the amount of the nourishment they absorb, their presence is associated with abnormal appetite on the part of the host.

Perhaps the most widespread and dangerous form is the small *Taenia echinococcus,* only a quarter of an inch long, which lives as an adult parasite in the small intestine of the dog. Its importance lies in the dangerous character of its larval development. This may occur in a very large number of mammals including man, sheep and cattle. The eggs are passed in the dog's faeces. When swallowed by the intermediate host they grow into cysts varying in size from a tangerine to a football. Within these cysts thousands of infective forms develop. When eaten by a dog these infective young attain sexual maturity. Echinococcal cysts usually develop in the liver, lung or spleen and cause considerable pressure atrophy of the tissues. Escape of fluid from ruptured cysts causes severe shock. Two other tapeworms of interest are *Taenia solium* and *T. saginata.* The larva of the former develops as a cyst in the muscles of the pig while that of the latter similarly develops in cattle. A search for these cysts is one of the objects of meat inspection. Sheep and rabbits frequently harbour cysts which develop into adult *Taenias* in the dog. One of these occurs in the brain producing symptoms of "gid" in sheep, *see* Plate, fig. 9. Cattle, sheep, horses and rabbits frequently harbour adult intestinal cestodes belonging to the family Anoplocephalidae. Although of economic importance, no information is available concerning their life history and intermediate hosts. In towns, dogs and cats are quite frequently heavily infested with tapeworms of relatively small size which are made up of lentil-shaped segments and belong to the genus *Dipylidium.* The lice and fleas which infest these animals are their intermediate hosts. A peculiar type of life history is that seen in the minute *Hymenolepis nana,* one of the commonest tapeworms in the United States. Man appears to act as intermediate as well as definitive host for this parasite. Larval development takes place in the wall of the small intestine in which the adult subsequently lives.

The cestodes so far described belong to the division Cyclophyllidea and are characteristically armed with four round suckers for purposes of attachment. The other main subdivision is named the Pseudo-phyllidea In this group the typical round suckers are replaced by two elongated slits. The most important member of this small group is *Dibothriocephalus latus* a parasite of man in Finland, Sweden, Latvia and Switzerland. It also occurs in other countries where lake fish form a staple article of diet. Infection is acquired from infected fish of the family Salmonidae, perch, pike, etc. These intermediate hosts acquire their infection from minute fresh water Crustacea belonging to the family Cyclopidae, which in turn have swallowed and been infected by the swimming larva which hatches from the eggs passed by infected man. For many years an anaemia resembling pernicious anaemia has been attributed to infection with *D. latus,* but recent studies have failed to bring evidence in support of these earlier clinical deductions.

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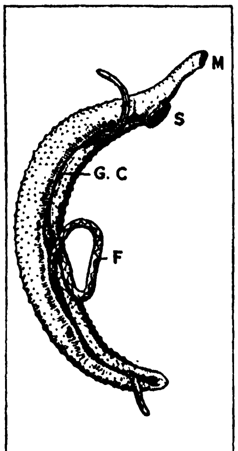
(R. T. L.)

PARASITISM, a one-sided nutritive relation between two organisms of different kinds, a relation which is more or less injurious, yet not usually fatal, to the host, a relation, moreover, that relieves the parasite from most of the activity or struggle which is usually associated with procuring food, and thus tends to favour or induce some degree of simplification or degeneracy. The parasitism may be (*a*) between one animal and another, *e.g.*, between tapeworm and dog; or (*b*) between an animal as host and a plant as parasite, *e g.*, the salmon infested with a *Saprolegnia* fungus; or (*c*) between one plant and another, *e.g.*, dodder on clover; or (*d*) between a plant as host and an animal as parasite, *e g.*, the ears of wheat infested by a minute threadworm, *Tylenchus tritici,* which causes "ear-cockles"; or (*e*) in rare cases, e.g., *Bonellia,* the male is a parasite of the female.

Variety of Parasitic Relations.—Parasitism takes many forms and occurs in many degrees, so that hard and fast definition is impossible. An organism may be parasitic during one period of life and independent at other times; thus the larval stages of hookworm live in the soil, the adult stage is reached in man's intestine; or again the young forms of the horsehair-worms (*Gordius*) occur in insects, whence the adults emerge into the water. The parasitism of the strange copepod crustacean, *Lernaea bran-*

chialis, common on the gills of the haddock, is confined to the female and does not begin until after pairing has taken place. In two or three angler-fishes, the male is a parasite of the female.

The parasite may be externally associated with the host, like mange-mites on dogs, but this ectoparasitism has also its grades, varying with the extent to which the host is punctured or penetrated by the parasite. Thus the rhynchocephalid crustacean *Sacculina* protrudes visibly on the ventral surface of the parasitized crab, but its root-like absorptive processes penetrate through and through its host, and the bean-like adult stage is actually a burrowing endoparasite that has come to bulge out like a hernia. The larval stage of *Sacculina* is a free-swimming nauplius. It might seem an easy matter to distinguish between outside and inside, but when the ectoparasite is sedentarily fixed to the skin and absorbs food by an intruded portion of its body, it becomes difficult to determine, as in some of the sedentary plant-mites, how far in it must go before becoming an endoparasite. It is no easy matter to decide whether small animals, such as mites, that wander about on the surface of an animal's body are to be regarded as parasites. Some are only scavengers, others draw blood, others deposit eggs in their host. On the whole the distinction between ectoparasites and endoparasites is convenient.



FROM SIR PATRICK MANSON, "TROPICAL DISEASES"

FIG. 1.—BILHARZIA (SCHISTOSOMUM HAEMATOBIUM)

The male is carrying the female (F) in a ventral groove (G C)

Distinguished from Epiphytic and Epizoic Relations.—Parasitism must be distinguished from epiphytic or epizoic relations. An epiphytic plant grows on another plant without deriving any nourishment from it, as in the case of orchids perched on trees. Similarly microscopic green Algae live on the surface of the coarse hairs of the Brazilian tree-sloths, and many a seashore crab carries a garden of seaweeds on its back. But if the crab such as *Hyas araneus,* has itself implanted these Algae, and if there is evidence that the crustacean is usefully masked, while the plant is benefited by being carried about, then the relation passes into a mutually beneficial external partnership.

An epizoic animal may live attached to another animal without deriving any nourishment from it, as a bunch of barnacles to the flattened tail of a sea-snake, or as a tunicate, a false oyster (*Anomia*), a serpulid worm, a polyzoon colony, and a sponge may all be found together on the shell of a whelk. But if the sponge (e.g., *Suberites*) should mask a hermitcrab ensconced in an empty periwinkle shell, and should be benefited by its association with the vigorously active animal, then the epizoic relation becomes a commensalism. Various marine animals, such as hydroids and even sea-anemones, live attached to large laminarian seaweeds, but without any nutritive relation.

Distinguished from Shelter-associations.—While the contrast between a parasitic relation and an epizoic or epiphytic one is in most cases clear, there may be some difficulty with what are called "shelter-associations." Thus the little pea-crab *Pinnotheres pisum* is often found off English coasts sheltering in the mantle-cavity of the Norway cockle; and other members of the pinnotherid family occur in other bivalve molluscs, as well as in worm-tubes and corals. A small bivalve is commonly embedded in the cellulose tunic of ascidians. The slender fish called *Fierasfer* insinuates itself tail-foremost into the end of the food-canal of sea-cucumbers (e.g., *Stichopus*), and of some large bivalves and starfishes. When the holothurian is placed in water with insufficient aeration, *Fierasfer* comes out and rises to the surface, taking gulps of air. A small fish, *Amphiprion,* with resplendent colours, lives inside a large sea-anemone, hiding itself deeply when disturbed. It does not seem to do either good or harm to the sea-anemone, but it is said to die when dissociated from its "host."

Similarly some insects find shelter in plants on which they do not feed. A spider may frequent a particular flower, another makes its web in a pitcher-plant. Many ants live in hollow stems and thorns, but feed elsewhere; they get nothing but shelter from the plant and confer no benefit. But in other cases the sheltering ants feed on secretions exuded by glands of the plant, and in return they form a "bodyguard" which is regarded by some, on perhaps insufficient evidence, as useful in warding off the attacks of leaf-cutting ants and other unwelcome visitors. Some plant-mites live in little shelters on the plants they frequent. The moist spaces between the leaves of the epiphytic bromeliads of tropical forests afford shelter to an astonishing number of more or less epiphytic insects, and the inter-relations are sometimes so subtle that firm classification becomes, as might be expected, almost impossible. It is an unscientific pedantry that seeks to put every grade of inter-relation into a separate pigeon-hole. There are also puzzling epiphytic shelter-associations between plant and plant, one of the best known being the occurrence of the alga, *Nostoc,* in certain parts of the water-fern, *Azolla,* and in the liverworts *Anthoceros* and *Blasia.*

Distinguished from Commensalism and Symbiosis.—From commensalism, if defined as a mutually beneficial external partnership between two organisms of different kinds, ectoparasitism is distinguished by being one-sided. From symbiosis, if defined as a mutually beneficial internal partnership between two organisms of different kinds, endoparasitism is distinguished by being one-sided. It is always more or less prejudicial to the host. As the definitions here adopted are historically justified and are very convenient, it seems undesirable to use "symbiosis" loosely for the intimate living together of two kinds of organisms, and then to subdivide it into parasitism and commensalism, as has been sometimes proposed. On this usage a mutually beneficial nutritive partnership, *e.g.,* between clover and its tubercle-forming bacteria, is called "reciprocal parasitism," and "commensalism" is used to include "those cases of symbiosis in which two or more organisms live together with possible benefit to some or all of the symbionts, but with injury to none." The usage adopted in this article is to distinguish endoparasitism from symbiosis and ectoparasitism from commensalism, and to recognize other linkages, such as the epiphytic and epizoic habits.

But emphasis must also be laid on the fact that parasitism is a nutritive relation, and there may be utility in following the botanists referred to in distinguishing among plants (*a*) the independent autophytes, which obtain all their food from inorganic sources, and (*b*) the dependent heterophytes, "whose existence depends upon antecedent or coexistent organic forms, because they derive at least a part of their food from organic sources." These heterophytes are then divided into saprophytes, which obtain food from dead organic matter, and parasites which obtain food or food materials from living organisms. On this classification of nutritive habits, a special corner would need to be found for carnivorous plants which obtain their food partly from inorganic sources and partly from the animals they capture. Among the bacteria and other plants that live in the alimentary tract of animals, it is sometimes difficult to draw a clear line between those that live on non-living material and those that attack living tissue. But all biologists are agreed that a parasite is in a relation of more or less nutritive dependence on its host.

Stricter Definition of Parasitism.—The biological concept of parasitism has been blurred by uncritical usage. When an animal is found to be infested externally or internally by other animals which are habitually present and are not found living independently, and when there is some degree of dependence between the infesting animal and the other, the term parasitism has been used without hesitation. Yet it seems of little value to apply the same ecological term to (1) a flea promenading over the skin and puncturing here and there for blood; (2) a tick firmly fixed with its mouth-parts deeply inserted in the dermis; (3) a follicle-mite, such as *Demodex folliculorum,* with the whole worm-like body embedded, and only the head end showing; (4) larval mites of *Trombidium* burrowing in the skin; (5) the microscopic larval cercariae of *Bilharzia* in the act of burrowing from the surface of man's skin to the interior; (6) the large maggots of the ox

warble-fly, which have come to lie passively under the skin, resting after a prolonged internal journey, and awaiting subsequent pupation in the soil; (7) the full-grown female Guinea-worm, lying in a long coil beneath the skin, and pressing upon it until a sore is formed. These are instances of the variety of habit seen among "parasites" near the surface of another animal.

Similarly for endoparasites, there is great diversity. Many infusorians and nematodes live in the large intestine on putrefying undigested food-material; they can hardly be called symbionts except in special cases, but they do little harm. Tapeworms have their heads attached to the wall of the intestine, but this has no nutritive significance, for it is the whole long surface of the body that absorbs the digested food of the host. Here is a passive mode of life, almost quite away from the struggle for existence, and here also is unmistakable degeneration. Another grade is illustrated by many parasites which depend not on the food of their host, but on the living tissues, and here again a distinction may be drawn between those, like growing bladder worms and *Sacculina*, that absorb lymph or other fluids from the surrounding tissue, and those, like larval ichneumon flies, that directly devour the living tissues of their hosts. The formidable hookworm sucks blood from the intestinal wall, the liver-fluke feeds on the blood of the sheep's liver, but the malaria organisms and many others live in the blood-stream itself, destroying the red blood-corpuscles. Not a few cases besides rhizocephalid crustaceans are known where the parasite castrates its host. The concept of parasitism would be clearer if there were excluded from it all cases where the infesting organism lives an energetic predatory life.

From a broad biological outlook parasitism is a negative reaction to the struggle for existence, and always implies the discovery and adoption of a mode of life that is nearer the line of least resistance. On this view the most diagnostic feature in parasitism is some retreat from strenuous struggle and independent endeavour. To some extent, to put it more metaphorically, the swimmer becomes a drifter. Thus the larvae of an ichneumon-fly, which are hatched out within a caterpillar and proceed to devour it from within, are hardly less predatory than the lion which devours the antelope from without. The larvae have none of the degenerative stigmata of thoroughgoing parasites. Similarly, while many of the protozoon parasites are sluggish throughout a great part of their life, many remaining for a long time within the same cell, it is more difficult to apply the term parasite to such organisms as the exceedingly active trypanosomes that cause sleeping sickness and allied diseases. They have their quiescent phases, but much of their life is spent in charging about among the blood-corpuscles at a high velocity. Many of the protozoa are much simplified cells, but not the flagellate trypanosomes.

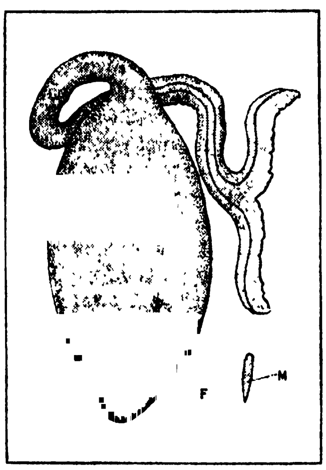


FIG. 2.—MALE (M) AND FEMALE (F) OF BONELLIA VIRIDIS, AN ECHIUROID WORM

And again, as regards ectoparasites, is not the definition blurred by including such types as the flea? That it is more habitual than a leech in its blood-letting does not make it less of a predatory animal. Its compressed body may be adaptive to escaping capture as it moves swiftly among the hairs of a mammal's skin, but it has no marks of degeneracy in its adult life. It is on an ecological level quite different from that occupied by such types as mange-mites.

Classification of Parasitic Animals.—Protozoon parasites are illustrated by the entire class of Sporozoa, including the malaria organism (*Plasmodium*); by some rhizopods, such as the *Amoebae* of man's mouth-cavity and intestine; and by some infusorians, such as the mouthless, ciliated, multinucleate *Opalina* of the frog's rectum, and predatory forms like trypanosomes.

There are no parasitic sponges. Among Coelentera there are but a few instances; thus the polyp, *Polypodium hydriforme*, occurs on the ova of the sterlet, *Acipenser ruthenus;* the medusoid, *Cunina* (*Cunoctantha*) *parasitica* is found in close association with another medusoid, *Geryonia proboscidalis*, and *Cunina octonaria* in the bell of *Turritopsis*. The Mesozoa (dicyemids and orthonectids) are all parasitic.

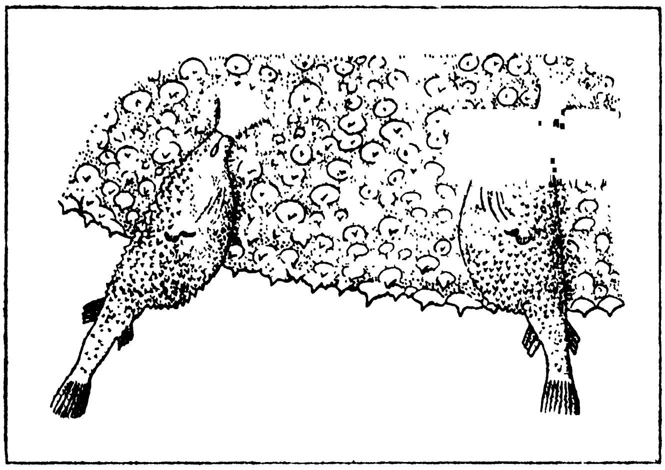
Among plathelminths, a few turbellarians are parasitic (*Graffilla* in marine molluscs, *Anoplodium* in or on holothurians); the trematodes are all either ectoparasites or endoparasites; the temnocephalids hang on to freshwater crayfish, crabs, turtles, etc., but do not feed on their hosts; the series has its bathos in the cestodes which are all endoparasitic, both in their larval (bladder worm) and adult (tapeworm) stages. All the nemerteans are free-living, unless two or three found on crustaceans can be called parasites. The aberrant Malacobdella found in the bivalve *Cyprina islandica* does not seem to do more than capture inswept organisms.

Numerous nematodes are parasitic, others saprophytic, but it is difficult to draw the line. Most of the parasites live in the alimentary canal and find nourishment in the half-digested food or in the putrefying undigested residue. Many of them are most accurately regarded as internal saprophytes, and are active agile animals. It is otherwise with the hookworm which sucks blood from the wall of the food-canal, or the gapes-worm which does the same in the windpipe of chickens. Distantly allied to nematodes are the Acanthocephala, e.g., *Echinorhynchus*, thoroughgoing parasites without mouth or food-canal. They are digenic, passing from arthropod to vertebrate; thus *Echinorhynchus gigas* of the pig has its larva in the grubs of cockchafers and the like.

Parasitism is very rare among chaetopods, but the mouthless pigmy males of *Bonellia* and *Hamingia* live within the females. The interesting discodrilids are found on freshwater crustaceans, —*Branchiobdella*, on the gills of *Astacus fluviatilis* and the American *Bdellodrilus* on *Cambarus*. These two types seem to be genuine *Oligochaeta*, but they are without setae and possessed of suckers and chitinous jaw-plates. In other words, there is a slight convergence towards leeches, in adaptation to a somewhat similar mode of life. Leeches (Hirudinea) themselves should be regarded as predatory, not as parasitic. The small Myzostomaria, e.g., *Myzostoma*, which form galls on crinoids, are perhaps offshoots from primitive annelids, degraded in relation to the parasitic mode of life. A few rotifers, e.g., *Albertia*, are parasitic in or on freshwater oligochaets; *Seison* occurs on the primitive marine crustacean called *Nebalia; Discopus* attaches itself to *Synapta*, and *Callidina parasitica* to the limbs of the freshwater crustaceans *Gammarus* and *Asellus*.

There are no parasitic echinoderms. The habit is common among the lower crustaceans, especially among copepods, many of which are called "fish-lice," e.g., *Caligus* and *Lernaea*. Many grades occur, for the association may be temporary or permanent (except in the early larval stages), and is often confined to the females. On the other hand the male may be reduced in size and a parasite on the female, as in *Chondracanthus*. Allied to the barnacles (Cirripedia) are the peculiar Rhizocephala, e.g., *Sacculina*, which occurs protruding from the ventral surface of the tail of crabs. It starts life as a free-swimming nauplius; it develops into a cyprid larva and fixes itself to a young crab at the uncalcified membrane around the base of a large seta. Its tissues dedifferentiate and pass into the crab; eventually, as it approaches maturity, it protrudes on the abdomen. The full-grown sac consists mainly of hermaphrodite reproductive organs, nourished by numerous absorbent root-like processes which spread through all the tissues of the crab. *Sacculina* lives for about three years, arresting the crab's growth, and causing degeneration of the gonads. In the case of male crabs the parasite so alters its host's constitution that it changes its secondary sexual characters, becoming more or less female in appearance. In short, *Sacculina* not only effects "parasitic castration," but partly reverses the sex of the male. There are various related forms, one of which, *Sesarmaxenos*, occurs on a freshwater crab, *Sesarma*, in the Andamans. Some of the true barnacles, normally hermaphrodite,

have small parasitic, "complementary" males, e.g., *Scalpellum villosum;* others, e.g., *S. regium,* are unisexual, but the males are minute and parasitic on the females. Even among the higher crustaceans, parasitic forms occasionally occur, notably the epicarid isopods, e.g., *Bopyrus* and *Entoniscus,* which infest other members of the class. The young forms are free-living and male, the adults are parasitic and female; but it seems that while all



FROM B. SAEMUNDSSON, IN "VIDENSKABELIGE MEDDELELSER FRA DANSK NATURHISTORISK FORENING" (C. A. REITZEL, COPENHAGEN)

FIG. 3.—TWO MALES OF ONE OF THE ANGLER FISHES (CERATIAS HOLBOELLI) ATTACHED CONTINUOUSLY TO THE FEMALE'S SKIN. 3/4 NATURAL SIZE

females pass through a male stage, without genital ducts, those males that become functional never grow up into females. Many epicarids cause parasitic castration of their hosts. Some of them afford good instances of hyper-parasitism, or parasite upon parasite. Thus a very common Mediterranean species, *Danalia curvata,* is parasitic on *Sacculina neglecta,* which in turn is parasitic on the spider-crab, *Inachus mauretanicus.* Somewhat similar to the epicarids are the cymothoids, not nearly related, though also in the order Isopoda. They infest the gill-chambers, mouth-cavity and skin of various fishes.

True parasitism is not to be expected among the winged insects, but many wingless types, such as lice, are parasites, and some free-living winged insects, like warble-flies, have parasitic larvae. The blood-sucking lice or Pediculidae constitute an order ectoparasitic on mammals. They are marked by absence of wings, small head with simple eyes or none, large abdomen and by the adaptation of the claws to clutch the hairs; but it cannot be said that lice are particularly degenerate. They appear to us to be not far removed from the predatory. This is even more marked in the case of the biting-lice or bird-lice (Mallophaga), which occur on birds and a few mammals, feeding not on blood, but on skin-cells and fragments of feathers and hairs. Some birds shelter numerous species of Mallophaga; thus the hen has nine; but occasionally a particular species of bird-louse is restricted to a particular species of bird. Related species are often found on related hosts. This specificity is often to be noticed in parasites, yet there are others, such as the liver-fluke, that have many different hosts. But as to the Mallophaga, there does not seem to be much of the parasite about them; they are skin-scavengers, and the same may be said of fleas and of the sheep-tick (*Melophagus ovinus*), a wingless fly. It is different, however, with the larvae of bot-flies and warble-flies, which illustrate temporary parasitism. A curiously isolated case of alleged parasitism is *Platypsyllus castoris,* a beetle found on beavers. In many of the ichneumon-flies and related types, which lay eggs in caterpillars and the like, the predatory larvae are themselves parasitized. This "hyper-parasitism" is sometimes carried far. Thus the caterpillars of *Hemerocampa leucostigma* which defoliate many trees in the north-eastern United States have 33 primary parasites, 13 secondary parasites, 2 (perhaps 5) tertiary parasites, and one of these (the chalcid *Asecodes albitarsis*) may be in some cases not tertiary but quaternary.

Among arachnids various degrees of parasitism are illustrated by mites and ticks, some externally adherent, others burrowing in the skin, a few, like the bee-mite, penetrating deeply. Sometimes placed in the vicinity of arachnids are the vermiform pentastomids, e.g., *Linguatula,* found in the nasal cavities and frontal sinuses of carnivores, crocodiles, snakes and some other flesh-eating animals. Apart from a few gastropods, such as *Entoconcha mirabilis* attached to blood-vessels in *Synapta,* there are no parasitic molluscs. Nor are there any parasitic vertebrates except the pigmy males of some angler-fishes.

A survey of parasitic animals shows the widespread distribution of this mode of life. But it is of rare occurrence (*a*) among types that are sensitive to stagnancy; thus there are no parasitic echinoderms; (*b*) among types that breathe dry air; thus endoparasitism is relatively uncommon among insects; and (*c*) among types whose shape of body is markedly unsuitable.

Parasitic Plants.—These will be dealt with separately, and they are only referred to here to give greater completeness to the general biological picture. Plants may be parasitic in or on animals, a striking case being a rod-like fructification of a fungus (*Cordyceps*) that grows out for several inches from the head-end of a parasitized larva, such as a caterpillar or a grub. The common house-fly is often seen dying from the ravages of a fungus, *Empusa muscae,* the spores forming a white powder around the moribund insect; another species is from man's point of view very useful as a check on the multiplication of green-flies.

An estimate of the number of parasitic animals that infest plants varies according to the conception of parasitism. The phytoptid gall-mites, which cause swellings on many plants, have only two pairs of legs, very simple mouth-parts, and a worm-like body, thus showing some marks of the degeneration so often associated with thoroughgoing parasitism; but it seems hardly justifiable to rank the numerous leaf-miners and stem-borers as parasites in the strict sense. They have adopted an internal herbivorous mode of life. Similarly it seems doubtful if a species of trypanosome that lives in some spurges is really a parasite.

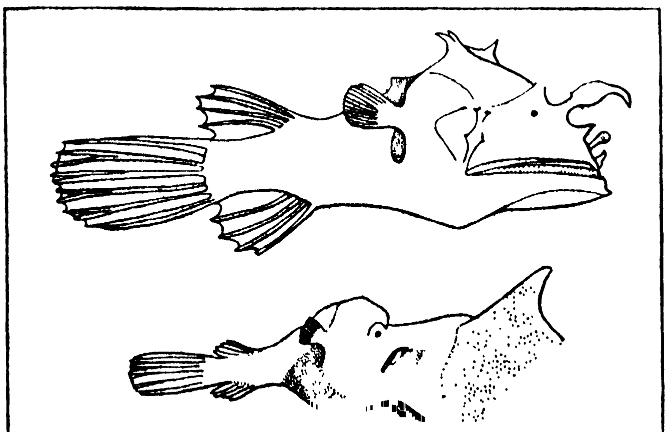
Of plants parasitic on plants there are multitudinous instances, though not approaching the diversity illustrated by animals parasitic on animals. At the one pole are parasitic moulds, mildews and rusts; at the other pole the dodder on clover or the toothwort on hazel roots.

Very clear among parasitic plants is the contrast between partial and complete parasitism. Thus the mistletoe is a partial parasite, for it is usually believed to take nothing but water and salts from the tree on which it grows. Its own green leaves are capable of normal photosynthesis. Yet there is no hint of reciprocity on its part, as has been experimentally corroborated by defoliating the bearer. In contrast to the mistletoe, the leafless and chlorophyll-less dodder is a familiar illustration of complete parasitism, for it depends on its host not only for water and salts, but for organic food in the form of carbohydrates and proteins. Eyebright and yellow rattle are good instances of partial parasites, for while they have green leaves and can absorb soil-water, they get on better if their roots come into organic continuity with the roots of neighbouring plants such as grasses. The related cow-wheat, though green, cannot survive without external aid. In the Alpine *Tozzia,* belonging to the same family, the whole first year is spent as a complete parasite underground; in the second year there rises a flowering shoot with yellow-green leaves. In broomrapes the parasitic dependence has gone still further, for the seeds will not germinate unless they are in contact with a suitable host, such as broom; there is no chlorophyll and apart from the underground absorbing system there is nothing left but flower-stalk. The extreme simplification of the vegetative system is seen in the *Rafflesias,* where "the whole vegetative body of the parasite may live inside the host-plant, reduced to a spreading weft of undifferentiated filaments, roots, stem and leaf alike lost." From this degenerate vegetative body, none the less effectively adapted for absorption, there burst forth strange and brilliant blossoms. One of them, *R. arnoldii* of Sumatra, is the largest of known flowers, with the immense diameter of a yard.

The vegetative body of *Rafflesia* may be reasonably called

degenerate, but it must be asked, following MacGregor Skene, whether all the simplifications of parasitic plants deserve this term, and whether the simplifications are to be regarded as primarily associated with the parasitism. The beginnings of reduction, *e.g.*, in leaves and in amount of chlorophyll, are often to be seen quite apart from parasitism. Some reduction in assimilatory power, or some other inferiority in competing with rivals in crowded conditions, may prompt root-parasitism or some other parasitic dependence. And when the habit of parasitism or partial parasitism has begun, it is natural to suppose that degenerative variations, *e.g.*, towards "golden leaves" or albinism, would be better able to survive because of the abundant nourishment supplied by the host.

Origin of Parasitism.—(*a*) Many animal parasites, such as some of the nematodes, may have begun as saprophytes. Several flies that normally lay their eggs in putrefying animals, may similarly utilize the abrased skin of one that is still living. (*b*) Many animals are cryptozoic, given to hiding themselves, negatively heliotropic, fond of narrow passages, and this is another way in which parasitism may arise. The commonplace is often overlooked that the host is not to the parasite another organism, but merely a convenient and attractive environment. (*c*) But it is likely that parasitism often arose when the struggle for existence was extremely keen, when even slightly open doors were welcome. As we have indicated, the most characteristic feature in parasitism is probably a kind of constitution more inclined to drift, rather than to swim. Just as some animals became cavernicolous, others became parasitic. (*d*) Crustacean parasites are particularly interesting because they afford many illustrations of parasitism restricted to the females. The parasitic habit arose in connection with the advantage of securing sheltered nooks for liberating the eggs or offspring. (*e*) Where the sex dimorphism is very pronounced, as in *Bonellia,* many copepods, and two mid-water anglerfish, there would be an advantage to the males and to the species, perhaps even to the females, in the occurrence of parasitic males, securing fertilization. In the anglers alluded to, which occur sparsely in thinly-peopled waters, the female carries the minute male, and all his nourishment is derived from an organic connection between his head and the blood-vessels of some part of her



AFTER SAEMUNDSSON, IN "PROCEEDINGS OF THE ROYAL SOCIETY"

FIG. 4.—FEMALE OF ONE OF THE ANGLER FISHES (PHOTOCORYNUS SPINICEPS), WITH THE MALE ATTACHED IN FRONT OF THE RIGHT SUPRA-ORBITAL SPINE, SHOWING, IN THE LOWER FIGURE, THE UNION BETWEEN THE PARASITE MALE AND FEMALE

skin. (*f*) It is possible that parasitism has in some cases evolved from shelter-associations and from commensalism (*see* SYMBIOSIS); as we have indicated it is often difficult to draw the line. (*g*) Probably one parasitism has frequently arisen from another. That is, the parasite of a freshwater crustacean may become adapted to become secondarily parasitic in a freshwater fish which habitually feeds on the first host. An elaboration of this extension of range comes about when different phases of life are restricted to each of the two hosts, a common punctuation being that an asexual phase occurs in the one host and a sexual phase in the other. Leuckart, who discussed the problem carefully, came to the conclusion that the "intermediate host," now containing the young non-reproductive phase, was the original host, and that the "secondary or definitive host" has been added on. Yet it is conceivable that in some cases the intermediate hosts of the immature stages have been intercalated. When there are two hosts, there is usually, though not invariably, this relation between them, that the intermediate host is part of the normal diet of the definitive host.

Damage Done to Host.—It is usual to emphasize the fact that it is usually not in the parasite's biological interest to destroy its host. In many cases, *e.g.*, follicle mites in man, or *Monocystis* in earthworms, the parasite is small compared with its host and the damage done may be unimportant. Yet a heavy infection with threadworms may be fatal to a horse, and if ichneumon-grubs are regarded as parasites, an interpretation here departed from, they are obviously fatal to their caterpillar hosts. Much depends on the numerical strength of the infection; a few gall-larvae, each imprisoned in its gall, may be regarded as trivial, but a multiple infection of a currant bush with "big bud" mites may be fatal. Then a distinction must be drawn between parasites that multiply in their host, as nematode worms often do, and those, like tapeworms, that cannot increase in number within the same animal. It may be that rapidly destructive parasites have been persistently eliminated in the course of evolution, as would naturally happen if they destroyed their host before becoming themselves reproductive. But the large fact to be emphasized is that in many cases a give-and-take relation is established between the parasite and the host, such that the parasite does not get the upper hand and the host is not too seriously prejudiced. In the intestinal caeca of the grouse there are often thousands of invisible transparent nematodes (*Trichostrongylus pergracilis*), whose early stages are found on the heather. If the grouse is otherwise in good condition, its nematodes seem to be unimportant, but if the grouse be constitutionally below par, the parasites may multiply excessively (10,000 in one bird) and fatally. When parasites or quasi-parasites prove quickly destructive, it is usually when they find their way into a new host that has no natural counteractives to their influence. This is illustrated by bacteria when they find themselves in a new host which has not the wonted natural checks, such as anti-bodies.

As to the nature of the damage done by parasites, it may be enough to mention the most outstanding effects:—robbing their host of much half-digested food; absorbing much blood; causing serious pressure on adjacent parts (the sturdie-worm on the sheep's brain); perforating the intestinal wall (as large threadworms sometimes do); blocking passages, as bee-mites (*Acarapis woodi*) in the tracheae of bees afflicted with "Isle-of-Wight" disease. More unusual is castration, *e.g.*, that of crabs infected by parasitic epicarids; or the formation of open sores by emerging guinea-worms; or the production of cancerous growth in fishes and rats by the irritation of nematode worms (*Gongylonema*).

It has been proved that some animal parasites are toxic. (*a*) Thus the malaria organisms produce toxic substances in the red blood corpuscles, and these are liberated when the corpuscles break up, causing fever. Sarcosporidia of sheep contain toxic substances which are fatal in very small quantities when injected into rabbits. (*b*) When the big bladders of *Taenia echinococcus* burst and the fluid escapes into the body cavities, there is violent poisoning; and the fluids of other bladderworms have been shown to be toxic. (*c*) Adult tapeworms, such as *Dibothriocephalus latus,* are also toxic, producing a haemolytic lipoid, which is liberated when segments disintegrate, and perhaps also as a secretion. Thus the anaemia of human patients suffering from worms becomes more intelligible. (*d*) *Ascaris* produces in the routine of its metabolism volatile aldehydes and fatty acids like valerianic and butyric. If the worms die and disintegrate in the intestine, the liberation of these substances may produce toxic effects. The poisoning observed in trichinosis is probably due to products of the parasite's metabolism and of the muscle-disintegration.

Adaptive Characters of Animal Parasites.—The assumption of a parasitic mode of life is a habitudinal reaction to the intensity of the struggle for existence, and while there is no dis-

charge from that war, intimate dependence on another organism for food and shelter implies to some extent a life of ease. What adaptations are there to the parasitic mode of life?

(1). Many parasites have structures that lessen the risk of dislodgment, *e.g.*, the adhesive suckers on the head of tapeworms, the gripping hooks of the hookworm, the attaching hold-fasts of parasitic copepods. (2). Many parasites are specially adapted for the absorption of food from the host. A very simple adaptation is the great increase of absorptive surface in tapeworms, which may be many feet long. In *Sacculina* the absorptive processes ramify like roots right through the body of the parasitized crab. The head of the pigmy parasitic male of the mid-water angler is concrescent with the tissue of the female who carries him The strange gastropod parasite *Entoconcha* has its head thrust into a blood-vessel of its synaptid host. When the available food from the host is very abundant it may be utilized by the parasite in a somewhat uneconomical fashion; thus some nematodes ferment glycogen into valerianic acid, carbon dioxide and hydrogen, which is far from making the most of the material. In tapeworms the whole surface of the body absorbs liquid food. Parasites deeply imbedded in tissues must be nourished by the lymph just as if they were parts of the host. (3). It is characteristic of many thoroughgoing endoparasites that they can survive in conditions where free oxygen is apparently very scarce. In most cases they seem to obtain a sufficient supply from the blood or tissues of their host, just as if they were parts of the body. There is no modern corroboration of the older view that some parasites can live anaerobically. (4). Many parasites, such as nematodes, crustaceans, insects, mites have a chitinous cuticle, which is very resistant, *e g*, to bacteria and to digestive juices. (5). There are some noteworthy adaptations in connection with reproduction Thus resistant egg-shells are characteristic of platyhelminths, and the tapeworm's liberation of an entire joint, capable of some independent movement, must often be advantageous The difficulty of securing fertilization, when the parasites do not occur in large numbers together, is met in various ways, *e g*, (*a*) by a very prolonged association of the sexes as in *Bilharzia*, where the male carries the female, or in *Chondracanthus* where the female carries the male; or (*b*) by self-fertilization or autogamy, as in the liver-fluke; or (*c*) by an emergence of the sexually mature forms into freedom, as in horsehair-worms (*Gordiacea*) There are some very remarkable cases, notably the trematode, *Diplozoon paradoxum*, where two mature hermaphrodite individuals are united in a permanent coition In *Wedlia* two individuals are found together inside a cyst, the smaller one—the male—imbedded into a protrusion of the vesicular posterior body of the larger one—the female But each individual shows traces of the gonads of the opposite sex, so that this looks like a secondary abandonment of hermaphroditism, when arrangements for securing fertilization had been in the course of time established.

(6). Deserving consideration by itself is the prolific multiplication. Leuckart's estimates have been often quoted, that *Taenia solium* may produce 42,000,000 eggs in a year, and *Ascaris* 64,000,000. It is possible, no doubt, to discover free-living animals still more prolific, such as the starfish *Luidia ciliaris* which Mortensen credits with containing 200,000,000 eggs, but there are not many instances of such extraordinary fecundity, even among fishes.

The eggs and larvae of parasites are often subject to severe elimination; the chances of death are enormous. Therefore in the course of the evolution of parasites, variants in the direction of increased reproductivity would have survival-value

Some Evolutionist Problems.—(1) It must not be facilely supposed that the adaptive peculiarities of parasites illustrate individual modifications that have hereditarily accumulated until they have become racial characters. Organisms that have begun the parasitic mode of life because of certain constitutional weaknesses may continue to show congruent germinal variations, some of which may have selective value. (2) It must not be too confidently assumed that all the diagnostic peculiarities of parasites are as such engrained hereditary characters. Many of them may be individual structural reactions to the peculiar conditions of life, which recur with each generation. An organism's characters develop as the outcome of environmental, nutritional and functional nurture operating upon hereditary nature. There is much to be said for the view that the pigmy male of *Bonellia* suffers arrest of development partly because it absorbs the secretion on the proboscis of the female. More attention should be paid to phenomena like those of "physogastry" in the guests of the white ants, where extraordinary deformations of body come about in probably direct individual reaction to the special conditions of life. But in all such cases a specific capacity for reaction is inherited. Experimental inquiry is also needed to show whether some of the specific characters of nearly related parasites may not be modificational Nearly related species in different hosts should be exchanged in early life. (3) It may be noted that many parasites probably illustrate the results of "isolation," which narrows the range of inter-crossing. For not only is the host in some ways like an island, to take the simplest form of "isolation," but the combination of circumstances which secure fertilization, dispersal, a second host, and so forth, is often so subtle that it operates as an isolating evolution-factor

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(J. A. Th)

PARASITOLOGY. The object of parasitology is the study of those organisms (parasites) which during the whole or a part of their life live upon other organisms (hosts). The parasite does not destroy its host immediately or rapidly even when both are of the same size. On the contrary, a perfect parasite while deriving its food and often protection from the body of the host, lives economically in doing as little direct damage to the host as possible. In this respect it differs from a predatory or carnivorous organism which recklessly destroys and utilizes its victim The association between the parasite and the host is beneficial and essential only for the parasite, while it is not beneficial, almost always harmful, and often fatal for the host It is, however, impossible to draw a sharp line separating parasitism from other modes of life such as saprophytism, carnivorism, commensalism, mutualism and symbiosis

Parasites, according to their mode of association with the host, can be divided into various groups such as. (1) permanent parasites which are parasitic throughout their life (tapeworm): (2) temporary parasites which live upon their host only during certain periods of their development (maggot of a warble fly): and (3) intermittent parasites which come only temporarily in contact with their host According to the localization, the parasites may be separated into ecto- and endoparasites The latter may invade the open cavities or the tissues of different organs; they may live inside the closed cavities of deeper organs; or inside the protoplasm, or even nuclei, of the cells.

No sharp line can be drawn between the different categories of parasitic adaptation The following examples will illustrate a typical transition between the free-living mode of life, intermittent and stationary ectoparasitism and endoparasitism. Among the mosquitoes only the females are blood-sucking, while the males are harmless and live upon plant juice. (1) There are, however, some wood mosquitoes which can complete their life history without taking a single meal of blood. (2) The malarial mosquito (*Anopheles*) can live without taking blood but the female will not lay eggs unless it has at least one blood meal. (3) The yellow fever mosquito (*Stegomyia*) lives and breeds near houses, and the female sucks blood more often. (4) The bed bug (*Cimex*) lives in the house and very near its food supply with which it can get in contact at more or less regular intervals. (5) The flea remains upon the host much longer than is required for the meal. (6) The body or head louse remains always upon the host, over the body of which it moves freely. (7) The crab louse is more stationary in habit, it moves very little, and is more adapted to the host. (8) In the case of the chigger flea (*Sarcopsylla*), common in tropical countries, the female penetrates deep into the skin forming

a small tumour. (9) Finally, there are larvae of insects which form deep galleries under the skin or invade open cavities of the host producing more or less dangerous cases of myiasis.

Distribution of Parasitism.—The parasitic mode of life is very widely distributed among bacteria, fungi, higher plants and animals. The parasitic bacteria (*see* BACTERIOLOGY) are known to invade and produce various diseases in man, animals and plants. In man for instance, tuberculosis, leprosy, diphtheria, pneumonia, enteric fever, tetanus, cholera, plague and other diseases are caused by parasitic bacteria. Relapsing fever and syphilis are caused by parasitic spirochaetes, which are organisms allied to bacteria.

The entire class of fungi is composed of organisms which derive their nourishment from other organisms, living or dead, and they contain an enormous number of forms parasitic on plants and on animals. They cause the smut and rusts of cereals; mildew of grape-vine; and blight of potatoes. In animals and man they cause ringworm, actinomycosis and many other diseases.

The largest number of parasitic forms and the greatest variety of parasitic adaptations, are found among animal organisms. Almost every order or phylum has parasitic representatives and certainly every animal can act as host to a variety of parasites belonging to several phyla. Protozoa, helminths and insects are the most widely distributed parasites, occurring in the greatest variety of hosts.

Parasitic helminths occur in representatives of most of the orders of the animal kingdom, and parasitic insects are found to attack a great variety of terrestrial animals. A great number of parasitic forms are known among Crustacea, but the range of their hosts is more limited. It is interesting to note that while parasitic insects have a special predilection to invade other insects, so the parasitic Crustacea have a tendency to live upon other Crustacea. Parasitism occurs also in Coelenterata, Rotifera, Annelida, Mollusca and even in fishes (Cyclostomata, *q v*).

Parasitism is so common in nature that it is hardly possible to find representatives of any species of animal which do not harbour parasites of some sort, and often the same individual is invaded simultaneously by parasites of various orders

Hyperparasitism.—There is no protection in nature against parasitic invasion. The parasite will reach its host however secluded may be its position. An insect burrowing itself deep into the tissues of a plant is not protected from invasion by another parasitic insect, which will find a way to insert its eggs on the skin or inside the body of such a burrowing host. Even the parasite living right inside the body of its animal host is not secure against attack by another parasite. The latter, which is called a hyperparasite, will reach, and will live upon the primary parasite which may ultimately be destroyed, and all this takes place inside the body of the primary host. Hyperparasitism is known among protozoa and helminths, but is more frequent among parasitic Crustacea and is very common among parasitic insects

Sexual Parasitism.—The parasites in this case are usually the dwarf degenerate males which live upon or inside the normal female that acts as host. This kind of sexual parasitism is known in a marine worm-like organism, *Bonellia,* in which the microscopic male lives inside the female. In a nematode (*Trichosomoides crassicauda*) parasitic in the bladder of the rat, the male lives inside the uterus of the female In some fish *Edriolynchus schmidti* and *Photocrinus spiniceps* the very small and completely degenerate male is permanently attached to, and lives upon the body of the female. (*See* ANGLER; FISH.)

PARASITIC ADAPTATION

Morphology.—An organism adapted to the parasitic mode of life often undergoes such a great modification that it becomes difficult to recognize the group to which it belongs. A number of forms such as *Sacculina, Peltogaster, Portunion* or *Xenocoeloma* (in their parasitic stages of development) could hardly be recognized as belonging to various families of Crustacea, if it were not for the free-living larval stages showing the essential characters of the corresponding families. The same applies to various marine snails (*Gastrosiphon, Entoconcha* and *Enterexenos*) living as parasites in starfishes (echinoderms). Parasites have the tendency to lose their organs of locomotion, such as wings, legs and other appendages The skin, in endoparasitic forms, being already protected by the tissues of the host, becomes thinner and the articulations between the segments gradually disappear. Sensory organs become atrophied. The alimentary canal in some cases becomes atrophied (Guinea worm), or it may disappear completely (tapeworm), and the parasite then feeds through the whole surface of its skin (tapeworm) or by means of absorbing appendages (*Monstrillidae*), or a ramified root system (*Sacculina*).

Hermaphroditism.—This is also a condition frequently met with in parasites. This may be explained partly by the more or less fixed position of the parasite, which greatly reduces the chances of meeting between individuals of different sexes On the other hand, when the sexes are separate the sexual dimorphism is extremely marked, the female being usually much more developed than the male (except in the Bilharzial parasite), and both sexes show a tendency to live in close association. Thus, among the parasitic Crustacea the males are attached to the females. In a parasitic worm (*Syngamus trachealis*) which causes gapes in fowl, the body of the male is permanently fixed and almost fused to that of the female In Schistosomes, which cause human Bilharziasis, the female is carried in a tube formed by the lateral inrolling of the body of the male.

Fertility.—The life of a parasite with a more or less restricted host specificity, and which passes during its development through one or two intermediate hosts, is dominated by one main factor, namely the great losses of its progeny. In fact, an enormous percentage of its eggs, scattered haphazard, never find the right conditions for development; the greater proportion of the larvae which hatch never reach the host, and die in various stages of development; and among those which reach the right host, many are lost during the internal migration and never reach maturity. Of a parasite, we can say that it is not death, but life, which is a marvellous accident of nature The enormous losses sustained by parasites during the successive stages of their development are compensated by various means. One of them is their greatly increased fertility While various internal organs such as the alimentary canal, nervous system and circulatory system, are more or less atrophied, the genital organs, on the contrary, and especially those of the female, increase in size, proliferate and become very active It was calculated that the round worm (*Ascaris lumbricoides*), parasitic in man, produces 64 million eggs a year; while in a tapeworm (*Taenia solium*) 80 million eggs are formed every year The genital organs in some parasites fill the whole of the body cavity, and in a small round worm (*Sphaerularia bombi*) parasitic in the bumble bee, the gravid uterus and the vagina gradually protrude outside the body of the parasite, increase in size, and finally form an enormous sac to which the shrivelled body of the female is attached as a hardly-perceptible appendage.

Asexual Reproduction.—Asexual multiplication, which takes the form of fission, budding, or parthenogenesis, occurs usually in the young or larval stages of the parasite, especially when it infects the secondary or intermediate host. This kind of multiplication occurs in a great number, but not in all parasites. It is very common in Protozoa, Orthonectids, tapeworm and flukes; and it occurs also in parasitic Crustacea (*Thompsonia*) In insects the asexual multiplication assumes the form of polyembryony, and occurs in a few species of Hymenoptera parasitic in other insects. Here the female of a parasitic Hymenopteron (*Encyrtus*) lays only one egg inside the egg of the apple moth (*Hyponomeuta*), but during the development of the latter, the egg of the parasite divides into many cells which give rise to several embryos

Primary and Secondary Host.—The life history of a parasite is direct or simple when the parasite is transferred directly from one host to another of the same species, and in both of them undergoes the same type of development. The direct mode of development is found as a rule in the great majority of parasitic bacteria and fungi; it is common in Protozoa and helminths, and is almost general in parasitic Mollusca, Crustacea and insects. The life cycle of a parasite is indirect when the adult or sexual stage develops in a host of one species known as the primary or final host, while its immature stages are harboured by another, known as the inter-

mediate or secondary host.

THE LIFE CYCLES OF PARASITES

The parasitic mode of life is by no means uniform and uneventful. It is, at least, as full of events and perilous adventures as the life of any free-living organism.

The main types of life histories of parasites can be illustrated easily by a few examples of the species attacking man. They show all the variety of means by which the infective stages of the parasites are liberated from the infected host and disseminated to invade fresh healthy hosts.

Protozoa.—Plasmodium, the cause of malaria (*q.v.*) in man, is a minute unicellular parasite (*see* PROTOZOA) living in, and feeding upon the red blood corpuscles. The parasite grows inside the corpuscle, elaborates a special black pigment, and multiplies forming a rosette of several young forms. Then the red blood corpuscle breaks and liberates the young stages which immediately invade fresh blood corpuscles and undergo the same development. The multiplication of the parasites and the invasion of fresh corpuscles occurs at regular intervals, and provokes the characteristic attacks of fever. After a period of ordinary multiplication, some of the parasites develop into forms which will not multiply in the blood of man, but only undergo development when they are taken up with the blood by a mosquito (*Anopheles*). The main features of this development are the fertilization of the female element (macrogamete) by the male element (microgamete), and the formation of a cyst which will form an immense number of small elongated bodies known as sporozoites. The latter will ultimately invade various organs of the mosquito, especially its salivary glands; and will be inoculated into a healthy man when he is bitten by the infected mosquito. The mosquito can transmit the disease only 10 to 12 days after it becomes infected. Trypanosomes (*T. gambiense* and *T. rhodesiense*) are unicellular mobile organisms living and multiplying in the blood plasma and lymphatic glands of man and ultimately causing the much dreaded African sleeping sickness (*q.v.*). The parasites are transmitted from man to man by the bites of tse-tse flies (*Glossina palpalis* and others). The transmission is either mechanical, taking place within 24 hours of the infective meal, or cyclical, infection then taking place after about 18 days when the parasites have accomplished their cycle of development within the tse-tse fly.

Flukes.—Schistosomes, which cause Bilharziasis (*q.v.*) in man, differ from other flukes by having the sexes separate, the female living in a tube formed by the body of the male. The coupled worms live in the venous system surrounding the intestinal (*Schistosoma mansoni*) or urinary (*S. haematobium*) tracts of man. When fertilized, the female leaves the male, migrates into the small blood vessels which it distends, and there lays spined eggs. The eggs rupture the vessels, appear in the surrounding tissues and reach the lumen of the organs, to be expelled with the urine or faeces of the host. On reaching fresh water, the eggs burst, and liberate microscopic, ciliated organisms (miracidia) which within 24 hours have to find a fresh-water snail, which is the secondary host, otherwise they perish. They penetrate into the snail and become transformed into shapeless sacs (sporocysts), which by external budding form daughter sporocysts. The latter develop a number of small organisms (cercaria) composed of an elliptical body and a forked tail. When completely developed they leave the body of the snail, swim actively in water, and within 48 hours must find their primary host, man, otherwise they die. Man is infected through the skin of any portion of the body which comes in contact with water containing living cercaria. The latter penetrate the skin, the blood vessels, and finally the veins of the intestinal or urinary tracts.

Other Worms.—The hookworms (*Ankylostoma duodenale* and *Necator americanus*) live attached by their widely open mouths to the wall of the intestine of man. The females lay numerous eggs, which are expelled with the excrement. Development takes place outside the host. Small larvae hatch from the eggs, and become infective. Infection of man takes place through any portion of the skin which comes in contact with this larval stage.

Trichinella spiralis is a small worm parasitic in man, pigs, rats, and other mammals. In the adult stage the worm is an intestinal parasite of the host. The female with ripe eggs does not remain in the lumen, but penetrates into the walls of the intestine, and there lays a great number of embryos. The latter become disseminated throughout the body, penetrate into muscle fibres and form cysts or capsules. Man becomes infected by eating raw infected pork; and pigs or rats become infected by eating the remains of other infected pigs or rats. When taken into the intestine of the new host, the capsules are digested, the small worms are liberated, and grow into male and female Trichinellas.

Filaria bancrofti is a round worm, the adult stages of which live in the lymphatic glands and ducts of man. The female is viviparous and lays an enormous number of embryos, which pass into the circulatory blood system. At regular intervals during the night, these embryos appear in the peripheral blood vessels. They become very numerous from about midnight to 1 A.M. and then gradually disappear, to reappear the following night. The parasite is transmitted from man to man by a night biting mosquito. The latter while sucking blood of an infected man, takes up the embryos, which perforate the mosquito's gut, migrate into its wing muscles, grow, leave the muscles and migrate into various parts of its body. When man is bitten by the infected mosquito, the parasites rupture its proboscis, penetrate through the skin of man to the lymphatics where they grow into male and female Filarias.

Arthropods.—The life history of parasitic Arthropods and especially their relationship with the host, is much simpler. All the blood-sucking insects are only intermittent parasites, others remain for a longer period in contact with their host, but do not penetrate deeply into its tissues. There are, however, examples, such as the ripe female of the chigger flea (*Sarcopsylla penetrans*), which penetrate deeply into the skin of man. A parasitic mite (*Sarcoptes scabiei*) forms superficial galleries in the skin. The larvae of flies such as *Cordylobia anthropophaga* and *Dermatobia hominis* form much deeper galleries and swellings under the skin. Instead of ovipositing directly upon the host, *Dermatobia* fixes its eggs on the body of mosquitoes or other insects. When the latter visit the host, the larvae hatch out from the eggs and penetrate the skin.

Influence of Parasite upon the Host.—The effect produced by parasites upon their host is not always in proportion to the size or the numbers of parasites. The latter may be very numerous without producing serious damage. A black stork, for instance, harbouring several hundreds of worms of six different genera invading the lungs, trachea, oesophagus, stomach and intestine did not show any signs of distress. In an apparently healthy two-year-old horse were found several thousand helminths belonging to seven different genera. A rat heavily infected with *Trypanosoma lewisi* may show no symptoms of infection. On the other hand, a man dying from African sleeping sickness produced by *Trypanosoma gambiense* shows very few parasites in his blood, and the same applies to animals dying from the "nagana" disease caused by *Trypanosoma brucei*. In man, bacterial infections are usually responsible for acute disease, which, when overcome, ends in the complete recovery of the host and the disappearance of the parasites. The host, moreover, often acquires properties protecting him from further attack by the same kind of parasite. Animal parasites, on the contrary, cause a chronic disease which gradually undermines the health and considerably lowers the vitality of the host. The mechanism of the action of parasites varies with the species of parasite and with its localization in the host. The action may be purely mechanical, consisting in the blocking of some channels, ducts or vessels. This is the case in malignant malaria, where the parasites have a tendency to clog together and obliterate the blood capillaries of the brain and of other organs. Other parasites destroy the cells of their host, as is the case with the malarial parasites which live upon the red blood corpuscles. The same applies to the intercellular stages of *Coccidia*, *Leishmania* and other Protozoa, as well as to the spined eggs of the Bilharzial parasites migrating through the tissues of the host. Animal parasites often liberate substances which are distinctly toxic to the host. The severe anaemia of man infected with hook-

worm and other intestinal worms is due to the absorption of toxic substances produced by these worms. In some cases parasites are known to produce more or less pronounced castration of their host. The sexual glands of the latter become atrophied and the host often acquires the secondary sexual characters of the opposite sex. Striking examples of parasitic castration are shown by crabs harbouring *Sacculina* and by wasps attacked by *Stylops.*

The Reaction of the Host.—The mechanism of the reaction of the host naturally varies with the host, the parasite, and the localization of the latter within the body of the host. These reactions can, however, be separated into two main categories: (1) cellular or tissue reactions; and (2) humoral reactions.

(1) The simplest and most widely distributed reaction of the host against the parasite is directed by phagocytes, or the white cells of the blood, which are capable of taking up and digesting small parasites. They can also surround a larger parasite and form several layers of cells around its body. Other cells of the tissues often surround the parasites forming thick cysts or capsules, which separate them more or less completely from the rest of the host's body. Inside these capsules or cysts, the parasites often undergo degeneration, and sometimes even calcification (*Cysticerci, Trichinella*). The cellular reaction may ultimately cause dangerous complications of the disease Bilharziasis. In rats infected with a small round worm, *Gongylonema neoplasticum* (from cockroaches), the cellular reaction which develops around the worm gives rise to a malignant tumour of the tongue or the stomach.

(2) Humoral reaction (*see* IMMUNITY) consists in a special alteration in the body of the parasitized host, which becomes insusceptible to infective disease (acquired immunity). It consists in the development of substances (antibodies) in organisms recovering from infectious diseases, especially if the latter are produced by an infective agent (antigen) such as bacteria and some spirochaetes. Immunity is less frequent and seldom complete when the disease is caused by animal parasites. It is known, however, in the infections produced by *Leishmania* (oriental sore), piroplasms, the parasites of malaria and sleeping sickness, and to some extent in cases of infection with various helminths.

Treatment and Preventative Measures.—A man suffering from a disease produced by a parasite may recover simply through an antiparasitic reaction of his body. Recovery is hastened, however, and is made more certain when the host undergoes treatment. The latter may be purely surgical, and consist in the removal of the parasites from not easily accessible parts of the body (hydatid cyst). In the majority of cases treatment is medical and consists in (1) chemotherapy or destruction of the parasite by specific chemical compounds or drugs, (2) immune therapy or introduction of the antitoxin or anti-bacteria immune sera, which destroy the parasites; or in the introduction of vaccines which help to stimulate the mechanism of natural reactions of the host

The knowledge of the life history of parasites is of paramount importance to man, as it reveals the weak points in their development and adaptations and shows the manner in which infection can be avoided and the parasites attacked and eradicated. The preventive measures directed against parasites fall into three categories: (1) measures against the dissemination of parasites from the infected host; (2) destruction of parasites inside and outside the host together with destruction of secondary hosts or vectors; and (3) measures to avoid infection.

(1) Dissemination of parasites such as *Entamoeba,* schistosomes, tapeworms, hookworms and other intestinal forms as well as bacteria causing cholera and typhoid, can be prevented by avoiding the pollution of soil and water by animals and man harbouring the parasites. Dissemination of parasites causing yellow fever, malaria, sleeping sickness and filariasis is prevented by protecting the infected hosts from the bites of blood-sucking insects which are the potential carriers of infection.

(2) Destruction of parasites inside the host, which can be attained by drugs and other treatment, not only cures the host but also diminishes the chances of dissemination of the parasites. The latter can also be attacked outside the body of the host, directly in their free stages, or indirectly by attacking the intermediate hosts such as the fresh-water snail in Bilharziasis, and the blood-sucking insects in yellow fever, sleeping sickness and malaria.

(3) Measures to avoid infection naturally vary with the parasite involved. Infection with *Trichinella,* tapeworms and other intestinal parasites, is easily prevented by food inspection and by the thorough cooking of suspected food. Infection with guinea worm is prevented by drinking only filtered water; and boiling all water and vegetables is preventative against such diseases as cholera, typhoid and dysentery Infection with hookworm and Bilharziasis can be avoided by protecting the skin from contact with contaminated soil or water. Malaria, yellow fever and sleeping sickness, can be avoided by protection from the bites of the blood-sucking insects which carry these diseases

Parasites as Agents Beneficial to Man.—Many parasites are distinctly detrimental to man himself or to the animals or plants on which he depends; others are of no economic importance to him; but there are also forms which may be beneficial. They may be considered under the following headings:

(1) *The utilization of parasites as therapeutic agents* is based upon the fact that acute attacks of fever are often beneficial to a host suffering from chronic and fatal disease. It has been found that general paralysis in man (caused by the spirochaete of syphilis) subsides when the host is artificially inoculated with spirochaetes of relapsing fever or with malarial parasites.

(2) *Biological control of injurious organisms by means of parasites.* Parasites play an important rôle in nature in checking the increase of numerous species of animals and plants which possess a great power of reproduction. The importance of parasites in attacking organisms detrimental to man has been recognized only in recent years. It has been found possible to protect these parasites, to cultivate them, to transfer them from one region to another, and to use them as a powerful weapon directed against organisms harmful to man. A striking example of biological control by means of parasites of an injurious insect is afforded by the Hawaiian sugar cane leaf-hopper (*see* ENTOMOLOGY)

(3) *Caprification or pollination of fig flowers by parasites.* It is known that in the Smyrna variety of fig the receptacles contain only female flowers and pollination is brought about by a small gall forming insect (*Blastophaga*) which is parasitic in the wild caprifigs containing both male and female flowers.

(4) *Parasites causing the formation of pearls.* Pearls are formed as a reaction of the mantle epithelium of the oyster around some foreign body which acts as an irritant. In most cases the foreign body which stimulates the formation of the pearl is the larval stage of a parasitic worm. Thus, "The most beautiful pearl is nothing else but a brilliant sarcophagus of a worm" (Dubois).

(5) *Useful products and substances of commercial value produced by parasites.* Scale insects or Coccids, which live as parasites upon a great variety of plants, are responsible for the production of several substances of commercial value, such as cochineal dyestuff, the stick-lac (*see* LAC) from which shellac and a red "lac dye" are prepared, and the objects called "ground pearls" (*q.v*).

Parasitism in the Past and Present Time.—Parasitism cannot be considered as a mode of life only recently acquired by various organisms. Although parasites, owing to their adaptation, could hardly develop characters favourable for fossilization, a number of remains have been found revealing the existence of parasitism in very old geological periods. There is some evidence that bacteria already existed in the pre-Cambrian period Parasitic or "spot" fungi have been found in the remains of plants in as early as Carboniferous time. Fossil specimens of *Rhinoceros* show evidence of infection with *Actinomyces* (lumpy jaw). Parasitism of sea snails (Gastropods) upon sea-lilies (Crinoids) began in Silurian, became common in Devonian and reached a climax in the Carboniferous period. Insect galleries and galls have been found in plants from Cretaceous and Tertiary rocks. It is quite possible that parasites also played an important rôle in the extinction of several forms of mammals. Tse-tse flies (*Glossina*) which transmit *Trypanosoma brucei* causing the "nagana" disease in mammals, in early Tertiary times were much more widely distributed and even reached the region of Colorado.

Man from very early times probably suffered from most of the parasitic diseases from which he suffers now Calcified eggs

of Bilharzial parasites have been found in the kidneys of Egyptian mummies of the 20th Dynasty (about 1,200 B.C.); that is in the country in which Bilharziasis is so very common now. Tuberculosis in the form of Pott's disease was also found in a mummy of the priest of Ammon from an Egyptian cemetery dating from the 21st dynasty—1,100 B.C. Parasitic diseases have undoubtedly played an important rôle in the history of man. They undermined his health, lowered and dissipated his energy, reduced or destroyed the stock of animals and plants upon which he depended, and were often the direct cause of enormous losses of human life.. Such diseases, especially malaria and hookworm, were in a great measure responsible for the disappearance of many human tribes, and for the fall of many very highly civilized empires. They played an important part in the history of military conquest as well as in the history of the commercial expansion of man. As recently as the 14th century Europe was swept by epidemics of plague which destroyed a quarter of the population. Parasites have hindered several human efforts in modern times. Thus, the construction of the St. Gothard tunnel was seriously hampered by hookworm disease; and the first enterprise of the construction of the Panama canal failed utterly after great loss of life from malaria and yellow fever. It was only when these diseases had been conquered in the Panama zone that the work could be brought to a successful conclusion. (*See* also PESTS.)

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PARASNATH, a hill and place of Jain pilgrimage in British India, in Hazaribagh district, Behar and Orissa; 4,480 ft. above the sea; 18 m. from Giridih station on the East Indian railway. It derives its name from the last of the twenty-four Jain saints, who is believed to have attained here the *nirvana*.

PARATHYROID: *see* DUCTLESS GLAND; SPRUE.

PARATYPHOID FEVER is the name given to a set of intestinal diseases clinically very like typhoid fever and caused by specific organisms akin to the bacillus typhosus. Three distinct organisms have been identified as causing these diseases and they have been designated as bacillus paratyphosus "A," "B" and "C," and the fevers they cause are therefore known as paratyphoid "A," "B" and "C" respectively.

All three paratyphoid organisms can be distinguished from B. typhosus by biochemical tests and B. paratyphosus "A" can be distinguished from "B" and "C" by the same means, but for the identification of the last two organisms serological methods have to be employed. The biochemical substances used in differentiating these organisms from one another are the sugars, glucose, mannite and dulcite, dissolved in a broth medium, and milk. B. typhosus produces acid in glucose and mannite whereas the paratyphoid organisms produce acid and gas in all three sugars. Again B. paratyphosus "A" turns milk acid, whilst the other paratyphoid organisms turn it first acid and then alkaline.

The anatomical lesions in the paratyphoid fevers resemble those found in typhoid fever and chiefly consist of inflammation and ulceration of the lymphoid tissue of the intestinal canal, especially in the lower part of the small intestine, and of the enlargement of the spleen and mesenteric glands. In paratyphoid "B" fever the ulceration often spreads into the large intestine.

The symptoms of the paratyphoid fevers are generally those of a mild form of typhoid fever, the only difference being one of degree, but it must be remembered that they may be just as severe and followed by the same complications as typhoid.

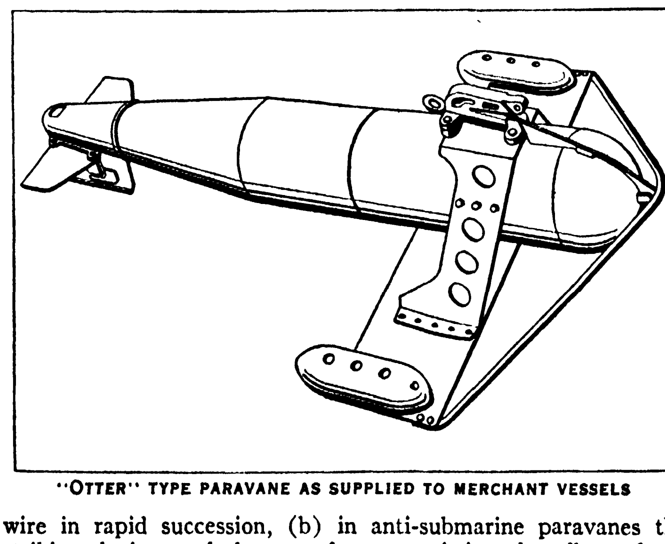
The incubation period averages between 5 and 21 days and the onset of the disease causes lassitude, headache, nose bleeding, pain in the back with sometimes a shivering fit and a sudden rise of temperature. Early and well marked gastro-intestinal symptoms, such as diarrhoea and vomiting, suggest a paratyphoid "B" infection. The characteristic "rose spots" of typhoid fever are not always present but on the other hand they may be very plentiful and by no means confined to the abdomen but spread over the neck, face and arms. They may also be very much larger than the usual rose spots and resemble the rash of measles. The mental condition, when impaired, may vary between dulness and delirium, according to the severity of the disease. The temperature often reaches its highest point shortly after the onset of the disease in contradistinction to the gradual rise in typhoid fever. It is usually of shorter duration, more irregular, and may return to normal suddenly instead of gradually as in typhoid fever. The pulse is slow and follows the variations of the temperature.

Diarrhoea is a fairly constant symptom and the stools resemble pea soup, have a putrid smell and may contain fragments from the inner coat of the intestine. Fresh blood may also be seen in the stools due to the erosion of a blood vessel in one of the intestinal ulcers. Ulceration may proceed so far as to cause a perforation into the abdominal cavity which leads to local or general peritonitis. The average time during which active symptoms of the disease are present is from 9 to 14 days. The complications of paratyphoid fever are those of typhoid fever though there is a greater tendency towards abscess formation in the former.

It should be possible to isolate the causal organisms, at one stage of the disease or another, from the blood, the urine and the stools and it is the persistence of the organisms in the latter situations which produces the paratyphoid carrier. The treatment of paratyphoid fever is identical with that of typhoid fever. Partial protection against the paratyphoid fevers can be obtained by anti-paratyphoid inoculation but the specific organism must be used in making the vaccine. In practice a combined vaccine is used which includes the paratyphoid and the typhoid organisms. (For Bibliography *see* TYPHOID FEVER.) (N. T. W.)

PARAVANE, THE, is a type of underwater kite which was developed by Lieutenant (now Lieut.-Commander, retired) C. D. Burney, R.N., during the World War as an anti-submarine and anti-mine weapon. It consists essentially of a torpedo-shaped buoyant body towed by a wire from a ship and carrying a plane which from the motion of the ship through the water gives the necessary thrust to cause the paravane to stand out a considerable lateral distance from the ship's side. It is fitted with a rudder to keep it at a pre-arranged depth below the surface, the rudder being governed by a hydrostatic valve and an oscillator.

The paravane is divided into three parts, namely: (1) head; (2) body; (3) tail. The head carries a tow anchorage, plane and (a) in anti-mine paravanes, the cutter, which requires no setting and can cut successive parts of a mine mooring of $1\frac{1}{2}$in.

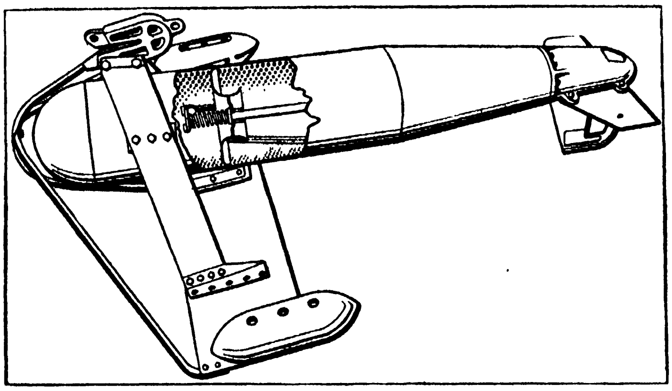


"OTTER" TYPE PARAVANE AS SUPPLIED TO MERCHANT VESSELS

wire in rapid succession, (b) in anti-submarine paravanes the striking device, and the gear for transmitting the effect of the impact to the striker-switch.

The body is watertight and is made of welded steel plate. (a) In the anti-submarine paravane the body carries within it the charge of T.N.T., the primer tin and the detonating gear. Whilst the paravane is on board or in close proximity to the ship the detonators are withdrawn from the primer and two safety shutters form an effective fire screen between the two. At a speed greater than about 10 knots, a water flap, which projects from the

under side of the paravane, is forced aft by the water pressure upon it. This movement is transmitted to the detonator carriage, which moves aft, forcing the safety shutters to one side and placing the detonators in position in the primer ready for firing. The body also carries the striker-switch and depth-recording gear. The depth-recording gear registers on the attacking vessel the depth at which the paravane is running. (b) In the case of the anti-



"OTTER" TYPE PARAVANE, SHOWING DEPTH CONTROL ARRANGEMENTS

mine paravane the body contains the oscillator. The depth-keeping mechanism in the paravane is composed of two distinct portions, the hydrostatic valve and the mercury oscillator. The hydrostatic valve depends, for its action, on a change of depth above or below the normal depth. It therefore causes the paravane to follow a sinusoidal path through the water. At high speeds this motion becomes excessive and a device is required which will return the paravane to its correct position as soon as it is inclined to move from its set depth. This function is performed by the oscillator. When a paravane is fitted with this gear, the depth at which it runs does not vary more than 4ft. on either side of the set depth.

The tail of the paravane carries the two rudders, the hydrostatic valve which actuates them, and the horizontal and vertical fins. The paravane being required to run at a certain depth, a compression corresponding to this depth is put upon the hydrostatic valve spring. The load due to this compression forces the rudders "down"; the water pressure acting on the hydrostatic valve tends to force the rudders "up"; when the two balance, the rudders return to the amidships position.

Protector Paravanes.—Paravanes for anti-mine use are known as Protector paravanes. The installation is designed to protect ships from moored mines. A paravane is towed on either side of the vessel, by means of a length of special wire. Due to the position taken up by the paravanes, the wires form a wedge on either side of the ship, and sweep through a broad path. If they foul the mooring wire of a mine, the mine is deflected away from the path of the vessel, and the mooring wire slips along the paravane wire until it reaches the paravane. There it is severed by the cutter fitted on the head and the mine rises to the surface, where it can be seen and destroyed. The towing wire is attached to the vessel by a specially designed fitting situated at the point of intersection of the stem and keel. When the towing wire fouls a mine mooring wire, a minimum outward thrust must be imparted to the mine and sinker in order to deflect them from the path of the vessel. If a paravane be designed to give this minimum thrust whilst moving at a moderate speed through the water, its total thrust when moving at a high speed would be very great, and an excessive load might be thrown upon the towing wire. Broadly speaking, a paravane is designed to protect a vessel at all speeds from about one-third her maximum upwards.

The protection afforded by the paravanes depends, amongst other things, upon the distance between the fore and aft line of the ship and the paravane when running. This distance, or spread, in turn depends upon three things:—(1) the length of the towing wire; (2) the size of the paravane; (3) the size of the towing wire. Also the paravanes must be attached to the ship as far forward and as low down as practicable. If the point of attachment were above the level of the keel, mines could pass under the towing wire and hit the ship. Further, the paravanes should not tow at any considerable depth below the keel. They are usually set to run at a depth about 5ft. in excess of the deepest draught of the vessel. Any mine within the sweep of the paravanes, which lies between the line of keel and the surface of the sea, will then be deflected by the towing wire. If a mine be moored so deeply that it passes under the towing wire, it cannot, under ordinary circumstances, strike the ship in calm water.

As already described, an effective paravane will deflect any mine from the path of a vessel which is on a straight course, but it is conceivable that, whilst a vessel is turning, a mine may be missed by the paravane and yet hit the ship near the stern. For relatively small ships, up to 400ft. in length, one pair of paravanes gives practically complete immunity from moored mines as long as the ship is not in a heavy sea. With larger ships, the distance swept out by the vessel when turning under full helm may be so great that one pair of paravanes does not give adequate protection.

Explosive Paravanes.—A considerable amount of auxiliary apparatus is required in connection with explosive paravanes, the whole installation being called the "high speed submarine sweep." It enables a vessel to attack a submerged hostile submarine whose position is only approximately known. The sweep consists essentially of a paravane, towed astern of the attacking vessel, and containing an explosive charge fired electrically by means of a dynamo fitted in the vessel. It is towed from a winch, by armoured electric cables led over a fairlead in the stern of the attacking vessel. When the towing wire fouls a submerged submarine it will slip over her smooth surface until the submarine is struck by the paravane. The striking gear which is fitted to the nose of the paravane is moved inwards by the impact, actuates a firing switch and detonates the charge. Alternatively, if the nose of the paravane does not strike the submarine, the wire may be caught or nipped over some part of the submarine, thus increasing the load on the wire. This increased load trips a dynamometer switch which again detonates the charge. A third method of firing, by a hand switch on the attacking vessel, is fitted in case it is desired to get rid of the paravane in an emergency. The principal advantages of this type of sweep are that it can be towed at high speeds and it leaves unaffected the manoeuvring powers of attacking vessels.

(A. H. W.)

PARAZOA, the name sometimes used in zoology to denote the grade of organization represented by the sponges (*q.v.*), in contradistinction to Protozoa and Metazoa (*qq.v.*).

PARCEL POST: *see* Post and Postal Services.

PARCENARY: *see* Co-parcenary.

PARCHIM or **PARCHEM,** a town of Germany, in the republic of Mecklenburg-Schwerin, on the Elde, 23 m. S.E. of Schwerin, on the railway from Ludwigslust to Neubrandenburg. Pop. (1925) 11,217. Founded about 1210, Parchim was during part of the 14th century the residence of one branch of the family of the dukes of Mecklenburg. It became a prosperous industrial town during the 16th century, but this prosperity was destroyed by the Thirty Years' War. It is a walled town, with a Gothic town hall. Here Moltke was born. It now manufactures machinery, cloth, chicory and cigars, and is a gardening centre.

PARCHMENT. Skins of certain animals, prepared after particular methods, have supplied writing material on which has been inscribed the literature of centuries. The preparation of such skins, in a manner which gave the material the name it possesses to-day (περγαμηνή, Lat. *charta pergamena,* Fr. *parchemin*) was traditionally attributed to Eumenes II. of Pergamum, 197–158 B.C.

The principal improvement in the new manufacture was the dressing of the skins in such a way as to render them capable of receiving writing on both sides, the older methods probably treating only one side for the purpose, a practice which was sufficient in times when the roll was the ordinary form of book and when it was not customary to write on the back as well as on the face of the material. The invention of parchment, with its two surfaces, ensured the development of the codex.

The animals whose skins were found appropriate for the manufacture of the new parchment were chiefly sheep, goats and calves.

But in the course of time there has arisen a distinction between the coarser and finer qualities of the material; and while parchment made from ordinary skins of sheep and goats continued to bear the name, the finer kinds of manufacture produced from the more delicate skins of the calf or kid, or of still-born or newly-born calves or lambs, came to be generally known as vellum (Fr. *velin*). The skin codices of the early and middle ages being for the most part composed of the finer kinds of material, it has become the custom to describe them as of vellum, although in some instances it would be more correct to call the material parchment.

The ordinary modern process of preparing the skins is by washing, liming, unhairing, scraping, washing a second time, stretching evenly on a frame, scraping a second time and paring down inequalities, dusting with sifted chalk and rubbing with pumice. Similar methods must have been employed from the first.

The comparatively large number of ancient and mediaeval mss. that have survived enables us to gather some knowledge of the varieties of the material in different periods and in different countries. We know from references in Roman authors that parchment or vellum was entering into competition with papyrus as a writing material as early as the 2nd century A.D. (*see* ILLUMINATED MANUSCRIPT), though at that time it was probably not so skilfully prepared as to be a dangerous rival. But the surviving examples of the 3rd and 4th centuries show that a rapid improvement must almost at once have been effected, for the vellum of that age is generally of a thin and delicate texture, firm and crisp, smooth and glossy. There was always a difference in colour between the surface of the skin from which the hair had been removed and the surface next to the flesh of the animal, the latter being whiter than the other. This difference is generally more noticeable in the older examples, those of a later period having usually been treated more thoroughly with chalk and pumice. To obviate any unsightly contrast, it was customary, when making up the quires for a volume, to lay hair-side next to hair-side and flesh-side to flesh-side, so that, at whatever place the codex was opened, the tint of the open pages should be uniform.

As a rule, the vellum of early mss., down to and including the 6th century, is of good quality and well prepared. After this, the demand increasing, a greater amount of inferior material came into the market. The manufacture necessarily varied in different countries. In Ireland and England the vellum of the early mss. is usually of a stouter quality than that of foreign examples. In Italy and Greece and in the European countries generally bordering on the Mediterranean, a highly polished surface came into favour in the middle ages, with the ill effect that the hardness of the material resisted absorption, and that there was always a tendency for ink and paint to flake off. On the other hand, in western Europe a soft pliant vellum was in vogue for the better classes of mss., from the 12th century onwards. In the Italian Renaissance a material of extreme whiteness was affected.

Examples of uterine vellum, prepared from still-born or newly-born young, are met with in choice volumes. A remarkable instance of a codex composed of this delicate substance is the Additional MS. 23935, of the 13th and 14th centuries, in the British Museum, which is made up of as many as 579 leaves, without being a volume of abnormal bulk.

In conclusion, we must briefly notice the employment of vellum of a sumptuous character to add splendour to specially choice codices of the early middle ages. The art of dyeing the material with a rich purple colour was practised both in Constantinople and in Rome; and, at least as far back as the 3rd century, mss., generally of the Scriptures, were produced written in silver and gold on the precious stained vellum; a useless luxury, denounced by St. Jerome in a well-known passage in his preface to the Book of Job. A certain number of early examples still survive, in a more or less perfect condition: such as the mss. of the Gospels in the Old Latin version at Verona of the 4th or 5th century; the celebrated codex of Genesis in the Imperial Library at Vienna; the Rossano ms. and the Patmos ms. of the Gospels in Greek; the Gothic Gospels of Ulfilas at Uppsala, and others of the 6th century, besides a few somewhat later specimens. In the revival of learning under Charlemagne a further encouragement was given to the production of such codices; but soon afterwards the art of purple-staining appears to have been lost or abandoned. A last trace of it is found in a few instances of stained vellum leaves inserted for ornament in mss. of the period of the Renaissance.

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PARDO BAZÁN, EMILIA (1851–1921), Spanish author, was born at Corunna. Her first novel, *Pascual López* (1879), was a simple exercise in fantasy of no remarkable promise; it was followed by a more striking story, *Un Viaje de novios* (1881), in which a discreet attempt was made to introduce into Spain the methods of French realism. The sensation caused by this book among the literary cliques was increased by the appearance of another naturalistic tale, *La Tribuna* (1885), wherein the influence of Zola is unmistakable. Meanwhile, the writer's reply to her critics was issued under the title of *La Cuestión palpitante* (1883), a clever piece of rhetoric, but of no especial value as regards criticism or dialectics. Probably the best of Emilia Pardo Bazán's work is embodied in *Los Pazos de Ulloa* (1886), the painfully exact history of a decadent aristocratic family, as notable for its portraits of types like Nucha and Julián as for its creation of characters like those of the political bravos, Barbacana and Trampeta. Yet perhaps its most abiding merit lies in its pictures of country life, its poetic realization of Galician scenery set down in an elaborate, highly-coloured style, which, if not always academically correct, is invariably effective. A sequel, with the significant title of *La Madre naturaleza* (1887), marks a further advance in the path of naturalism, and henceforward Emilia Pardo Bazán was universally recognized as one of the chiefs of the new naturalistic movement in Spain. The title was confirmed by the publication of *Insolación* and *Morriña*, both issued in 1889. In this year her reputation as a novelist reached its highest point. Her later stories, *La Cristiana* (1890), *Cuentos de amor* (1894), *Arco Iris* (1895), *Misterio* (1903), *La Quimera* (1905), *Dulce Dueño* (1911), and *Cuentos de la Tierra* (1922), though not wanting in charm, awakened less interest.

PARDON, the remission, by the power entrusted with the execution of the laws, of the penalty attached to a crime. The right of pardoning is coextensive with the right of punishing. In practice the prerogative is extremely valuable, when used with discretion, as a means of adjusting the different degrees of moral guilt in crimes or of rectifying a miscarriage of justice. By the law of England pardon is the sole prerogative of the king, and it is declared by 27 Hen. VIII. c. 24 that no other person has power to pardon or remit any treasons or felonies whatsoever. This is a position that is based on the theory of English law that all offences are breaches of the king's peace. Thus, the Crown by pardon only remits the penalty for an attack upon itself. The prerogative is in modern times exercised by delegation, the Crown acting upon the representation of the secretary of State for the home department in England and the secretary for Scotland in that country. The prerogative of the Crown is subject to some restrictions: (1) The committing of a subject of the realm to a prison out of the realm is by the Habeas Corpus Act a *praemunire*, unpardonable even by the king (31 Car. II. c. 2, s. 12). (2) The king cannot pardon an offence in a matter of private rather than of public wrong, so as to prejudice the person injured by the offence. Thus a common nuisance cannot be pardoned while it remains unredressed, or so as to prevent an abatement of it. A fine or penalty imposed for the offence may, however, be remitted. (3) The king's pardon cannot be pleaded in bar of an impeachment. This principle, first asserted by a resolution of the House of Commons in the earl of Danby's case (May 5, 1679), forms one of the provisions of the Act of Settlement, 12 and 13 Will. III. c. 2.

Pardon may be actual, conditional or constructive. Actual pardon is by warrant under the great seal, or under the sign-manual countersigned by a secretary of State (7 and 8 Geo. IV. c. 28, s. 13). Constructive pardon is obtained by endurance of

the punishment. By 9 Geo. IV. c. 32, s. 3, the endurance of a punishment on conviction of a felony not capital has the same effect as a pardon under the great seal. Further, pardon may be free or conditional. A conditional pardon most commonly occurs where an offender sentenced to death has his sentence commuted to penal servitude or any less punishment. But it of course applies to other cases (*see* Criminal Law Act 1827, s. 13, and Children Act 1908, s. 84). The condition of his pardon is the endurance by him of the substituted punishment. The effect of a free pardon, whether actual or constructive, is to put the person pardoned in the position of an innocent man; he may have an action against any one thenceforth calling him traitor or felon.

It is obvious that, though the Crown is invested with the right to pardon, this does not prevent pardon being granted by the higher authority of an Act of parliament. Acts of indemnity have frequently been passed, the effect of which is the same as pardon or remission by the Crown. Civil rights are not divested by pardon. The person injured may have a right of action against the offender in spite of the pardon of the latter, if the right of action has once vested, for the Crown cannot affect private rights.

In the United States, the president has authority to pardon all offences against the Government except in case of impeachment. In the States, the governor has the authority, usually acting upon recommendation of a board of pardons, or, as in New Jersey, as a member himself of the board of pardons. In the States, a pardon generally is necessary to restore to a person convicted of a felony and in some cases a misdemeanour, his political rights of voting and holding public office.

PAREJA, JUAN DE (1606–1670), Spanish painter, was born a slave in the West Indies about 1606, and in early life passed into the service of Velasquez, who employed him in colour-grinding and other work of the studio. By day he closely watched his master's methods, and by night stealthily practised with his brushes until he had attained considerable skill. The story goes that, having succeeded in producing a picture satisfactory to himself, he contrived furtively to place it among those on which Velasquez had been working, immediately before an expected visit of King Philip IV. The performance was duly discovered and praised, and Pareja forthwith received his freedom, which, however, he continued to devote to his former employer's service. His best known work is the "Calling of St. Matthew," in the Prado, Madrid. Velasquez took Pareja with him to Rome and painted his portrait (now at Longford Castle).

PARENT, SIMON NAPOLEON (1855–1920), Canadian politician, son of Simon Polycarpe Parent, merchant, was born in the village of Beauport, in the province of Quebec, on Sept. 12, 1855. He was educated at Laval university, where he graduated in 1881. In the same year he was called to the bar of the province of Quebec. Parent was mayor of Quebec from 1894 to 1906. From the year 1890 to 1905 he represented the county of Saint-Sauveur as a Liberal in the Quebec assembly, and was minister of lands in the Marchand administration of 1897. He was prime minister of Quebec from 1900 to 1905, when he became chairman of the Transcontinental railway of Canada. He died in Sept. 1920.

PARENTAL EDUCATION, an organized effort to provide systematic parental training which will insure harmonious and efficient functioning of parent and child in the rapidly changing civilization. (For England *see* SCHOOL AND THE HOME.)

THE UNITED STATES

The movement has grown in the U.S. from scattered groups in the '90s to definite organizations of national proportions. The major programme of agencies engaged in this work is to translate research materials of sociological and biological science into popular terms of use to parents.

The National Congress of Mothers, founded in 1897 by Mrs. Theodore W. Birney, became in 1908 the National Congress of Mothers and Parent-Teacher Associations, and in 1924 the National Congress of Parents and Teachers. It has affiliated branches in all but one State, a membership of over 1,000,000, and committees on every phase of child welfare. Its programme has stressed social contact of parent and teacher, discussion of school problems and, more recently, child study.

The Child Study Association of America had in 1928 124 study groups associated or affiliated, some of which are in China, Japan, Russia, London and Canada. Independently and in co-operation with local groups it conducts annual national conferences on parenthood education. It publishes a magazine, "Child Study." The association inspired the formation of the National Council of Parental Education. The Child Development Committee of the National Research Council (1926) co-ordinates the child welfare research of the various universities. In connection with a study of the pre-school, elementary and adolescent child sponsored by the American Association of University Women, 224 child study groups have been formed. In New York, Boston and Hartford the visiting teacher movement (later the National Association of Visiting Teachers) sprang up almost simultaneously in a direct attempt to serve those parents not reached through the organizations mentioned. The Public Education Association has conducted many experiments and investigations through the visiting teacher, pointing out the significance of family conditions and relationships in forming desirable moral and social responses. The National Committee on Mental Hygiene (1910), searching for the causes of nervous diseases, found unhealthy emotional habits to be the largest factor, and organized child guidance clinics. In 1919 the Progressive Education Association was formed to present to the public efforts being made to adapt education to changing conditions. In 1921, through the initiative of the Parents' Association of the Horace Mann school, Teachers' college, of Columbia university, the United Parents' Associations of Greater New York Schools was formed. Its contribution has been the search for a technique to provide popular parental education in a cosmopolitan, congested centre. It conducted the Parents' Exposition (1928). In 1922 the American Child Health Association evolved from an older organization to continue the interpretation of findings and discoveries of specialists to the lay public. It is assisted by the State Bureau of Infant and Maternity Hygiene, baby clinics and hospital courses for pregnant mothers.

Outstanding work has been done in colleges and universities with nursery schools (*q.v.*) and home management facilities such as the Merrill-Palmer schools, Detroit, Mich., University of Minnesota, University of Chicago, Cornell university, Iowa State college and Vassar college. Many not having nursery schools co-operate with other agencies, as in the case of the University of Cincinnati, which has been aided by the Mothers' Training Centre to form a nursery school where parents observe the play, occupations and methods suited to the pre-school child. In 1926 this movement crystallized in a national organization under Miss Patty Hill.

Other agencies are the American Home Economics Association, founded by Mrs. Ellen H. Richard (1907) to emphasize the significance of home making, and the American Social Hygiene Association (1914), which assists parents to give proper sex instruction. The U.S. Bureau of Education, the Federal Board of Vocational Education, the Federal Children's Bureau and the U.S. Department of Agriculture have made valuable contributions by furnishing lecturers and outlines for reading courses and through study groups. Some municipalities and State departments of education and several private organizations maintain training courses.

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PARENZO, a seaport and episcopal see of Italy, province of Pola, 95 m. S.W. of Trieste by rail. Pop. (1921) 9,288, town; 12,252, commune. It is situated on the west coast of Istria, on a peninsula not more than 5 ft. above the sea-level; and as the pavements of the Roman period are 3 ft. below the present surface it is inferred that this part of the coast is slowly subsiding. The well-preserved cathedral of St. Maurus (543–554) is a basilica

with nave and two aisles. There are a number of Venetian Gothic houses.

Parenzo (Lat. *Parentium*), conquered by the Romans in 178 B.C., still preserves the Roman ground plan, and the small museum is housed in the ruins of a temple. The bishopric was founded in A.D. 524. The city formally recognized Venetian supremacy in 1267, and was in 1354 plundered by Paganino Doria of Genoa.

See Neumann, *Der Dom von Parenzo* (Vienna, 1902).

PARGA, a seaport of southern Epirus, in Greece, on the Ionian Sea. Parga has a rock-built citadel and a harbour formed by a mole which the Venetians constructed in 1572. It exports citrons, wool, oak, bark and skins. It is perhaps the site of the ancient Toryne, a short distance to the west; Parga was removed to its present position after the Turkish invasion in the 15th century. Under Venetian protection, freely accepted in 1401, the inhabitants maintained their municipal independence and commercial prosperity down to the destruction of the Venetian republic in 1797, though on two occasions, in 1500 and 1560, their city was burned by the Turks. The attempts of Ali Pasha of Iannina to make himself master of the place were thwarted partly by the presence of a French garrison in the citadel and partly by the heroic attitude of the Pargiotes themselves, who were anxious to have their city incorporated with the Ionian Republic. To secure their purpose they in 1814 expelled the French garrison and accepted British protection; but the British Government in 1815 determined to go back to the convention of 1800 by which Parga was to be surrendered to Turkey, though no mosque was to be built or Muslim to settle within its territory. Rather than subject themselves to the tyranny of Ali Pasha, the Pargiotes decided to forsake their country; and accordingly in 1819, the majority migrated to the Ionian Islands The Turkish government was constrained to pay them £150,000 by way of compensation. The town has been largely rebuilt since that date.

PARGETTING, a term applied to the decoration in relief of the plastering between the studwork on the outside of half-timber houses, or sometimes covering the whole wall. The devices were stamped on the wet plaster. This seems generally to have been done by sticking a number of pins in a board in certain lines or curves, and then pressing on the wet plaster in various directions, so as to form geometrical figures. Sometimes these devices are in relief, and in the time of Elizabeth represent figures, birds, foliages, etc.; fine examples are to be seen at Ipswich, Maidstone, Newark, etc. The term is also applied to the lining of the inside of smoke flues to form an even surface for the passage of the smoke.

PARHELION or **MOCK SUN,** a spot on a solar halo reflected at various angles near the sun. The most brilliant are situated at the intersections of the inner halo and the parhelic circle, and are particularly brilliant when the sun is setting They are caused by refraction through a pair of alternate faces of a vertical prism. When the sun is on the horizon the rays fall from the principal section of the prisms and the parhelia are therefore not only on the inner halo but also on the parhelic circle. The different values of the angle of minimum deviation for differently coloured rays give rise to most effective colourings. *See* also HALO.

PARIAH, in European usage the name for the outcasts of India but many castes rank below them. The term *paraiyan* probably means "drummer" but it is now almost a generic one and the caste is split up into a number of sub-castes pursuing many avocations generally humble or even criminal but occasionally respectable. As a caste their touch pollutes men of high caste yet they belong to the right-hand faction and their priests actually wear the sacred thread. The Paraiyans would appear to have been either a pre-Dravidian element or a caste depressed in Dravidian times which was closely connected with the soil. It may once have held a better status but its occasional privileges are not inconsistent with an age-long predial serfdom. Its main strength is in the Tamil districts. Nowadays it forms almost a nationality apart, living in its own hamlets but holding them inviolate, asserting its meagre rights, retaining many of its primitive beliefs, yet not uninfluenced by Brahmanism. Paraiyans, once enlisted in Clive's troops, are still recruited for the Madras sappers and miners. Conversion to Christianity has done much for this and the other castes included in the Panchamas or "people of the fifth" caste, whose education has been specially fostered by Government.

See E. Thurston, *Castes and Tribes of S. India*, vi. (1909).

PARIAH DOG, a dog of a domesticated breed that has reverted, in a greater or less degree, to a half-wild condition. Troops of such dogs are found in the towns and villages of Eastern Europe, Asia and Africa; and they probably interbreed with wolves, jackals and wild dogs.

PARIAN CHRONICLE, a marble tablet found in the island of Paros in 1627, now among the Arundel Marbles at Oxford. It originally embraced an outline of Greek history from the reign of Cecrops, legendary king of Athens, down to the archonship of Diognetus at Athens (264 B.C.). The author of the Chronicle has given much attention to the festivals, and to poetry and music; thus he has recorded the dates of the establishment of festivals, of the introduction of various kinds of poetry, the births and deaths of the poets, and their victories in contests of poetical skill. Important political and military events are often omitted. The years are reckoned backwards from the archonship of Diognetus, and further specified by the kings and archons of Athens The Chronicle consists of 93 lines in the Attic dialect.

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PARI MUTUEL: *see* TOTALIZATOR

PARINI, GIUSEPPE (1729–1799), Italian poet, was born at Bosisio in the Milanese, on May 22, 1729 His parents, who possessed a small farm on the shore of Lake Pusiano, sent him to Milan, where he studied under the Barnabites in the Academy Arcimboldi, maintaining himself latterly by copying manuscripts. In 1752 he published at Lugano, under the pseudonym of Ripano Eupilino, a small volume of *sciolto* verse which secured his election to the Accademia dei Trasformati at Milan and to that of the Arcadi at Rome. In 1754 poverty drove him to take priest's orders, and he then obtained a place as tutor. *Il Mattino* (1763), the first part of his *Il Giorno,* gives ironical instructions to a young nobleman as to the best method of spending his mornings It at once established Parini's fame, and two years later there followed *Il Mezzogiorno*. The Austrian plenipotentiary, Count Firmian, appointed him editor of the Milan *Gazette,* and in 1769 to a specially created chair of belles lettres in the Palatine School. Parini hoped for great things from the French Revolution, and on the French occupation of Milan he was appointed magistrate by Napoleon and Saliceti. Three years later he was dismissed. He then completed *Il Vespro* and *La Notte* (published after his death), which with the two other poems already mentioned compose *Il Giorno.* The score of *Odi,* composed between 1757 and 1795, are among the classics of Italian poetry. Parini's scorn for the aristocratic society of his day and his independent character induced de Sanctis to speak of him as "the first man of the new Italy" He died at Milan on Aug 15, 1799.

See editions of Parini's *Opere* by Reina (6 vols., Milan, 1801–04), and by Mazzoni (Florence, 1897). *See* also F de Sanctis, *Nuovi Saggi Critici* (1872); and Carducci, *Studi su G. Parini* in vol. xiii. & xiv. of his *Opere*.

PARIS (also called ALEXANDROS, *i.e.,* "champion"), the son of Priam and Hecuba, who dreamed that she was delivered of a firebrand. The dream was interpreted that her child would ruin his country, and when Paris was born he was exposed on Mt. Ida. His life was saved by the herdsmen, and he grew up among them, till he was recognized and received by his parents. When the strife arose between Hera, Athena, and Aphrodite (*see* ERIS) Paris was selected as the judge. Each tried to bribe him, Hera promising power, Athena wisdom, Aphrodite the most beautiful woman in the world. Paris decided in favour of Aphrodite, and thus made

Hera and Athena bitter enemies of his country. Paris now set sail for Lacedaemon, deserting his old love Oenone, daughter of the river-god Cebren. In Menelaus' absence he carried off Helen; thereupon followed the siege of Troy, during which Paris, although inferior to Hector, fought well enough, slaying Achilles (*q.v.*) by the help of Apollo. Before the capture of the city he was mortally wounded by Philoctetes with an arrow. He then bethought him of Oenone, who he knew could heal the wound. She refused to save him, but when he died she committed suicide. The judgment of Paris became a favourite subject in Greek art.

PARIS, ALEXIS PAULIN (1800–1881), French *savant,* was born at Avenay (Marne) on the 25th of March, 1800. He published in 1824 an *Apologie pour l'école romantique,* and took an active part in Parisian journalism. His appointment, in 1828, to the department of manuscripts in the Bibliothèque royale left him leisure to pursue his studies in mediaeval French literature. Paulin Paris lived before minute methods of research had been generally applied to modern literature, and his chief merit is that by his numerous editions of early French poems he continued the work begun by Dominique Méon in arousing general interest in the then little-known epics of chivalry. Admitted to the Académie des Inscriptions et Belles Lettres in 1837, he was shortly afterwards appointed on the commission entrusted with the continuation of the *Histoire littéraire de la France*. In 1853 a chair of mediaeval literature was founded at the Collège de France, and Paulin Paris became the first occupant. He retired in 1872 with the title of honorary professor, and was promoted officer of the Legion of Honour in the next year. He died on the 13th of February 1881 in Paris.

His works include: *Manuscrits français de la bibliothèque du roi* (7 vols., 1836–1848); *Li Romans di Garin le Loherain, précédé d'un examen des romans carlovingiens* (1883–1885); *Li Romans de Berte aux grans piés* (1832), *Le Romancero français, histoire de quelques anciens trouvères et choix de leurs chansons* (1833); an edition of the *Grandes chroniques de France* (1836–1840); *La Chanson d'Antioche* (1848); *Les Aventures de maître Renart et d'Ysengrin* (1861) and *Les Romans de la table ronde* (1868–1877), both put into modern French.

His son Gaston Paris contributed a biographical notice to vol. xxix. of the *Histoire littéraire.*

PARIS, FRANÇOIS DE (1690–1727), French theologian, was born in Paris on the 3rd of June, 1690. He zealously opposed the bull *Unigenitus* (1713), which condemned P. Quesnel's annotated translation of the Bible. He gave further support to the Jansenists, and when he died (May 1, 1727) his grave in the cemetery of St. Médard became a place of fanatical pilgrimage and wonder-working. The king ordered the churchyard to be closed in 1732, but earth which had been taken from the grave proved equally efficacious and helped to encourage the disorder which marked the close of the Jansenist struggle (*see* JANSENISM).

Lives by B. de la Bruyère and B. Doyen (1731). *See* also P. F. Matthieu, *Histoire des miracles et des convulsionnaires de St. Médard;* M. Tollemache, *French Jansenists* (London, 1893).

PARIS, GASTON [BRUNO PAULIN GASTON] (1839–1903), French scholar, son of Alexis Paulin Paris, was born at Avenay (Marne) on Aug. 9, 1839. An early impulse to the study of Romance literature was developed by courses of study at Bonn (1856–57) under Friedrich Diez, at Göttingen (1857–58) and finally at the École des Chartres (1858–61). His first important work, *Étude sur le rôle de l'accent latin dans la langue française* (1862), was developed later in his *Lettre à M. Léon Gautier sur la versification latine rhythmique* (1866). Gaston Paris maintained that French versification was a natural development of popular Latin methods which depended on accent rather than quantity, and were as widely different from classical rules as the Low Latin was from the classical idiom. He succeeded his father as professor of mediaeval French literature at the Collège de France in 1872, becoming director in 1895; in 1876 he was admitted to the Academy of Inscriptions and in 1896 to the French Academy. Gaston Paris won a European reputation as a Romance scholar, and was a literary critic of great acumen and breadth of view. His *Vie de Saint-Alexis* (1872) provided a model for future editors of mediaeval texts. It included the original text and the variations dating from the 12th, 13th and 14th centuries. Gaston Paris contributed largely to the *Histoire littéraire de la France,* and with Paul Meyer published *Romania,* a journal devoted to Romance literature. He trained at the École des Chartres and the Collège de France a band of disciples who continued his traditions of exact research. Gaston Paris died in Paris on March 6, 1903. He had endeared himself to a wide circle of scholars outside his own country by his unfailing urbanity and generosity.

His works include: *Les plus anciens monuments de la langue française* (1875); *Deux rédactions du roman des sept sages de Rome* (1876); *La poésie du moyen âge* (1885 and 1895); *Penseurs et Poètes* (1897); *François Villon* (1901, "Grands écrivains français" series); *Légendes du moyen âge* (1903); an edition (with G. Raynaud) of the *Mystère de la passion d'Arnaud Greban* (1878); and a translation (with Brachet and A. Morel-Fatio) of Friedrich Diez's *Grammaire des langues romanes* (1874–78).

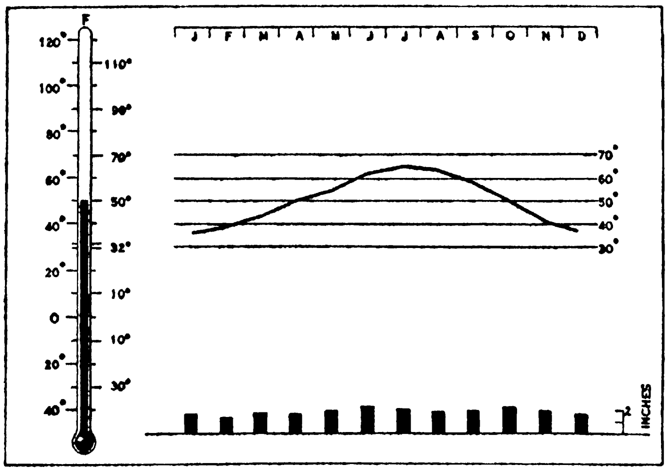
See "Hommage à Gaston Paris" (1903), the opening lecture of his successor, Joseph Bédier, in the chair of mediaeval literature at the Collège de France; A. Thomas, *Essais de philologie francaise* (1897); W. P. Ker, in the *Fortnightly Review* (July, 1904); M. Croiset, *Notice sur Gaston Paris* (1904); J. Bédier et M. Roques, *Bibliographie des travaux de Gaston Paris* (1904).

PARIS, LOUIS PHILIPPE ALBERT D'ORLÉANS, COMTE DE (1838–1894), son of the duc d'Orléans, the eldest son of King Louis Philippe, was born on Aug. 24, 1838. His mother was the princess Helen of Mecklenburg-Schwerin, a Protestant. By the death of his father in 1842, the count, then four years of age, became heir-apparent to the French throne. On the deposition of Louis Philippe in 1848, the duchess took her sons, the comte de Paris and the duc de Chartres, first to Eisenach in Saxony, and then to Claremont. In 1861 he and his brother were attached to the staff of General McClellan, commanding the "Army of the Potomac." The count fought in the siege of Yorktown (April 1862), at Williamsburg (May 5) and at Gaines Mill (June 27). When difficulties arose between France and the United States with regard to Mexico, the Orléans princes returned to Europe. On May 30, 1864, the count married his cousin, the princess Marie Isabelle, daughter of the duc de Montpensier; and his son and heir, the duc d'Orléans, was born in 1869. He returned to France after the fall of Napoleon III. and lived quietly on his estates. He had been refused permission to serve in the Franco-Prussian War.

In August 1873, at an important political conference at Frohsdorf, a fusion was effected, by which the comte de Paris agreed to waive his claims to the throne in favour of those of the comte de Chambord. By the death of the latter in 1883 the count became undisputed head of the house of Bourbon; but he did not push his claims. The popularity of the Orléans family, however, was shown on the occasion of the marriage of the comte de Paris's eldest daughter with the duke of Braganza, son of the king of Portugal, in May 1886. This led to a new law of expulsion, by which direct claimants to the French throne and their heirs were banished from France (June 11, 1886). The comte de Paris again retired to England, and devoted his leisure to study. In addition to his work *Les Associations ouvrières en Angleterre* (1869, and Eng. trs.), the count edited the letters of his father, and published at intervals *Histoire de la guerre civile en Amérique* (8 vols.). In his later years the count compromised the Royalist party by his relations with General Boulanger. He died on Sept. 8, 1894.

PARIS, capital of France and of the department of Seine, situated on the Île de la Cité, the Île St. Louis and the Île Louviers, in the Seine, as well as on both banks of the Seine, 233 m. from its mouth and 285 m. S.S.E. of London (by rail and steamer via Dover and Calais), in 48° 50′ 14″ N., 2° 20′ 14″ E. (observatory). It occupies the centre of the so-called Paris basin, which is traversed by the Seine from south-east to north-west, open towards the west, and surrounded by a line of Jurassic heights. The granitic substratum is covered by Jurassic, Cretaceous and Tertiary formations; and at several points building materials—freestone, limestone or gypsum—have been laid bare by erosion. It is partly, indeed, to the existence of such quarries in its neighbourhood, and to the vicinity of the grain-bearing regions of the Beauce and Brie, that the city owes its development. Still more important is its position at the crossing place of many continental lines of communication, that from Spain via western France, that from east Spain and the Mediterranean via the Rhône, those from

Switzerland via Geneva, Pontarlier or Basle and on via Belfort and Troyes or via Dijon and Sens, those from Germany via Lorraine, those from the Low Countries via Flanders, and lastly, those from the western sea. Paris is intermediately situated between the Mediterranean and the British regions, and also between the Mediterranean and Central Europe. The altitude of Paris varies between 80 ft. (at the Point du Jour, the exit of the Seine



WEATHER GRAPH OF PARIS. THE THERMOMETER INDICATES THE ANNUAL MEAN TEMPERATURE THE CURVE SHOWS THE MONTHLY MEAN TEMPERATURE, AND THE COLUMNS, THE NORMAL MONTHLY PRECIPITATION

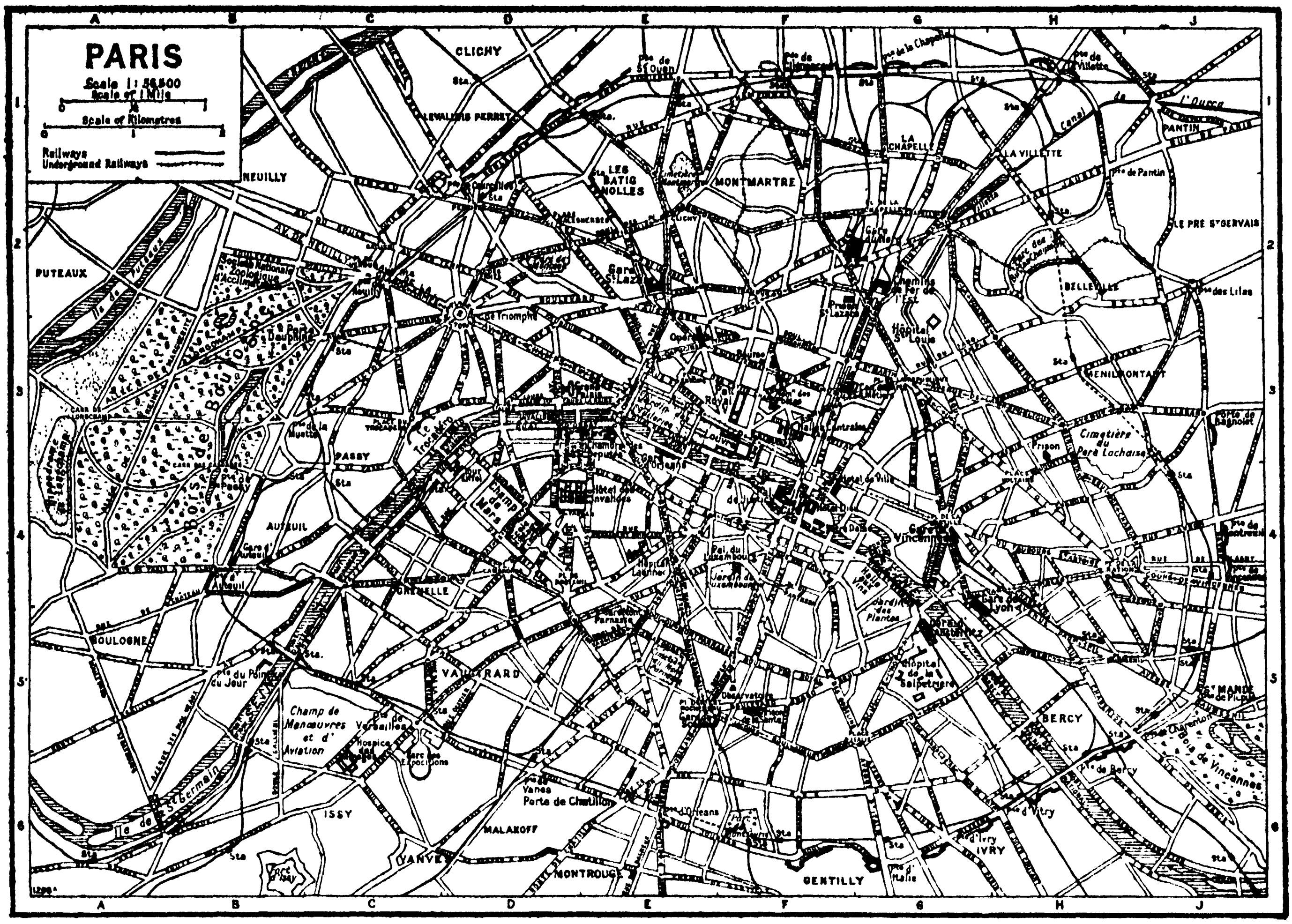
from the fortifications) and 420 ft. at the hill of Montmartre, in the north of the city; the other chief eminence is the hill of Ste. Geneviève, on the left bank The 1840 walls are, since 1860, the limit for the collection of municipal customs dues (*octroi*). The fortifications have been superseded since 1919 Within the wall the area of the city is 19,279 ac.; the river runs through it from east to west in a broad curve for a distance of nearly eight miles.

Climate.—The mean temperature is 50·5°, that for January being 36·5° and that for July 65·5°. The lowest temperature recorded is −14° and the highest 101° The Seine freezes when the temperature stays below 18° for a time. Frost is expected on about half the nights of the three winter months.

The rainfall is rather evenly distributed, with 20% in winter, 23% in spring, 28% in summer, and 29% in autumn The rainiest months are June and October and the driest is February. The average yearly fall is 20·8 inches The climate has been described as somewhat continental in winter and somewhat oceanic in summer. There are observatories on the Tour St Jacques, and at Montsouris, at Parc St. Maur, and at the three levels on the Tour Eiffel.

Topography.—The development of Paris can be traced outwards, in approximately concentric rings, from the Gallo-Roman town on the Île de la Cité to the fortifications which now form its boundary. A line of boulevards known as the Grands Boulevards, coinciding in great part with ramparts of the 14th, 16th and 17th centuries, encloses most of old Paris, a portion of which extends southwards beyond the Boulevard St Germain Outside the Grands Boulevards lie the *faubourgs* or old suburbs, round which runs another enceinte of boulevards—*boulevards extérieurs*—corresponding to ramparts of the 18th century Beyond them, other and more modern suburbs, incorporated with the city after 1860, stretch to the boulevards which line the fortifications of the period 1860–1919. In 1919 the fortified enceinte was abolished and its area was set apart for the building of flats at moderate rentals (Pelouse d'Avron on the east, and La Courneuve and Le Bourget on the north-east), and the provision of open spaces (park of the ancient Château des Sceaux, sites of former forts, etc.). A new "cité" for the university, with hostels, so far for British, Belgian and Argentine students, has been begun near Montsouris park, south of the city. The north, east and south are commercial or industrial in character, inhabited mainly by the working classes and *petite bourgeoisie,* on the west are wealthier residential centres (Auteuil and Passy). Of the *faubourgs* of Paris, those to the north and east are mainly commercial (Faubourgs St. Denis, St. Martin, Poissonnière) or industrial (Faubourgs du Temple and St. Antoine) in character, while to the west the Faubourg St. Honoré, the Champs Élysées and the Faubourg St. Germain have been occupied by mansions, but these areas, including the Champs Élysées as far west as the Arc de Triomphe, seem destined to be absorbed by business. The chief resorts of business and pleasure are concentrated within the Grands Boulevards, and more especially on the north bank of the Seine. No uniformity marks the street-plan of this or the other quarters of the city. One broad and almost straight thoroughfare bisects it, under various names, from Neuilly (west-north-west) to Vincennes (east-south-east). Within the limits of the Grands Boulevards it is known as the rue de Rivoli (over 2 m. in length) and the rue St. Antoine, and runs parallel with and close to the Seine from the place de la Concorde to the place de la Bastille. From the Eastern station to the observatory, Paris is traversed north-north-east and south-south-west for 2½ m. by another important thoroughfare—the boulevard de Strasbourg, continued as the boulevard de Sébastopol, as the boulevard du Palais on the Île de la Cité, and on the south bank as the boulevard St Michel. A further line of boulevards has been developed between the place de la Concorde and the place Denfert Rochereau on the southern prolongation of the boulevard St Michel, while the boulevard Jules Ferry has been made to give access from the boulevard Richard Lenoir to the quays beside the canal St. Martin, thus providing another way around the east of the city. The line of the Grands Boulevards from the Madeleine to the Bastille, by way of the place de l'Opéra, the porte St. Denis and the porte St Martin (two triumphal arches erected in the latter half of the 17th century in honour of Louis XIV.) and the place de la République, stretches for nearly 3 miles It contains most of the large cafés and several of the chief theatres, and though its gaiety and animation are concentrated at the western end—in the boulevards des Italiens, des Capucines and de la Madeleine—it is, as a whole, one of the most celebrated avenues in the world. On the right side of the river may also be mentioned the rue Royale, from the Madeleine to the place de la Concorde; the Malesherbes and Haussmann boulevards, the first stretching from the place Madeleine north-west to the former fortifications, the second from the Grands Boulevards near the place de l'Opéra now right to the place de l'Étoile; the avenue de l'Opéra, which unites the place du Palais Royal, approximately the central point of Paris, with the place de l'Opéra; the rue de la Paix, connecting the place Vendôme with the place de l'Opéra, and noted for its fashionable dress-making establishments, and the rue Auber and rue du Quatre Septembre, also terminating in the place de l'Opéra, in the vicinity of which are found some of the finest shops in Paris; the rue St. Honoré running parallel with the rue de Rivoli, from the rue Royale to the Central markets; the rue de Lafayette, one of the longest streets of Paris, traversing the town from the Opéra to the Bassin de la Villette; the boulevard Magenta, from Montmartre to the place de la République; and the rue de Turbigo, from this *place* to the Halles Centrales On the left side of the river the main thoroughfare is the boulevard St Germain, beginning at the Pont Sully, skirting the Quartier Latin, the educational quarter on the north, and terminating at the Pont de la Concorde after traversing a quarter mainly devoted to ministries, embassies and other official buildings.

Squares.—Some of the chief squares have already been mentioned The finest is the place de la Concorde, laid out under Louis XV. by J. A. Gabriel, the scene of the execution of Louis XVI., Marie Antoinette and many victims of the Revolution. The central decoration consists of an obelisk from the great temple at Luxor in Upper Egypt, presented to Louis Philippe in 1831 by Mohammed Ali. The place Vendôme, begun towards the end of the 17th century, has a column surmounted by a statue of Napoleon I, and decorated with plates of bronze, on which are depicted scenes from the campaign of 1805. The place de l'Étoile is the centre of 12 avenues radiating from it in all directions. The chief of these is the avenue des Champs Élysées, which connects it with the place de la Concorde; while on the other side the avenue de la Grande Armée leads to the former fortifications, the



two forming a section of the main artery of Paris; the well-wooded avenue du Bois de Boulogne leads to that celebrated park. In the centre of the place, the Arc de Triomphe de l'Étoile, the largest triumphal arch in the world (162 ft. high by 147 ft. wide), commemorates the military triumphs of the Revolutionary and Napoleonic troops. Under it has recently been placed the "Grave of the Unknown Soldier." In the place de la République stands a huge statue of the Republic. The place de la Bastille stands a little to the east of the site of the famous State prison. It contains the Colonne de Juillet, erected in memory of those who fell in the revolution of July 1830. The place du Carrousel, within the western wings of the Louvre, and so named from a revel given there by Louis XIV., was enlarged about the middle of the 19th century. The triumphal arch on its west side commemorates the victories of 1805 and formed the main entrance to the Tuileries palace (*see* below). Facing the arch there is a stone pyramid forming the background to a statue of Gambetta. Other squares are the place des Victoires, dating from 1685; the place des Vosges, formerly place Royale, formed by Henry IV. on the site of the old Tournelles palace; the place de l'Hôtel de Ville, once the place de Grève; the place du Châtelet, on the site of the prison of the Grand Châtelet, pulled down in 1802, with a fountain and a column commemorative of victories of Napoleon, and the place de la Nation, corresponding at the east of the city to the place de l'Étoile at the west.

South of the Seine are the place St. Michel, one of the great centres of traffic in Paris; the Carrefour de l'Observatoire, with the monument to Francis Jarnier, the explorer, and the statue of General Ney standing on the spot where he was shot; the place du Panthéon; the place Denfert Rochereau, adorned with a colossal lion symbolizing the defence of Belfort in 1871; the place St. Sulpice, with a modern fountain embellished with the statues of the preachers Bossuet, Fénelon, Massillon and Fléchier; the place Vauban, behind the Invalides; and the place du Palais Bourbon, in front of the Chamber of Deputies. On the Île de la Cité, in front of the cathedral, is the place du Parvis-Notre-Dame.

The Seine.—The Seine flows for nearly 8 m. through Paris. As it enters and as it leaves the city it is crossed by a viaduct used by the circular railway and for ordinary traffic; that of Point du Jour has two storeys of arches. Three bridges—the Passerelle de l'Estacade, between the Île St. Louis and the right bank, the Pont des Arts and the Passerelle Debilly (close to the Trocadéro)—are for foot passengers only; all the others are for carriages as well. The most famous, and in its actual state the oldest, is the Pont Neuf, begun in 1578, the two portions of which rest on the extremity of the island called La Cité, the point at which the river is at its widest (863 ft.). On the embankment below the Pont Neuf stands the equestrian statue of Henry IV. Between La Cité and the left bank the width of the lesser channel is reduced to 95 feet. The river has a width of 540 ft. as it enters Paris and of 446 ft. as it leaves it. After its entrance to the city it passes under the bridges of Tolbiac, Bercy and Austerlitz, that of Sully, those of Marie and Louis Philippe between the Île St. Louis and the right bank; that of La Tournelle between the Île St. Louis and the left bank; that of St. Louis between the Île St. Louis and La Cité. The Cité communicates with the right bank by the Pont d'Arcole, the Pont Notre-Dame, built on foundations of the 15th century, and the Pont au Change, owing its name to the shops of the money-changers and goldsmiths which bordered its mediaeval predecessor; with the left bank by that of the Archevêché, the so-called Pont au Double, the Petit Pont and the Pont St. Michel, the original of which was built towards the end of the 14th century. Below the Pont Neuf come the Pont des Arts, Pont du Carrousel, Pont Royal (a fine stone structure leading to the Tuileries), and those of Solférino, La Concorde, Alexandre III., Invalides, Alma, Iéna (opposite the Champ de Mars), Passy, Grenelle and Mirabeau. The Seine has at times caused disastrous floods in the city. A canal to unite the Marne (from

the Transition style, dates from the 11th to the 13th centuries. The Musée Carnavalet was built in the 16th century for François de Kernevenoy, whence its present name, and enlarged in 1660; Mme. de Sévigné afterwards resided there. The national archives are stored in the hôtel Soubise (early 18th and 19th century), on the site of a house built by Olivier de Clisson in 1370. It was afterwards added to by the family of Guise, and rebuilt by François de Rohan, duke of Soubise. The palace of Cardinal Mazarin, augmented in modern times, contains the Bibliothèque Nationale. The palais de l'Institut, formerly the Collège Mazarin, dates from the last half of the 17th century; it is the seat of the academies (except the Academy of Medicine, which occupies a modern building close to the École des Beaux-Arts) and of the Bureau des Longitudes, the great national astronomical council. The Military school (18th century) overlooks the Champ de Mars. The huge Sorbonne buildings date from the latter years of the 19th century, with the exception of the church, which belonged to the college as reconstructed by Richelieu. The astronomical observatory is a splendidly-equipped building erected under Louis XIV. The École des Beaux-Arts (facing the Louvre, on the left bank of the Seine), with its interesting collections, partly occupies the site of an Augustinian convent, and comprises the old hôtel Chimay. It was erected from 1820 to 1838 and added to later. The courtyard contains part of the façade of the Norman château of Gaillon (16th century), destroyed in the Revolution, and the portal of the château of Anet (erected by Philibert Delorme in 1548) has been adapted as one of the entrances. The Grand Palais des Beaux-Arts, where horse-shows, etc., as well as annual exhibitions of paintings and sculptures are held, and the Petit Palais des Beaux-Arts, which contains art collections belonging to the city, date from 1897–1900. The Bourse belongs to the first half and the Tribunal of Commerce and the Trocadero are of the second half of the 19th century.

The so-called Maison de François I. (on the Cours la Reine, overlooking the Seine), is a small but beautifully decorated building, erected at Moret in 1527 and re-erected in Paris in 1826. In the St. Gervais quarter are the hôtel de Beauvais, of the latter half of the 17th century, and the hôtel Lamoignon, built after 1580 for Diane de France, duchess of Angoulême, both of which have handsome courtyards; in the same quarter is the hôtel de Sens, of the 15th century, residence of the archbishops of Sens, whose province then included the diocese of Paris. The hôtel Lambert, on the Île St. Louis, built by L. Levau, in the 17th century, for Nicholas Lambert, and afterwards inhabited by Mme. du Châtelet and Voltaire and George Sand, has a magnificent staircase and many works of art. The hôtel de Sully, built for the duke of Sully, from 1624 to 1630, is in the rue St. Antoine and has an interesting courtyard. Of the fine mansion of the dukes of Burgundy the only relic is a tower of the early 15th century, built by Jean Sans Peur.

Theatres, etc.—The Opéra (entitled the National Academy of Music) was originally founded in 1671. After several changes of locale, it was eventually transferred from the rue Le Peletier to the present fine opera-house (1861–75).

The Théâtre Français or Comédie Française was formed in 1681, under the latter name, by the union of Molière's company with two other theatrical companies of the time. The name Théâtre Français dates from 1791, when part of the company headed by the tragedian, Talma, migrated to the south-west wing of the Palais Royal, which the company, reunified in 1799, has since occupied. Both the Théâtre Français and the less important Odéon, a building of 1782 twice rebuilt, close to the Luxembourg garden, present the works of the classical dramatists and modern dramas, both tragic and comic. The Opéra-Comique, founded in the early 18th century, occupies a building in the boulevard des Italiens, reconstructed after a fire in 1887. Serious, as well as light opera, is performed there. There are many other well known theatres. A journal, *Comoedia,* publishes (1929) details of the cast at the various theatres, and thus offers a useful theatre guide. There are many music halls with variety turns, and also numerous *cafés concerts,* usually without admission charge, at which one is supposed to order refreshments. *Cabarets artistiques* specialize in social and political satire.

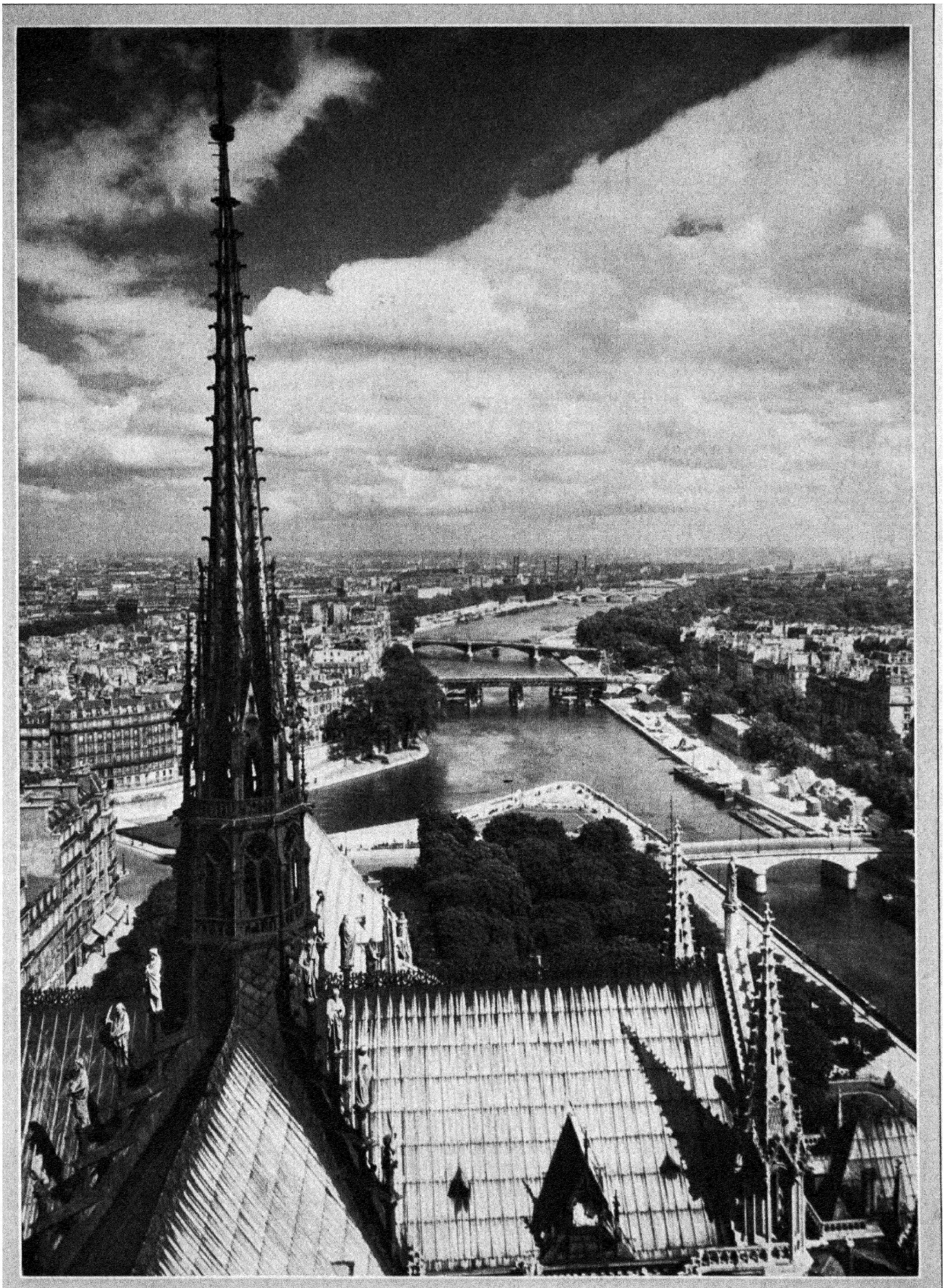
Music and Painting.—Music has its headquarters at the Conservatoire de Musique with concerts (1929) especially on Sunday afternoons; the concerts Colonne, Lamoureux, Pasdeloup, Touche, are widely known, while the Schola Cantorum and the concerts spirituels de la Sorbonne are of special interest, and music is also often given at the Trocadero. The Salles Gaveau, Pleyel, Erard, etc., also provide music; of the churches, La Madeleine, St. Eustache, St. Roch, St. Sulpice, and Notre Dame are most famed for music. Paris is famed for its exhibitions of pictures, the "Salon" at the Grand-Palais des Champs Elysées being best known; it is held in May and June. Several societies organize other exhibitions, and some firms also hold exhibitions of value.

Sport.—Paris is the chief centre of French sports, and many forms of sport are directed from the Fédération française d'athlétisme, the Stade français and the Racing Club de France. The chief horse-races are at Longchamps and Auteuil, with other important ones at Chantilly and elsewhere; the large Stade Pershing was given to France by the American army and the Y.M.C.A. It is situated at Vincennes. There are several aviation clubs. Special mention may be made of the important tennis clubs.

Museums.—The Louvre now houses one of the most celebrated museums in the world. On its ground floor are collections: (1) of antique sculpture, including the Venus de Milo, the Pallas of Velletri, the Hera of Samos, the "Tiber" group, and many other famous treasures. The well known Nike of Samothrace is apart from these, at the head of a staircase; (2) of mediaeval and Renaissance sculpture, including work by Michelangelo, Jean Goujon, Germain Pilon, the Della Robbia, Donatello, Benvenuto Cellini (bronze), etc.; (3) of Egyptian antiquities; (4) of south-west Asiatic and Carthaginian antiquities, including such famous objects as the stele of Hammurabi and the Moabite stone; and (5) of French sculpture of the 17th–20th centuries.

The first floor has been much rearranged in recent years, the splendid collection of paintings of non-French artists being now arranged in "schools" in the Grande Galérie. This collection contains many masterpieces by Leonardo da Vinci (the "Virgin of the Rocks," "Mona Lisa," etc.), Raphael ("Baldassare Castiglione," the "Man with the Glove," etc.), Correggio (the "Marriage of St. Catherine"), and almost all the chief painters of the Renaissance. Velasquez, El Greco, Murillo and Goya are represented. The Van Dyck collection is most remarkable, including the famed picture of Charles I. of England, the "Flight of Lot," and others. The work of Rembrandt is choicely and richly represented, and the salle Rubens preserves 18 of that master's 21 large allegorical paintings of the life of Marie de' Medici. Another section includes a "Virgin and Child" by Jan van Eyck, "Salvator Mundi" by Roger van der Weyden, and work by Memling and others. The salon Carré has some large Italian pictures (Raphael, Titian, Tintoretto, Correggio, Paolo Veronese). There is a *salle des primitifs italiens,* with such treasures as Fra Angelico's "Coronation of the Virgin." The collection of French pictures includes a historical section and the Chauchard collection of Corot, Meissonier, Millet ("The Angelus," etc.) and other artists. French art occupies the second floor (work of Manet, Monet, Dégas, Cézanne and others), and the pavillon de Marsan houses a museum of decorative art. The first floor also includes the collections of pottery, furniture, tapestry, metal work, enamels, jewellery, ivories, bronzes, etc., a collection of British pictures, a collection of drawings (Watteau is notably represented). On this floor are also collections of Egyptian, Asiatic and classical antiquities supplementing those on the ground floor, and still others are housed in the pavillon de la Trémoille. In addition to the pictures above mentioned, the second floor houses a Muslim museum and a naval museum. The entresol contains a collection of engravings and the Far Eastern collections.

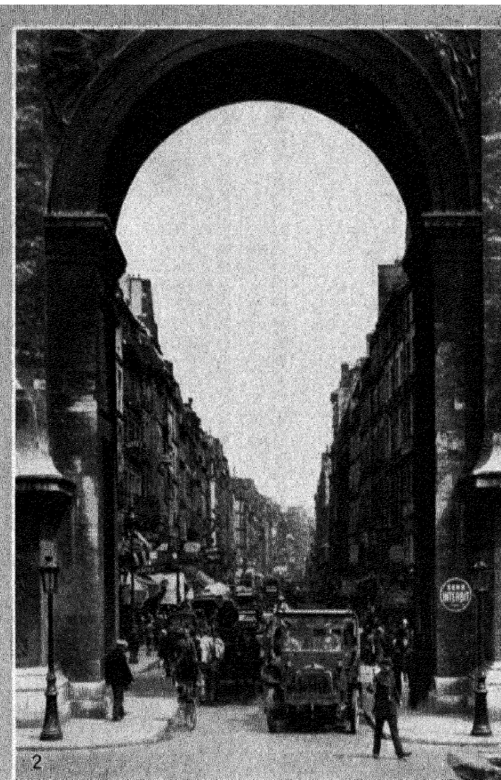
The museum of the Luxembourg, installed in a building near the palace occupied by the senate, is devoted to works of living painters and sculptors acquired by the State. They remain there for ten years after the death of the artist, that the finest may be selected for the Louvre. Some pictures by Dégas and Cézanne

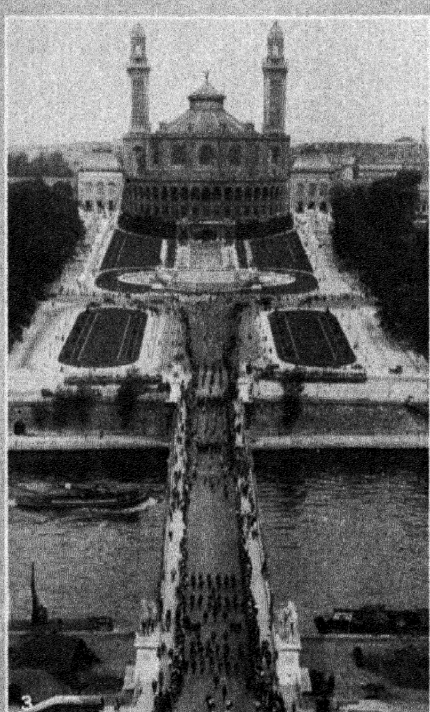


LOOKING EAST ALONG THE SEINE, FROM THE ROOF OF NOTRE DAME

The cathedral of Notre Dame (built 1163–1240) is situated at the east end of the Ile de la Cité, the oldest part of Paris, and the centre of the mediaeval city. The bridge at the lower right, the Pont de l'Archevêché, connects the island with the "Left Bank" where the university and student quarters are situated. At the left centre of the illustration is seen a part of the Ile Saint-Louis

PARIS





SITES OF HISTORICAL INTEREST IN OLD PARIS

1. Aerial view of the Ile de la Cité, the oldest section of Paris. In the foreground is the Palais de Justice a vast pile of buildings within the enclosures of which are the Sainte-Chapelle, erected in 1246–48 under St. Louis, and the Conciergerie, famous prison of the Revolution. At the upper end of the island, at the right, is the cathedral of Notre Dame (1163–1240). Beyond, is seen the Ile St.-Louis, connected with the Cité by the Pont St.-Louis
2. Porte St. Denis, looking toward the Rue du Faubourg-St.-Denis. This gate was built in 1672–73 by F. Blondel in honour of the victories of Louis XIV., and stands on the site of the old city gate
3. View of the park and palace of the Trocadéro, from the Eiffel tower on the left bank of the Seine. The palace, built for the Exhibition of 1878, contains a large hall, an ethnographical museum, a museum of Casts and a museum of Cambodian antiquities. The Pont d' Iena, in the foreground was built in 1806–13 to commemorate the victory of Napoleon over the Prussians at Jena in 1806
4. Place de la Bastille, near the site of the famous state prison demolished at the beginning of the French Revolution. The bronze Colonne de Juillet, 154 feet in height, which was erected in memory of those who fell in the July Revolution of 1830, occupies the centre of the square

Arrondissements	Quarters	Population 1906	Population 1926	Inhabitants per acre
I. Louvre	St. Germain l'Auxerrois, Halles, Palais Royal, Place Vendôme	60,906	45,803	103
II. Bourse	Gaillon, Vivienne, Mail, Bonne-Nouvelle	61,116	47,817	198
III. Temple	Arts-et-Métiers, Enfants-Rouges, Archives, Ste. Avoie	86,152	74,389	258
IV. Hôtel-de-Ville	St. Merri, St. Gervais, Arsenal, Notre-Dame	96,490	85,886	223
V. Panthéon	St. Victor, Jardin des Plantes, Val de Grâce, Sorbonne	117,666	116,882	190
VI. Luxembourg	Monnaie, Odéon, Notre-Dame des Champs, St. Germain des Prés	97,055	96,957	186
VII. Palais Bourbon	St. Thomas d'Aquin, Invalides, École-Militaire, Gros-Caillou	97,375	104,134	105
VIII. Elysée	Champs Élysées, Faubourg-du-Roule, La Madeleine, l'Europe	99,769	90,771	96
IX. Opéra	St. Georges, Chaussée d'Antin, Faubourg Montmartre, Rochechouart	118,818	106,772	202
X. St. Laurent	St. Vincent de Paul, Porte St. Denis, Porte St. Martin, Hôpital St. Louis	151,697	136,683	194
XI. Popincourt	Folie-Méricourt, St. Ambroise, La Roquette, Ste. Marguerite	232,050	222,443	248
XII. Reuilly	Bel-Air, Picpus, Bercy, Quinze-Vingts	138,648	150,535	108
XIII. Gobelins	Salpêtrière, Gare, Maison-Blanche, Croulebarbe	133,133	151,731	98
XIV. Observatoire	Montparnasse, Santé, Petit-Montrouge, Plaisance	150,136	167,373	145
XV. Vaugirard	St. Lambert, Necker, Grenelle, Javel	168,190	229,829	128
XVI. Passy	Auteuil, La Muette, Porte-Dauphine, Chaillot	130,719	163,836	94
XVII. Batignolles-Monceau	Ternes, Plaine-Monceau, Batignolles, Epinette	207,127	217,759	198
XVIII. Montmartre	Grandes-Carrières, Clignancourt, Goutte-d'Or, La Chapelle	258,174	277,873	216
XIX. Buttes-Chaumont	La Villette, Pont-de-Flandre, Amérique, Combat	148,081	157,815	113
XX. Ménilmontant	Belleville, St. Fargeau, Père-Lachaise, Charonne	169,429	184,918	144

were still at the Luxembourg in 1927, and here is also the famous "Bronze age" of Rodin. Foreign pictures belonging to the Luxembourg are now housed in the Musée du Jeu de Paume, in the Tuileries gardens. They include well known works of G. F. Watts, Constantin Meunier, J. S. Sargent and others.

The Cluny museum occupies the old mansion of the abbots of that order (*see* above). It contains about 11,000 examples of mediaeval and Renaissance art-sculptures in marble, wood and stone, ivories, enamels and mosaics, pottery and porcelain, tapestries, bronzes, specimens of goldsmith's work, both religious and civil, including nine gold crowns of the 7th century found near Toledo, Venetian glass, furniture, iron-work, State carriages, ancient boots and shoes, and pictures.

The Carnavalet museum comprises a collection illustrating the history of Paris, and includes pictures, portraits, furniture, etc. The Petit Palais des Beaux-Arts contains art collections belonging to the city (especially the Dutuit collection). The house of Gustave Moreau, rue Rochefoucauld, is now a museum of his paintings, and that of Victor Hugo, place des Vosges, contains a collection of objects relating to the poet. The Musée Jacquemart-André, opened in 1913, has choice paintings, sculpture, tapestry, etc. The Musée Rodin is of special value for the great sculptor's work.

The Trocadero palace contains a museum of casts illustrating the progress of sculpture, chiefly that of France, from the 11th to the 18th century; it also possesses a collection of Khmer antiquities from Cambodia and an ethnographical museum. In the same neighbourhood are the Guimet museum, containing the collections of oriental pottery, of objects relating to the oriental religions, and of antiquities presented to the State in 1885 by Émile Guimet of Lyons; and the Galliéra museum, erected by the duchess of Galliéra and containing a collection of tapestries and other works of art belonging to the city. The Cernuschi oriental museum is close to the Monceau park.

The collection of mss., engravings, medals and antiques in the rich Bibliothèque Nationale are important, as also are the industrial and machinery exhibits of the Conservatoire des Arts et Métiers. The Musée de l'Armée at the Invalides has much historical interest.

The Musée des Antiquités Nationales, one of the most important of all archaeological collections, is housed near Paris in the château de St. Germain-en-Laye. The musée des Monnaies is attached to the Mint, and exhibits coins, medals and plaquettes. The Jardin des Plantes has attached to it zoological, botanical, geological, mineralogical, palaeontological, anatomical and anthropological galleries, and there is also a separate collection illustrating plant physiology.

For libraries *see* LIBRARIES.

Population.—The growth of the population since 1801 is shown in the following table, which gives the population present on the census day, including the *population comptée à part, i.e.,* troops, inmates of hospitals, prisons, schools, etc.

Years	Population	Years	Population
1801	547,756	1881	2,239,928
1831	785,862	1891	2,424,705
1851	1,053,262	1901	2,660,559
1861	1,696,141	1906	2,722,731
1872	1,851,792	1926	2,871,429

Paris is divided into 20 arrondissements, of which the first 12 belonged to it before 1861 and the others were suburbs then annexed:—

In the first four, which constitute old Paris north of the Seine, with the islands, the population has long been decreasing, as this is the great business area. In arrondissements V.–VII., on the left or south bank, opposite nos. I.–IV., the population is relatively stable, with a slight tendency to increase in the west. In arrondissements VIII.–XI., which fringe old Paris on the north bank, the tendency to decrease is very clear. In the arrondissements of the outer zone (XII.–XX.) there is a general increase of population, most marked in the south-west (XV. and XVI.); Nos. XIII.–XV. belong to the left bank. The east side of old Paris (III. and IV.), and arrondissement XI., fringing it, to the east, are the most densely-populated areas, and some parts of them are very closely packed indeed. Montmartre and Batignolles stand out in the matter of density of population in the outer zone.

Administration.—Paris occupies a large part of the department of Seine, and the typical French departmental and municipal systems of administration are to some extent modified to meet the special circumstances. Paris has 20 divisions, called arrondissements, each containing four quarters, while the rest of the department includes two arrondissements with 22 cantons. The head of the administration of a department is a prefect, appointed by the minister of the Interior, and there is usually a sub-prefect for each arrondissement. In the case of the department of Seine and the City of Paris, the prefect is head of the administration of both, but there are no sub-prefects for the arrondissements within the city. There is a prefect of police, also appointed by the minister of the Interior, and his jurisdiction extends even beyond the department to a few communes that are practically parts of Paris.

There is a municipal council of 80 members, one from each of the four quarters of each of the 20 arrondissements of the city. The council elects its own chairman, votes the budget and discusses the prefect's administration. The prefect of the department and the prefect of police may attend its meetings and, under certain circumstances, may overrule its decisions if this be necessary in order to maintain the public services. In cases of illegality, the decisions of the municipal council may be overruled by the President of the Republic. The municipal council, together with one representative from each of the 22 cantons outside Paris, forms the council of the department of Seine.

The prefect of the department has charge of finance, elections, public works, public lands, primary education, charities, roads, lighting, markets, pawnbroking (the *mont de piété*), and judicial actions. He is helped by staffs of technical experts and by committees on housing, statistics, etc. A housing policy has been pursued since 1918, and a labour exchange was established for Paris and the department of Seine in 1915.

The prefect of police has a judicial staff for pursuit of crime, and a general staff for social duties. He maintains the peace, inspects weights and measures, licenses public spectacles, licenses public vehicles, overlooks markets, is in charge of prisons, and has much to do with health. In the last matter he is helped by a council of public health of the department. This discusses water supply and sewage problems, disinfection, etc., and it has attached to it a board of health in each arrondissement of Paris.

Each of the 20 arrondissements has a mayor, who is allowed three deputies; all of these are appointed by the President of the Republic. This mayor has charge of the affairs of the arrondissement, is a registrar of births, marriages and deaths, and has to call up the conscripts. Each arrondissement has its juge de paix and its police force under an officier de paix. In nearly every quarter there is a commissaire de police, who sanctions the committing of arrested persons to prison, and who acts as a magistrate in small disputes.

Law and Justice (*see* FRANCE: *Justice*, for an account of the judicial system of the country as a whole).—Paris is the seat of four courts having jurisdiction over all France: (1) The Tribunal des Conflits, for settling disputes between the judicial and administrative authorities on questions as to their respective jurisdiction; (2) the Council of State, which includes a section for cases of litigation between private persons and public departments; (3) the Cour des Comptes, and (4) the Cour de Cassation. The first three sit in the Palais Royal, the fourth in the Palais de Justice, which is also the seat of: (1) a *cour d'appel* for seven departments (seven civil chambers, one chamber of appeal for the correctional police, one chamber for preliminary proceedings); (2) a *cour d'assises;* (3) a tribunal of first instance for the department of Seine, comprising seven chambers for civil affairs, four chambers of correctional police; (4) a police court where each *juge de paix* presides in his turn, assisted by a *commissaire de police*. Litigations between the departmental or municipal administrations and private persons are decided by the *conseil de préfecture*. Besides these courts there are *conseils de prud'hommes* and a tribunal of commerce. The *conseils de prud'hommes* settle differences between workmen and workmen, or between workmen and masters; the whole initiative, however, rests with the parties. There are four of these bodies in Paris (for the metal trades, the chemical trades, the textile trades and building industries), composed of an equal number of masters and men. The tribunal of commerce, sitting in a building opposite the Palais de Justice, is composed of business men elected by the "notables" of their order, and deals with cases arising out of commercial transactions; declarations of bankruptcy are made before it; it also acts as registrar of trade-marks and of articles of association of companies, and as court of appeal to the *conseils de prud'hommes.*

Prisons.—There are three places of detention in Paris—the Dépôt of the prefecture of police (in the Palais de Justice), where persons arrested and not released by the commissaries of police are temporarily confined, the Conciergerie or *maison de justice*, for the reception of prisoners accused of crimes, who are there submitted to a preliminary examination before the president of the court of assizes, and the Santé (near the Place Denfert-Rochereau), for prisoners awaiting trial and for remanded prisoners. The old prisons of Mazas, Ste. Pélagie and La Grande-Roquette, the demolition of which was ordered in 1894, have been replaced by the prison of Fresneslès-Rungis for condemned prisoners. The prisoners, kept in solitary confinement, are divided into three groups: those undergoing short sentences, those sentenced to hard labour while awaiting transference to their final place of detention or to sentences over a year, and sick prisoners, occupying the central infirmary of the prison. The Petit Roquette (occupied by children) was replaced by the agricultural and horticultural colony of Montesson inaugurated in 1896.

Communications.—The great railways of France, with the exception of the Midi railway, have terminal stations in Paris. The principal stations of the Nord, Est and Ouest-État systems (that of the last is the Gare St. Lazare), lie near the outer boulevards in the north-centre of the city; the terminus of the Paris-Lyon-Méditerranée railway is in the south-east, close to the right bank of the Seine; opposite to it, on the left bank, is the Gare du Quai d'Austerlitz, and on the Quai d'Orsay the Gare du Quai d'Orsay, both belonging to the Orléans railway. The Gare Montparnasse, to the south-west of the Luxembourg, is used by the Ouest-État and the État railways. Other less important stations are the Gare de Vincennes (line of the eastern railway to Vincennes), the Gares du Luxembourg and de Paris-Denfert (line of the Orléans railway to Sceaux and Limours), and the Gare des Invalides (line of Ouest-État railway to Versailles).

Railway communication round Paris is afforded by the Chemin de Fer de Petite Ceinture, running around just within the line of the old fortifications. There is a Grande Ceinture line farther out, used chiefly for goods. The underground electric railways, with stations about ½ km. apart, include the Nord-Sud (from the three northern gates to the Porte de Versailles) and the Métropolitain. This latter system now includes lines west-east (Maillot-Vincennes) and north-east-south-west (porte de la Villette–vicinity of Montparnasse), loop lines more or less following the inner and the outer boulevards, the latter making a wide arc through south Paris as well, and other loops and branches. The above systems cross beneath the river in seven places. There is an extensive tramway system, and the omnibus system has developed on a large scale in recent years. The river steamers (*bateaux-omnibus*) run at frequent intervals right through Paris.

Water Supply.—The earliest water supply was that due to the Romans, who brought it from Rungis by aqueduct; in the middle ages numerous springs were used until Henri IV. built a hydraulic machine (La Samaritaine) on the Pont Neuf, to pump water from the river. The city acquired, in the 19th century, the sources of a number of streams of the district, Ourcq, Beuvronne, Vanne, Dhuys, Voulzie, Durtain and Avre, and built long aqueducts. There are modern pumping and filtering stations at Ivry, St. Maur and elsewhere, to get drinking water from the river when other sources of supply run low. These pumping stations also supply water for public and industrial purposes, and the Ourcq canal is also drawn upon for this purpose, as are artesian wells. There are reservoirs in the higher parts of the city and the supply is distributed by two systems of pipes, at high and low pressure respectively. Wherever possible, a main pipe receives its supply from two different directions, thus minimizing effects of accidental interruptions. The development of sewers began under Louis XIII., but the main growth of the system is modern. There is a main sewer on each side of the river, and that of the left side is conducted under the river to join that of the right. The sewage of some low-lying areas has to be pumped up into the system.

The debouchment of part of the system is beyond the porte de Clichy, on the riverine peninsula of Gennevilliers, which is thus fertilized. From this the water returns to the Seine. The collecting sewer of the north-eastern area is led out to St. Denis. The sewers serve as conduits for water pipes, gas pipes, telegraph and telephone wires, pneumatic tubes, etc.

Education (*see* also FRANCE).—The public system includes *écoles maternelles* or kindergartens, and infant schools, managed by women, primary schools, with some amount of charitable assistance and of school feeding, school camp and boarding schemes, higher primary schools, technical schools, domestic science schools for girls, the college Chaptal and the college Rollin, which send boys on to the School of Mines, the Polytechnic school, etc., a number of lycées or secondary schools, of which some are old and famous foundations, and a good many private institutions and *écoles confessionnelles* (denominational schools).

The five faculties of medicine, law, science, literature and Protestant theology, and the higher school of pharmacy, form the body of faculties, the association of which is known as the

University of Paris. The faculties of science and literature, together with their library, are established at the Sorbonne, which is also the seat of the *académie*, of which Paris is the centre, and of the *École des chartes*. The faculty of medicine, with its laboratories (*École pratique*), occupies separate buildings near the Sorbonne. The law school is also close to the Sorbonne. Of the 12,600 students at the university in 1905–06 some 1,260 were foreigners, Russians and Rumanians being most numerous among the latter. The faculty of law is the most largely attended, some 5,000 students being enrolled therein At the *Collège de France*, founded by Francis I., and situated opposite the Sorbonne, the various branches of learning are represented by very numerous chairs, to which are elected scholars of special distinction. They give courses of lectures open to the general public. The *Muséum d'histoire naturelle* gives instruction in the natural sciences; the *Écoles des hautes études* have for their main object the encouragement of scientific research. The *École pratique des hautes études*, attached to the Sorbonne, is the chief institution of the kind. In addition, there are several great national schools attached to various ministries. Dependent on the Ministry of Education are the *École normale supérieure*, for the training of teachers in lycées; the *École des chartes* (palaeography and the use of archives); the *École spéciale des langues orientales*, for the training of interpreters; the *École nationale et spéciale des beaux-arts* (painting, sculpture, architecture, etc), in the various departments of which are conferred the *prix de Rome*, entitling their winners to a four years' period of study in Italy, the *Conservatoire national de musique et de déclamation* (music and acting), which also confers a *grand prix* and possesses a fine library and collection of musical instruments; the *École nationale des arts décoratifs* (art applied to the artistic industries); the *École du Louvre*, for the instruction of directors of museums. Depending on the Ministry of War are the *École polytechnique*, which trains military, governmental and civil engineers; the *École supérieure de guerre* (successor of the officers' training school, founded in 1751) for advanced military studies Attached to the Ministry of Commerce and Industry are the *École centrale des arts et manufactures*, for the training of industrial engineers, works managers, etc ; the *Conservatoire des arts et métiers*, which has a rich museum of industrial inventions and provides courses in science as applied to the arts. The *Institut national agronomique*, a higher school of scientific agriculture, is dependent on the Ministry of Agriculture, and the *École coloniale* for the instruction both of natives of French colonies and of colonial functionaries, on the Ministry of the Colonies. The *École nationale des ponts et chaussées*, for the training of Government engineers, and the *École nationale supérieure des mines*. for mining engineers, are under the minister of public works. Of free institutions of higher education, the most prominent are the *Catholic institute*, with faculties of law and theology and schools of advanced literary and scientific studies, the *Pasteur institute*, founded by Pasteur in 1886 and famous for the treatment of hydrophobia and for its research laboratories, and the *École libre des sciences politiques*, which prepares candidates for political and governmental careers. The two latter receive State subvention. There are numerous private associations giving courses of instruction, the more important being the Philotechnic Association, the Polytechnic Association and the *Union française de la jeunesse*.

Among the numerous learned societies of Paris, the first in importance is the Institut de France. (*See* ACADEMIES) The French Association for the Advancement of the Sciences, founded in 1872, is based on the model of the older British society, and like it, meets every year in a different town. There are very numerous specialist societies promoting the various branches of learning. In art, also, Paris has long held a leading position; her artistic activities are described under various departments of art.

Charity.—The administration of public charity is now entrusted to a responsible director, under the authority of the Seine prefect, and assisted by a board of supervision, the members of which are nominated by the president. The funds at his disposal are derived: (1) from the revenue of certain estates, houses, farms, woods, stocks, shares; (2) from taxes on seats in the theatres (one-tenth of the price), balls, concerts, the mont de piété (the public pawnbroking establishment), and allotments in the cemeteries; (3) from the municipal subsidy; (4) from other sources (including voluntary donations). The charges on the administration consist of. (1) the treatment of the sick in the hospitals; (2) the lodging of old men and of incurables in the *hospices;* (3) the support of charity children, (4) the distribution of outdoor relief (*secours à domicile*) by the *bureau de bienfaisance* of each arrondissement; (5) the dispensation of medical assistance *à domicile;* (6) asylums for mental cases

The doctors, surgeons, chemists, both resident and non-resident, connected with the numerous hospitals, are all admitted by competitive examination. They are assisted by three grades of students, *internes* (who receive a salary), *externes* and *stagiaires* (probationers).

Of the *hospices* and similar institutions, the following are the chief: Bicêtre (men), less than a mile south of the fortifications, La Salpêtrière (women), Ivry (both sexes), *maisons de retraite* (for persons not without resources) Issy, La Rochefoucauld, Ste Périne; *fondations* (privately endowed institutions)—Brézins at Garches (for ironworkers), Devillas, Chardon-Lagache, Lenoir-Jousseran, Galignani (booksellers, printers, etc.), Alquier-Debrousse; and sections for the insane—Bicêtre (men), Salpêtrière (women), these being distinct from the ordinary departmental asylums controlled by the prefect.

Foundlings and orphans are sent to the *Hospice des enfants assistés*, which also receives children whose parents are patients in the hospitals or undergoing imprisonment This institution is not intended as a permanent home Infants are not kept in the institution, but are boarded out with nurses in the country; the older ones are boarded out with families or placed in technical schools. Up to 13 years of age the children are kept at the expense of the department of Seine, after which they are apprenticed

The following additional establishments in or near Paris belong to the nation, and are dependent on the Ministry of the Interior The Quinze-Vingts gives shelter to the 300 blind for whom it was founded by St. Louis, and gives outdoor assistance besides The blind asylum for the young (*Institution des jeunes aveugles*) has 250 pupils of both sexes The deaf mute institution (*Institution nationale des sourds-muets*) is for boys only, and they are generally paid for by the State, the departments and the communes. The Charenton asylum is for the insane Those of Vincennes (for male patients) and Le Vesinet (for female patients), take in convalescents from the hospitals The Vacassy asylum at Charenton is for workmen incapacitated by accident. The *Hôtel des invalides* is for old and infirm soldiers Private bodies also maintain a great number of institutions

Religion.—A large element of the population practises the Roman Catholic faith. The department of Seine forms the diocese of the archbishop of Paris, and the city is divided into 70 parishes It has the important higher ecclesiastical seminary of St. Sulpice, two lower seminaries and others for training the clergy for missionary and colonial work Paris is also the seat of the central council of the Reformed Church and of the executive committee of the General Synod of the Lutheran Church, and forms a consistory of both these Churches Paris is also the seat of the Grande Rabbinate of France and of the central consistory

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HISTORY

Gallic and Roman Periods.—Paris grew up at the intersection of two great natural highways, one of them leading from the Rhine district to the south by way of what is now the rue Saint-Martin on the right bank of the Seine and the rue Saint-Jacques on the left bank, and the other being the river itself. The land route crossed the Seine at the point where it was most easily forded—the Ile de la Cité. Paris thus sprang up on the natural stronghold of the island. It was at first a fortified town of the Gallic tribe of the Parisii. It was called Lutetia, and was connected with the two banks of the river by two wooden bridges where the Pont Notre-Dame and the Petit-Pont now stand. Caesar describes in his *Commentaries* how it was burnt during the Gallic War of Independence (52 B.C.).

During the 1st century A.D. we hear of Lutetia as a Roman town. Its character has now changed. The original island was about half the size of the modern Ile de la Cité, and was liable to be flooded by the river; it was not a normal site for a town, and could only have been selected for defensive reasons. Under the *pax Romana* Lutetia spread beyond its island to the Montagne Sainte Geneviève which lay opposite it on the left bank; on the right bank there was only low-lying and uninviting ground, bounded by a semicircle of hills—those of Charonne, Ménilmontant and Belleville to the east, Montmartre in the north and Chaillot to the west. A new Roman city grew up on the northern slopes of the Montagne Sainte-Geneviève, with the straight roads and the public buildings characteristic of all Roman towns —the thermae or public baths, probably on the site of the Musée de Cluny, the theatre, about where the boulevard Saint-Michel crosses the rue Racine, and the arena on the site of the square which now bears that name. The town was supplied with water by the aqueduct of Arcueil. Lutetia was extended up the hillside, and was unfortified; its cemetery was by the side of the Roman road later to become the rue Saint-Jacques.

Lutetia was destroyed by the barbarian invasions of the 3rd century, but reappeared towards the end of the century on its original site, the Ile de la Cité, with its natural defences. A hastily erected rampart supplemented the protection afforded by the two branches of the river. The town was concentrated in this narrow space the better to resist attack. It had straight streets, and a few public buildings. There was probably a temple at the eastern end, and a palace, the headquarters of the Roman authorities, at the other end. There were two wooden bridges opposite what are now the rue Saint-Martin and the rue Saint-Jacques. The name of the town changed from Lutetia to Paris. This stronghold was built for protection against the dangers of the time, for it lay on the route followed by the barbarians on their way from the north to the south.

Christianity reached Paris from Lyons. The earliest Christian community or village was situated on the road from Lyons to Paris, near a ford over the Bièvre, at a place where there were stone quarries which had been worked since early Roman times. The spot was near what is now the carrefour des Gobelins, where a Christian cemetery has been discovered with tombs the earliest of which date from the end of the 3rd century. In the following century Christianity gained a footing in the city itself.

THE MIDDLE AGES

In the 5th century the Franks made themselves masters of Paris; they did not, however, destroy the Roman civilization, but were themselves influenced by its more advanced culture. Under Clovis they became converted to Christianity and thus came doubly under the influence of Rome. By his victory over the Visigoths in A.D. 508, the Frankish leader made himself the ruler of the south of France. He established his capital at Paris in order to bring the seat of his authority nearer to the newly conquered territories.

Paris was now a royal and episcopal city, and churches began to be built on both banks of the Seine. These were the first buildings on its banks; houses later sprang up around them. Clovis and his wife Clothilde built a church dedicated to the Apostles on the left bank, on the top of the hill overlooking the Ile de la Cité, on the Lyons road. In the 6th century the relics of Sainte Geneviève were deposited in this church, which became the abbey of Sainte-Geneviève, behind where the Pantheon now stands. On the same bank, further west Childebert, one of the sons of Clovis, built a basilica in which Saint Germain, bishop of Paris, was buried towards the end of the 6th century. This later became the abbey of Saint-Germain-des-Prés, the church of which still exists to-day. Another bishop of Paris, Saint Marcel, was buried during the 6th century on the banks of the Bièvre, in the village where the first Christian community was situated. This village later developed round the collegiate church of Saint-Marcel. During the same century two churches were built on the right bank of the river: that of Saint Gervais and Saint Protais on a little hill by the Seine, and that of Saint Laurent beyond the low-lying ground to the north of the river, near the modern Gare de l'Est. Many more churches were built in the following centuries; they were particularly numerous in the Ile de la Cité, and many more sprang up along the two great roads on either side of the river.

Although the Ile de la Cité, which at that date was practically the whole of Paris, had a comparatively large number of buildings, there were few dwellings on the banks of the Seine except some houses round the religious establishments or beside the roads. There were patches of cultivated land, vineyard and meadow amidst a setting of waste ground and forest. In the 9th century the bridge over the wider of the two arms of the river was not situated where the Pont-Notre-Dame now stands, but nearly on the site of the Pont-au-Change. Where it touched the right bank, a road came into existence leading towards the great abbey of Saint-Denis; this later became the rue Saint-Denis. This bridge and the Petit-Pont were protected at each end by a fortified tower, the most important of which was that on the right bank which guarded the entrance to Paris on that side. It was called the Porte de Paris.

During the Norman invasions of the 9th century, the fortified Grand-Pont was of great importance for defensive purposes when Paris was besieged in 885 and 886. The Norman invasions hastened the advent of the feudal system. Moreover, the Mediterranean, which in ancient times had been the means of communication between west and east, and where the Byzantine empire held the former place of Rome, was transformed during the 8th century into a Saracen lake from which Christendom was shut off. Communication between different parts of the world became much more restricted, and each feudal domain tended more and more to be its own narrow world. Paris at this time may be regarded as the juxtaposition of the centres of a number of great domains—principally ecclesiastical domains—in fact, a sort of feudal mosaic. But after the accession of the Capetian dynasty in 987, the feudal suzerain was at the same time the king of the country, and the more the monarchy increased in power and extended its influence over France, the more Paris grew in importance.

Growth.—In the 11th century the channels of human intercourse began to be opened up once more and to exercise their life-giving influence. The population of Paris increased. The close organization of feudalism began to relax. It was at this time that the earliest of the guilds were formed in Paris, among them that of the river traders who plied up and down the Seine. With the growth of commerce during the 11th century there came into being a mercantile quarter near the Porte de Paris, bounded by the latter on the west, Saint-Merri on the north and Saint-Gervais on the east. This mercantile quarter might be regarded as deriving its origin from the intersection of the course of the river and the land route represented by the two streets of the rue Saint-Martin and the rue Saint-Denis. In the 12th century it was surrounded by a rampart, and contained the market,

situated on the Grève, where the Hôtel de Ville now stands. Louis VI. (1108–37) transferred the market to the site near the rue Saint Denis now occupied by the Halles Centrales. The Grand-Pont, on which the money-changers had their shops, became the Pont-au-Change in 1142.

Paris now began to grow rapidly. A parish was formed near the priory of Saint-Martin-des-Champs; about 1080 the priory church was also the parish church, but early in the following century the functions of parish church were transferred to the neighbouring chapel of Saint-Nicolas-des-Champs. The road to Saint-Denis, of which the street of that name forms part, increased in importance; from early in the 12th century the Lendit fair was held along this road, between Saint-Denis and Paris. The Paris leper hospital, which bore the name of Saint-Lazare, was on this road; its existence is first mentioned in 1122. It occupied the site of the modern prison of the same name. Further to the south the church of the Innocents, which was built about 1150, and the abbey of Saint-Magloire, founded at about the same period, bear witness to the increasing population in the neighbourhood of Louis VI.'s new market. To the east, a new centre of activity was created towards the end of the 12th century by the foundation of the Temple, south of the site now occupied by the place de la République. The Couture du Temple is mentioned in 1184, and the Ville Neuve du Temple came into existence in the following century. The church of Saint-Paul, near the corner of the street of that name and the rue Saint-Antoine, is first mentioned in 1136, and the township (bourg) of Saint-Paul came into being in the next century. Rural settlements gathered round the churches and abbeys; for example the small village of La Villette-Saint-Ladre grew up in the second half of the 12th century on the land of the Paris leper hospital. This is the origin of the modern district of La Villette. About the middle of the century the land which lies beyond where the chief boulevards now are and almost as far as Chaillot, which had been used as public pasturage, was brought under cultivation and formed the beginning of the ring of vegetable gardens which surrounds Paris, but has been driven farther and farther out with the growth of the city. By about 1110 there was a township around the church of Saint-Germain-l'Auxerrois; like the church itself, it was dependent on the bishop of Paris. About 100 years later there was in addition to the old Bourg de Saint-Germain-l'Auxerrois or Bourg de l'Evêque, prolonged towards the west, a new Bourg de l'Evêque.

It was, however, to the mercantile quarter near to the island city that the right bank principally owed its development; it thus acquired the character of the central business quarter which it has retained to the present day. This was strictly speaking the Town, as opposed to the left bank, which came to be called the University, the latter having been founded there early in the 13th century and having at once taken possession of it. Thus there is an organic division, corresponding to the natural division of the site of Paris, which accounts for the old expression "the Town, City and University of Paris."

About 1175 there existed at the foot of the Châtelet of the Petit-Pont a township which was a fief of the abbey of Saint-Germain-des-Prés. Another township clustered round the abbey itself. The district to the west of the Petit-Pont came under the feudal overlordship of the same abbey, while the district to the east was subject to the abbey of Sainte-Geneviève, which also had a township gathering round it; on the bank of the Bièvre was the village of Saint-Médard, and still farther to the south the township centring round the collegiate church of Saint-Marcel. The abbey of Saint-Victor, founded during the reign of Louis VI., formed yet another nucleus of rural population in the neighbourhood of what is now the Halle aux Vins. The church of Notre-Dames-des-Champs, situated in the cultivated land on the plateau by the road which continued the rue Saint-Jacques, also formed the centre of a small cluster of rustic houses. This bank of the river was mainly devoted to the cultivation of the vine.

Later, however, the various groups of buildings were enclosed within a rampart; it was built by Philip Augustus, and dates from 1190 on the right bank and about 1209 on the left bank. To describe its course in terms of present-day Paris, the wall on the right bank started from the end of the Pont-des-Arts in front of the Louvre, reached the rue Saint-Honoré opposite the Oratoire, and thence ran parallel to the rue Jean-Jacques Rousseau as far as the rue Montmartre, whence, following the direction of the rue Etienne-Marcel, it reached the rue Saint-Martin. Thence it bent in the direction of the rue des Francs-Bourgeois, and thus, passing by the southern end of the rue de Sévigné, reached the rue Saint-Antoine and the Seine. The gates were situated at the position of the present-day rue Saint-Antoine, rue Vieille-du-Temple, rue Saint-Martin, rue Saint-Denis, rue Saint-Honoré and quai du Louvre. Outside the rampart, in the south-western part of what is now the courtyard of the Louvre, was a tower of defence which Philip Augustus called "our tower of the Louvre." This is the origin of the palace of that name. The wall on the left bank ran in the direction of the rue des Fossés-Saint-Bernard, touched the place du Panthéon on the south, cut through the rue Soufflot and ran parallel to the rue Monsieur-le-Prince, rue de l'Ancienne Comédie and rue Mazarine, to the east of those streets.

New churches were erected about this time at the points where the town was growing. On the right bank of the river, Saint-Honoré was built early in the 13th century in the street of the same name, opposite where the Magasins du Louvre now stand; Saint-Eustache was built in 1223 at the point where the rue Montmartre met the rue Montorgueil, by which sea fish arrived in Paris. On the left bank there were Saint-Sulpice, first mentioned in 1211, and Saint-André-des-Arts, built about 1215. Saint-Etienne-du-Mont was built in 1222 to serve the growing parish around the abbey of Sainte-Geneviève. Finally, Saint-Nicolas-du-Chardonnet (1243) was erected farther east as the parish church for a population which, here as elsewhere, had increased as a result of the building of Philip Augustus' fortifications The left bank was more particularly the domain of the Church, on which the University was dependent. It was here that the four mendicant orders established themselves—the Preaching Friars or Jacobins in 1219 near the corner of the rue Saint-Jacques and the modern rue Soufflot; the Cordeliers in 1230 in what is now the rue de l'Ecole-de-Médecine; the Austin Friars in 1293 on the quai des Augustins, named after them; the Carmelites in 1319 in the place Maubert. The Carthusians settled in 1259 on the site of the modern avenue de l'Observatoire. A large number of colleges were established on the left bank of the river in the second half of the 13th century and the 14th century, among them the college founded in 1257 by Robert de Sorbon and named after him the Sorbonne.

The opposite bank was the centre of activity of the trades. Towards the middle of the 13th century there grew up the first municipal authority: the *Prévôté des marchands*. Its headquarters, the *Parloir-aux-Bourgeois*, was near the Châtelet. The latter was the seat of the administration of the provost of Paris, who represented the royal authority. The centre of commercial activity on the Seine later shifted to the Grève, and in consequence the *Parloir-aux-Bourgeois* was transferred there in 1357, to the site which has ever since been occupied by the *Hôtel de Ville*. The kings of France also contributed to the making of the right bank, adding the royal to the commercial element. Charles V. (1364–80) built the Hôtel Saint-Paul, which was his favourite residence, south of the rue Saint-Antoine. No trace of it remains. From that time onwards the kings no longer made the palace in the city (now the *Palais de Justice*) which had been rebuilt by Philip the Fair, their habitual residence. Charles VI. lived in the Hôtel Saint-Paul, and his successors in the Hôtel des Tournelles, near the modern place des Vosges. After the death of Henry II. (1559) the kings took up their residence in the Louvre, thus transferring their favour from the east of Paris to the west—a fact to which the development of the west of Paris is entirely due. The fortunes of Paris were as a matter of fact closely bound up with those of the French monarchy. It was the fact that Paris was the royal capital which, from the 12th century onwards, conferred on it a peculiar lustre. Manners became more refined, and the city came to be an intellectual and artistic centre in which crafts of all kinds flourished.

Political Struggles.—The Black Death and the Hundred

Years' War interrupted the prosperity of Paris in the 13th and early 14th centuries. The political life of the city began in the 14th century; in the time of Étienne Marcel it was for a time a revolutionary commune, and it subsequently felt the effects of the reconstruction policy of Charles V. This king rebuilt the Louvre, which he made into a magnificent palace, though he still preferred to live in the Hôtel Saint-Paul. He also built a new line of fortifications to contain the part of the town on the right bank which had outgrown that on the left. The number of gates in the old rampart had already been increased because the town on the right bank had spread beyond it. The new fortification, described in terms of modern Paris, started from the Pont du Carrousel, crossed the square of that name, and cut through the south-east of the Palais-Royal to reach the place des Victoires. Thence it ran almost in a straight line to the Porte Saint-Denis, and thence to the place de la Bastille, following the direction of the main boulevards, but a little farther to the west. It had six gates: Saint-Honoré, Montmartre, Saint-Denis, Saint-Martin, Temple and Saint-Antoine, where there was a large *bastide* or fortress to protect the gate. This was the Bastille, built in 1370 on the western part of what is now the place de la Bastille, captured by the populace on July 14, 1789, and then destroyed. In the east the rampart enclosed the marshes of the Temple, and consequently this part of Paris was formerly known as the *Marais* (marsh). Other bridges were built in addition to the Pont au Change and the Petit-Pont: the Pont Saint-Michel about 1380, and in 1413 the Pont Notre-Dame, so called by Charles VI.

Paris was again troubled by revolutionary agitation in 1382 as a result of the imposition of taxes; the revolt of the Maillotins was repressed with great severity in Jan. 1383. As a result, Paris lost its municipal régime, which was not restored until 1412. Further disturbances were caused by the struggle between the Burgundians and the Armagnacs, which followed on the madness of Charles VI. Paris fell into the hands of each party in turn, was subjected to the violent rule of the butchers and skinners under Caboche, became involved in revolution, called in Capeluche and his bands, and fell into a state of starvation. The English invasion and the Anglo-Burgundian alliance made matters worse. The English entered Paris, and the duke of Bedford, at the Hôtel des Tournelles, acted as regent for the young Henry VI., king of England and France (1422). Joan of Arc attempted in vain to recapture Paris in 1429. It was not until 1436 that the capital once more came into the possession of the king of France, Charles VII. These successive disturbances resulted in greatly reducing the population of Paris and in introducing foreign elements. Its prosperity suffered greatly.

FRANCIS I. TO LOUIS XVI.

Francis I. made extensive alterations in the Louvre so as to make it suitable for the royal palace (1528). In his reign the town increased in size; and it began to be adorned with buildings in the Renaissance style. A new Hôtel de Ville was begun, and at the same time Saint-Eustache and Saint-Etienne-du-Mont were rebuilt, as well as Saint-Merri and Saint-Gervais; but in the two latter churches the Gothic style survived. The population of the suburbs increased. The Faubourg Saint-Germain, under the influence of the neighbourhood of the Louvre, became an aristocratic quarter. The need of a new enclosing wall made itself felt; the lines of this were laid down in the 16th century, but it was not built until the reign of Louis XIII., and then only on the right bank of the river. It was in the reign of Francis I. that Protestantism was introduced into Paris and the royal authority made its first efforts to stamp it out.

Renaissance and Reformation.—Henry II.'s solemn entry into his capital in 1549 marks the triumph of the Renaissance in Paris. Jean Goujon's *Fontaine des Innocents* dates from the same year. Modern Paris now came into existence. Work on the Louvre was continued, and Catherine de Médici began the construction of the Tuileries in 1564. It was as though temples were being built to the new divinity, the monarch. Towards the end of the 16th century the gardens of the Tuileries began to be the meeting-place of the polite world; this was a custom of Renaissance origin. The influence of the court spread over Paris, and with it the Renaissance spirit. Increased refinement of manners was the result. The Pont-Neuf, which was begun in 1577 and completed under Henry IV., was the first classical bridge to be built in Paris. Quays were constructed in the 16th century, and an effort began to be made to set out the streets in line. It was the king's wish that new houses should have their façades made of stone and not of wooden beams and plaster. Paris began to wear the external characteristics of the capital of the absolute monarchy. The first theatre was built in 1548; it was known as the Théâtre de l'Hôtel de Bourgogne, in the rue Française.

The wars of religion did not spare the capital; on the Day of Barricades (May 12, 1588) it parted company with king Henry III., and was besieged by Henry IV. Poverty and hunger prevailed, and Paris was given over to the terrorism of the Sixteen —adherents of the *Ligue* representing the 16 districts. On March 22, 1594, the city once more came under the authority of its sovereign; and the monarchical era, which coincides with the classical age, entered upon its course. Henry IV. built the place Royale (place des Vosges) and the place Dauphine, as well as the quai de l'Horloge and the quai des Orfèvres. The building of the place Royale resulted, under Louis XIII., in the building over of the marshes which formerly lay to the north of it; the whole became the aristocratic quarter of Paris during the 17th century. The Pont-Neuf, on which a statue of Henry IV., the first statue to be erected in a public place in Paris, was set up in 1614, became one of the centres of the life of the city. It was also in the reign of Henry IV. that the work of joining the Louvre to the Tuileries, begun in 1566, was completed, the hospital of Saint-Louis was built for plague patients, and a supply of spring water, which had been brought to the right bank at the end of the 12th century, was carried over to the Île de la Cité. The left bank was not supplied with spring water until the reign of Louis XIII.

Under the latter king, Paris increased still further in size. Straight streets were laid out towards the edge of the town. Two uninhabited islands in the river were built over and became the Île Saint-Louis. It was connected with the two banks of the Seine by the Pont de la Tournelle and the Pont-Marie. The Pont-au-Double was built in 1634 between Notre-Dame and the left bank. In 1632 a wooden bridge was erected opposite the rue de Beaune to carry the traffic of the growing Faubourg Saint-Germain. The rue Neuve-Saint-Louis was built out over the river along the southern side of the Palace in 1622, and the rue and quai de Gesvres in 1642. In 1631 the western suburbs on the right bank were attached to the town, and a new line of fortifications with bastions was constructed. It followed the line of the old rampart until the Porte Saint-Denis; thence it was carried westward to what is now the corner of the rue Royale and the rue Saint-Honoré, and then ran along the western side of the Tuileries garden. To the west of the Tuileries garden the regent, Marie de Médicis, laid out the Cours-la-Reine, where the carriages of the fashionable world used to drive. The same queen built the Luxembourg palace (1615), and Cardinal Richelieu the Palais-Royal (1636); both of these palaces had gardens which were frequented by fashionable society. The Jardin des Plantes also dates from the reign of Louis XIII. During his reign a number of monasteries and convents were also established at Paris. Of the religious institutions built at this time, there still remain les Carmes (1613), the Oratoire (1621–30), Saint-Louis-des-Jésuites (1627–41), la Visitation (1634), le Val-de-Grâce (1645), Port-Royal (now the Maternité), Sainte-Elisabeth, les Petits-Pères (Notre-Dame-des-Victoires), the Assomption, etc.

Louis XIV.—The Fronde was a leading event of the minority of Louis XIV. Paris was in such a disturbed state that the court was obliged to leave the town in Jan. 1649. The king returned in Oct. 1652. In the period following Mazarin's death in 1661, Paris became the triumphant capital of a victorious and all-powerful monarch. The Louvre, work on which had been resumed in 1624, was completed by the magnificent colonnade (1667–74). The Tuileries palace was altered, completed and sumptuously decorated; its gardens, transformed by Le Nôtre, were prolonged beyond the Paris boundaries by the tree-planted avenues

f the Champs Elysées (1667). The line of fortifications, with s bastions, was replaced by a rampart along which were planted :ees so as to form a walk; this was the origin of the Grands oulevards (1670). The rampart was pierced by the Porte Saint)enis (1672) and the Porte Saint-Martin (1674) in the form of :oman triumphal arches. Both arches still exist. Other trimphal monuments were the place des Victoires (1686) and the lace de Vendôme (1699), each containing a statue of Louis XIV.)n the left bank, the Collège des Quatre-Nations (1662–74; the ıodern Institute), endowed by Mazarin's will, and open to young ıen from four recently conquered countries, and the Hôtel des nvalides (1670) formed a counterpart to the Louvre and the 'uileries opposite and were yet another testimony to the glory of ıe king of France. The Faubourg Saint-Germain was adorned ith a stately line of *quais*, and in 1685 the Pont-Royal was built ɔ take the place of the wooden bridge opposite the rue de ieaune. On the left bank the Cours was laid out, corresponding ɔ the line of the great boulevards on the other side; thus the outh part of Paris, which had remained within the limits of 'hilip Augustus' fortifications, was enlarged. The quai Peletier 'as built along the Seine between the Pont Notre-Dame and the irève (1673). Many of the streets were widened. The first arracks were constructed. The Observatory was built in 1667–72. n 1667 the Gobelins manufactory was organized. Various academies were added to the Académie Française owing to the inreasing centralization which was taking place round the monrchy. Everything tended to gravitate towards the *Roi Soleil.* 'he number of districts into which the town was divided was aised from 16 to 20 in 1702. But Louis XIV. transferred the seat f the monarchy to the palace which he built at Versailles.

The 18th Century.—In the nonage of Louis XV. the Tuileries, ow the royal residence in Paris, was occupied for a few ears. This encouraged urban development in the neighbourhood f the Tuileries. The Faubourg Saint-Honoré increased in size uring the 18th century, and became, like the Faubourg Saint-iermain, an aristocratic quarter. The rue Royale was made in 732, and the place Louis XV. was laid out around the statue f that king which was set up in 1763. This later became the lace de la Concorde. The construction of the parish church of he Madeleine was begun in 1764 at the end of the rue Royale, nd the Pont Louis XVI , now the Pont de la Concorde, was built ı 1787. The great boulevards now began to be bordered with ıouses, including some fine mansions, and the eastern part of hem became a fashionable promenade. Small theatres and cafés dded to the animation of this part of the boulevards. Paris now pread even beyond this limit; the rues de Provence and d'Artois or Laffitte) were laid out in 1770, the rue Taitbout in 1773, the ue Chauchat in 1779, the rue Richer in 1782 and the rue Le 'eletier in 1786. Villas built by nobles and financiers were cattered about this outlying part of Paris. Elegance and easy njoyment of life were the outstanding characteristics of the age. ıbout 1780 the Comédie-Italienne was built on the site which had ıeen occupied by the Hôtel de Choiseul, where the Opéra Comique ıow stands. New streets were constructed in its neighbourhood.)n the former site of the Hôtel de Condé, now occupied by the)déon, was built the Théâtre-Français, which was opened in 1782. n front of it was a semicircular open space from which streets adiated. On the left bank the work of laying out the Cours and ılanting it with trees was continued, and houses were soon built .long it. This was the beginning of the line of boulevards vhich was only completed under the Second Empire. The Ecole Ailitaire, with the Champ-de-Mars, dates from 1751. The Ecoles le Chirurgie (now the Ecole-de-Médecine) were built about this ime, and also the Monnaie (1771) on the quai Conti and the 'alais-Bourbon, now the Chambre des Députés, on the quai l'Orsay. Soufflot built a new church (now the Panthéon) for the bbey of Sainte-Geneviéve, and Saint-Sulpice, which had been ıegun about 1640, was completed. The Petit-Châtelet was lemolished and replaced by a quay (1782) on the left bank; the irand-Châtelet on the opposite bank did not disappear until early n the 19th century. The houses on the bridges were demolished n 1786–88: some however. remained until 1808. Water was supplied to both banks by the two fire pumps of the brothers Périer (1779 and 1787) which were the precursors of steam-driven machinery. The garden of the Palais-Royal, round which the duke of Orleans built arcades in the reign of Louis XVI., became a centre of Parisian life. The *octroi* wall of the *fermiers généraux*, built about the same time, bore witness to the growth of Paris.

PARIS SINCE THE REVOLUTION

The Revolution brought about the unification of Paris, in which traces of the old feudal domains had survived until that time. It set the seal on the age-long tendency towards centralization in France, and thus increased the importance of the capital. The days of Oct. 5 and 6, 1789, brought the king back to the Tuileries and thus put an end to the duality between Versailles and Paris. The Assembly followed the king, and set up in the riding school close by, near the present rue de Rivoli. The Jacobin club had its headquarters not far off in an old convent of the order of that name, while the Cordeliers' club occupied another convent in what is now the rue de l'École-de-Médecine. After the storming of the Tuileries by the populace on Aug. 10, 1792, the royal family was imprisoned in the Temple. Louis XVI. was guillotined on the place de la Révolution (place de la Concorde) on Jan. 21, 1793. The Terror prevailed until it was ended by the 9th Thermidor (July 27, 1794). The love of amusement then began to revive; the boulevard des Italiens began to be a haunt of the fashionable world, and continued to be so until the reign of Napoleon III. The boulevard du Temple on the other hand, where most of the small theatres were situated, was the resort of the populace.

The consulate was now established, and Bonaparte, as first consul, took up his residence in the Tuileries. This was the reason for the construction of the rue de Rivoli with its arcades (1801). In 1806 Napoleon ordered the triumphal arches of the Carrousel and of the Étoile to be set up; the latter was not completed until 1836. The fountain of the Châtelet, surmounted by a triumphal column, dates from 1806, and the Vendôme column was inaugurated on Aug. 15, 1810. The Madeleine was completed to serve as a temple to Glory. The neo-classical style began to give Paris an antique aspect; the city became, so to speak, the imperial Rome of a new Caesar. The Bourse was constructed in the style of a temple (1808–26). At the same time, however, the first iron bridges were constructed—the Ponts des Arts and d'Austerlitz. The Pont d'Iéna was also built in the time of Napoleon I., who likewise brought the water of the Ourcq to Paris and constructed the canal of the same name. The first public slaughter houses were established. Large cemeteries were laid out beyond the boundaries of the town. The Halle aux Vins, which dates from the time of Louis XIV., received approximately its present form. The first French industrial exhibitions were organized at Paris in 1801.

Machinery and other new processes and products now began to come into use. Large-scale industries began to grow up under the Restoration; the earliest social effects of this development made themselves felt in the reign of Louis-Philippe, and may explain the Revolution of 1848. Economic centralization began to take place. Paris received its first railway in 1837; it ran to le Pecq, near Saint-Germain. The use of gas for lighting purposes began under the Restoration. At this period and under Louis-Philippe there was a great deal of building on the outskirts of Paris—the districts of François I[er] (1823) and Beaujon (1825–42), that of l'Europe (1826–47) and that of Notre-Dame-de-Lorette came into existence. This was the time when covered passages, the first of which was that of the Panoramas (1800), were in fashion. Many bridges were built: the Ponts des Invalides, du Carrousel, d'Arcole, de l'Archevêché, Louis-Philippe and de Bercy. Omnibuses began to run in 1828. In 1840 fortifications were constructed beyond the *octroi* wall of the *fermiers généraux,* though the latter continued to form the limit of the town. A column commemorating the Revolution of 1830 was set up in the place de la Bastille, and in 1836 the Luxor obelisk was erected in the place de la Concorde.

Paris had in many respects retained the characteristics of a mediaeval city. It was Napoleon III. who, with the help of

Haussmann, the prefect of the Seine, really made it into a modern town. He was the creator of Paris as it exists to-day. The railway stations, which were now the real gates of the city, were provided with the main streets necessary to give access to them. These included the boulevard de Strasbourg and the rues de Rennes, Auber and de Lyon. A new intersection of routes was created between the boulevards de Strasbourg, Sébastopol, du Palais and Saint-Michel and the rue de Rivoli. The Halles Centrales were constructed and provided with the necessary means of access. The great cross-roads of the place de la République were created. The Opéra became another great meeting-place of roads. The Etoile, with its great system of radiating main roads, was laid out, and a corresponding system of radiating roads, starting from the place de la Nation, was planned at the other end of Paris. The Louvre was completed. The houses of the Cité gave place to public buildings. Wide streets were cut through the town on the left bank of the river. The population was provided with open spaces in the form of the Bois de Boulogne and the Bois de Vincennes and the Parcs des Buttes-Chaumont, de Montsouris and Monceau. Many squares were laid out on the English model. An immense system of sewers was created. The water of the Dhuys and the Vanne was brought to Paris. The Ponts National, de Solférino and de l'Alma and the viaduct of Auteuil were constructed. New parish churches were built, including those of la Trinité, Saint-Augustin and Sainte-Clotilde. Paris entered on a period of great brilliance. Universal exhibitions were held in 1855 and 1867. The town spread up to the fortifications (1860) and the old *octroi* wall was replaced by the outer boulevards.

The Tuileries palace was burned in the Commune which followed on the war of 1870–1871. The third republic carried on the work of Napoleon III., directing its attention mainly to the quarters added to the town in 1860. Further universal exhibitions were held in 1878, 1889 and 1900, and these were the occasion for the building of the Trocadéro, the Eiffel tower and the Grand and Petit Palais des Champs-Elysées. The church of the Sacré-Coeur was erected in Montmartre. The Métropolitain railway was constructed. Conditions of life have been radically altered by various modern inventions. Paris has no rival in France as a centre of material and intellectual interests. Commercial establishments have now taken the place of dwelling houses in the centre of the city, and the population has moved farther out, thus greatly increasing the extent of the suburbs. The upper part of the Champs-Elysées is now, like the great boulevards, given over to commerce. The World War transformed Paris into a great industrial centre. The town itself cannot now be distinguished from its suburbs, which have spread disproportionately. The fortifications of 1840 have been demolished. The aerodrome of Le Bourget will be the great terminus of the future. The port of Paris continually grows larger. In the town itself, the great development of motor transport is giving rise to difficult traffic problems. Although only half a century has passed since Haussmann's time, a fresh transformation of Paris is already becoming necessary. (For particulars of the Paris Grand Opéra *see* ACADÉMIE NATIONALE DE MUSIQUE.)

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PARIS, a city of eastern Illinois, U.S.A., 10 m. N.W. of Terre Haute (Indiana); the county seat of Edgar county. It is served by the Big Four and the Pennsylvania railways. Pop. 7,985 in 1920 (95% native white) and was estimated locally at over 10,000 in 1928. It is a junction and transfer point on the Big Four, which has repair shops here; ships large quantities of corn and other agricultural products. The city was incorporated in 1853.

PARIS, a city of Kentucky, U.S.A., the county seat of Bourbon county; 18 m. N.E. of Lexington, on Federal highways 27, 227 and 68, and served by the Frankfort and Cincinnati and the Louisville and Nashville railways. Pop. 6,310 in 1920 (25% negroes). It is the trade centre of a section of the blue-grass region.

PARIS, a city of north-western Tennessee, U.S.A., the county seat of Henry county; served by the Louisville and Nashville and the Nashville, Chattanooga and St. Louis railways. Pop. 4,730 in 1920 (26% negroes); estimated locally (after annexations of territory) at 9,000 in 1928, with an additional 3,000 in the suburbs. It is an important shipping point for clay, tobacco, cotton, grain and vegetables, and has large timber interests. The city was founded in 1820 and incorporated in 1823.

PARIS, a city of northern Texas, U.S.A., the county seat of Lamar county; 100 m. N.E. of Dallas and 15 m. from a free highway bridge over the Red river. It is served by the Frisco, the Gulf, Colorado and Santa Fe, the Paris and Mount Pleasant, the Southern Pacific, and the Texas and Pacific railways. Pop. (1920) 15,040 (24% negroes); estimated locally at 20,000 in 1928. It is an important cotton market, sales from wagons aggregating 35,000–50,000 bales in a season; a shipping point for the farm and orchard produce of a wide area; has a large wholesale distributing business, and more than 50 manufacturing plants, with an output in 1925 valued at $5,552,878. The city has an aldermanic form of government in which the mayor functions as city-manager. Paris was settled in 1841, incorporated as a town in 1874, and chartered as a city in 1905.

PARIS, CONFERENCE OF. The conference for framing the treaties which ended the World War was held in Paris in 1919–20.

I. PRELIMINARIES

The Pre-Armistice Agreement.—Germany faced complete defeat and unconditional surrender when, one after the other, her allies Bulgaria, Turkey and Austria-Hungary broke under the strain of war in Sept. and Oct. 1918, and sought terms with the enemy. Germany saw her best chance in overtures to the President of the United States, whose speeches during months past had underlined the principles necessary to the restoration and preservation of world peace (*see* FOURTEEN POINTS). Accordingly, on Oct. 4 the German Government despatched a note to Wilson through the Swiss Government requesting an armistice.

In reply, President Wilson laid down the stipulations that before negotiations for peace could be opened: (1) Germany must accept without qualification the principles of the Fourteen Points, leaving for discussion only the practical details of their application; (2) the German armies must be withdrawn from all territories of the Allies under the direction of the Allied military authorities; (3) Germany must cease all illegal and inhuman practices and abandon unlimited submarine warfare; and (4) the German nation must free itself of the arbitrary Government which had conducted the war. Gen. Ludendorff resigned rather than accede to those conditions, but the civil Government, although it protested against the charges of illegal and inhuman practices, despatched a note on Oct. 20 accepting the stipulations of President Wilson as preliminary to an armistice. Wilson then presented the matter to the Allies. The President had already sent Col. Edward M. House to Paris as American representative on the Supreme War Council. He met with the Allied leaders, Lloyd George, Clemenceau and Orlando, to discuss, first, whether an armistice should be granted, and second, whether Germany's request that the Fourteen Points be used as the basis of peace should be accepted.

President Wilson has been much criticized on the ground that he was responsible for too early a peace, and that had it not been for him terms would have been dictated to Berlin. This is far from the truth. The Allied Council agreed to grant the

ırmistice on the recommendation of the military leaders; the ımericans were in fact less eager than the French and the British or the cessation of hostilities. To be certain of Allied sentiment egarding the Armistice, House asked Marshal Foch directly 'hether or not from a purely military point of view he would refer to have hostilities cease on the terms proposed. Foch eplied that, since the terms demanded of Germany were pracically the same as those that would be demanded at Berlin, he 'as opposed to the useless sacrifice of even one more life. *On ne fait la guerre que pour ses résultats.*"

The Allied leaders were more doubtful whether President Wilon's Fourteen Points should be taken as the basis of the peace, s Germany asked. Clemenceau, Lloyd George, Hymans and)rlando each raised objections. They finally agreed, however, pon the strong insistence of Col. House, to accept the Fourteen 'oints with two reservations regarding the freedom of the seas nd restoration of invaded territory. Acknowledging these reserations, Wilson on Nov. 5 communicated the reply of the Allies o the German Government. This note is of vital importance. It constitutes the formal and written offer of the Allied and ıssociated States to conclude with Germany (*a*) an armistice onvention and (*b*) a treaty of peace. This offer, it is conceived, 'as accepted by Germany by the act of sending representatives, hrough military channels, to meet Marshal Foch for the purpose f arranging an armistice. By the acceptance of the offer a olemn Agreement was reached which served, both morally and egally, as the basis of the armistice convention and the treaty f peace[1]."

The note of Nov. 5, in which Wilson stated that Marshal Foch 'ould communicate the conditions of an armistice, contained the ext of the memorandum of observations by the Allied Governıents on the correspondence between President Wilson and iermany. In this memorandum those Governments "declare heir willingness to make peace with the Government of Germany n the terms of peace laid down in the President's address of an. 8, 1918 (the Fourteen Points), and the principles of settleıent enunciated in his subsequent Addresses," subject to two ualifications. These reserved complete liberty, as regards the freedom of the seas," and interpreted "restoration of invaded erritory" as meaning that "compensation will be made by Gerıany for all damage done to the civilian population of the Allies nd their property by the aggression of Germany by land, by ea and from the air."

Both the Allied and Associated Powers and the Germans ccepted this Pre-Armistice Agreement as the basis of the peace. The protests of the German delegation against the Versailles Treaty in May 1919 were based upon their allegation that the reaty was not in accord with the principles of the agreement. The Allied and Associated powers, although they denied the validty of the allegation, explicitly acknowledged the validity of the ıasis: "The Allied and Associated Powers are in complete accord 'ith the German delegation in their insistence that the basis for he negotiation of the treaty of peace is to be found in the corespondence which immediately preceded the signing of the Armistice of Nov. 11, 1918[2]."

Organization of Peace Conference.—Representatives of he chief Allied and Associated Powers—France, Great Britain, taly, Japan and the United States—held consultations in Dec., ınd the first plenary session of the Peace Conference did not ake place until Jan. 18 1919. President Wilson did not reach Europe until Dec. 13 1918. The British Prime Minister, Lloyd George, was detained at home by the political uncertainties of a general election until after New Year. So important to any negoiations was the participation of these two heads of governments hat nothing definite could be attempted until their arrival. In he meantime, the smaller Powers which had been overrun by the ırmies of Germany had time to reorganize their governments ınd to send plenipotentiaries to the Conference.

The Peace Conference was called by the five principal powers to assemble at Paris. Geneva had been suggested as a neutral meeting-place for victors and vanquished, but the opinion prevailed that the enemy should be excluded from the conference until summoned to hear the terms which must be accepted. Brussels also was suggested in appreciation of Belgium's heroic rôle in the war, but the honour was finally given to France. The war against the Central Powers had been directed from France; there sat the Supreme War Council of the Allies, and upon this the structure of the Peace Conference could best be erected.

II. ORGANIZATION OF THE CONFERENCE

The Council of Ten.—Upon the arrival of Lloyd George in Paris, a meeting of the Supreme War Council was held, Jan. 12, at the Quai d'Orsay. France was represented by Clemenceau and Pichon, Great Britain by Lloyd George and Balfour, Italy by Orlando and Sonnino, the United States by Wilson and Lansing. Though ostensibly an informal conversation among plenipotentiaries of the four leading Powers, the meeting was the occasion of the significant decision to add only the representatives of Japan to the Supreme Council and to exclude all others from the major decisions of the Peace Conference. Thus the Council of Ten sprang from the Supreme War Council. There also came to Paris the representatives of Belgium, Serbia, Rumania, Greece and the other States—32 in all—which had fought against the Central Powers or had broken off diplomatic relations with them. Obviously it was impossible for all to have equal part in determining the conditions of peace. To each, seats and a vote were allotted in the plenary sessions of the conference. Representatives of those states which had remained neutral during the war, and yet had interests to safeguard or to advance at the Peace Conference, were permitted to attend only those sessions which were arranged for discussion of their claims, whenever they were specially summoned by the five chief Powers. It had been the intention of the latter, at first to put on the same footing the new states which were rising from the ruins of the Central Powers. Before the first plenary session, Poland and Czechoslovakia were conceded representation in the conference; but Yugoslavia—including Serbia, Montenegro and the south Slav provinces of Austria-Hungary—was not officially recognized until the end of May, chiefly because of the opposition of Italy.

The Delegates.—Outstanding among the delegates from the smaller Powers were Hymans, Foreign Minister of Belgium; Paderewski, Premier of Poland, and his Foreign Minister Dmowski; and Bratianu, Premier of Rumania. For Serbia and the south Slavs came Pasić, Vesnić and Trumbić. Venizelos came to speak for Greece. For Czechoslovakia came its Premier, Kramarsz, and the brilliant young Foreign Minister, Beneš. The new Kingdom of the Hejâz was represented by the Emir Feisul.

But there was considerable dispute before the five principal Powers finally assigned places in the conference to each state in accordance with its military strength and its share in the war. Five seats were given to each of the five chief Powers; three apiece were assigned to Belgium, Serbia and Brazil; two each to Canada, Australia, South Africa, India, China, Czechoslovakia, Poland, Greece, the Hejâz, Portugal, Rumania and Siam; one each to New Zealand, Bolivia, Cuba, Ecuador, Guatemala, Haiti, Honduras, Liberia, Nicaragua, Panama, Peru and Uruguay. Many delegates were thus left out, but the panel system was adopted so that all Powers could use their plenipotentiaries in rotation if they desired. Representatives of the British Dominions, for example, more than once shared in important decisions of the Supreme Council by reason of their membership in the panel of the British Empire. Other work was found for excess members of several delegations on commissions and sub-committees.

When the plenary assembly of the conference met for the first time on Jan. 18 it proved to be only a body of approval merely passing upon actions that had already been determined in the Supreme Council. Clemenceau was elected president of the conference. A secretariat-general previously selected by the Supreme Council was appointed. A drafting committee was approved, on which had been placed only representatives of the five chief powers. The smaller Powers endeavoured to protest against such

[1]Temperley, *A History of the Peace Conference of Paris*, i., 382.
[2]Reply of the Allied and Associated Powers to the Observations of he German Delegation on the Conditions of Peace.

rigid control by the Five. But at the second plenary session on Jan. 25 Clemenceau bluntly dismissed their objections with allusion to the 12,000,000 soldiers behind the Five Powers.

Administrative Work.—With this matter of authority arbitrarily arranged, the Peace Conference settled to the work of constructing a peace. Peace-making, however, was not to be its sole task. It was obliged also to assume executive duties of tremendous consequence. It must direct the Allied Armistice Commission at Spa. It must set up and control the Supreme Economic Council at Paris. It had to maintain its own authority over Poland, Germany, Hungary, Czechoslovakia and Rumania. The Supreme Council of the Conference administered the Armistice by instructions to Marshal Foch, who in turn forwarded them to the International Commission at Spa. The Allied members of the commission consequently had no authority to make any decision beyond their instructions. They did have full power to explain and to stress important points in the Allied interpretation of the Armistice and, by personal intercourse, to prevail upon the German representatives to accept the decisions of the Supreme Council at Paris. The matters that chiefly concerned the Armistice Commission were: the withdrawal of German forces from the territory of the Allies and their demobilization, the repatriation of prisoners interned in Germany, surrender by Germany of the required amounts of arms, aeroplanes, mercantile and agricultural machinery, railroad equipment, and the delivery of other commodities stipulated in the Armistice.

Supreme Economic Council.—At the instance of President Wilson, on Feb. 8 the Supreme Council resolved to create a Supreme Economic Council of five members each from interested Powers to advise the conference on the temporary economic measures necessary pending the completion of peace negotiations.

At its first meeting on Feb. 17 the Supreme Economic Council decided to co-ordinate the work of all the former war boards and to direct them as sections of its own organization. As a result, matters of food and relief were placed under Herbert Hoover of the United States as director-general; matters of finance, under Norman Davis of the United States; the problems of communications were ultimately assigned to Brig.-Gen. H. O. Mance of Great Britain; raw materials, to Loucheur of France; problems of blockade, to Vance McCormick of the United States; and shipping to Kimball Cooke of Great Britain.

The Supreme Economic Council endeavoured to supply devastated areas with materials necessary for reconstruction and to revive the economic activity of those countries which were victims of the war. It was especially concerned with the problem of relieving the famine-stricken areas of Eastern Europe—a situation recognized as dangerous to political stability and likely to encourage the spread of Bolshevism. It arranged the Brussels Agreement by which Germany was provided with foodstuffs, to carry out that provision in the Armistice which pledged the Allies to revictual Germany in return for cash payments. It delegated to a sub-committee the special task of economic administration in the territories of Germany occupied by Allied armies. It carried on direct negotiations with the German Finance Commission, studied the economic effects of the Allied blockades of a Bolshevist Russia and Hungary, and urged the Supreme Council of the conference to relax those blockades for the benefit of the peoples of other states near by. It relaxed the blockade against Germany and reorganized the transportation systems of Austria, Hungary and Poland.

In short, the Supreme Economic Council under the efficient chairmanship of Lord Robert (Viscount) Cecil, established only as a temporary commission to administer economic affairs until the advent of peace, became one of the most important international bodies directing the reorganization of Europe. After the Treaty of Versailles had been signed, it continued to act as agent for the Allies. The last meeting was held in Feb. 1920.

Hostilities on Eastern Fronts.—The authority of the Peace Conference was menaced seriously not only by the hostility of the enemy, Germany, but by the resistance of the ally, Rumania, and the new governments of Poland and Czechoslovakia. Early in Nov. 1918 hostilities had broken out between the Poles and the Ruthenians in East Galicia, where Polish proprietors constituted a landed minority, and Ruthenian peasants, closely related to the Ukrainians in Russia, were a majority. During Feb. 1919 an Allied Mission intervened, but the Ukrainian commander refused to accept the proposed truce. In March the Supreme Council of the Peace Conference arranged another truce with the Ukrainian commander, and on April 2 set up an Inter-Allied Commission at Paris to arrange the terms of an armistice concerning Eastern Galicia. The Polish delegation rejected this armistice on the ground that Poland's safety required military occupation of East Galicia. The Supreme Council sanctioned the Polish occupation. The status of Eastern Galicia was left for later decision.

To safeguard Poland on its western border, the Peace Conference imposed an obligation upon Germany that had not been stipulated in the Armistice. In Posen, where Germans constituted in large part the class of landed proprietors and Poles were the peasants, local conflicts developed during Dec. 1918 between garrisons and Polish volunteer forces. The Peace Conference finally in Jan. 1919 despatched an Inter-Allied Commission to stop these hostilities and served notice of that intention upon Germany through Marshal Foch. Germany protested, but practically accepted the provisional line of demarcation as laid down by the Allied Commission until the boundaries of Germany and Poland were determined by treaty (*see* below VERSAILLES, TREATY OF). Germany also objected strongly to the transport of Gen. Haller's Polish army from France to Poland via Danzig, on the ground that its presence would prejudice the ultimate disposition of Danzig. The conference forced Germany to admit the technical right of the Allies to use Danzig as such a port of entry to Poland, but allowed Germany to route Haller's army via railroad without touching Danzig.

Still more vexatious to the Peace Conference, perhaps, was the situation that developed in Hungary after the establishment of a Bolshevist régime under Béla Kun and the conflict between Hungary and Rumania. (*See* HUNGARY, *History*.) Other matters to distract the Supreme Council of the Peace Conference from its major task of peace-making were the sharp controversies between Czechoslovakia and Poland over Teschen and between Austria and Yugoslavia over Klagenfurt. The situation in Russia caused much discussion during the first days. Decision was reached on Jan. 22 that all the Russian factions should be summoned into consultation on the island of Prinkipo, in order to determine who was to be responsible for Russian interests at the Peace Conference. But nothing came of the effort. Neither the old Tsarist order, the revolutionary Government of Kerensky, nor the Bolshevist régime of Lenin were represented at the Peace Conference. Nor were the new Baltic States—Finland, Estonia, Latvia, Lithuania—which were breaking away from the old Russian Empire.

Official Language.—Two preliminary questions of procedure for a time disturbed the plenipotentiaries at Paris. What was to be the official language of the conference? Should its proceedings be made public? It was decided that French and English texts, of equal authority, should be presented in the treaty with Germany, which included the Covenant. Italian texts, along with English and French, were presented in the Austrian, Hungarian and Bulgarian treaties; and in all these the French version was declared to prevail in case of divergence. The languages of the enemy states were denied admission to the texts of the treaties. With regard to publicity for the actions of the conference, the decision was reached to withhold details of discussions as much as possible until definite understandings had been secured.

Special Commissions.—Among the special agents established to assist in making a peace were commissions on:—(1) Responsibility for War and Guarantees, with Lansing of the United States as president, and sub-committees on criminal acts, responsibility for war, responsibility for violation of laws and customs of war; (2) Reparation for Damage, with Klotz of France presiding and sub-committees on estimation of damages, financial capacity of the enemy, and means of payment and reparation; (3) International Labour Legislation, with S. Gompers (U.S.A.) presiding (*see* INTERNATIONAL LABOUR ORGANIZATION); (4) Inter-

national Control of Ports, Waterways and Railways, with Crespi of Italy as president and sub-committees on transit and control of routes of communication; (5) Financial Questions, with Montagu of Great Britain presiding, and sub-committees on financial problems preliminary to peace, on monetary questions, enemy debts and so on; (6) Economic Questions, with Clémentel of France as president and sub-committees on permanent commercial relations, tariffs and customs, navigation, industrial property and others; (7) Aeronautics, with Colonel Dhé of France as president; (8) Inter-Allied Naval and Military Affairs, under the presidency of Marshal Foch, which with other associated committees constructed the military and naval and air terms for presentation to the enemy; and (9) The Central Commission on Territorial Questions, over which Tardieu of France presided, to co-ordinate the work of the committees and commissions examining the complex problems of Czechoslovakia, Poland, Rumania, Yugoslavia, Greece, Albania, Belgium, Denmark, the Saar valley and Alsace-Lorraine.

In all of these agencies of the Peace Conference the five Allied and Associated Powers kept for themselves either the entire membership or at least a majority over the smaller Powers.

III. COVENANT OF THE LEAGUE

First and most important of all was the commission on the League of Nations, chosen on Jan. 25 at the second plenary session of the conference upon the recommendation of the Supreme Council. The membership of this commission was drawn from the political leaders of 14 nations. Among them were Lord Robert Cecil and Gen. Smuts of the British Empire, Bourgeois of France, Orlando of Italy, Hymans of Belgium, Venizelos of Greece, Vesnich of Serbia, Wilson and House of the United States. The commission met on Feb. 3, and after daily sessions in the Hotel Crillon (held at hours that did not conflict with the meetings of the Council of Ten) presented to the plenary session of the conference on Feb. 14 the first draft of the Covenant. The usual procedure at the conference, of translating into French when English was used and into English when French was spoken, lengthened the sittings twofold and, while necessary, consumed much time. On the other hand, at the meetings of the commission to form the Covenant for the League of Nations, interpreters, sitting by those who did not speak both languages, kept them informed in an undertone of the progress of the discussion. It was agreed by the commission to use as a basis for discussion the American plan for the Covenant prepared by Wilson and House, which had, by consent, been put into legal phraseology by Sir Cecil Hurst and David Hunter Miller, legal advisers respectively of the British and American delegations. There were difficult problems to solve. The question of political equality and that of having a league with an army at its command to enforce its decisions, advocated by the Japanese and French respectively, caused acrimonious debates.

The debate in the plenary session—the one important discussion in that body throughout the period of the conference—resulted in approval of the principle of the Covenant and brought forward various suggestions for amendment. President Wilson left on the following day for the United States.

The Covenant was revised by the commission and finally approved by the fifth plenary session of the conference on April 28, without change of a single word. It is to be doubted whether there were many sitting at that historic table who realized that with the acceptance of the Covenant a new phase of civilization had begun and that the League of Nations was its keystone. The Covenant specifically provided for safeguarding the Monroe Doctrine against actions by the League; it contained a clause to permit any state to withdraw upon giving notice of its intention two years in advance. The chief objection to the Covenant raised in America was passed over. With the full support of President Wilson, Article X. was retained in the Covenant. *See* also LEAGUE OF NATIONS.

IV. PROGRESS OF PEACE MAKING

Council of Four.—Four days after President Wilson left for the United States, Clemenceau was shot by a fanatic. Although not dangerously wounded, he was confined to his home. Col. House, who had been delegated to take Wilson's place, came to meet him there and, with the return of Lloyd George from England, the same group was reformed which had worked with celerity and success during the Armistice proceedings. Thus the Council of Four took form. The Japanese plenipotentiary, Saionji, held to the policy of standing off when Japanese interests were not concerned, especially when the matters under discussion pertained purely to a European problem.

Upon Wilson's return to Paris (March 14) he replaced House in these informal conferences. The four heads of states abandoned the Council of Ten. It was reduced to the five foreign ministers. Whenever they desired, the Four assumed the authority of the Ten as the Supreme Council of the Peace Conference and drew apart to confer in private. The ministers of foreign affairs continued to sit as a Council of Five, although they were concerned chiefly with minor executive duties and other matters of routine. But, while the Four were still engrossed in negotiation with the recalcitrant German delegation, the Five went ahead with discussion of the terms to be given to Austria. The power of the Peace Conference had been drawn into the hands of four men, and the Italian, Orlando, found that final decision belonged really to the Three—Clemenceau, Lloyd George and Wilson.

No one listened to the arguments of the Four except their interpreter, Capt. Paul Mantoux, and later their secretary, Sir Maurice Hankey, who rendered invaluable service by keeping the minutes of their discussions and by drafting the resolutions upon which they agreed. On occasion, experts were summoned to give data and technical advice. Inter-Allied commissions were formed directly by the Four and ordered to report to them.

National Claims.—When Wilson returned to Paris (March 14) the problem of meeting the claims of France, Italy, Belgium and Japan immediately became acute. The French asked for continued occupation by the Allies of the Rhineland and the bridgeheads of Cologne, Coblenz and Mainz. Unauthorized demands were made for the permanent separation from the Reich of German territory on the left bank of the Rhine. France asked further for complete sovereignty over the Saar Valley, as compensation for its own mines which had been deliberately ruined by the German forces. The French representatives pressed vehemently for "integral reparation," assessment of actual damages done by the enemy and exaction of the total amount in reparation. France supported Poland's claim to complete sovereignty over Danzig and the approaches to that city.

Although at one time (April 7) President Wilson threatened to break off negotiations over these questions and return to the United States without finishing the task of peace-making, compromises that he could accept were found one after another. The scheme for a republic on the Rhine was repudiated, but agreement was reached that the left bank of the Rhine, and a wide strip on the right bank, should be demilitarized and all fortifications razed, and that the Allies should maintain their joint military occupation for 15 years. It was to be continued if France, in the opinion of the Allies, was not then sufficiently secured against an unprovoked attack. The decision to prohibit union of Germany with Austria, described by Tardieu as one of Clemenceau's fundamentals, was inserted in the first draft of the German Treaty in May and remained there in the definite text of June 28.

As for the French claim to the Saar valley, the compromise was reached that France should have full ownership of the coal mines but that, on account of the 650,000 German inhabitants, government of the region should not be given to France but should be put under the control of the League for 15 years. At the end of that time, the inhabitants resident prior to this arrangement should vote for one of three settlements: the *status quo* under the League, union with France or return to Germany. In case they voted for return to Germany, France was to give back the mines and to receive compensation from Germany.

Reparations.—The problem of reparation was not effectively solved by the Council of Four. Many English and American advisers, thinking of Germany's exhaustion, the danger of making

the German people desperate and the mistaken policy of asking that a blank cheque be signed and handed over for the Allies to fill in, urged that Germany be cleared of charges for reparation by payment at once of whatever amount it could produce. The debate ramified into the uncertainties of Germany's capacity to pay and the largest sum for which Germany might be held liable. The French view prevailed. It was agreed that Germany should be held liable to pay to the last cent. The demands of the British and French that pensions should be included in the reparations bill were first opposed by Wilson, but he finally yielded (*see* REPARATIONS). The deadlock over Danzig was broken by Lloyd George, who sought and found a way between Wilson's Thirteenth Point that Poland should have free and secure access to the sea, and British fears that a *Germania irredenta* with 2,000,000 inhabitants might be created. Danzig was to be a free city under the protection of the League of Nations, but Poland was to have access through Polish territory to the Baltic Sea and virtual control over Danzig's interests abroad. Within a week after President Wilson had threatened to leave the conference, these differences had been ironed out so well that the representatives of Germany were invited to appear at Versailles on April 25.

Crises over National Claims.—But another crisis suddenly appeared. The Italians threatened to withdraw from the conference unless their claims to Austro-Hungarian territories were met before the Germans signed the treaty. These claims were grounded upon promises given by France and Great Britain in the secret Treaty of London (April 26, 1915). Orlando went further, however, to claim the city and port of Fiume (*q.v.*) which had not been allotted to Italy by the secret treaty. In this case he argued for the principle of self-determination, although he had opposed the application of that principle to the German population in the Tyrol south of the Brenner Pass. Wilson gave way to Orlando's contention to the extent of agreeing that Italy's northern frontier should be extended to the Brenner. But he resisted the Italian pretensions on the eastern shore of the Adriatic; for they were advanced at the expense of Yugoslavia and Albania. Fiume had a large Slav population and a purely Slav hinterland. It was the natural seaport of the Slav and Magyar regions to the east. Wilson rejected the suggestion that Fiume should be given to Italy in exchange for the Italian renunciation of claims upon Dalmatia under the Treaty of London. On April 23 Wilson publicly declared his reasons for opposing Italian claims. Orlando and his foreign minister, Sonnino, left Paris for Rome, but returned after the conference determined to proceed with the German treaty. They reached Paris on May 7, a day too late for the sixth plenary session, which approved the draft of the treaty, and only a few hours before it was handed to the Germans at Versailles. The Italians were back in the conference, but the question of the Adriatic was not settled.

Meanwhile the claims of Belgium, Yugoslavia and Japan further complicated the situation for the Council of Four. Hymans appeared on April 29 to demand that, as Belgium had been first to suffer in the war, she should be first to receive compensation for war costs. She had been promised as much in the Armistice. He asked that Belgium be given a prior lien upon $500,000,000 of the first cash receipts from Germany and complete settlement of the Belgian account within ten years. Eventually the American view prevailed, that Belgium's case was different from all others. Belgium was practically assured payment of her war costs by receiving a special issue of German bonds and priority on the cash receipts. Serbia immediately asked for $400,000,000, but the Council of Four dismissed that claim summarily.

The Japanese issue, however, could not be settled so easily as the Belgian or the Serbian claims. The Japanese representatives took exception to the suggestion that the German area in Shantung should be handed back directly to the Chinese. Japan claimed Shantung on several grounds, and a secret agreement in 1917 with the Allies had assured Japan that they would offer no objection to Japanese claims in Shantung, although the United States had never been a party to the agreement. Wilson resisted the Japanese claims, but finally accepted a compromise on April 30.

The Italian crisis was threatening to disrupt the conference, and an understanding with Japan was more than ever necessary. It was to the effect that the Japanese were to keep Kiaochow and its adjacent district, with rights also to exploit the mines and railways in the peninsula; but that Chinese sovereignty would be restored over the peninsula of Shantung "as soon as possible." The American President expressed faith in the oral promise of the Japanese that Japan would eventually evacuate Shantung in favour of China and retain there only commercial concessions. The Chinese representatives at the Peace Conference did not have such faith. They refused to sign the treaty with Germany. But they gained a place for China in the League of Nations by signing the subsequent treaty with Austria.

V. TREATY OF VERSAILLES

With these crises over national claims passed, the draft of the treaty with Germany was handed to its chief representative, Count Brockdorff-Rantzau, on May 7, 1919, at the Trianon. Without rising from his chair the German hurled sharp words at the representatives of the Allies for their dilatory methods. In the past six months, he declared, the blockade had caused the deaths of hundreds of thousands in Germany. "Think of that," he said, "when you speak of guilt and punishment." He and his countrymen would accept the liabilities to which they were committed by the Armistice, would share in restoring Belgium and the devastated areas of France. But they and their nation did not hope for a just peace. "We know," he said, "the power of the hatred that we encounter here."

German Objections.—The Germans were given 15 days, and then an extension of time, in which to represent their objections to the terms of the treaty. They complained that the Allied plan for reparations was too severe and claimed the right of appeal from the assessment of the Reparations Commission to some neutral arbitrator. They demanded a plebiscite in Alsace-Lorraine. In place of the Allied arrangement for the Saar valley, they offered fixed annual supplies of coal to France until the French mines should be restored. Instead of giving up Danzig, Memel and West Poland, they offered to make Danzig, Memel and Königsberg free ports under German sovereignty. They demanded that Germany's claim to its colonies should be referred to arbitration. They asked for reciprocity with regard to commerce and goods in transit. They offered to negotiate concerning the League of Nations, provided Germany were admitted immediately, the members of the League were pledged against waging economic war and the Allied Powers also should abolish compulsory military service within two years and disarm themselves. They desired that the armies of occupation should leave German territory within six months after the signing of the treaty. They summed up their criticisms with the charge that the treaty as a whole was inconsistent with the terms of the Pre-Armistice Agreement. Such an imputation was angrily rejected by the Allies, but suggestions were made in the Supreme Council of the conference that the terms of the treaty should be softened.

Movement for Revision.—Lloyd George, backed by members of the British Ministry and representatives of the British Dominions, led the movement for revision. But the dangers of further delay were apparent. The movement for revision came to an end on June 13 with the only consequence that some concessions were made to Germany on minor points.

The Allies maintained their position with regard to reparations and the armies of occupation. They conceded some changes in the Polish frontier, to make it more consistent with ethnographic divisions. They agreed to a plebiscite in Upper Silesia. They withdrew the provision for making the Kiel Canal an international waterway. They intimated that they would open negotiations at once looking toward reduction of their own armaments. They promised to admit Germany into the League, if Germany complied with the terms of the treaty. They invited from Germany an offer (hedged round with many conditions), within four months of the signing of the treaty, of a lump sum to settle reparations. This suggestion was not accepted by Germany.

There was suspense as Count Brockdorff-Rantzau presented the final terms of the Allies to the German Government at Wei-

mar. The Allied Armies of Occupation prepared for a general advance into Germany if the Germans should refuse to sign the treaty. The Scheidemann Ministry resigned on June 20, and the new Premier, Bauer, offered on the next day to sign the treaty without its articles requiring the surrender of war criminals and declaring Germany solely responsible for causing the war. The Allies refused. In this tense situation, the crews of the German battle-fleet scuttled their ships in Scapa Flow. But on June 22 Bauer obtained the permission of the Weimar National Assembly to sign without conditions, and the new German Minister of Foreign Affairs, Muller, with his colleague, Dr. Bell, at last on June 28 signed the treaty in the Salle des Glaces at Versailles.

Subsidiary Agreements.—Dependent upon the Treaty of Versailles, although apparently the result of separate negotiations among the interested Powers, were several other treaties and international agreements: (1) two defensive treaties, each signed by France, first with Great Britain, and next, with the United States. The two latter Powers bound themselves to come to the aid of France in case of an unprovoked aggression by Germany any time within the next ten years. Great Britain made her ratification dependent on that of the United States. The latter refused to ratify, and so both treaties became nugatory; (2) a protocol defining certain ambiguities in the Treaty of Versailles; (3) an agreement among the United States, Belgium, the British Empire, France and Germany to define the nature of the military occupation of the Rhineland; (4) a treaty between Poland and the Allies to assure protection of life and liberty to all inhabitants of Poland without distinction as to birth, nationality, language, race or religion. Similar protection was later secured by the Allied Powers for minorities in Czechoslovakia, Rumania and Yugoslavia, provisions which were not applied to Italy (*see* MINORITIES; ST. GERMAIN, TREATY OF).

Ratification.—The Treaty of Versailles was ratified on July 9 by Germany, and by Oct. Great Britain, France, Italy and Japan also had ratified The exchange of ratifications was delayed for two reasons. First, it was hoped that the Senate of the United States would ratify at least with reservations. Second, Germany must make amends for the destruction of its fleet in violation of the Armistice. On Nov. 19, 1919, the American Senate failed to ratify; but on Jan. 10, 1920, Germany finally signed a protocol to give compensation for scuttling the fleet. Then the exchange of ratifications was made at Paris between the European Allies and Germany, and on Jan. 16, 1920, the League of Nations was formally inaugurated.

VI. OTHER TREATIES

After the Germans had signed the Treaty of Versailles on June 28, 1919, the Peace Conference turned to the problems of Austria, Hungary, Bulgaria and Turkey, over which many of its commissions had been labouring for months. Chiefs of state began to resume their political tasks. Foreign ministers one by one left for home. Power to act in behalf of the respective states, however, was delegated to lesser dignitaries. The organization of the conference remained intact to complete negotiations with the former allies of Germany. Austria was presented with terms drawn on lines similar to those granted to Germany. Her representatives signed at Saint Germain-en-Laye on Sept. 10, 1919 (*see* SAINT GERMAIN, TREATY OF). And in Jan. 1920, Hungary, freed from its Communist régime and from Rumanian control, was accorded terms varying from the Austrian in minor details. The Hungarians signed on June 4, 1920 (*see* TRIANON, TREATY OF THE).

For Bulgaria, a delegation headed by Teodoroff, the Prime Minister, arrived in Paris on July 26, 1919, but did not receive the draft of the treaty until Sept. 19. The Bulgarians delayed their reply more than a month to frame objections; but other than the promise for speedy admission into the League, they got no concessions from the Peace Conference. Further remonstrance from the Bulgarians led Clemenceau to give them ten days to accept or to reject. By this time Teodoroff had lost power in Bulgaria, and Stambuliisky, head of the Agrarian party, had taken control of the Bulgarian Government. On Nov. 27, 1919, at Neuilly-sur-Seine, Stambuliisky signed the treaty as the sole representative of Bulgaria (*see* NEUILLY, TREATY OF).

Following the establishment of the League of Nations on Jan. 16, 1920, the Peace Conference came to an end. Several issues of first importance remained for disposal, among them the problem of the Adriatic and the settlement with Turkey. The plenipotentiaries left these matters, however, to the Conference of Ambassadors or to negotiation among the interested states. (*See* AMBASSADORS, CONFERENCE OF.) Italy continued to press her claims to Fiume and strategic points on the eastern shore of the Adriatic. Great Britain and France, though recognizing their obligations under the secret Treaty of London, endeavoured to satisfy Italy with a compromise short of those obligations so as to gain the approval of the American Government. But Wilson persisted in opposition for the sake of the interests of Yugoslavia and Albania. The upshot of the controversy was that Italy secured the island of Sasseno outside the port of Valona, the port remaining in Albanian hands, and at a later date reached an agreement with Yugoslavia. Albania maintained her independence and on Dec. 17, 1920, gained admission to the League of Nations.

The Turkish Settlement.—The Turkish question had been discussed at Paris in May and June 1919 and a Turkish deputation had visited the Conference, but the drafting of the treaty was not taken seriously in hand until the London Conference of Feb. 1920. The delay was due in part to the hope that the United States would join in signing the treaty, but there were also great difficulties involved in the assignment of mandates over the national minorities in the Turkish Empire. Wilson's Twelfth Point had stipulated that these territories should receive "unmolested opportunity of autonomous development." An article in the Treaty of Versailles indicated that some of them at least would be recognized as independent states, under such mandatories as they chose to accept.

But there had been understandings among the Allies that ran counter to the principle of self-determination. In May 1916 France and Great Britain had made the Sykes-Picot agreement with regard to their respective spheres of influence in Turkey. The French sphere was to include Cilicia, southern Armenia and Syria. The British area was to include Haifa and Mesopotamia. Palestine was to be international territory. Greece claimed the whole of Turkish Thrace, the Aegean islands and Smyrna, which Greek forces occupied in May 1919, with the approval of the Supreme Council of the Peace Conference. Italy claimed the Dodecanese, which it had held since the war with Turkey in 1912, and a sphere of influence on the adjacent mainland. Both France and the Hejāz desired the Arab districts of Syria. The disposition of Constantinople also was uncertain.

On Feb. 16, 1920, the London Conference of the Allies announced that Constantinople would remain the capital of Turkey; but a month later the Allies informed Turkey that this concession depended upon its good behaviour. Constantinople had been occupied by Allied troops under the command of Sir G. F. Milne before the end of 1918. On April 25, at the Conference of San Remo, mandates were given to France for Syria, Cilicia and the Lebanon; to Great Britain for Palestine and Mesopotamia, but the mandate over Armenia was declined both by the League of Nations and by the United States. Finally, on May 11, 1920, the draft of a treaty similar in many respects to the Treaty of Versailles was handed to the Turkish representatives at Sèvres. It was signed on Aug. 10, 1920 (*see* SÈVRES, TREATY OF). Thus the task of constructing terms of peace was brought to an end. Real peace, however, had not yet come to the world.

VII. SUMMARY CRITIQUE OF THE CONFERENCE

The Peace Conference should have sat immediately after the conclusion of the Armistice, and should have made a preliminary peace to be followed later by a permanent peace. The belligerent nations had been so shattered by the war that the need for bringing about a resumption of normal conditions as soon as possible was imperative. Much of the distress which has overtaken Europe since 1918 might have been avoided by an early preliminary peace. When the conference first got down to work there was much confusion as to method and also as to the precedence to be given

the subjects to be discussed. There should have been a well-defined programme laid out in advance so as to form a basis for discussion, as was done when the Covenant was formed. The lack of this caused the conference to waste time, and it resulted in the setting up of the ineffective Council of Ten which was, indeed, a council of 30 or 40 when the secretaries, experts and representatives of states interested were included in the meetings. After wasting many weeks in a futile endeavour to get at the facts, the Council of Four was substituted for the Council of Ten. Decisions then came rapidly.

Reparations and Security.—The question of reparations was the most potent cause of delay in negotiations. There was common agreement that Germany should pay to the full extent of her capacity, but there was a wide difference of opinion as to what her capacity was. The heads of the British and French delegations demanded of Germany the entire cost of the war on land and sea. The American Commission deemed this impossible, and sought to have a sum named which Germany might reasonably be expected to pay. After weeks and months of fruitless discussion, President Wilson finally agreed to a compromise which amounted to Germany's signing a blank cheque to be filled in later. He consented to this because it was thought that the Reparations Commission which the treaty provided, would, of necessity, name a sum which could be met. No one then considered the possibility of the United States Senate refusing to ratify the treaty.

The question of French security ran through the discussions at Paris and finally was met by compromise. President Wilson and Lloyd George agreed on behalf of the United States and Great Britain respectively to come to the assistance of France in the event of an unwarranted invasion by Germany. The terms of the treaty were somewhat indefinite, but they were the best that Clemenceau, after long negotiation, was able to secure. Wilson and Lloyd George were adamant in refusing all proposals regarding the left bank of the Rhine as a permanent line.

If the Versailles Treaty had been accepted by the United States, the Franco-American Security Treaty would, in all probability, have gone through; and the Versailles Treaty would have been ratified by the Senate provided President Wilson had been willing to accept the Lodge reservations. The Versailles Treaty failed by six votes of getting the necessary two-thirds; twenty-odd Democrats who were ardently for the treaty voted against it, because of the reservations. As with the League of Nations, the importance of the French Security Treaty was not realized at Paris in the making of the peace. It has been the crux of nearly all the troubles which have beset Europe since the Armistice was signed on Nov. 11, 1918. If the French had been assured of protection, their attitude toward Germany, toward reparations and toward disarmament undoubtedly would have been more in keeping with the public opinion of the world. (*See* SECURITY.)

It is only in retrospect that historic events are seen at their just value. Those who are making history oftentimes exaggerate the importance of some things and underestimate the importance of others. At Paris undue stress was laid on questions of enemy disarmament and reparations—both matters of temporary interest and susceptible of quick solution. Within a few decades they pass from view; but questions like the League of Nations and the security of France reach to the heart of peace and war, and are vital if Western civilization is to live. If it had been seen at Paris, untold hardships might have been averted.

The so-called Secret Treaties were mischievous elements in making decisions, particularly regarding the Italian frontier. Great Britain and France entered the conference with their hands tied by promises made to Italy in order to induce her to enter the war on the side of the Allies. The United States was free to act as seemed best. The fight between Wilson on the one hand and Orlando and Sonnino on the other produced the most acute crisis of the conference. The breaking-point came when Wilson gave out his statement of April 23, 1919. This infuriated the Italians and they left Paris with the threat never to return. Wilson bore the brunt of the criticism which this rift in the conference caused, but he was by no means solely responsible.

Shantung.—At this moment feeling regarding Shantung ran high. No direct threat was made by the Japanese delegates, but it was in the air that if the conference refused their request they too would withdraw. They did not ask to keep Shantung, but merely that it should be returned to China through them. Here again Wilson bore the brunt of the fight, and the taunts of the liberals throughout the world were levelled at him. Even his associate commissioners from the United States, with one exception, protested against his acceding to the Japanese request. However, he and House had personal assurance from Baron Makino and Viscount Chinda that the province would be returned. They were men of the highest character and integrity, and their word, which has since been fully kept, was accepted without question.

The Belgians also were dissatisfied at this period of the conference. Suggestions of withdrawal were made and, with Italy gone, for the moment at least, it would have been fatal to the conference if Japan had left because her pledged word to restore Shantung to China was not accepted. It was a critical period of the conference, and the subsequent action of Japan has shown the wisdom of meeting her request.

Self-Determination.—During the war, when President Wilson announced his theory of self-determination, it stirred the dormant hopes of many peoples and did much to break the discipline in the Central Powers behind the lines. This declaration of war aims brought to Paris many and diverse delegations from Europe, Asia and Africa. They were the most picturesque as well as the most ill-informed and unreasoning of all those who gathered around the historic centre where the peace was made. This noble sentiment, carried to its logical conclusion, would have wrecked the governmental machinery of the world. The conference has received unjustified blame for dividing up the Austrian Empire, but it must be remembered that the empire had already fallen apart before the Peace Conference met. The questions which came before the conference involved the boundaries of states in process of formation, and not the creation of such states. Had the conference undertaken to curb the demand for national independence, its authority to do so would have been denied and another war would have begun.

Mandates.—The acceptance of the principle of mandates was one of the most far-reaching decisions of the conference. It was a new venture in the government of backward peoples, and one destined to play a large part in the affairs of many nations. It gave an excuse and a method for taking over the German colonies by the several countries interested. The German colonial empire vanished overnight. It was one of the hardest blows which her pride received, and one which she resents with passionate fervour.

Until the Paris Conference there had been no attempt to reach a general understanding or fixed policy between the more powerful civilized nations regarding the control or betterment of such states or territories. However, the system hitherto practised was admittedly so bad that when the conference came to the disposition of the late German colonies, there was general agreement that a more enlightened policy should be inaugurated. In furtherance of this desire Article 22 was incorporated in the Covenant of the League of Nations, and subsequently a commission was appointed to sit in London during the summer of 1919 for the purpose of preparing the terms of the mandates. Upon this commission were Lord Milner, who had as his adviser Lord Robert Cecil; M. Simon, French Minister for the Colonies; Viscount Chinda of Japan; Signor Marconi for Italy; and Col. House for the United States, with Mr. George Louis Beer as adviser (*see* MANDATES).

BIBLIOGRAPHY.—The standard history of the Peace Conference is *A History of the Peace Conference in Paris*, 6 vol., ed. H. W. V Temperley (1920–24). It is written chiefly by British experts, many of whom took part in the conference, but its point of view is objective. The texts of the treaties are to be found in the *Treaty Series* of the British Foreign Office, published by H.M. Stationery Office (1920). There is a special volume, *The Treaty of Peace between the Allied and Associated Powers and Germany (with amendments) and other Treaty Engagements Signed at Versailles June 28, 1919, together with the Reply of the Allied and Associated Powers to the Observations of the German Delegation on the Conditions of Peace* (1925). *Comments by the German Delegation on the Conditions of Peace* and the *Reply of the Allied and Associated Powers* are published by the American Association for International Conciliation (1919) and the

covering letter in the *American Journal of International Law* (July 1919). *See* also Deutscher Geschichtskalender, *Vom Waffenstillstand zum Frieden von Versailles*, pp. 565 *seq.* (Leipzig, 1918).

Important confidential documents are contained in R. S. Baker, *Woodrow Wilson and World Settlement* (1922). Important memoirs have been written by participants in the Peace Conference, especially André Tardieu, *The Truth about the Treaty* (1921); B. M. Baruch, *The Making of the Reparation and Economic Sections of the Treaty* (1920); Robert Lansing, *The Peace Negotiations* (1921); *see* also J. M. Keynes, *The Economic Consequences of the Peace* (1920); E M House and C. Seymour, *What Really Happened at Paris* (1921).

(E. M H.)

VIII. LATER CONFERENCES IN PARIS

After the conclusion of the important conference already described, three meetings of Allied statesmen were held in Paris to consider matters arising out of the execution of the Treaty of Versailles

Jan 24–30, 1921.—A meeting to consider proposals put forward by Allied experts as a result of a meeting between them and German experts at Brussels from Dec 16–22, 1920, in continuation of the Conference of Spa (*see* SPA, CONFERENCE OF). The Allied statesmen adopted the experts' proposal for two German annuities, one fixed and the other on a sliding scale, but they proposed to saddle Germany with a far heavier burden than the experts had considered reasonable The Allied Governments' proposals were rejected by Germany

Aug 8–13, 1921—A meeting of the Supreme Council of the Allied Powers to take action upon the results of the plebiscite in Upper Silesia (*see* SILESIA, UPPER) After failing to agree upon a line of partition between Germany and Poland, the representatives of the principal Allied Powers decided unanimously to refer the question to the Council of the League of Nations, under Article 13 of the Covenant

Jan 2–4, 1923—A meeting between Allied statesmen to consider the terms on which Germany might be granted a reparations moratorium The British Government proposed that Germany should be given an absolute moratorium for four years (except for certain deliveries in kind which were to be credited against future payments), on condition that Germany should stabilize the mark on lines suggested in the majority report of a commission of international experts which the German Government had called in during the preceding autumn; and secondly, that Germany should accept financial control by a foreign finance council, of which the German Minister of Finance was to be chairman, *ex officio*, and which was virtually to supersede the reparations commission. In regard to inter-Allied debts, the British Government made specific proposals which would have given substantial relief to France in exchange for a remission of German indebtedness, which would have been equally substantial

The gulf between these two sets of proposals was so great that there was no chance of an accommodation The conference broke up after the French and British Governments had "agreed to disagree" A week later, on Jan. 11, 1923, the French and Belgian armies invaded the Ruhr (q v ; *see* also REPARATIONS)

PARIS, TREATIES OF. Many treaties and conventions have been signed at Paris, among the more important being the treaty of Feb. 10, 1763, between Great Britain and France at the end of the Seven Years' War; the Treaty of Alliance of Feb. 6, 1778, between France and the United States; the definitive treaty of Sept. 3, 1783, which ended the War of American Independence; and the Treaty of March 30, 1856, between Great Britain, Austria, France, Prussia, Russia, Sardinia and Turkey, which followed the Crimean War When "the treaties of Paris" are referred to without qualification, however, what is commonly meant are the two sets of treaties signed in Paris on May 30, 1814, and Nov 20, 1815. The first embodied the abortive attempt made by the Allies and Louis XVIII. of France to re-establish lasting peace in Europe after the first abdication of Napoleon at Fontainebleau on April 11, 1814. The second contained the penal and cautionary measures which the Allies found it necessary to impose when the practically unopposed return of Napoleon from Elba, and his resumption of power, had proved the weakness of the Bourbon monarchy. It is with these treaties, which are of great importance in the history of Europe and the formation of its public law, that this article is alone concerned.

The treaty of May 30, 1814, and the secret treaty which accompanied it, were signed by Talleyrand for France; by Lords Castlereagh, Aberdeen and Cathcart for Great Britain; by Counts Rasumovski and Nesselrode for Russia, by Prince Metternich and Count Stadion for Austria; and by Baron Hardenberg and W. von Humboldt for Prussia Sweden and Portugal adhered later, and Spain adhered on July 20, to the public treaty, to which there were in all eight signatories. It is this public treaty which is known as the First Treaty of Paris. The Allies declared that their aim was to establish a lasting peace based on a just distribution of forces among the powers, and that as France had returned to "the paternal government of her kings" they no longer thought it necessary to exact those guarantees which they had been regretfully compelled to insist on from her late government. The preamble was more than a flourish of diplomatic humanity, for the treaty was extraordinarily favourable to France It secured her in the possession of all the territory she held in Europe on Jan 1, 1792 (Art II), it restored her colonies, except Tobago, Santa Lucia, Île de France (Mauritius), Rodriguez, and the Seychelles, surrendered to England and the part of San Domingo formerly Spanish, which was to return to Spain (Art. VIII.). Sweden resigned her claim on Guadaloupe (Art IX); Portugal resigned French Guiana (Art X). The rectifications of the European frontier of France are detailed in the eight subsections of Art III They were valuable. France obtained (1) a piece of territory south of Mons, (2 and 3) a larger piece of territory around Philippeville, on the Sambre and Meuse, (4) a rectification including Sarrelouis, (5) a piece of land to connect the formerly isolated fortress of Landau with her own dominions; (6) a better frontier east at Doubes, (7) a better frontier as against Geneva, (8) the sub-prefectures of Annecy and Chambéry (Savoy) By the same article she secured all the German *enclaves* in Alsace, also Avignon, the Venaissin and Montbéliard Art VI. secured Holland to the house of Nassau, with an addition of territory, not defined in this instrument, asserted the independence, and right to federate of the German states, and the full sovereignty of all the states of Italy outside of the Italian dominions of Austria Art. VII gave Malta to Great Britain By Art XV. France was to retain two-thirds of all warships and naval stores existing in ports which had belonged to the empire of Napoleon, but were outside the borders of France, with exception of the Dutch ships By Art XXXII the powers bound themselves to meet at Vienna within two months to arrange a final settlement of Europe Among the additional articles was an agreement with Great Britain by which France undertook to suppress the slave trade

The separate and secret articles of the treaty (or "Secret Treaty" as they are commonly called), were meant to bind France to agree in principle to the readjustments and allotments of territory and population to be made at the Congress of Vienna (*q v*)

The treaties of Nov 20, 1815, and their dependent instruments, were signed in very different circumstances. The representative of France was the duc de Richelieu; Great Britain was represented by Castlereagh and Wellington; Austria by Metternich and Count Wessenberg, Prussia by Hardenberg and W von Humboldt; Russia by Rasumovski and Capo D'Istria The preamble stated the altered spirit and purpose of the Allies It insisted that, as the powers had saved France and Europe from Napoleon's last adventure, they were entitled to compensation and security for the future They had decided to exact indemnities, partly pecuniary and partly territorial, such as could be exacted without injuring the essential interest of France. The territorial penalty imposed was moderate France retained the *enclaves* she had secured by the previous treaty She had to resign her gains on the north and eastern frontier, to surrender Philippeville, Marienbourg, Bouillon, Sarrelouis and Landau, to cede certain territories to Geneva, and she lost Annecy and Chambéry. The standard taken was the frontier of 1790 (Art I). By Art. III. she agreed to dismantle the fortress of Hüningen near Basle. The most grievous articles of the treaty are those which imposed the payment of an indemnity, and the occupation of a part of French terri-

tory as security for payment. Art. IV. fixed the indemnity at 700,000,000 frs. Art. V. fixed the strength of the army of occupation at 150,000 under a commander-in-chief to be later named by the powers, and specified the fortresses it was to hold in the north and north-east of France. The period of occupation was limited to five years, but might be reduced to three. All provisions of the treaty of May 30, 1814, and of the Final Act of the Congress of Vienna not expressly revoked were to remain in force. By an additional article the powers agreed to join Great Britain in suppressing the slave trade. On the day of the signing of the Second Treaty of Paris, a treaty of alliance, commonly spoken of as the treaty of Nov. 20, 1815, was signed in Paris by Great Britain, Austria, Russia and Prussia. It contained six articles. The first declared the determination of the Allies to enforce the treaty signed with France; the second, third and fourth reaffirmed their determination to exclude the Bonaparte family from the throne, and specified the measures they were prepared to take to support one another. The fifth declared that the alliance for the purposes stated would continue when the five years' occupation of France was ended. The sixth article stated that in order to facilitate and assure the execution of the present treaty, the High Contracting Parties had decided to hold periodical meetings of the sovereigns or their ministers, for the examination of such measures as appeared to be salutary for the repose and prosperity of their peoples and the maintenance of the peace of Europe. It was in accordance with this last article that the congresses of Aix-la-Chapelle (1818), Troppau (1820), Laibach (1821), and Verona (1822) were held (*see* EUROPE: *History*).

See texts in Hertslet, *The Map of Europe by Treaty*, I. (1875), and Martens, *Nouveau recueil de traités, etc.*, ii. (Göttingen, 1818); W. Alison Phillips, *The Confederation of Europe* (2nd ed. 1919) and C. K. Webster, *The Foreign Policy of Castlereagh* (1925). (W. A. P.)

PARIS COMMUNE: *see* COMMUNE.

PARISH. In the early Christian Church each district was administered by a bishop and his attendant presbyters and deacons, and the word *parochia* was frequently applied to such a district. Scattered congregations or churches within the *parochia* were served by itinerant presbyters. Towards the close of the 4th century it had become usual for the bishop to appoint resident presbyters to defined districts or territories, to which the term "parish" came gradually to be applied. (*See* also DIOCESE.) Parish, in English ecclesiastical law, may be defined as the township or cluster of townships assigned to the ministration of a single priest, to whom its tithes and other ecclesiastical dues were paid; but the word has now acquired several distinct meanings.

The parish as an institution is later in date than the township, for the latter has been in fact the unit of local administration ever since England was settled in its several States and kingdoms. The beginnings of the parochial system in England are attributed to Theodore of Tarsus, archbishop of Canterbury towards the close of the 7th century. The system was extended in the reign of Edgar, but was not complete until the reign of Edward III.

After the abolition of compulsory church rates in 1868 the old ecclesiastical parish ceased to be of importance as an instrument of local government. Its officers, however, have still important duties to perform. The rector, vicar or incumbent is a corporation-sole, in whom is vested the freehold of the church and churchyard, subject to the parishioners' rights of user; their rights of burial have been enlarged by various Acts. (*See* CHURCHWARDEN.) The other officials are the parish clerk and sexton. They have freeholds in their offices and are paid by customary fees, but can now be dismissed by a joint act of the incumbent and the parochial church council. The office of the clerk is regulated by an Act of 1844, enabling a curate to undertake its duties. The only civil function of the parish clerk remaining in 1894 was the custody of maps and documents, required to be deposited with him under standing orders of parliament before certain public works were begun. By the Local Government Act 1894 they are now deposited with the chairman or clerk of a parish council. Church parochial councils have been created by the Parochial Church Councils (Power) Measure 1921. The primary duty of the new church parochial council is to co-operate with the incumbent. It is a body corporate with perpetual succession. The powers of the vestry and church trustees have been mostly transferred to it, and it has power to levy a voluntary church rate.

Under the powers given by the Church Building Acts, and Acts for making new parishes, many populous parishes have been subdivided into smaller ecclesiastical parishes. This division has not affected the parish in its civil aspect. For purposes of civil government the term "parish" means a district for which a separate poor-rate is or can be made, or for which a separate overseer is or can be appointed; and by the Interpretation Act 1889 this definition is to be used in interpreting all statutes subsequent to 1866, except where the context is inconsistent therewith. The civil importance of the poor-law parishes may be dated from the introduction of the poor law by the statute of 43 Elizabeth, which directed overseers of the poor to be appointed in every parish, and made the churchwardens into *ex officio* overseers. The chief part of the parochial organization was the vestry-meeting. The vestry represented the old assembly of the township, and retained so much of its business as had not been insensibly transferred to the court-baron and court-leet. The freemen, now appearing as the ratepayers, elected the "parish officers," as the churchwardens and way-wardens, the assessors, the overseers, and (if required) paid assistant-overseers, a secretary or vestry-clerk, and a collector of rates if the guardians applied for his appointment. The Local Government Act 1894 restored the parish to its position as the unit of local government by establishing parish councils. (*See* UNITED KINGDOM.)

The Parish in Scotland.—There can be little doubt that about the beginning of the 13th century the whole, or almost the whole, of the kingdom of Scotland was divided into parishes. It seems probable that the bishops presided at the first formation of the parishes—the parish being a subdivision of the diocese—and down to the Reformation they exercised the power of creating new parishes. After the Reformation the power of altering parishes was assumed by the legislature. The existing parochial districts being found unsuited to the ecclesiastical requirements of the time, a general Act was passed in 1581, which made provision for the parochial clergy, and, *inter alia*, directed that "a sufficient and competent" district should be appropriated to each church as a parish (1581, cap. 100). Thereafter, by a series of special Acts in the first place, and, subsequent to the year 1617, by the decrees of parliamentary commissions, the creation of suitable parochial districts was proceeded with. In the year 1707 the powers exercised by the commissioners were permanently transferred to the Court of Session, whose judges were appointed to act in future as "commissioners for the Plantation of Kirks and Valuation of Teinds." Under this statute the areas of parishes continued to be altered and defined down to 1844, when the Act commonly known as Graham's Act was passed. This Act, which applied to the disjunction and erection of parishes, introduced a simpler procedure.

The main division of parishes in Scotland was into civil and ecclesiastical, or, to speak more accurately, into parishes proper (*i.e.*, for all purposes, civil and ecclesiastical) and ecclesiastical parishes. This division is expressed in legal language by the terms, parishes *quoad omnia* (i.e., *quoad civilia et sacra*) and parishes *quoad sacra*—*civilia* being such matters as church rates, education, poor law and sanitary purposes, and *sacra* being such as concern the administration of church ordinances, and fall under the cognizance of the church courts. There are other minor divisions. The Local Government (Scotland) Act 1894 reformed parish government. It established a local government board for Scotland, with a council in every parish, and abolished parochial boards.

The Parish in the United States.—The term "parish" is not in use as a territorial designation except in Louisiana, the 60 parishes of which correspond to the counties of the other States of the Union. In the American Episcopal Church the word is frequently used to denote an ecclesiastical district.

BIBLIOGRAPHY.—The principal records from which information may be gained as to the oldest parochial system in England are the records called *Nomina villarum*, the *Taxatio papae Nicholai* made in 1291, the *Nonarum inquisitiones* relating to assessments made upon the clergy, the *Valor ecclesiasticus* of Henry VIII., the lay subsidies from the reign of Edward III. to that of Charles II., the hearth-tax

assessments and the land-tax accounts. On the subject of the parish generally *see* J. Toulmin Smith, *The Parish* (1854), W. Stubbs, *Constitutional History* (1880); W. C. Glen, *Parish Law* (1881); J. Steer, *Parish Law* (1899), O. Reichel, *Rise of the Parochial System in England* (1905); S and B Webb, *English Local Government*, vol. i. (1906). For fuller information regarding the Scottish parish *see* J. Connell, *Tithes* (1815), *Parishes* (1818, 1820), J M Duncan, *Parochial Ecclesiastical Law* (1864), H Goudy and W. C. Smith, *Local Government in Scotland* (1880), Cobden club essays on *Local Government and Taxation in the United Kingdom* (1882), M. Atkinson, *Local Government in Scotland* (1904).

PARISH CLERK: *see* CLERK and PARISH.

PARISITE, a rare mineral, consisting of cerium, lanthanum, didymium and calcium fluo-carbonate $(CeF)_2Ca(CO_3)_3$ It is found only as crystals, which belong to the hexagonal system and usually have the form of acute double pyramids terminated by the basal planes; parallel to the basal plane there is a perfect cleavage The crystals are hair-brown in colour and are translucent. Light which has traversed a crystal of parisite exhibits a characteristic absorption spectrum. Until recently the only known occurrence of this mineral was in the famous emerald mine at Muzo in Colombia, South America, found by J. J. Paris, who rediscovered the mine. (L. J S.)

PARIS MÉTROPOLITAIN. The main line of the Métropolitain underground railway, crossing Paris practically from the east to the west (Porte de Vincennes to the Porte Maillot) was opened during the Exhibition, on July 19, 1900

Since then, work has not ceased and, at the present time, the system comprises ten lines affording 95 km 654 m. of working double track Further, 18 km are in course of construction and will be ready for use before 1931; finally, the extension to the suburbs of the existing lines and the opening up of new lines in the interior of Paris will comfortably complete the urban system of the Métropolitain railway

Since the Metropolitain has been working, the number of passengers who travel by it has augmented unceasingly The 1900 figure was 17,660,286 which increased to 702,471,969 in 1928, and the progress is continuing

As new lines were operated and rolling stock was renewed, the original trains of 4 carriages affording accommodation for about 200 seats, were replaced on the main lines of the system by 5-carriage trains with over 500 seats and following each other at intervals of between 1 min 35 sec to 3 min at the peak hours

Thus, 1,770 carriages enable the service to give 122,000 places (sitting room) at the peak hours.

The trains composed of three carriages with engines of two motors of 175 h p and two coaches of which one is first class, can reach the speed of 45 km per hr which may be said to correspond with an average commercial speed of 21–23 km per hr., according to the variance of the lines

The average inter-station distance is 493 m, the highest gradients are 40 mm per metre and the lowest are 50 m

The working of the signal system is almost perfect although each particular signal functions from 400 to 500 times a day The system adopted ensures every train being safeguarded by at least two stop signals

Ticket prices in 1900 were ofr 15 (2nd class) ofr 25 (1st class) and ofr 20 for a return. These prices are now increased to · 2nd class, ofr 60; 1st class, 1fr and the return ofr 70; this increase, a coefficient of 3 8, allows profits being realized however, which proves that in spite of the great increase in cost of material, the Métropolitain has been able to direct its system with very efficient managership (P MA)

PARIS UNIVERSITY. This university is also known as the Sorbonne, the name originally given to the college founded by Robert de Sorbon in Paris; hence applied afterwards popularly to the theological faculty, and so to the institution which is now the seat of the *académie* of that city For the early beginnings of the university, *see* UNIVERSITIES The Sorbonne itself was founded in Feb. 1256 (O S) and was originally one of the various colleges which formed part of the university, but it soon became a meeting-place for all the students of the University of Paris, who resorted thither to hear the lectures of the most learned theologians of the period—Guillaume de Saint Amour, Eudes de Douai, Laurent l'Anglais, Pierre d'Ailly. At the close of the century it was organized into a full faculty of theology, and under this definite form it conferred bachelors', licentiates' and doctors' degrees, and the severity of its examinations gave an exceptional value to its diplomas. The so-called "thèse sorbonique," instituted towards the beginning of the 14th century, became the type of its order by the length and difficulty of its tests. Ultimately the professors of the Sorbonne came to be resorted to for dogmatic decisions and judgments in canon law, the clergy of France and of the whole Catholic world had recourse to them in difficult cases, and the Curia Romana more than once laid its doubts before them To the Sorbonne belongs the glory of having introduced printing into France in 1470, within its precincts it assigned quarters for Ulric Gering and two companions in which to set up their presses The Sorbonne took a leading part in the religious discussions which agitated France during the 16th and 17th centuries, and its influence thus inevitably extended to political questions During the insanity of Charles VI it helped to bring about the absolution of Jean Sans-Peur for the assassination of the duke of Orleans Shortly afterwards it demanded and supported the condemnation of Joan of Arc, during the Reformation it was the animating spirit of all the persecutions directed against Protestants and unbelievers The declaration of the clergy in 1682, which it subscribed, ended its authority with the Curia Romana; it revived for a short time under Louis XV during the struggle against Jansenism, but this was its last exploit, it was suppressed like the old universities, in 1792

When the University of France was organized in 1808 (*see* UNIVERSITIES), the Sorbonne became the seat of the *académie* of Paris as well as of the university itself Between 1816 and 1821 the faculties of theology (since disappeared), science and literature were installed there The university library was transferred to the Sorbonne in 1823. In 1868 was organized the Ecole des Hautes Etudes, and in 1897 the Ecole des Chartes also found its home alongside of the Sorbonne, both being independent institutions, as are also the Collège de France, the Ecole Normale Supérieure, and the schools of oriental languages, fine-arts, decorative arts, scientific agriculture and the specialised schools for the training of Colonial administrators, civil engineers, army officers, etc.

In 1852 the Sorbonne was made the property of the city of Paris; a reconstruction of the buildings, projected by Napoleon III, was begun in 1885, under the direction of Nénot This new Sorbonne is one of the finest university edifices in the world In 1896 the higher education of France was decentralized, regional universities were created out of the existing isolated faculties, and the new University of Paris received its present constitution Since then, except for the World War period, it has gone forward under a series of able administrators, Louis Liard, Lucien Poincaré, Appel, Lepic and its present head, Charléty

Benefactions.—The system of benefactions inaugurated by Liard has resulted in the foundation of numerous chairs and institutes. Among the benefactors may be cited the prince of Monaco, the Marquise Arconati Visconti, Albert Kahn, David Weill, the city of Paris, Czechoslovakia Two of the most recent are the Sauberan benefaction of three successive millions of francs, and the gift of Leo Kahn of nearly 700 000 francs for a chair of American civilization

The influx of foreign students has been fostered by the creation of a university quarter A site was provided by mutual concessions of the State and the city of Paris on ground originally occupied by the fortifications, on which accommodation has been created for French students through the princely gift of E Deutsch de la Meurthe of 10 million francs This was followed by a gift by M. and Mme. Lapôtre of five millions for a Belgian hostel Other hostels in being or in course of construction are the Canadian, Argentine, Japanese, United States, British, Swedish Armenian, Indo-china, etc The total number of rooms, when completed, will be nearly 2,000, of which about 600 will be for French, 300 for British and 275 for United States students Ten other countries are contemplating the erection of national hostels A general assembly building with restaurants, library, etc, is being provided mainly by the generosity of J D. Rockefeller,

Jr. The British Institute comprises also a building next the Sorbonne which provides special coaching for English and French students and possesses a fine library of English books.

In 1900 the University of Paris contained 11,000 students, of whom 1,100 were foreigners. In 1928 the number was nearly 27,000 of whom about 6,500 were foreigners; male students numbered nearly 20,000. Of the above nearly 14,000 were enrolled, nearly 8,000 had matriculated, and over 4,500 had taken examinations in the year under review.

See Denifle, *Documents relatifs à la fondation de l'université de Paris* (1883); J. A. Randolph, *History of the Sorbonne; La Cité Universitaire de Paris* (Imprimerie Choix). (C. Br.)

PARK, MUNGO (1771–1806?), Scottish explorer of the Niger, was born in Selkirkshire, Scotland, on Sept. 20, 1771, at Foulshiels on the Yarrow. He was apprenticed to a surgeon, Thomas Anderson, and took his surgeon's diploma at Edinburgh. By his brother-in-law, James Dickson, he was introduced to Sir Joseph Banks, then president of the Royal Society, and through his good offices obtained the post of assistant-surgeon on board the "Worcester" East Indiaman. He made the voyage in 1792 to Benkulen, in Sumatra, and on his return in 1793 he contributed a description of eight new Sumatran fishes to the *Transactions* of the Linnean Society.

Park in 1794 offered his services to the African Association, then looking out for a successor to Major Daniel Houghton, who had been sent out in 1790 to explore the Niger. On June 21, 1795, he reached the Gambia and ascended that river 200m. to a British trading station named Pisania. On Dec. 2, he started for the unknown interior, crossing the upper Senegal basin and the semi-desert region of Kaarta. The journey was full of difficulties, and at Ludamar he was imprisoned by a Moorish chief for four months. He escaped, alone and with nothing save his horse and a pocket compass, on July 1, 1796, and on the 21st of the same month reached the long-sought Niger at Segu. He followed the river down stream 80m. to Silla, where he was obliged to turn back, being without means and utterly exhausted. On his return journey he took a route more to the south keeping close to the Niger as far as Bamako, tracing the course of that stream in all for some 300 miles. He reached Pisania again on June 10, 1797. An account of his journey was drawn up for the African Association by Bryan Edwards, and a detailed narrative from his own pen appeared in 1799 (*Travels in the Interior of Africa*). Abundance of incident and an unaffected style rendered the work extremely popular, and it still holds its place as an acknowledged classic in this department of literature.

Settling at Foulshiels, Park in August 1799 married a daughter of his old master, Thomas Anderson. In Oct. 1801 Park removed to Peebles, where he practised as a doctor. In the autumn of 1803 he was invited by the government to lead another expedition to the Niger. Park accepted the offer, but the starting of the expedition being delayed, part of the waiting time was occupied in the perfecting of his Arabic. In May 1804 Park went back to Foulshiels where he made the acquaintance of Sir Walter Scott, then living near by at Ashestiel. In September he was summoned to London to leave on the new expedition. Park had adopted the theory that the Niger and the Congo were one. He sailed from Portsmouth for the Gambia on January 31, 1805, having been given a captain's commission as head of the government expedition. Alexander Anderson, his brother-in-law, was second in command, and on him was bestowed a lieutenancy. George Scott, a fellow Borderer, was draughtsman, and the party included four or five artificers. At Goree (then in British occupation) Park was joined by Lieut. Martyn, R.A., thirty-five privates and two seamen. The expedition did not reach the Niger until the middle of August, when only eleven Europeans were left alive; the rest had succumbed to fever or dysentery. From Bamako the journey to Segu was made by canoe. Having received permission from the ruler of that town to proceed, at Sansandig, a little below Segu, Park prepared for his journey down the still unknown part of the river. He converted two canoes into one tolerably good boat, 40ft. long and 6ft. broad. This he christened H.M. schooner "Joliba" (the native name for the Niger), and in it, with the surviving members of his party, he set sail down stream on Nov. 19. At Sansandig on Oct. 28, Anderson had died, and in him Park lost the only member of the party—except Scott, already dead—who had been of real use. Those who embarked in the "Joliba" were Park, Martyn, three European soldiers (one mad), a guide and three slaves.

To his wife he wrote stating his intention not to stop nor land anywhere till he reached the coast, where he expected to arrive about the end of Jan. 1806. No more was heard of the party until reports of disaster reached the settlements on the Gambia. At length the British government engaged Isaaco to go to the Niger to ascertain the fate of the explorer. At Sansandig Isaaco found the guide who had gone down stream with Park, and the substantial accuracy of the story he told was later confirmed by the investigations of Hugh Clapperton and Richard Lander. This guide (Amadi) stated that Park's canoe descended the river to Yauri, where he (the guide) landed. In this long journey of about 1,000m. Park, who had plenty of provisions, stuck to his resolution of keeping aloof from the natives. At the Bussa rapids, not far below Yauri, the boat struck on a rock and remained fast. On the bank were gathered hostile natives, who attacked the party with bow and arrow and throwing spears. Their position being untenable, Park, Martyn and the two soldiers who still survived, sprang into the river and were drowned. The sole survivor was one of the slaves, from whom was obtained the story of the final scene. Isaaco, and later Lander, obtained some of Park's effects, but his journal was never recovered. In 1827 his second son, Thomas, landed on the Guinea coast, intending to make his way to Bussa, where he thought his father might be detained a prisoner, but after penetrating some little distance inland he died of fever. Park's widow died in 1840.

J. Thomson's *Mungo Park and the Niger* (London, 1890) contains the best critical estimate of the explorer and his work. *See* also the Life (by Wishaw) prefixed to *Journal of a Mission into the Interior of Africa in 1805* (London, 1815) and H. B., *Life of Mungo Park* (Edinburgh, 1835).

PARK: *see* Forest Law; Deer Park; Commons.

PARKER, ALTON BROOKS (1852–1926), American lawyer, was born at Cortland, N.Y., May 14, 1852. He graduated from the Albany Law School in 1873. Admitted to the bar, he began to practise at Kingston, N.Y., and in 1877 was elected surrogate of Ulster county. In 1885 he was appointed by the governor justice of the N.Y. supreme court to fill a vacancy, and the following year was regularly elected. He was appointed a member of the second division of the N.Y. court of appeals in 1889 and a member of the general term in 1893. In 1898 he was elected chief justice of the N.Y. court of appeals. In 1904 he resigned on being nominated by the Democrats for President, but he was defeated by Theodore Roosevelt. He then resumed the practice of law in New York city. In 1913 he was counsel for the managers of the impeachment of Governor Sulzer of New York. He died in New York city, May 10, 1926.

PARKER, SIR GILBERT (1862–), British novelist and politician, was born at Camden East, Addington, Ontario, on Nov. 23, 1862, the son of Captain J. Parker, R.A. He was educated at Ottawa and at Trinity university, Toronto. In 1886 he went to Australia, and became for a while associate-editor of the *Sydney Morning Herald*. He also travelled extensively in the Pacific and in northern Canada; and in the early '90s he made his name in London as a writer of romantic fiction. The best of his novels are those in which he first took for his subject the history and life of the French Canadians; and his permanent literary reputation rests on the fine quality, descriptive and dramatic, of his Canadian stories. *Pierre and his People* (1892) was followed by *Mrs. Falchion* (1893), *The Trail of the Sword* (1894), *When Valmond came to Pontiac* (1895), *An Adventurer of the North* (1895), and *The Seats of the Mighty* (1896, dramatized in 1897). *The Lane that had no Turning* (1900) contains some of his best work. In *The Battle of the Strong* (1898) he broke new ground, laying his scene in the Channel islands. Among his many later books is *Carnac's Folly* (1922). M.P. for Gravesend 1900 to 1918, he was a notable champion of imperialism. In 1902 he was made a knight, in 1915 a baronet, and in 1916 a privy councillor.

PARKER, HENRY TAYLOR (1867–), American music and dramatic critic, was born at Boston (Mass.) on April 29, 1867. Educated at Harvard, 1886–89, and in Europe, 1889–91, he was the New York correspondent of the Boston *Transcript* 1892–98 and again 1901–03, with the intermediate years as its London correspondent, when he made a special study of European theatres and opera houses. He was dramatic critic of the New York *Globe* to 1905, adding music criticism later, then rejoined the Boston *Transcript*. He published *Eighth Notes*, 1921.

PARKER, HORATIO WILLIAM (1863–1919), American composer and musician, was born at Auburndale, Mass., Sept. 15, 1863. He studied music first in Boston, later at the Royal Conservatoire, Munich. In 1894 he was appointed professor of the theory of music at Yale. His oratorio *Hora Novissima* was widely performed in America. It was also given in England in 1899 at Chester and at the "Three Choirs" festival at Worcester, the latter an honour never before paid an American composer. His opera *Mona* won the Metropolitan Opera Company's $10,000 prize in 1911, and in 1914 his opera *Fairyland* gained the National Federation of Women's Clubs' $10,000 prize. For the centenary celebration of the Handel and Haydn Society of Boston in 1915 he wrote the cantata *Morven and the Grail*.

His other works include the cantatas, *King Trojan* and *The Kobolds*, and the oratorios, *St. Christopher* and *A Wanderer's Psalm*. He died at Cedarhurst, Long Island, Dec. 18, 1919.

PARKER, SIR HYDE, Bart. (1739–1807), British admiral, second son of Sir Hyde Parker (1714–82), entered the navy at an early age, and became lieutenant in 1758. Five years later he became a post-captain, and from 1766 served in the West Indies and in North American waters, particularly distinguishing himself in breaking the defences of the North river (New York) in 1776. His services on this occasion earned him a knighthood in 1779. In 1778 he was engaged in the Savannah expedition, and in the following year his ship was wrecked on the hostile Cuban coast. His men, however, entrenched themselves, and were in the end brought off safely. Parker was with his father at the Dogger Bank, and with Howe in the two actions in the Straits of Gibraltar. In 1793, having just become rear-admiral, he served under Lord Hood at Toulon and in Corsica, and two years later, now a vice-admiral, he took part, under Hotham, in the indecisive fleet actions of March 13, and July 13, 1795. From 1796 to 1800 he was in command at Jamaica. In 1801 he was appointed to command the fleet destined to break up the northern armed neutrality, with Nelson as his second-in-command. Copenhagen fell on April 2 to the fierce attack of Nelson's squadron, Parker with the heavier ships taking little part. Subsequently Parker hesitated to advance up the Baltic after his victory, a decision which was severely criticised. Soon afterwards he was recalled and Nelson succeeded him. He died in 1807.

PARKER, JOSEPH (1830–1902), English Nonconformist divine, was born at Hexham-on-Tyne on April 9, 1830, his father being a stonemason. He managed to pick up a fair education, which in after-life he constantly supplemented. In the revolutionary years from 1845 to 1850 young Parker as a local preacher and temperance orator gained a reputation for vigorous utterance. He was influenced by Thomas Cooper, the Chartist, and Edward Miall, the Liberationist, and was much associated with Joseph Cowen, afterwards M.P. for Newcastle. In the spring of 1852 he wrote to Dr. John Campbell, minister of Whitefield Tabernacle, Moorfields, London, for advice as to entering the Congregational ministry, and after a short probation he became Campbell's assistant. He also attended lectures in logic and philosophy at University College, London. From 1853 to 1858 he was pastor at Banbury. His next charge was at Cavendish Street, Manchester, where he rapidly made himself felt as a power in English Nonconformity. While here he published a volume of lectures entitled *Church Questions*, and, anonymously, *Ecce Deus* (1868), a work provoked by Seeley's *Ecce Homo*. In 1869 he returned to London as minister of the Poultry church, founded by Thomas Goodwin. He then began the scheme which resulted in the erection of the great City Temple in Holborn Viaduct. It cost £70,000, and was opened on May 19, 1874. His original sermons, with their notable leaning towards the use of a racy vernacular, made him one of the best known personalities of his time. Dr. Parker was twice chairman of the London Congregational Board and twice of the Congregational Union of England and Wales. The death of his second wife in 1899 was a blow from which he never fully recovered, and he died on Nov. 29, 1902.

Parker's published works are mainly sermons and expositions, chief among them being *City Temple Sermons* (1869–70) and *The People's Bible*, in 25 vols. (1885–95). Other volumes include the autobiographical *Springdale Abbey* (1869), *The Inner Life of Christ* (1881), *Apostolic Life* (1884), *Tyne Chylde: My Life and Teaching* (1883; new ed., 1889), *A Preacher's Life* (1899).

See E. C. Pike, *Dr. Parker and his Friends* (1905); *Congregational Year-Book* (1904).

PARKER, MARTIN (*c.* 1600–*c.* 1656), English ballad writer, was probably a London tavern-keeper. About 1625 he seems to have begun publishing ballads, a large number of which bearing his signature or his initials, "M.P.," are preserved in the British Museum. Dryden considered him the best ballad writer of his time. Sympathy with the fortunes of Charles I. inspired the best known of his ballads, "When the King enjoys his own again" (1643), a favourite Jacobite song in the 18th century.

See *The Roxburghe Ballads*, vol. iii. (Ballad Soc., 9 vols., 1871–1899); Joseph Ritson, *Bibliographia Poetica* (1802); *Ancient Songs and Ballads from Henry II. to the Revolution*, ed. by W. C. Hazlitt (1877); Sir S. E. Brydges and J. Haslewood, *The British Bibliographer*, vol. ii. (1810); Thomas Corser, *Collectanea Anglo-poetica* (1860–83).

PARKER, MATTHEW (1504–1575), archbishop of Canterbury, was born at Norwich, on Aug. 6, 1504. Matthew was sent in 1522 to Corpus Christi college, Cambridge. He graduated B.A. in 1525, was ordained deacon in April and priest in June 1527, and was elected fellow of Corpus in the following September. He commenced M.A. in 1528, and was one of the Cambridge scholars whom Wolsey wished to transplant to his newly founded Cardinal College at Oxford. Parker, like Cranmer, declined the invitation. He had come under the influence of the Cambridge reformers, and after Anne Boleyn's recognition as queen he was made her chaplain. Through her he was appointed dean of the college of secular canons at Stoke-by-Clare in 1535. In 1537 he was appointed chaplain to Henry VIII., and in 1538 he was threatened with prosecution by the reactionary party. But in 1541 he was appointed to the second prebend in the reconstituted cathedral church of Ely. In 1544 on Henry VIII.'s recommendation he was elected master of Corpus Christi College, and in 1545 vice-chancellor of the university. He got into some trouble with the chancellor, Gardiner, over a ribald play, "Pammachius," performed by the students, deriding the old ecclesiastical system, though Bonner wrote to Parker of the assured affection he bore him. On the passing of the act of parliament in 1545, enabling the king to dissolve chantries and colleges, Parker was appointed one of the commissioners for Cambridge, and their report saved its colleges, if there had ever been any intention to destroy them. Stoke, however, was dissolved in the following reign, and Parker received a pension equivalent to £400 a year in modern currency. He took advantage of the new reign to marry in June, 1547, before clerical marriages had been legalized by parliament and convocation, Margaret, daughter of Robert Harlestone, a Norfolk squire. During Kett's rebellion he was allowed to preach in the rebels' camp on Mousehold Hill, but without much effect; and later he encouraged his chaplain, Alexander Neville, to write his history of the rising. His Protestantism advanced with the times, and he received higher promotion under Northumberland than under the moderate Somerset. Bucer was his friend at Cambridge, and he preached Bucer's funeral sermon in 1551. In 1552 he was promoted to the rich deanery of Lincoln, and in July 1553 he supped with Northumberland at Cambridge, when the duke marched north on his campaign against Mary.

As a supporter of Northumberland and a married man, Parker was naturally deprived of his preferments. But he was not cast in a heroic mould, and he had no desire to figure at the stake; he lived quietly in retirement throughout Mary's reign. He was elected archbishop of Canterbury on Aug. 1, 1559; but it was not until Dec. 17 that four bishops were found willing and qualified to

consecrate him. Parker's consecration was, however, only made legally valid by the royal supremacy; for the Edwardine Ordinal, which was used, had been repealed by Mary and not re-enacted by the parliament of 1559. Parker was a modest and moderate man of genuine piety and irreproachable morals. His historical research was exemplified in his *De antiquitate ecclesiae,* and his editions of Asser, Matthew Paris, Walsingham and the compiler known as Matthew of Westminster; his liturgical skill was shown in his version of the psalter and in the occasional prayers and thanksgivings which he was called upon to compose; and he left a priceless collection of manuscripts to his college at Cambridge.

He was happier in these pursuits than in the exercise of his jurisdiction. He was left to stem the rising tide of Puritan feeling with little support from parliament, convocation or the crown. The bishops' *Interpretations* and *Further Considerations,* issued in 1560, tolerated a lower vestiarian standard than was prescribed by the rubric of 1559; the *Advertisements,* which Parker published in 1566, to check the Puritan descent, had to appear without specific royal sanction; and the *Reformatio legum ecclesiasticarum,* which Foxe published with Parker's approval, received neither royal, parliamentary nor synodical authorization. Parker died on May 17, 1575, lamenting that Puritan ideas of "governance" would "undo the queen and all others that depended upon her."

John Strype's *Life of Parker,* originally published in 1711, and re-edited for the Clarendon Press in 1821 (3 vols.), is the principal source for Parker's life. *See* also J. Bass Mullinger's scholarly life in *Dict. Nat. Biog.;* W. H. Frere's volume in Stephens and Hunt's *Church History;* Strype's *Works* (General Index); Gough's Index to *Parker Soc. Publ.* Fuller, Burnet, Collier and R. W. Dixon's Histories of the Church; Birt's *Elizabethan Settlement;* H. Gee, *Elizabethan Clergy* (1898); W. M. Kennedy, *Archbishop Parker* (1908).

PARKER, THEODORE (1810–1860), American preacher and social reformer, was born at Lexington, Mass., on Aug. 24, 1810, the grandson of Capt. John Parker, leader of the minutemen in the skirmish at Lexington. From his mother he learned the religion of love and good works; from his father the use of good books; and his formal training he secured in the district school and one term at Lexington academy. At 17 he became a schoolmaster, and in his 20th year he entered himself at Harvard, working on his father's farm as usual while he followed his studies, and going over to Cambridge for the examinations only. For the theological course he resided at the college, graduating in 1836. At the close of his college career he began his translation (published in 1843) of Wilhelm M. L. De Wette's *Beiträge zur Einleitung in das Alte Testament.* He found himself extremely antagonistic to the popular theology of the period. He was ordained in West Roxbury, however, in 1837, and preached there until 1846. His rationalistic views were slow in assuming form; but on May 19, 1841, he preached at Boston a sermon on "the transient and permanent in Christianity," which presented in embryo the main principles and ideas of his final theological position. The Boston Unitarian clergy denounced him, and declared that the "young man must be silenced." Nevertheless, he delivered in the Masonic hall, in the winter of 1841–42, the lectures published as the *Discourse of Matters pertaining to Religion* (1842). Beginning in 1845 he preached to the Twenty-Eighth Congregational society of Boston. He took up the question of the emancipation of the slaves, and fearlessly advocated in Boston and elsewhere, from the platform and through correspondence and the press, the cause of the negroes. He assisted actively in the escape of fugitive slaves, and aided John Brown (*q.v.*). But his days were numbered. In Jan. 1859 he suffered a violent haemorrhage of the lungs, and vainly sought relief by retreating first to the West Indies and then to Europe. He died in Florence on May 10, 1860. A preacher rather than a thinker, a reformer rather than a philosopher, he spoke straight to men's intelligence and conscience and the goodness of their hearts.

Among his principal works are: *Ten Sermons of Religion* (1852) and *Theism, Atheism and the Popular Theology* (1853). A collected edition of his works was published in England by Frances P. Cobbe (1863–70), and another—the Centenary edition—in Boston, Mass., by the American Unitarian Association (1907–11); a volume of *Theodore Parker's Prayers,* edited by Rufus Leighton and Matilda Goddard, was published in 1861, and a volume of Parker's *West Roxbury Sermons,* with a biographical sketch by F. B. Sanborn, in 1892. A German translation of part of his works was made by Ziethen (Leipzig, 1854–57).

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PARKER OF WADDINGTON, ROBERT JOHN PARKER, BARON (1857–1918), English judge, was born at Claxby, Lincs., on Feb. 25, 1857, and educated at Westminster, Eton and King's College, Cambridge. In 1883 he was called to the bar, and built up an important connection, largely dealing with Government work. He was raised to the Bench in 1906. In 1913 he was made a lord of appeal with a life peerage. From 1916 until shortly before his death Lord Parker presided over the Prize Court branch of the Privy Council Judicial Committee. He died at Haslemere on July 12, 1918.

PARKERSBURG, a city of West Virginia, U.S.A., the county seat of Wood county; on the Ohio river, at the mouth of the Little Kanawha, about midway between Wheeling and Huntington. It is on Federal highways 21 and 50, and is served by the Baltimore and Ohio and the Little Kanawha railways and river steamers. Pop. 20,050 in 1920 (94% native white); estimated locally at 28,000 in 1928. It is pleasantly situated among low hills, at an altitude of about 600 feet. Oil, coal, natural gas and fireclay abound in the vicinity. Parkersburg has a large trade in petroleum and ship timber, and its manufactures (valued in 1925 at $19,565,391) include petroleum products, lumber, glass, steel, shovels and electrical porcelain. The city was founded in 1789 and incorporated in 1820.

PARKES, SIR HARRY SMITH (1828–1885), English diplomatist, son of Harry Parkes, founder of the firm of Parkes, Otway and Company, ironmasters, was born at Birchills Hall, near Walsall in Staffordshire, in 1828, and was educated at King Edward's school, Birmingham. In 1842 he received an appointment in the consular service, and accompanied Sir Henry Pottinger to Peking, and witnessed the signing of the treaty on board the "Cornwallis" in August 1842. By this treaty the five ports of Canton, Amoy, Fuchow, Ningpo and Shanghai were opened to trade. After short residences at Canton and the newly opened Amoy, Parkes was appointed to the consulate at Fuchow. Here he served under Rutherford Alcock. In 1849 he returned to England, returning to China in 1851. After a short stay at Amoy as interpreter he was transferred in the same capacity to Canton. In May 1854 he was promoted to be consul at Amoy, and in 1855 was chosen as secretary to the mission to Bangkok, being employed in negotiating the first European treaty with Siam.

In June 1856 he returned to Canton as acting consul, a position which brought him into contact with the obstinate Commissioner Yeh. When, in Oct. 1856, as a climax to many outrages, Yeh seized the British lorcha "Arrow" and made prisoners of her crew, Parkes at once closed with his enemy. In response to a strongly worded despatch from Parkes, Bowring, governor of Hong-Kong, placed matters in the hands of Admiral Sir M. Seymour, who took Canton at the close of the same month but had not a sufficient force to hold it. In December 1857 Canton was again bombarded by Seymour. Parkes, who was attached to the admiral's staff, was the first man to enter the city, and Parkes virtually governed this city of a million inhabitants for three years.

Meanwhile the treacherous attack at Taku upon Sir Frederick Bruce led to a renewal of hostilities in the north, and Parkes was ordered up to serve as interpreter and adviser to Lord Elgin (July, 1860). While arranging for a meeting between Lord Loch and the Chinese peace commissioners he, Mr. (afterwards Lord) Loch, Mr. de Norman, Lord Elgin's secretary of legation, Mr. Bowlby, the *Times* correspondent, and others, were

treacherously taken prisoners (Sept. 18, 1860) and incarcerated for some days. In revenge Lord Elgin burned down the Summer Palace of the emperor. Towards the end of 1860 Parkes returned to his post at Canton. On the restoration (Oct. 1861) of the city to the Chinese he returned to England on leave, and received the K.C.B.

On his return to China he served for a short time as consul at Shanghai, and was then appointed minister in Japan (1865). For eighteen years he held this post, using his influence in support of the Liberal party of Japan. So earnestly did he throw in his lot with these reformers that he became a marked man, and incurred the bitter hostility of the reactionaries, who on three separate occasions attempted to assassinate him. In 1882 he was transferred to Peking. He died on March 21, 1885.

The standard *Life* is by Stanley Lane-Poole (1894). (R. K. D.)

PARKES, SIR HENRY (1815–1896), Australian statesman, was born at Stoneleigh, in Warwickshire, on May 27, 1815. The son of parents in very humble circumstances, he received only a rudimentary education, and at an early age was obliged to earn his living as a common labourer. Failing to make his way in England, he emigrated to Australia in 1839, and after a time settled in Sydney as an ivory-turner. He took a prominent part in the movement against the transportation of convicts, and in 1849 started the *Empire* newspaper to inculcate his policy of attacking abuses while remaining loyal to the Crown. The paper appeared until 1858. One of the reforms for which Parkes fought most strenuously was the full introduction of responsible government. He was returned to the legislative council under the old constitution as member for Sydney, and on the establishment of a legislative assembly in 1856 was elected for East Sydney. He was elected for East Sydney again in 1859 at the first general election under the new electoral act, and sat till 1861, when he was sent to England to promote emigration.

He made a prolonged stay in England, and described his impressions in a series of letters to the *Sydney Morning Herald*, some of which were reprinted in 1869 under the title of *Australian Views of England*. He returned to Australia in 1863, and became colonial secretary from 1866 to 1868. He passed the Public Schools Act of 1866, which for the first time instituted an efficient system of primary education in the colony. His great chance came in 1872, when the Martin ministry resigned on the question of the sum payable by Victoria in lieu of border duties. Parkes had for several years persistently advocated free imports as a remedy for the financial distress of the colony. He now became prime minister and colonial secretary; and he threw the colony open to trade. He held office till 1875, and on the fall of the Robertson ministry again became premier and colonial secretary from March till Aug. 1877. At the end of this year he was made K.C.M.G. He formed a coalition with Sir John Robertson, and became premier and colonial secretary for the third time from Dec. 1878 to Jan. 1883. In 1887 he again took office as prime minister. His free trade policy was once more successful. Other important measures of his administration were the reform of the civil service, the prohibition of Chinese immigration, and the railways and public works acts. He fell from office in Jan. 1889, but in the following March became for the fifth time premier and colonial secretary. The remainder of his life was chiefly devoted to the question of Australian federation. The Federal Convention at Melbourne in 1890 was mainly his work; and he presided over the convention at Sydney in 1891, and was chiefly responsible for the draft constitution there carried. Defeated in Oct. 1891 on his refusal to accept an eight hours' day for coal-miners, he remained in opposition for the rest of his career. He died at Sydney on April 27, 1896. Parkes may justly be called the Father of the Australian Commonwealth.

He published, in addition to the works already named and numerous volumes of verse, a collection of speeches on the *Federal Government of Australia* (1890), and an autobiography, *Fifty Years in the making of Australian History* (1892). *See* also *Life of Sir H. Parkes*, C. E. Lyne (1897).

PARKMAN, FRANCIS (1823–1893), American historian, was born in Boston on Sept. 16, 1823. He was the son of Francis Parkman, a graduate of Harvard in 1807.

Francis Parkman was the eldest of six children. As a boy his health was delicate, so that it was thought best for him to spend much of his time at his grandfather Hall's home in Medford on the border of the Middlesex Fells, a rough and rocky woodland, which was as wild in many places as the primaeval forest. This breezy life saved him from the artificial stupidity which is too often superinduced in boys by their school training. At the age of 14 Parkman began to show a strong taste for literary composition. In 1841, while a student at Harvard, he made a rough journey of exploration in the woods of northern New Hampshire, and at this time he determined to write a history of the last French war in America, which ended in the conquest of Canada, and some time afterwards he enlarged the plan so as to include the whole course of the American conflict between France and Great Britain; or, to use his own words, "The history of the American forest; for this was the light in which I regarded it. My theme fascinated me, and I was haunted with wilderness images day and night." In the course of 1842 illness led to his making a journey to Italy. In 1844 he graduated at Harvard with high honours.

He now determined to study the real wilderness in its gloom and vastness. He had become an adept in woodcraft and a dead shot with the rifle, and could do such things with horses, tame or wild, as civilized people never see done except in a circus. In company with his friend and classmate, Quincy Shaw, he passed several months with the Ogillalah band of Sioux. Knowledge, intrepidity and tact carried Parkman through these experiences unscathed, and good luck kept him clear of encounters with hostile Indians. It was a very important experience in relation to his life-work.

But outdoor life did not suffice to recruit Parkman's health, and by 1848, when he began writing *The Conspiracy of Pontiac*, he had reached a truly pitiable condition. The trouble seems to have been some form of nervous exhaustion, accompanied with such hypersensitiveness of the eyes that it was impossible to keep them open except in a dark room. Against these difficulties he struggled with characteristic obstinacy. He invented a machine which so supported his hand that he could write legibly with closed eyes. Books and documents were read aloud to him, while notes were made by him with eyes shut, and were afterwards deciphered and read aloud to him till he had mastered them. After half an hour his strength would give out, and in these circumstances his rate of composition for a long time averaged scarcely six lines a day. The superb historical monograph composed under such difficulties was published in 1851. It had but a small sale, as the American public was then too ignorant to feel much interest in American history. But Parkman began his great work on *France and England in the New World*, to which the book just mentioned was in reality the sequel. This work involved several journeys to Europe, and was performed with a thoroughness approaching finality.

In 1865 the first volume appeared, with the title of *Pioneers of France in the New World;* 27 years elapsed before the final volumes came out in 1892. After the *Pioneers* the sequence is *The Jesuits in North America, La Salle and the Discovery of the Great West, the Old Régime in Canada, Frontenac and New France and Louis XIV., Montcalm and Wolfe, A Half Century of Conflict.* As one obstacle after another was surmounted, as one grand division of the work after another became an accomplished fact, the effect upon Parkman's condition seems to have been bracing, and he acquired fresh impetus as he approached the goal. His physical condition was much improved by his cultivating plants. He was an adept horticulturist and himself originated several new varieties of flowers. He was professor of horticulture in the agricultural school of Harvard in 1871–72, and published a few books on the subject of gardening. He died at Jamaica Plain Nov. 8, 1893.

The significance of Parkman's work consists partly in the success with which he has depicted the North American Indians. Parkman was the first great writer who really understood the Indian's character and motives. Against this savage background of the forest he shows the rise, progress and dramatic termination of the colossal struggle between France and Great Britain for

colonial empire. With all its instructiveness, his book is a narrative as entertaining as those of Macaulay or Froude. In judicial impartiality Parkman may be compared with Gardiner, and for accuracy of learning with Stubbs. (J. F.)

See G. H. Farnham, *Life of Francis Parkman* (Boston, 1900; 2nd ed., 1905); H. D. Sedgwick, *Francis Parkman* (Boston, 1904); H. C. Lodge, "Francis Parkman," *Mass. Hist. Soc. Proc.*, vol. lvi., pp. 319–335 (Boston, 1923); J. Russell, "What We Owe to Francis Parkman," *Dalhousie Review*, vol. iii., pp. 330–341 (Halifax, 1923); J. W. Oliver, "Francis Parkman," *Western Pa. Hist. Mag.*, vol. vii., pp. 1–9 (Pittsburgh, 1924).

PARLAKIMEDI, a town of British India, in Ganjam district of Madras. Pop. (1921) 18,719. It is the residence of a raja, claiming descent from the ancient kings of Orissa. The town is on a light railway connecting with Naupada.

PARLEMENT, in O.Fr. the name given to any meeting for discussion or debate (*parler*, to speak), a sense in which it was still used by Joinville, but from the latter half of the 13th century employed in France in a special sense to designate the sessions of the royal court (*curia regis*). Finally, when the parlement of Paris had become a permanent court of justice, having the supreme authority in cases brought before it, and especially in appeals against the sentences of the *baillis* and seneschals, it retained this name, which was also given to the other supreme courts of the same nature which were created after its model in the provinces.

Early Usage.—The early Capetians had a custom, based upon ancient precedents, of summoning periodically to their court their principal vassals and the prelates of their kingdom. These gatherings took place on the occasion of one of the great festivals of the year, in the town in which the king was then in residence. Here they deliberated upon political matters and the vassals and prelates gave the king their advice. But the monarch also gave judgment here in those cases which were brought before him. These were few in number during the early days of the Capetian dynasty; for though the king always maintained the principle that he was judge, and even that his competence in this respect was general and unlimited, this competence was at the same time undefined and it was not compulsory to submit cases to the king. At this period, too, appeals, strictly so called, did not exist. Nevertheless when a suit was brought before the king he judged it with the assistance of his prelates and vassals assembled around him, who formed his council. This was the *curia regis*. But in law the king was sole judge, the vassals and prelates being only advisers. During the 12th and at the beginning of the 13th centuries the *curia regis* continued to discharge these functions, except that its importance and actual competence continued to increase, and that we frequently find in it, in addition to the vassals and prelates who formed the council, *consiliarii*, who are evidently men whom the king had in his entourage, as his ordinary and professional councillors. Under the reign of St. Louis (which was also the period at which the name parlement began to be applied to these judicial sessions) the aspect of affairs changed. The judicial competence of the parlement developed and became more clearly defined; the system of appeals came into existence, and appeals against the judgments of the *baillis* and seneschals were brought before it; cases concerning the royal towns, the *bonnes villes*, were also decided by it. Again, in the old registers of the parlement at this period, the first *Olim* books, we see the names of the same councillors recurring from session to session. This suggests that a sufficient number of councillors was assured beforehand, and a list drawn up for each session; the vassals and prelates still figuring as a complementary body at the council.

Reforms.—Next came the series of ordinances regulating the tenure of the parlement, those of 1278, 1291, 1296 and 1308, and the institution was regularized. Not only were the persons who were to constitute each parlement named in advance, but those who were not placed on this list, even though vassals or prelates, were excluded from judging cases. The royal *baillis* had to attend the parlement, in order to answer for their judgments, and at an early date was fixed the order of the different *bailliages*, in which the cases coming from them were heard. The *baillis*, when not interested in the case, formed part of the council, but were afterwards excluded from it. Before the middle of the 14th century the personnel of the parlement, both presidents and councillors, became fixed *de facto* if not *de iure*. Every year a list was drawn up of those who were to hold the session, and although this list was annual, it contains the same names year after year; they are as yet, however, only annual commissaries (*commissaires*). In 1344 they became officials (*officiers*) fixed but not yet irremovable. At the same time the parlement had become permanent; the number of the sessions had diminished, but their length had increased. In the course of the 14th century it became the rule for the parlement to sit from Martinmas (Nov. 11) till the end of May; later the session was prolonged till the middle of August, the rest of the year forming the vacation. The parlement had also become fixed at Paris, and, by a development which goes back to fairly early times, the presidents and councillors, instead of being merely the king's advisers, had acquired certain powers, though these were conferred by the monarch; they were, in fact, true magistrates. The king held his court in person less and less often, and it pronounced its decrees in his absence; we even find him pleading his cause before it as plaintiff or defendant. In the 14th century, however, we still find the parlement referring delicate affairs to the king; but in the 15th century it had acquired a jurisdiction independent in principle. As to its composition, it continued to preserve one notable feature which recalled its origin. It had originally been an assembly of lay vassals and prelates; when its composition became fixed and consisted of councillor-magistrates, a certain number of these offices were necessarily occupied by laymen, and others by ecclesiastics, the *conseillers lais* and the *conseillers clercs*.

The parlement was at the same time the court of peers (*cour des pairs*). This had as its origin the old principle according to which every vassal had the right to be tried by his peers, *i.e.*, by the vassals holding fiefs from the same lord, who sat in judgment with that lord as their president. This, it is well known, resulted in the formation of the ancient college of the peers of France, which consisted of six laymen and six ecclesiastics. But although in strict logic the feudal causes concerning them should have been judged by them alone, they could not maintain this right in the *curia regis*; the other persons sitting in it could also take part in judging causes which concerned the peers. Finally the peers of France, the number of whom was increased in course of time by fresh royal creations of peerages, became *ex officio* members of the parlement; they were the hereditary councillors, taking the oath as official magistrates, and, if they wished, sitting and having a deliberative function in the parlement. In suits brought against them personally or involving the rights of their peerage they had the right of being judged by the parlement, the other peers being present, or having been duly summoned.

Divisions.—While maintaining its unity, the parlement had been subdivided into several *chambres* or sections. In the first place there was the *Grand Chambre*, which represented the primitive parlement. To it was reserved the judgment in certain important cases, and in it a peculiar procedure was followed, known as *oral*, though it admitted certain written documents. Even after the offices of the parlement had become legally saleable the councillors could only pass from the other chambers into the *grand chambre* by order of seniority. The *chambres des enquêtes* and *des requêtes* originated at the time when it became customary to draw up lists for each session of the parlement. The *enquêteurs* or *auditeurs* of the parlement had at first been an auxiliary staff of clerks to whom were entrusted the inquests ordered by the parlement. But later, when the institution of the appeal was fully developed, and the procedure before the various jurisdictions became a highly technical matter, above all when it admitted written evidence, the documents connected with other inquests also came before the parlement. A new form of appeal grew up side by side with the older form, which had been mainly an oral procedure, namely the appeal by writing (*appel par écrit*). In order to judge these new appeals the parlement had above all to study written documents, the inquests which had been made and written down under the jurisdiction of the court of first instance. The duty of the *enquêteurs* was to make an abstract of the written documents and report on them. Later the reporters (*rapporteurs*) were

admitted to judge these questions together with a certain number of members of the parlement, and from 1316 onwards these two kinds of members formed together a *chambre des enquêtes*. As yet, no doubt, the *rapporteur* only gave his opinion on the case which he had prepared, but after 1336 all those who formed part of the chamber were put on the same footing, taking it in turn to report and giving judgment as a whole. For a long time, however, the *grand chambre* received all cases, then sent them to the *chambre des enquêtes* with directions; before it too were argued questions arising out of the inquiry made by the *chambre des enquêtes* to the decisions of which it gave effect and which it had the power to revise. But one by one it lost all these rights, and in the 16th century they are no longer heard of. Several *chambres des enquêtes* were created after the first one, and it was they who had the greater part of the work.

The *chambre des requêtes* was of an entirely different nature. At the beginning of the 14th century a certain number of those who were to hold the session of the parlement were set apart to receive and judge the petitions (*requêtes*) on judicial questions which had been presented to the king and not yet dealt with. This eventually led to the formation of a chamber, in the strict sense of the word, the *requêtes du palais*. But this became purely a jurisdiction for privileged persons; before it (or before the *requêtes de l'hôtel*, as the case might be) were brought the civil suits of those who enjoyed the right of *committimus*. The *chambre des requêtes* had not supreme jurisdiction, but appeals from its decisions could be made to the parlement proper The parlement had also a criminal chamber, that of *La Tournelle*, which was not legally created until the 16th century, but was active long before then. It had no definite membership, but the *conseillers lais* served in it in turn.

Provincial Parlements.—Originally there was only one parlement, that of Paris, as was indeed logical, considering that the parlement was simply a continuation of the *curia regis*, which, like the king, could only be one. But the exigencies of the administration of justice led to the successive creation of a certain number of provincial parlements. Their creation, moreover, was generally dictated by political circumstances, after the incorporation of a province in the domain of the Crown. Sometimes it was a question of a province which, before its annexation, possessed a superior and sovereign jurisdiction of its own, and to which it was desired to preserve this advantage. Or else it might be a province forming part of feudal France, which before the annexation had had a superior jurisdiction from which the Crown had endeavoured to institute an appeal to the parlement of Paris, but for which after the annexation it was no longer necessary to maintain this appeal, so that the province might now be given a supreme court, a parlement. Sometimes an intermediate régime was set up between the annexation of the province and the creation of its provincial parlement, under which delegates from the parlement of Paris went and held assizes there. Thus were created successively the parlements of Toulouse, Grenoble, Bordeaux, Dijon, Rouen, Aix, Rennes, Pau, Metz, Douai, Besançon and Nancy. From 1762 to 1771 there was even a parlement for the principality of Dombes. The provincial parlements reproduced on a smaller scale the organization of that of Paris; but they did not combine the functions of a court of peers. They each claimed to possess equal powers within their own province. There were also great judicial bodies exercising the same functions as the parlements, though without bearing the name, such as the *Conseil souverain* of Alsace at Colmar, the *Conseil supérieur* of Roussillon at Perpignan; the provincial council of Artois had not the supreme jurisdiction in all respects.

The parlements, besides their judicial functions, also possessed political rights; they claimed a share in the higher policy of the realm, and the position of guardians of its fundamental laws. In general the laws did not come into effect within their province until they had been registered by the parlements. This was the method of promulgation admitted by the ancient law of France, but the parlements verified the laws before registering them, *i.e.*, they examined them to see whether they were in conformity with the principles of law and justice, and with the interests of the king and his subjects; if they considered that this was not the case they refused their registration and addressed remonstrances (*remontrances*) to the king. In acting thus they were merely conforming to the duty of counselling (*devoir de conseil*) which all the superior authorities had towards the king, and the text of the ordinances (*ordonnances*) had often invited them to do so. It was natural, however, that in the end the royal will should seek to impose itself. In order to enforce the registration of edicts the king would send *lettres de cachet*, known as *lettres de jussion*, which were not, however, always obeyed. Or he could come in person to hold the parlement, and have the law registered in his presence in a *lit de justice*. This was explained in theory by the principle that if the king himself held his court, it lost, by the fact of his presence, all the authority which he had delegated to it; for the moment the only authority existing in it was that of the king, just as in the ancient *curia regis* there was the principle that *apparente rege cessat magistratus*. But, principally in the 18th century, the parlements maintained that only a voluntary registration, by the consent of the parlement, was valid. The parlements had also a wide power of administration. They could make regulations (*pouvoir réglementaire*) having the force of law within their province, upon all points not settled by law, when the matter with which they dealt fell within their judicial competence, and for this it was only necessary that their interference in the matter was not forbidden by law. These were what were called *arrête de règlement*. By this means the parlements took part in the administration, except in matters the cognizance of which was attributed to another supreme court as that of taxation was to the *cours des aides*. They could also, within the same limits, address injunctions (*injonctions*) to officials and individuals.

See La Roche-Flavin, *Treize livres des parlements de France* (1617); Felix Aubert, *Histoire du parlement de Paris, des origines à François I.* (2 vols., 1894); Ch. V. Langlois, *Textes relatifs à l'histoire du parlement depuis les origines jusqu'en 1314* (1888); Guilhiermoz, *Enquêtes et procès* (1892); Glasson, *Le Parlement de Paris, son rôle politique depuis le règne de Charles VII. jusqu'à la révolution* (2 vols., 1901). (J. P. E.)

PARLIAMENT, the name given to the supreme legislature of the United Kingdom of Great Britain and Ireland. (For the old French *parlement*, *see* PARLEMENT; and for analogous foreign assemblies *see* the articles on the respective countries.) The word is found in English from the 13th century, first for a debate, then for a formal conference, and for the great councils of the Plantagenet kings; and the modern sense has come to be applied retrospectively. William the Conqueror is said in the Chronicle to have had "very deep speech with his Witan"; this "deep speech" (in Latin *colloquium*, in French *parlement*) was the distinguishing feature of a meeting between king and people, and thus gave its name to the national assembly itself. The Statute of Westminster (1275) first uses "parlement" of the great council in England.

The British parliament consists of the king (or queen regnant), the Lords spiritual and temporal, and the Commons; and it meets in two houses, the House of Lords (the Upper or Second chamber) and the House of Commons.

The Crown, pre-eminent in rank and dignity, is the legal source of parliamentary authority. The sovereign virtually appoints the lords spiritual, and all the peerages of the lords temporal have been created by the Crown. The king summons parliament to meet, and prescribes the time and place of its meeting, prorogues and dissolves it, and commands the issue of writs for the election of members of the House of Commons. By several statutes, beginning with the 4 Edward III. c. 14, the annual meeting of parliament had been ordained; but these statutes, continually disregarded, were virtually repealed in the reigns of Charles II. and William and Mary (16 Ch. II. 31; 6 and 7 Will. and Mary, 32). The present statute law merely exacts the meeting of parliament once in three years; but the annual voting of supplies has long since superseded obsolete statutes. When parliament is assembled it cannot proceed to business until the king has declared the causes of summons, in person or by commission; and though the veto of the Crown on legislation has long been obsolete, bills passed by the two houses only become law on receiving the royal assent.

The House of Lords is distinguished by peculiar dignities, priv-

ileges and jurisdictions. Peers individually enjoy the rank and precedence of their several dignities, and are hereditary councillors of the Crown. Collectively with the lords spiritual they form a permanent council of the Crown; and, when assembled in parliament, they form the highest court of judicature in the realm, and were, until the Parliament Act of 1911, a co-equal branch of the legislature, without whose consent no laws could be made. Their judicature is of various kinds, viz., for the trial of peers; for determining claims of peerage and offices of honour, under references from the Crown; for the trial of controverted elections of Scotch and Irish peers; for the final determination of appeals from courts in England and Scotland; and lastly, for the trial of impeachments.

The House of Commons also has its own peculiar privileges and jurisdictions. Above all, it has the paramount right of originating the imposition of all taxes, and the granting of supplies for the service of the State. It has also enjoyed, from early times, the right of determining all matters concerning the election of its own members, and their right to sit and vote in parliament. This right, however, has been greatly abridged, as, in 1868, the trial of controverted elections was transferred to the courts of law; but its jurisdiction in matters of election, not otherwise provided for by statute, is still retained intact. As part of this jurisdiction the house directs the Speaker to issue warrants to the clerk of the Crown to make out new writs for the election of members to fill up such vacancies as occur during the sitting of parliament.

Privileges of Parliament.—Both houses are in the enjoyment of certain privileges, designed to maintain their authority, independence and dignity. These privileges are founded mainly upon the law and custom of parliament, while some have been confirmed, and others abridged or abrogated by statute. The Lords rely entirely upon their inherent right, as having "a place and voice in parliament"; but, by a custom dating from the 6th Henry VIII., the Commons lay claim, by humble petition to the Crown at the commencement of every parliament, "to their ancient and undoubted rights and privileges." Each house has its separate rights and jurisdictions; but privileges properly so-called, being founded upon the law and custom of parliament, are common to both houses. Each house adjudges whether any breach of privilege has been committed, and punishes offenders by censure or commitment. This right of commitment is incontestably established, and it extends to the protection of officers of the house, lawfully and properly executing its orders, who are also empowered to call in the assistance of the civil power. The causes of such commitments cannot be enquired into by courts of law, unless it be manifest that the cause of commitment is other than for contempt (Lord Ellenborough in *Burdett* v. *Abbott,* 1811, 14 East at p. 150), nor can prisoners be admitted to bail. Breaches of privilege may be summarized as disobedience to any orders or rules of the house, indignities offered to its character or proceedings, assaults, insults or libels upon members, or interference with officers of the house in discharge of their duty, or tampering with witnesses. Such offences are dealt with as contempts, according to the circumstances of the respective cases, of which numerous precedents are to be found in the journals of both houses. The Lords may imprison for a fixed period, and impose fines; the Commons can only imprison generally, the commitment being concluded by the prorogation, and have long discontinued the imposition of fines.

Freedom of speech has been one of the most cherished privileges of parliament from early times. Constantly asserted, and often violated, it was finally declared by the Bill of Rights "that the freedom of speech, and debates and proceedings in parliament, ought not to be impeached or questioned in any court or place out of parliament." Such a privilege is essential to the independence of parliament, and to the protection of members in discharge of their duties. But, while it protects members from molestation elsewhere, it leaves them open to censure or other punishment by the house itself, whenever they abuse their privilege and transgress the rules of orderly debate.

Freedom from arrest is a privilege of the highest antiquity. It was formerly of extended scope, but has been reduced, by later legislation, within very narrow limits. Formerly not only the persons of members but their goods were protected, and their privilege extended to their servants. At present members are themselves free from arrest, but otherwise they are liable to all the processes of the courts. If arrested, they will be immediately discharged, upon motion in the court whence the process issued. Peers and peeresses are, by the privilege of peerage, free from arrest at all times. Members of the House of Commons are free only for 40 days after prorogation and 40 days before the next appointed meeting; but prorogations are so arranged as to ensure a continuance of the privilege. Formerly, even suits against members were stayed, but this offensive privilege has been abolished by statute. Exemption from attending as witnesses upon subpoena, once an acknowledged privilege, is no longer insisted upon; but immunity from service upon juries is at once an ancient privilege and a statutory right. The privilege of freedom from arrest is limited to civil causes, and has not been suffered to exempt members from the operation of the criminal law, nor even from commitments for contempt by other courts. But, whenever the freedom of a member is so interfered with, the courts are required immediately to inform the house of the causes of his commitment. Witnesses, suitors, counsel and agents in attendance upon parliament are protected from arrest and molestation, and from the consequences of statements made by them, or other proceedings in the conduct of their cases.

As both houses, in enforcing their privileges, are obliged to commit offenders or otherwise interfere with the liberty of the subject, the exercise of these privileges has naturally been called in question before the courts. Each house is the sole judge of its own privileges; but the courts are bound to administer the law, and, where law and privilege have seemed to be at variance, a conflict of jurisdiction has arisen between parliament and the courts. Many interesting controversies have arisen upon such occasions; but of late years privilege has been carefully restrained within the proper limits of the law, and the courts have amply recognized the authority of parliament.

Parliamentary Procedure.—On the day appointed by royal proclamation for the meeting of a new parliament both houses assemble in their respective chambers, when the Lords Commissioners for opening the parliament summons the Commons to the bar of the House of Lords, by the mouth of Black Rod, to hear the commission read. The lord chancellor states that, when the members of both houses shall be sworn, the king will declare the causes of his calling this parliament; and, it being necessary that a Speaker of the House of Commons shall be first chosen, the Commons are directed to proceed to the appointment of a Speaker, and to present him, on the following day, for His Majesty's royal approbation. The Commons at once withdraw to their own house and proceed to the election of their Speaker. The next day the Speaker-elect proceeds, with the house, to the House of Lords, and, on receiving the royal approbation, lays claim, in the accustomed form, on behalf of the Commons, "to their ancient and undoubted rights and privileges." The Speaker, now fully confirmed, returns to the House of Commons, and, after repeating his acknowledgments, reminds the house that the first thing to be done is to take and subscribe the oath required by law. Having first taken the oath himself, he is followed by other members, who come to the table to be sworn. The swearing of members in both houses proceeds from day to day, until the greater number have taken the oath, or affirmation, when the causes of summons are declared by His Majesty in person, or by commission, in "the king's speech." This speech being considered in both houses, an Address (*q.v.*) in answer is agreed to, which is presented to His Majesty by the whole house, or by "the lords with white staves" in one house and privy councillors in the other.

The debate on the Address being over, the real business of the session now commences: the committees of supply and ways and means are set up; bills are introduced; motions are made; committees are appointed; and both houses are, at once, in full activity. The lord chancellor presides over the deliberations of the Lords, and the Speaker over those of the Commons.

Members claim to be heard in debate by rising in their places. When more than one member rises at the same time, in the Lords the member who is to speak is called by the house, in the Com-

mons by the Speaker. Every member, when called, is bound to speak to the question before the house; and calls to order are very frequent. A member may speak once only to any question, except to explain, or upon a point of order, or to reply when a member has himself submitted a motion to the house, or when an amendment has been moved which constitutes a new question. He may not refer to past debates, nor to debates in the other house; nor may he refer to any other member by name, or use offensive and disorderly language against the king, either House of parliament, or other members. Members offending against any of the rules of debate are called to order by the Speaker, or the attention of the chair is directed to the breach of order by another member.

At the conclusion of a debate, unless the motion be withdrawn, or the question (on being put from the chair) be agreed to or negatived, the house proceeds to a division, which effects the twofold purpose of ascertaining the numbers supporting and opposing the question, and of recording the names of members voting on either side. On each side of the house is a division lobby; and in the Lords the "contents" and in the Commons the "ayes" are directed to go to the right, and the "not contents" or "noes" to the left. In case of an equality of numbers, in the Lords the question is negatived in virtue of the ancient rule "semper praesumitur pro negante"; in the Commons the Speaker gives the casting vote. (*See* also PARLIAMENTARY PROCEDURE; SPEAKER.)

Committees.—For the sake of convenience in the transaction of business there are several kinds of committees. Of these the most important is a committee of the whole house. In this committee are discussed the several provisions of bills, resolutions and other matters requiring the consideration of details. In the Lords the chair is taken by the chairman of committees; and in the Commons by the chairman of the committee of ways and means.

In the House of Commons there are now six grand committees. They were founded upon the valuable principle of a distribution of labours among several bodies of members.

In select committees both houses find the means of delegating inquiries, and the consideration of other matters, which could not be undertaken by the whole house. The reports of such committees have formed the groundwork of many important measures; and bills are often referred to them which receive a fuller examination than could be expected in a committee of the whole house. Power is given to such committees, when required, to send for persons, papers and records. In the Lords the power of examining witnesses upon oath has always been exercised, but it was not until 1871 that the same power was extended to the Commons, by statute.

Communications Between the Two Houses, etc.—In the course of the proceedings of parliament, frequent communications between the two houses become necessary. Of these the most usual and convenient form is that of a message. Formerly the Lords sent a message by two judges or two masters in chancery, and the Commons by a deputation of their own members; but since 1855 messages have been taken from one house to the other by one of the clerks at the table. A more formal communication is effected by a conference, in reference to amendments to bills or other matters; but this proceeding has been in great measure superseded by the more simple form of a message. The two houses are also occasionally brought into communication by means of joint committees and of select committees communicating with each other.

Communications, in various forms, are also conducted between the Crown and both houses of parliament. Of these the most important are those in which the king, in person or by commission, is present in the House of Lords to open or prorogue parliament, or to give the royal assent to bills. His Majesty is then in direct communication with the three estates of the realm, assembled in the same chamber. The king also sends messages to both houses under the royal sign manual, when all the members are uncovered. Verbal messages are also sent, and the king's pleasure, or royal recommendation or consent to bills or other matters, signified through a minister of the Crown or a privy councillor. Messages under the sign manual are acknowledged by addresses, except where grants of money are proposed, in which case no address is presented by the Commons, who acknowledge them by making provision accordingly.

Both houses approach the Crown, sometimes by joint addresses, but usually by separate addresses from each house. Such addresses are presented to His Majesty, either by the whole house, or by the lords with white staves in one house and by privy councillors in the other. His Majesty answers, in person, addresses presented by the whole house; but, when presented otherwise, an answer is brought by one of the lords with white staves, or by one of the privy councillors, by whom the address has been presented. Resolutions of either house are also sometimes directed to be laid before His Majesty; and messages of congratulation or condolence are sent to other members of the royal family.

The Passing of Public Bills.—The passing of bills forms the most considerable part of the business of parliament; for an account of the methods of procedure reference should be made to the article PARLIAMENTARY PROCEDURE. But the privileges of the Commons, in regard to supply and taxation, require that all bills imposing a charge upon the people should originate in that house. On the other hand, the Lords claim that bills for restoration of honours or in blood, or relating to their own privileges and jurisdiction, should commence in their house. An act of grace, or general pardon, originates with the Crown, and is read once only in both houses.

Both houses are approached by the people by means of petitions, of which prodigious numbers are presented to the House of Commons every session. They are referred to the committee on public petitions, under whose directions they are classified, analysed, and the number of signatures counted; and, when necessary, the petitions are printed *in extenso*.

Other Functions.—The exclusive right of the Commons to grant supplies, and to originate all measures of taxation, imposes a very onerous service upon that house. This is mainly performed by two committees of the whole house—the committee of supply, and the committee of ways and means. The former deals with all the estimates for the public service presented to the house by command of His Majesty; and the latter votes out of the Consolidated Fund such sums as are necessary to meet the supplies already granted, and originates all taxes for the service of the year. It is here that the annual financial statement of the chancellor of the exchequer, commonly known as "the Budget," is delivered. The resolutions of these committees are reported to the house, and, when agreed to, form the foundation of bills, to be passed by both houses, and submitted for the royal assent; and towards the close of the session an Appropriation Act is passed, applying all the grants for the service of the year.

Whenever a vacancy occurs during the continuance of a parliament, a warrant for a new writ is issued by the Speaker, by order of the house during the session, and in pursuance of statutes during the recess. The causes of vacancies are the death of a member, his being called to the House of Peers, his acceptance of an office from the Crown, his bankruptcy, or a resolution for his expulsion, a matter which is absolutely within the jurisdiction of the House. When any doubt arises as to the issue of a writ, it is usual to appoint a committee to inquire into the circumstances of the case; and during the recess the Speaker may reserve doubtful cases for the determination of the house.

Controverted elections had been originally tried by select committees, afterwards by the committee of privileges and elections, and ultimately by the whole house, with scandalous partiality, but under the Grenville Act of 1770, and other later Acts, by select committees, so constituted as to form a more or less judicial tribunal. At length, in 1868, the trial of election petitions was transferred to judges of the superior courts, to whose determination the house gives effect, by the issue of new writs or otherwise. The house, however, still retains and exercises its jurisdiction in all cases not relegated, by statute, to the judges.

Other forms of parliamentary judicature still remain to be mentioned. Upon impeachments by the Commons, the Lords exercise the highest criminal judicature known to the law; but the occasions upon which it has been brought into action have

been very rare in modern times. Another judicature is that of the trial of peers by the House of Lords. And, lastly, by a bill of attainder, the entire parliament may be called to sit in judgment upon offenders.

One other important function of parliament remains to be noticed—that of private bill legislation. Here the duties of parliament are partly legislative and partly judicial. Public interests are promoted, and private rights secured. This whole jurisdiction has been regulated by special standing orders, and by elaborate arrangements for the nomination of capable and impartial committees. A prodigious legislative work has been accomplished—but under conditions most costly to the promoters and opponents of private bills, and involving a serious addition to the onerous labours of members of parliament.

HISTORY OF THE BRITISH PARLIAMENT

The shire-moot was also the general folk-moot of the tribe, assembled in arms, to whom their leaders referred the decision of questions of peace and war.

The origin of parliament may be sought in the assemblies of the Anglo-Saxons known as the "folk-moot" or tribal assembly and in the "shire-moot" or assembly of the freemen of the shire. Superior to these local institutions was the witenagemót, or assembly of wise men, with whom the king took counsel in legislation and the government of the State This national council has sometimes been regarded as the origin of parliament but to describe it as such is an unhistorical anticipation of modern usage. Its character has been the subject of much antiquarian investigation, notably by Stubbs and Liebermann It must never be forgotten that in these early times, and indeed long after, the making of new laws is as abhorrent as it is rare The cry of the nation, so often expressed in the charters, is not for making of of new law but for the preservation of old ones, while the levying of taxes is almost unknown except for purposes of national defence. Such a council was originally held in each of the kingdoms commonly known as the Heptarchy; and after their union in a single realm, under King Edgar, the witenagemót became the national assembly. The witenagemót concluded treaties, advised the king as to the disposal of public lands and the appointment and removal of officers of State, and even assumed to elect and depose the king himself. The king had now attained to greater power, and more royal dignities and prerogatives. He was unquestionably the chief power in the witenagemót; but the laws were already promulgated, as in later times, as having been agreed to with the advice and consent of the witan. The witan also exercised jurisdiction as a supreme court. These ancient customs present further examples of the continuity of English constitutional forms.

The constitution of the witenagemót, however, was necessarily less popular than that of the local moots in the hundred or the shire. The king himself was generally present; and at his summons came prelates, abbots, ealdormen, the king's gesiths and thegns, officers of State and of the royal household, and leading tenants in chief of lands held from the Crown Crowds sometimes attended the meetings of the witan, and shouted their acclamations of approval or dissent; and, so far, the popular voice was associated with its deliberations; but it was at a distance from all but the inhabitants of the place in which it was assembled, and until a system of representation (*q v*) had slowly grown up there could be no further admission of the people to its deliberations.

The Norman Conquest.—The Anglo-Saxon polity was suddenly overthrown by the Norman Conquest A stern foreign king had seized the crown, and was prepared to rule his conquered realm by the sword. He brought with him the absolutist principles of Continental rulers, and the advanced feudal system of France and Normandy. Feudalism had been slowly gaining ground under the Saxon kings, and now it was firmly established as a military organization. William the Conqueror at once rewarded his warlike barons and followers with enormous grants of land. The Saxon landowners and peasants were despoiled, and the invaders settled in their homesteads. The king claimed the broad lands of England as his own, by right of conquest; and when he allowed his warriors to share the spoil he attached the strict condition of military service in return for every grant of land. An effective army of occupation of all ranks was thus quartered upon every province throughout the realm. England was held by the sword; a foreign king, foreign nobles, and a foreign soldiery were in possession of the soil, and swore fealty to their master, from whom they held it. Saxon bishops were deposed, and foreign prelates appointed to rule over the English Church. Instead of calling a national witenagemót, the king took counsel with the officers of his State and household, the bishops, abbots, earls, barons and knights by whom he was pleased to surround himself. Some of the forms of a national council were indeed maintained but the witenagemót was now transformed into a "common council" of tenants-in-chief. It was thus a purely feudal assembly.

In spite of the immense constitutional prestige enjoyed by Magna Carta, that historical document played little or no part in the development of parliament. It was there ordained that no scutage or aid, except the three regular feudal aids, should be imposed, save by the common council of the realm. To this council the archbishops, bishops, abbots, earls and greater barons were to be summoned personally by the king's letters, and the lesser tenants in chief by a general writ through the sheriff. The summons was required to appoint a certain place, to give 40 days' notice at least, and to state the cause of meeting.

This council was in no sense a modern parliament nor was it intended to be. Magna Carta has been truly described as "a very feudal document," how feudal McKechnie has forcibly shown in his standard commentary. By these clauses the tenants-in-chief protected themselves from arbitrary taxation by the Crown without their "common counsel," but they did not thereby preclude themselves from taxing their own mesne tenants. It is only when later kings begin, of their own initiative, to summon representatives of the shires and boroughs to attend meetings of the common council to grant a tax that the "Commons" come into existence. And there can be no doubt that Maitland is right when he traces the origin of the "Commons," and the principle of representation which their summons implied, to the adaptation of the pre-existing institution of the jury to that purpose. Originating as a fiscal instrument for valuation of land, as in Domesday Book, or for assessment to the first tax on personalty, as in the case of the Saladin tithe, the jury was extended to the "presentment" of crimes by Henry II. and, as such, it represented the township, the borough and the "hundred" in the "county court." It was originally elected and from this it was but a step to summoning elected representatives of the counties and boroughs to Westminster

But it must be remembered that the idea that the consent of the local communities or "communes" of county and borough to taxation is necessary is of very late growth. The juries of neighbours who were summoned to assess the people under the Saladin tithe were assessing a tax to which their consent was neither asked nor required. A definite departure was made when, in 1265, Simon de Montfort, the leader of the revolt against Henry III, summoned to Lewes a national assembly which was distinctive in that writs were issued not only to the knights of the shire, who had occasionally been summoned before, but to representatives of the boroughs. It was a revolutionary assembly but none the less it established a precedent.

The transition period between Simon de Montfort's parliament of 1265 and the "model parliament" of 1295 was long a puzzle to historical students, since, except for two provincial councils in 1283, no traces were found in the records, between 1265 and 1295, of the representation of cities or boroughs, or of representation of the counties between 1275 and 1290. But in 1910 C. Hilary Jenkinson (see *English Historical Review*, for April) found in the Record Office some old documents which proved to be fragments of three writs and of returns of members for the Easter parliament of 1275. They make it certain that knights of the shire were then present, and that burgesses and citizens were summoned (not as in 1265 through the mayors, but as since 1295 through the sheriffs). The importance of the 1295 parlia-

ment thus appears to be smaller in English constitutional history, the full reforms appearing to have been adopted 20 years earlier. It is noteworthy, however, that in the writs of 1275 the instruction to the sheriff is "venire facias," not "elegi facias."

In 1295 these precedents were followed with a parliament summoned by Edward I. which was long regarded as the first "model parliament." But as an institution it had yet to make its footing good as the exclusive authority on taxation. In legislation it was long subject to competition by the king's council and by the "Great Council." (*See* Privy Council.) The "Great Council" continued to be summoned not infrequently without the issue of writs to the Commons, and this is the test applied in peerage cases to determine whether the descendant of a baron summoned to a national assembly has made out his claim to be a "lord of parliament." (*See* the *St. John Barony* case, 1915, A.C. 305, where it was held that a national assembly of 1290 was not a parliament, in spite of its having passed the "Statute" of *Quia Emptores,* because the Commons were not summoned.)

Secession of the Clergy.—It formed part of Edward's policy to include the clergy in his scheme for the representation of all orders and classes of his subjects. They were summoned to attend the parliament of 1295 and succeeding parliaments of his reign, and their form of summons has been continued until the present time; but the clergy resolutely held aloof from the national council, and insisted upon voting their subsidies in their own convocations of Canterbury and York. The bishops retained their high place among the earls and barons, but the clergy sacrificed to ecclesiastical jealousies the privilege of sharing in the political councils of the State. As yet, indeed, this privilege seemed little more than the voting of subsidies, but it was soon to embrace the redress of grievances and the framing of laws for the general welfare of the realm. By the 17th century the clergy definitely lost their power of separate taxation and were included in the grant made by the Commons (1664).

Meanwhile the Commons, unconscious of their future power, took their humble place in the great council of the realm. The knights of the shire, as lesser barons, or landowners of good social standing, could sit beside the magnates of the land without constraint; but modest traders from the towns were overawed by the power and dignity of their new associates. They knew that they were summoned for no other purpose than the taxing of themselves and their fellow townsmen; their attendance was irksome; it interrupted their own business; and their journeys exposed them to many hardships and dangers. It is not surprising that they should have shrunk from the exercise of so doubtful a privilege. Considerable numbers absented themselves from a thankless service; and their constituents, far from exacting the attendance of their members, as in modern times, begrudged the sorry stipend of 2s. a day, paid to their representatives while on duty, and strove to evade the burden imposed upon them by the Crown. Some even purchased charters, withdrawing franchises which they had not yet learned to value. Nor, in truth, did the representation of towns at this period afford much protection to the rights and interests of the people. Towns were enfranchised at the will or caprice of the Crown and the sheriffs; they could be excluded at pleasure; and the least show of independence would be followed by the omission of another writ of summons. But the principle of representation (*q.v.*), once established, was to be developed with the expansion of society; and the despised burgesses of Edward I., not having seceded, like the clergy, were destined to become a potential class in the parliaments of England. Eventually, in 1624, the principle that once a writ had been issued to a borough to send representatives to parliament, and obeyed, it could no longer be withheld was established and thereby the independence of the Commons was secured. The Crown, however, retained the prerogative to incorporate new boroughs with parliamentary representation and thus, in days when there was no such thing, except in the case of the counties, as a common franchise, the Crown could by the charter of incorporation create what franchise for the borough it pleased. The Tudors made free use of this prerogative to "pack" the Commons, but in the reign of Charles II. it fell wholly into desuetude.

Another constitutional change during the reign of Edward I. was the summoning of parliament to Westminster instead of to various towns in different parts of the country. This custom invested parliament with the character of a settled institution, and constituted it a high court for the hearing of petitions and the redress of grievances. The growth of its judicature, as a court of appeal, was also favoured by the fixity of its place of meeting.

Authority of Parliament Recognized by Law.—Great was the power of the Crown, and the king himself was bold and statesmanlike; but the union of classes against him proved too strong for prerogative. In 1297, having outraged the church, the barons, and the Commons, by illegal exactions, he was forced to confirm the Great Charter and the Charter of Forests, with further securities against the taxation of the people without their consent and, in return, obtained timely subsidies from the parliament. Henceforth the financial necessities of a succession of kings ensured the frequent assembling of parliaments. Nor were they long contented with the humble function of voting subsidies, but boldly insisted on the redress of grievances and further securities for national liberties. In 1322 it was declared by statute 15 Edw. II. that "the matters to be established for the estate of the king and of his heirs, and for the estate of the realm and of the people, should be treated, accorded, and established in parliament, by the king, and by the assent of the prelates, earls and barons, and the commonalty of the realm, according as had been before accustomed." The constitutional powers of parliament as a legislature were here amply recognized —not by royal charter, or by the occasional exercise of prerogative, but by an authoritative statute. And these powers were soon to be exercised in a striking form. Already parliament had established the principle that the redress of grievances should have precedence of the grant of subsidies; it had maintained the right of approving councillors of the Crown, and punishing them for the abuse of their powers; and in 1327 the king himself was finally deposed, and the succession of his son, Edward III., declared by parliament.

At this period the constitution of parliament was also settling down to its later and permanent shape. Hitherto the different orders or estates had deliberated separately, and agreed upon their several grants to the Crown. The knights of the shire were naturally drawn, by social ties and class interests, into alliance with the barons; but at length they joined the citizens and burgesses, and in the first parliament of Edward III. they are found sitting together as "the Commons." This may be taken as the turning point in the political history of England. If all the landowners of the country had become united as an order of nobles, they might have proved too strong for the development of national liberties, while the union of the country gentlemen with the burgesses formed an estate of the realm which was destined to prevail over all other powers. The withdrawal of the clergy, who would probably have been led by the bishops to take part with themselves and the barons, further strengthened the united Commons.

The reign of Edward III. witnessed further advances in the authority of parliament, and changes in its constitution. The king, being in continual need of subsidies, was forced to summon parliament every year, and in order to encourage its liberality he frequently sought its advice upon the most important issues of peace or war, and readily entertained the petitions of the Commons praying for the redress of grievances. During this reign also, the advice and consent of the Commons, as well as of the Lords spiritual and temporal, was regularly recorded in the enacting part of every statute.

Separation of the Two Houses.—But a more important event is to be assigned to this reign,—the formal separation of parliament into the two houses of Lords and Commons. There is no evidence—nor is it probable—that the different estates ever voted together as a single assembly. It appears from the rolls of parliament that in the early part of this reign, the causes of summons having been declared to the assembled estates, the three estates deliberated separately, but afterwards delivered a

collective answer to the king. While their deliberations were short they could be conducted apart, in the same chamber; but, in course of time, it was found convenient for the Commons to have a chamber of their own, and they adjourned their sittings to the chapter-house of the abbot of Westminster, where they continued to be held after the more formal and permanent separation had taken place. The date of this event is generally assigned to the 17th Edward III.

Parliament had now assumed its present outward form. But it was far from enjoying the authority which it acquired in later times. The Crown was still paramount; the small body of earls and barons—not exceeding 40—were connected with the royal family, or in the service of the king, or under his influence; the prelates, once distinguished by their independence, were now seekers of royal favour; and the Commons, though often able to extort concessions in return for their contributions to the royal exchequer, as yet held an inferior position among the estates of the realm. Instead of enjoying an equal share in the framing of laws, they appeared before the king in the humble guise of petitioners. Their petitions, together with the king's answers, were recorded in the rolls of parliament, but it was not until the parliament had been discharged from attendance that statutes were framed by the judges and entered on the statute rolls Under such conditions legislation was, in truth, the prerogative of the Crown rather than of parliament. Enactments were often found in the statutes at variance with the petitions and royal answers, and neither prayed for by the Commons nor assented to by the Lords. In vain the Commons protested against so grave an abuse of royal authority; but the same practice was continued during this and succeeding reigns Henry V, in the second year of his reign, promised "that nothing should be enacted to the petitions of the Commons, contrary to their asking, whereby they should be bound without their assent"; but, so long as the old method of framing laws was adhered to, there could be no security against abuse; and it was not until the reign of Henry VI. that the introduction of the more regular system of legislating by bill and statute ensured the thorough agreement of all the estates in the several provisions of every statute.

The Commons, however, notwithstanding these and other discouragements, were constantly growing bolder in the assertion of their rights. In 1377 the demands of a former parliament were reiterated with greater boldness and persistence, the evil councillors of the late reign were driven out, and it was conceded that the principal officers of State should be appointed and removed, during the minority of Richard II, upon the advice of the lords. The Commons also insisted upon the annual assembling of parliament, under the stringent provisions of a binding law. They claimed the right, not only of voting subsidies, but of appropriating them, and of examining public accounts. They inquired into public abuses, and impeached ministers of the Crown Even the king himself was deposed by the parliament Thus during this reign all the great powers of parliament were asserted and exercised. The foreign wars of Henry IV. and Henry V., by continuing the financial necessities of the Crown, maintained for a while the powers which parliament had acquired.

Relapse of Parliamentary Influence.—But a period of civil wars and disputed successions was now at hand, which checked the further development of parliamentary liberties. With the close of the Wars of the Roses the life of parliament seems to have well-nigh expired.

To this constitutional relapse various causes contributed at the same period. The Crown had recovered its absolute supremacy. The powerful baronage had been decimated on the battlefield and the scaffold; and vast estates had been confiscated to the Crown. The Commons had lost the liberal franchises of an early age. All freeholders, or suitors present at the county court, were formerly entitled to vote for a knight of the shire; but in the eighth year of Henry VI. (1430) an Act was passed (c. 37) by which this right was confined to 40s. freeholders, resident in the county. Large numbers of electors were thus disfranchised.

As for the cities and boroughs, they had virtually renounced their electoral privileges. As we have seen, they had never valued them very highly; and now by royal charters, or by the usurpation of small self-elected bodies of burgesses, the choice of members had fallen into the hands of town councils and neighbouring landowners. The anomalous system of close and nomination boroughs, which had arisen thus early in English history, was suffered to continue without a check for four centuries, as a notorious blot upon a free constitution. None the less during the period of what Stubbs called the "Lancastrian experiment" there was a marked, though premature, period of parliamentary ascendancy, due, no doubt, to the fact that the Lancastrian kings themselves reigned under a parliamentary title The Commons frequently asserted, and made good, a claim that the king's councillors should be named in parliament, although they were very far from asserting the modern principle of "responsible government."

The Three Estates of the Realm.—This check in the fortunes of parliament affords a fitting occasion for examining the composition of each of the three estates of the realm. The archbishops and bishops had held an eminent position in the councils of Saxon and Norman kings, and many priors and abbots were from time to time associated with them as lords spiritual, until the suppression of the monasteries by Henry VIII. They generally outnumbered their brethren, the temporal peers, who sat with them in the same assembly The king can create new bishoprics by Order in Council but his power to summon them to parliament is now limited by the Act of 1878 which limits the number of Lords Spiritual to 26.

The lords temporal comprised several dignities. Of these the baron, though now the lowest in rank, was the most ancient. The title was familiar in Saxon times, but it was not until after the Norman Conquest that it was invested with a distinct feudal dignity. Next in antiquity was the earl, whose official title was known to Danes and Saxons, and who after the Conquest obtained a dignity equivalent to that of count in foreign States. The highest dignity, that of duke, was not created until Edward III conferred it upon his son, Edward the Black Prince. The rank of marquess was first created by Richard II, with precedence after a duke. It was in the reign of Henry VI. that the rank of viscount was created, to be placed between the earl and the baron. Thus the peerage consisted of five dignities of duke, marquess, earl, viscount and baron. During the 15th century the number of temporal peers summoned to parliament rarely exceeded 50, and no more than 29 received writs of summons to the first parliament of Henry VII There were only 59 at the death of Queen Elizabeth At the accession of William III. this number had been increased to about 150. The most important step in the development of the independence of the Lords is their successful assertion in the *Earl of Bristol's case*, in the reign of Charles I, that once the king had issued a writ of summons to a subject to attend the House of Lords and it had been obeyed, a hereditary right to the writ had been created and vested in his heirs. The king's prerogative to create new peerages of the United Kingdom remains unlimited, except as regards the "limitation" or definition of the mode of descent. (*See* PEERAGE.) By an Act of 1887 he has the power to create four life peerages in the case of the "law lords" who sit in a judicial council for the hearing of appeals.

The Commons formed a more numerous body. In the reign of Edward I. there were about 275 members, in that of Edward III. 250, and in that of Henry VI. 300. In the reign of Henry VIII parliament added 27 members for Wales and four for the county and city of Chester, and in the reign of Charles II. four for the county and city of Durham. Between the reigns of Henry VIII and Charles II. 130 members were also added by royal charter.

Parliament Under the Tudors.—To resume the history of parliament at a later period, let us glance at the reign of Henry VIII. Never had the power of the Crown been greater than when this king succeeded to the throne, and never had a more imperious will been displayed by any king of England. Parliament was at his feet to do his bidding, and the Reformation enormously increased his power He had become a pope to the bishops; the old nobles who had resisted his will had perished in the field or on the scaffold; the new nobles were his creatures;

and he had the vast wealth of the church in his hands as largesses to his adherents. Such was the dependence of parliament upon the Crown and its advisers during the Reformation period that in less than 30 years four vital changes were decreed in the national faith. Each of the successive reigns inaugurated a new religion.

With the reign of Elizabeth commenced a new era in the life of parliament. She had received the royal prerogatives unimpaired, and her hand was strong enough to wield them. But in the long interval since Edward IV. the entire framework of English society had been changed; it was a new England that the queen was called upon to govern. The coarse barons of feudal times had been succeeded by English country gentlemen, beyond the influence of the court, and identified with all the interests and sympathies of their country neighbours. From this class were chosen nearly all the knights of the shire, and a considerable proportion of the members for cities and boroughs. They were generally distinguished by a manly independence, and were prepared to uphold the rights and privileges of parliament and the interests of their constituents. In the country the yeomen and farmers were far superior to the cultivators of the soil in feudal times; and the towns and seaports had become important centres of commerce and manufactures.

The parliaments of Elizabeth, though rarely summoned, displayed an unaccustomed spirit They discussed the succession to the Crown, the marriage of the queen, and ecclesiastical abuses; they upheld the privileges of the Commons and their right to advise the Crown upon all matters of State; and they condemned the grant of monopolies. The bold words of the Wentworths and Yelvertons were such as had not been heard before in parliament The conflicts between Elizabeth and the Commons marked the revival of the independence of parliament, and foreshadowed graver troubles at no distant period

The Stuart Kings.—James I, with short-sighted pedantry, provoked a succession of conflicts with the Commons, in which abuses of prerogative were stoutly resisted and the rights and privileges of parliament resolutely asserted. The "remonstrance" of 1610 and the "protestation" of 1621 would have taught a politic ruler that the Commons could no longer be trifled with, but those lessons were lost upon James and upon his ill-fated son

The momentous struggles between Charles I and his parliaments cannot be followed in this place The earlier parliaments of this reign fairly represented the earnest and temperate judgment of the country They were determined to obtain the redress of grievances and to restrain undue prerogatives; but there was no taint of disloyalty to the Crown; there were no dreams of revolution But the contest at length became embittered, until there was no issue but the arbitrament of the sword The period of the Great Rebellion and the Commonwealth proved the supreme power of the Commons, when supported by popular forces. Everything gave way before them They raised victorious armies in the field, they overthrew the church and the House of Lords, and they brought the king himself to the scaffold.

It is to this time of fierce political passions that we trace the origin of political agitation as an organized method of influencing the deliberations of parliament. The whole country was then aroused by passionate exhortations from the pulpit and in the press. No less than 30,000 political tracts and newspapers during this period have been preserved Petitions to parliament were multiplied in order to strengthen the hands of the popular leaders Clamorous meetings were held to stimulate or overawe parliament Such methods, restrained after the Restoration, have been revived in later times, and now form part of the acknowledged system of parliamentary government.

Parliament After the Restoration.—On the restoration of Charles II. parliament was at once restored to its old constitution, and its sittings were revived as if they had suffered no interruption. No outward change had been effected by the late revolution; but that a stronger spirit of resistance to abuses of prerogative had been aroused was soon to be disclosed in the deposition of James II and "the glorious revolution" of 1688 At this time the full rights of parliament were explicitly declared, and securities taken for the maintenance of public liberties. The end of the Stuart dynasty marked the final triumph of the principle of parliamentary sovereignty. Henceforth it is never again disputed that parliament may abolish the prerogatives and alter the common law. (*See* PREROGATIVE; COMMON LAW; PRIVY COUNCIL.) The theory of a constitutional monarchy and a free parliament was established; but after two revolutions it is curious to observe the indirect methods by which the Commons were henceforth kept in subjection to the Crown and the territorial aristocracy. The representation had long become an illusion The knights of the shire were the nominees of nobles and great landowners; the borough members were returned by the Crown, by noble patrons or close corporations; even the representation of cities, with greater pretensions to independence, was controlled by bribery. Nor were rulers content with their control of the representation, but, after the Restoration, the infamous system of bribing the members themselves became a recognized instrument of administration. The country gentlemen were not less attached to the principles of rational liberty than their fathers, and would have resisted further encroachments of prerogatives; but they were satisfied with the Revolution settlement and the remedial laws of William III., and no new issue had yet arisen to awaken opposition. Accordingly, they ranged themselves with one or other of the political parties into which parliament was now beginning to be divided, and bore their part in the more measured strifes of the 18th century From the Revolution till the reign of George III the effective power of the State was wielded by the Crown, the church and the territorial aristocracy, but the influence of public opinion since the stirring events of the 17th century had greatly increased Both parties were constrained to defer to it; and, notwithstanding the flagrant defects in the representation, parliament generally kept itself in accord with the general sentiments of the country

On the union of Scotland in 1707 important changes were made in the constitution of parliament The House of Lords was reinforced by the addition of 16 peers, representing the peerage of Scotland, and elected every parliament; and the Scottish peers, as a body, were admitted to all the privileges of peerage, except the right of sitting in parliament or upon the trial of peers. No prerogative, however, was given to the Crown to create new peerages after the union; and, while they are distinguished by their antiquity, their number is consequently decreasing To the House of Commons were assigned 45 members, representing the shires and burghs of Scotland

Parliament Under George III.—With the reign of George III. there opened a new period in the history of parliament. Agitation in its various forms, an active and aggressive press, public meetings and political associations, the free use of the right of petition, and a turbulent spirit among the people seriously changed the relations of parliament to the country And the publication of debates, which was fully established in 1771, at once increased the direct responsibility of parliament to the people, and ultimately brought about other results, to which we shall presently advert.

In this reign another important change was effected in the constitution of parliament Upon the union with Ireland, in 1801, four Irish bishops were added to the lords spiritual, who sat by rotation of sessions, and represented the episcopal body of the Church of Ireland But those bishops were deprived of their seats in parliament in 1869, on the disestablishment of the Church of Ireland. Twenty-eight representative peers, elected for life by the peerage of Ireland, were admitted to the House of Lords All the Irish peers were also entitled to the privilege of peerage In two particulars the Irish peerage was treated in a different manner from the peerage of Scotland The Crown was empowered to create a new Irish peerage whenever three Irish peerages in existence at the time of the Union have become extinct, or when the number of Irish peers, exclusive of those holding peerages of the United Kingdom, has been reduced to 100. And, further, Irish peers were permitted to sit in the House of Commons for any place in Great Britain, forfeiting, however, the privilege of peerage while sitting in the lower house

At the same time 100 representatives of Ireland were added to the House of Commons. This addition raised the number of members to 658 Parliament now became the parliament of the United Kingdom. In 1922 (*see* p 326) the provisions of the Act of Union

as to the representation of Ireland in the Commons were, save in the case of "Northern Ireland," repealed and the term "United Kingdom" is now restricted to Great Britain and Northern Ireland.

Schemes for Improving the Representation.—By the union of Scotland and Ireland the electoral abuses of those countries were combined with those of England. Notwithstanding a defective representation, however, parliament generally sustained its position as fairly embodying the political sentiments of its time. Public opinion had been awakened, and could not safely be ignored by any party in the State. Under a narrow and corrupt electoral system the ablest men in the country found an entrance into the House of Commons; and their rivalry and ambition ensured the acceptance of popular principles and the passing of many remedial measures. As society expanded, and new classes were called into existence, the pressure of public opinion upon the legislature was assuming a more decisive character. The grave defects of the representation were notorious, and some minor electoral abuses had been from time to time corrected. But the fundamental evils —nomination boroughs, limited rights of election, the sale of seats in parliament, the prevalence of bribery, and the enormous expense of elections—though constantly exposed, long held their ground against all assailants. All moderate proposals were rejected till the concurrence of a dissolution, on the death of George IV., with the French Revolution in 1830, and an ill-timed declaration of the duke of Wellington that the representation was perfect and could not be improved, suddenly precipitated the memorable crisis of parliamentary reform. (*See* also REFORM MOVEMENT.)

The Reform Acts of 1832.—The result of the memorable struggle which ensued may be briefly told. By the Reform Acts of 1832 the representation of the United Kingdom was reconstructed. In England, 56 nomination boroughs returning 111 members were disfranchised; 30 boroughs were each deprived of one member, and Weymouth and Melcombe Regis, which had returned four members, were now reduced to two. Means were thus found for the enfranchisement of populous places. Twenty-two large towns, including metropolitan districts, became entitled to return two members, and 20 less considerable towns acquired the right of returning one member each. The number of county members was increased from 94 to 159, the larger counties being divided for the purposes of representation.

The elective franchise was also placed upon a new basis. In the boroughs a £10 household suffrage was substituted for the narrow and unequal franchises which had sprung up—the rights of freemen, in corporate towns, being alone respected. In the counties, copyholders and leaseholders for terms of years, and tenants at will paying a rent of £50 a year, were added to the 40s. freeholders. Reform Acts, similar in character, were passed to deal with the franchise and constituencies in Ireland and Scotland respectively. The most decisive feature of these Reform Acts was not so much the extension of the franchise, as five-sixths of the male adult population were still left without a vote, the working-classes being practically without a vote. But what the Acts did do, once and for all, was to take the control of the constituencies, particularly by the disfranchisement of the "rotten boroughs," out of the hands of the peers who had hitherto bought or sold the right of nomination of candidates. From henceforth the political balance of power was shifted from the Lords to the Commons.

The legislature was now brought into closer relations with the people, and became more sensitive to the pressure of popular forces. The immediate effects of this new spirit were perceptible in the increased legislative activity of the reformed parliament, its vigorous grappling with old abuses, and its preference of the public welfare to the narrower interests of classes. But, signal as was the regeneration of parliament, several electoral evils still needed correction. Strenuous efforts were made, with indifferent success, to overcome bribery and corruption, and proposals were often ineffectually made to restrain the undue influence of landlords and employers of labour by the ballot; improvements were made in the registration and polling of electors, and the property qualification of members was abolished. Complaints were also urged that the middle classes had been admitted to power, while the working classes were excluded from the late scheme of enfranchisement. It was only with the enactment of the second Reform Act of 1867 that the working-classes were admitted to the franchise in the borough, by the introduction of what was known as "household franchise," *i.e.*, inhabitant occupation without any minimum restriction of annual value. . In 1884 this franchise qualification was extended to the counties, thereby enabling the agricultural labourer to exercise a vote. Other important stages in reform were the Acts removing a property qualification for election to the House (1858) and securing freedom of election by the secrecy of the ballot (1872).

Prior to the reign of Charles I. the condition of society had been such as naturally to subordinate the Commons to the Crown and the Lords. After the Revolution of 1688 society had so far advanced that, under a free representation, the Commons might have striven with both upon equal terms. But, as by far the greater part of the representation was in the hands of the king and the territorial nobles, the large constitutional powers of the Commons were held safely in check. After 1832, when the representation became a reality, a corresponding authority was asserted by the Commons. For several years, indeed, by reason of the weakness of the Liberal party, the Lords were able successfully to resist the Commons upon many important occasions; but it was soon acknowledged that they must yield whenever a decisive majority of the Commons, supported by public opinion, insisted upon the passing of any measure, however repugnant to the sentiments of the upper house. And it became a political axiom that the Commons alone determined the fate of ministries.

Results of Reform Since 1832.—From a constitutional standpoint it is important to recognize the results of the successive Reform Acts on the working of parliament as regards the position of the executive on the one hand and the electorate on the other. Before 1832 the functions of ministers were mainly administrative, and parliament was able to deal much as it pleased with their rare legislative proposals without thereby depriving them of office. Moreover, since before that date ministers were, generally speaking, in fact as well as in theory appointed by the king, while the general confidence of the majority in the House of Commons followed the confidence not so much of the electorate as of the Crown, that house was able on occasions to exercise an effective control over foreign policy. Pitt, after 1784, was defeated several times on foreign and domestic issues, yet his resignation was neither expected nor desired. In 1788, when the regency of the prince of Wales appeared probable, and again in 1812, it was generally assumed that it would be in his power to dismiss his father's ministers and to maintain the Whigs in office without dissolving parliament. This system, while it gave to ministers security of tenure, left much effective freedom of action to the House of Commons. But the Reform Act of 1832 introduced a new order of things. In 1835 the result of a general election was for the first time the direct cause of a change of ministry, and in 1841 a House of Commons was elected for the express purpose of bringing a particular statesman into power. The electorate voted for Sir Robert Peel, and it would have been as impossible for the house then elected to deny him their support as it would be for the college of electors in the United States to exercise their private judgment in the selection of a president. As time went on, and the party system became more closely organized in the enlarged electorate, the voting power throughout the country came to exercise an increasing influence. The premier was now a party leader who derived his power in reality neither from the Crown nor from parliament, but from the electorate, and to the electorate he could appeal if deserted by his parliamentary majority. Unless it was prepared to drive him from the office in which it was elected to support him, that majority would not venture to defeat, or even seriously to modify, his legislative proposals, or to pass any censure on his foreign policy for all such action would now be held to be equivalent to a vote of no confidence. From the passing of the Reform Act of 1867 down to 1900 (with a single exception due to the lowering of the franchise

and the redistribution of seats) the electorate voted alternately for the rival party leaders, and it was the function of the houses elected for that purpose to pass the measures and to endorse the general policy with which those leaders were respectively identified. The cabinet (*q.v.*), composed of colleagues selected by the prime minister, had practically, though indirectly, become an executive committee acting on behalf of the electorate, that is to say, the majority which returned their party to office; and the House of Commons practically ceased to exercise control over ministers except in so far as a revolt in the party forming the majority could influence the prime minister, or force him to resign or dissolve. Meanwhile, the virtual identificaton of the electorate with the nation by the successive extensions of the franchise added immensely to its power, the chief limitation being supplied by the Septennial Act. The House of Lords, whatever its nominal rights, came henceforth in practice to exercise restriction rather on the House of Commons than on the will of the electorate, for the acquiescence of the upper house in the decision of the electors, when appealed to on a specific point of issue between the two houses, was gradually accepted by its leaders as a constitutional convention.

The history of parliament, as an institution, centres in this later period round two points, (A) the friction between Lords and Commons, resulting in proposals for the remodelling of the upper house, and (B) the changes in procedure within the House of Commons, necessitated by new conditions of work and the desire to make it a more business-like assembly.

A. **House of Lords Question.**—The parliament which met at Westminster in Aug. 1892 was more democratic in its tendencies than any of its predecessors. At the beginning of the session of 1893, in the course of which the Home Rule Bill was passed by the House of Commons, Government bills were introduced for quinquennial parliaments, for the amendment of registration, and for the limitation of each elector to a single vote. But the rejection of the Home Rule Bill by the House of Lords, with the apparent acquiescence of the country, combined with the retirement of Gladstone to weaken the influence of this House of Commons, and small importance was attached to its abstract resolutions. In the ensuing session of 1894 an amendment to the Address condemning the hereditary principle was moved by Labouchere, and carried by 147 to 145. The Government, however, holding that this was not the way in which a great question should be raised, withdrew the Address, and carried another without the insertion. In his last public utterance Gladstone directed the attention of his party to the reform of the House of Lords, and Lord Rosebery endeavoured to concentrate on such a policy the energies of his supporters at the general election. But the result of the dissolution of 1895, showing, as it did, that on the chief political issue of the day the electorate had agreed with the House of Lords and had disagreed with the House of Commons, greatly strengthened the upper house, and after that date the subject was but little discussed until the Liberal party again came into power ten years later. The House of Lords claimed the right to resist changes made by the House of Commons until the will of the people had been definitely declared, and its defenders contended that its ultimate dependence on the electorate, now generally acknowledged, rendered the freedom from ministerial control secured to it by its constitution a national safeguard.

In 1907, under the Radical Government of Sir H. Campbell-Bannerman (*q.v.*), the conflict between the Commons and the Lords again became more acute. And the prime minister in May obtained a large majority in the lower house for a resolution, on which a bill was to be founded, involving a complicated method of overriding the will of the Lords when the Commons had three times passed a bill. But no further immediate step was taken. In 1908 a strong committee of the House of Lords with Lord Rosebery as chairman, which had been appointed in consequence of the introduction by Lord Newton of a bill for reforming the constitution of the upper house, presented an interesting report in favour of largely restricting the hereditary element and adopting a method of selection.

So the question stood when in 1909 matters came to a head through the introduction of Lloyd George's budget. It had always been accepted as the constitutional right of the House of Lords to reject a financial measure sent up by the Commons but not to amend it, but the rejection of the budget (which was, in point of form, referred to the judgment of the electorate) now precipitated a struggle with the Liberal party, who had persistently denied any right on the part of the upper house to force a dissolution. The Liberal leaders contended that, even if constitutional, the claim of the House of Lords to reject a budget was practically obsolete, and having been revived must now be formally abolished; and they went to the country for a mandate to carry their view into law. The elections of Jan. 1910 gave an unsatisfactory answer, since the two principal parties, the Liberals and the Unionists, returned practically equal; but the Liberal Government had also on their side the Irish Nationalist and the Labour parties, which gave them a majority in the House of Commons if they could concentrate the combined forces on the House of Lords question. This Asquith contrived to do; and having introduced and carried through the House of Commons a series of resolutions defining his proposals, he had also tabled a bill which was to be sent up to the House of Lords, when the death of the king suddenly interrupted the course of the constitutional conflict, and gave a breathing-space for both sides to consider the possibility of coming to terms. In June Asquith took the initiative in inviting the leaders of the Opposition to a conference with closed doors, and a series of meetings between four representatives of each side were begun. The Government were represented by Asquith, Lloyd George, Birrell and Lord Crewe. The Unionists were represented by Balfour, Lord Lansdowne, Austin Chamberlain and Lord Cawdor.

The situation on the Radical side at this juncture may be best understood by reference to the resolutions passed in the House of Commons, and the text of a "Parliament Bill" of which Asquith had given notice. The text, alike of the resolutions and of the Parliament Bill, virtually disestablishing the House of Lords as a co-equal and independent estate of the realm in legislation, was almost identical with the subsequent Parliament Act of 1911 (*see* p. 324) and as such it received a kind of "mandate" at the General Election of Dec. 1910.

Meanwhile, in the House of Lords, Lord Rosebery had carried three resolutions declaring certain principles for the reform of the second chamber, which were assented to by the Unionist leaders; the policy opposed to that of the Government thus became that of willingness for reform of the constitution of the Upper Chamber, but not for abolition of its powers.

During the summer and autumn the private meetings between the eight leaders were continued, until 20 had been held. But on Nov. 10 Asquith issued a brief statement that the conference on the constitutional question had come to an end, without arriving at an agreement. Within a few days he announced that another appeal would at once be made to the electorate. The Parliament Bill was hurriedly introduced into the House of Lords, with a statement by Lord Crewe that no amendments would be accepted. The dissolution was fixed for Nov. 28. Time was short for any declaration of policy by the Unionist peers, but it was given shape at once, first by the adoption of a further resolution moved by Lord Rosebery for the remodelling of the Upper House, and secondly by Lord Lansdowne's shelving the Parliament Bill by coupling the adjournment of the debate on it with the adoption of resolutions providing for the settlement of differences between a reconstituted Upper House and the House of Commons. These resolutions still possess something more than historical importance, in view of the revival in 1927, by the Conservative Party, of plans for the reform of the House of Lords.

Lord Rosebery's additional resolution provided that "in future the House of Lords shall consist of lords of parliament: (*a*) chosen by the whole body of hereditary peers from among themselves and by nomination by the Crown; (*b*) sitting by virtue of offices and of qualifications held by them; (*c*) chosen from outside." The Lansdowne resolutions provided in effect that, when the House of Lords had been "reconstituted and reduced in num-

bers" in accordance with Lord Rosebery's plan, (1) any differences arising between the two houses with regard to a bill other than a money bill, in two successive sessions, and within an interval of not less than one year, should be settled, if not adjustable otherwise, in a joint sitting composed of members of both houses, except in the case of "a matter which is of great gravity and has not been adequately submitted to the judgment of the people," which should then be "submitted for decision to the electors by Referendum"; (2) and as to money bills, the Lords were prepared to forgo their constitutional right of rejection or amendment, if effectual provision were made against "tacking," the decision whether other than financial matters were dealt with in the bill resting with a joint committee of both Houses, with the Speaker of the House of Commons as chairman, having a casting vote only.

The general election took place in December, and resulted practically in no change from the previous situation. Asquith retained an apparent majority of 126 for the ministerial policy, resting as it did on the determination of the Irish Nationalists to pave the way for Home Rule by destroying the veto of the House of Lords.

B. **House of Commons Internal Reforms.**—We have already sketched the main lines of English parliamentary procedure. Until the forms of the House of Commons were openly utilized to delay the progress of Government business by what became known as "obstruction" the changes made in the years following 1832 were comparatively insignificant. They consisted in (1) the discontinuance of superfluous forms, questions and amendments; (2) restrictions of debates upon questions of form; (3) improved arrangements for the distribution of business; (4) the delegation of some of the minor functions of the house to committees and officers of the house; and (5) increased publicity in the proceedings of the house. But with the entry of Parnell and his Irish Nationalist followers into parliament (1875–80) a new era began in the history of the House of Commons. Their tactics were to oppose all business of whatever kind, and at all hours.

It was not until Feb. 1880 that the house so far overcame its reluctance to restrict liberty of discussion as to pass, in its earliest form, the rule dealing with "order in debate." It provided that whenever a member was named by the Speaker or chairman as "disregarding the authority of the chair, or abusing the rules of the house by persistently and wilfully obstructing the rules of the house," a motion might be made, to be decided without amendment or debate, for his suspension from the service of the house during the remainder of the sitting; and that if the same member should be suspended three times in one session, his suspension on the third occasion should continue for a week, and until a motion had been made upon which it should be decided, at one sitting, by the house, whether the suspension should then cease or not. The general election, which took place two months later, restored Gladstone to power and to the leadership of the house. Parnell returned to parliament with a more numerous following, and resumed his former tactics. In Jan. 1881 the Protection of Persons and Property (Ireland) Bill was introduced. For 22 hours Parnell fought the motion giving precedence to the bill, and for four sittings its introduction. The fourth sitting lasted 41 hours. Then Mr. Speaker Brand intervened, and declined to call on any other member who might rise to address the house, because repeated dilatory motions had been supported by small minorities in opposition to the general sense of the house. He added: "A crisis has thus arisen which demands the prompt interposition of the chair and of the house. The usual rules have proved powerless to ensure orderly and effective debate. An important measure, recommended by Her Majesty nearly a month since, and declared to be urgent in the interests of the State by a decisive majority, is being arrested by the action of an inconsiderable minority, the members of which have resorted to those modes of obstruction which have been recognized by the house as a parliamentary offence. The dignity, the credit and the authority of this house are seriously threatened, and it is necessary they should be vindicated. . . . Future measures for ensuring orderly debate I must leave to the judgment of the house. But the house must either assume more effectual control over its debates, or entrust greater powers to the chair." The Speaker then put the question, which was carried by an overwhelming majority. Then followed the decisive struggle. Gladstone gave notice for the next day (Feb. 3) of an urgency rule, which ordered, "That if the house shall resolve by a majority of three to one that the State of public business is urgent, the whole power of the house to make rules shall be and remain with the Speaker until he shall declare that the state of public business is no longer urgent." On the next day a scene of great disorder ended in the suspension of the Nationalist members, at first singly, and afterwards in groups. The urgency rule was then passed without further difficulty, and the house proceeded to resolve, "That the state of public business is urgent." The Speaker laid upon the table rules of sufficient stringency, and while they remained in force progress in public business was possible. During this session the Speaker had to intervene on points of order 935 times, and the chairman of committees 939 times; so that, allowing only five minutes on each occasion, the wrangling between the chair and members occupied 150 hours.

The Closure.—The events of the session of 1881 and the direct appeal of the Speaker to the house proved the necessity of changes in the rules of procedure more drastic than had hitherto been proposed. Accordingly, in the first week of the session of 1882 Gladstone laid his proposals on the table, and in moving the first resolution on Feb. 20, he reviewed, in an eloquent speech, the history of the standing orders. It was his opinion, on general grounds, that the house should settle its own procedure, but he showed that the numerous committees which, since 1832, had sat on the subject, had failed for the most part to carry their recommendations into effect from the lack of the requisite "propelling power," and he expressed his regret that the concentration of this power in the hands of the Government had rendered it necessary that they should undertake a task not properly theirs. He defined obstruction as "the disposition either of the minority of the house, or of individuals, to resist the prevailing will of the house otherwise than by argument," and reached the conclusion that the only remedy for a state of things by which the dignity and efficiency of the house were alike compromised, was the adoption in a carefully guarded form of the process known on the Continent as the "clôture." The power to close debate had been of necessity assumed by almost all the European and American assemblies, the conduct of whose members was shaped by no traditional considerations; and the entry into parliament of a body of men to whom the traditions of the house were as nothing made it necessary for the House of Commons to follow this example. He proposed, therefore, that when it appeared to the Speaker, or to the chairman of committees, during any debate to be the evident sense of the house, or of the committee, that the question be now put, he might so inform the house, and that thereupon on a motion being made, "That the question be now put," the question under discussion should be forthwith put from the chair, and decided in the affirmative if supported by more than 200 members, or, when less than 40 members had voted against it, by more than 100 members. This resolution was vehemently contested by the opposition, who denounced it as an unprecedented interference with the liberty of debate, but was eventually carried in the autumn session of the same year, after a discussion extending over 19 sittings.

On Nov. 20 the standing order of Feb. 28, 1880, providing for the suspension of members who persistently and wilfully obstructed the business of the house or disregarded the authority of the chair, was amended by the increase of the penalty to suspension on the first occasion for one week, on the second occasion for a fortnight, and on the third, or any subsequent occasion, for a month. The other rules, framed with a view to freeing the wheels of the parliamentary machine, and for the most part identical with the regulations adopted by Mr. Speaker Brand under the urgency resolution of 1881, were carried in the course of the autumn session, and became standing orders on Nov. 27.

Gladstone's closure rule verified neither the hopes of its supporters nor the fears of its opponents. It was not put into operation until Feb. 20, 1885, when the Speaker's declaration of the evident sense of the house was ratified by a majority of 207—

a margin of but seven votes over the necessary quorum. It was clear that no Speaker was likely to run the risk of a rebuff by again assuming the initiative unless in the face of extreme urgency, and, in fact, the rule was enforced twice only during the five years of its existence.

In 1887 the Conservative Government, before the introduction of a new Crimes Act for Ireland, gave efficiency to the rule by an important amendment They proposed that any member during a debate might claim to move, "That the question be now put," and that with the consent of the chair this question should be put forthwith, and decided without amendment or debate *Thus the initiative was transferred from the Speaker to the house.* Gladstone objected strongly to this alteration, chiefly on the ground that it would throw an unfair burden of responsibility upon the Speaker, who would now have to decide on a question of opinion, whereas under the old rule he was only called upon to determine a question of evident fact. The alternative most generally advocated by the opposition was the automatic closure by a bare majority at the end of each sitting, an arrangement by which the chair would be relieved from an invidious responsibility; but it was pointed out that under such a system the length of debates would not vary with the importance of the questions debated After 14 sittings the closure rule was passed on March 18 and made a standing order

In the next session, on Feb 28, 1888, the rule was yet further strengthened by the reduction of the majority necessary for its enforcement from 200 to 100, the closure rule remaining as follows. That, after a question has been proposed, a member rising in his place may claim to move, "That the question be now put," and, unless it shall appear to the chair that such motion is an abuse of the rules of the house or an infringement of the rights of the minority, the question, "That the question be now put," shall be put forthwith, and decided without amendment or debate

When the motion "That the question be now put" has been carried, and the question consequent thereon has been decided, any further motion may be made (the assent of the chair as aforesaid not having been withheld), which may be requisite to bring to a decision any question already proposed from the chair; and also if a clause be then under consideration, a motion may be made (the assent of the chair as aforesaid not having been withheld), "That the question 'That certain words of the clause defined in the motion stand part of the clause,' or 'That the clause stand part of, or be added to, the bill,' be now put " Such motions shall be put forthwith, and decided without amendment or debate.

That questions for the closure of debate shall be decided in the affirmative, if, when a division be taken, it appears by the numbers declared from the chair that not less than 100 members voted in the majority in support of the motion

The Guillotine.—The closure, originally brought into being to defeat the tactics of obstruction in special emergencies, thus became a part of parliamentary routine And, the principle being once accepted, its operation was soon extended It can now be put into operation not only in committee of the whole house but in any of the "grand" standing committees Furthermore, the practice of retarding the progress of Government measures by amendments moved to every line, adopted by both the great political parties when in opposition, led to the use of what became known as the "guillotine," for forcing through parliament important bills, most of the clauses in which were thus undiscussed. The "guillotine," means that the house decides how much time shall be devoted to certain stages of a measure, definite dates being laid down at which the closure shall be enforced and division taken On June 17, 1887, after prolonged debates on the Crimes Bill in committee, clause 6 only having been reached, the remaining 14 clauses were put without discussion, and the bill was reported in accordance with previous notice. This was the first use of the "guillotine," but the precedent was followed by Gladstone in 1893, when many of the clauses of the Home Rule Bill were carried through committee and on report by the same machinery. To the Conservatives must be imputed the invention of this method of legislation, to their opponents the use of it for attempting to carry a great constitutional innovation to which the majority of English and Scottish representatives were opposed, and subsequently its extension and development (1906–09) as a regular part of the legislative machinery.

Supply Rule.—The principle of closure has been extended even to the debates on supply. The old rule, that the redress of grievances should precede the granting of money, dating from a time when the minister of the Crown was so far from commanding the confidence of the majority in the House of Commons that he was the chief object of their attacks, nevertheless continued to govern the proceedings of the house in relation to supply without much resultant inconvenience, until the period when the new methods adopted by the Irish Nationalist party created a new situation Until 1872 it continued to be possible to discuss any subject by an amendment to the motion for going into supply In that year a resolution was passed limiting the amendments to matters relevant to the class of estimates about to be considered, and these relevant amendments were further restricted to the first day on which it was proposed to go into committee. This resolution was continued in 1873, but was allowed to drop in 1874 It was revived in a modified form in 1876, but was again allowed to drop in 1877 In 1879, on the recommendation of the Northcote committee, it was provided in a sessional order that whenever the committees of supply or of ways and means stood as the first order on a Monday, the Speaker should leave the chair without question put, except on first going into committee on the army, navy and civil service estimates respectively. In 1882 Thursday was added to Monday for the purposes of the order, and, some further exceptions having been made to the operation of the rule, it became a standing order. The conditions, however, under which the estimates were voted remained unsatisfactory. The most useful function of the opposition is the exposure of abuses in the various departments of administration, and this can best be performed upon the estimates But ministers, occupied with their legislative proposals, were irresistibly tempted to postpone the consideration of the estimates until the last weeks of the session, when they were hurried through thin houses, the members of which were impatient to be gone To meet this abuse, and to distribute the time with some regard to the comparative importance of the subjects discussed, Balfour in 1896 proposed and carried a sessional order for the closure of supply, a maximum of 23 days being given to its consideration, of which the last three alone might be taken after Aug 5. On the last but one of the allotted days at 10 o'clock the chairman was to put the outstanding votes, and on the last day the Speaker was to put the remaining questions necessary to complete the reports of supply In 1901 Balfour so altered the resolution that the question was put, not with respect to each vote, but to each class of votes in the Civil Service estimates, and to the total amounts of the outstanding votes in the army, navy and revenue estimates.

Other Changes in Methods.—It is only possible here to refer briefly to some other changes in the procedure of the house which altered in various respects its character as a business-like assembly The chief of these is as regards the hours. On Mondays, Tuesdays, Wednesdays and Thursdays the house meets at 2 45 P M, "questions" beginning at 3 and ending (apart from urgency) at 3 45, and opposed business ends at 11. On Fridays the house meets at 12 noon, and opposed business is suspended at 5 P M; this is the only day when Government business has not precedence, and private members' bills have the first call, though at 8 15 P.M. on Tuesdays and Wednesdays up to Easter and on Wednesdays up to Whitsuntide the business is interrupted in order that private members' motions may be taken These arrangements, which only date from 1906, represent a considerable change from the old days before 1879 when the standing order was formed that no opposed business, with certain exceptions, should be taken after 12.30 A M., or 1888 when the closing hour was fixed at midnight. In fact the hours of the house have become generally earlier. Another important change has been made as regards motions for the adjournment of the house, which used to afford an opportunity to the private members at any time to discuss matters of urgent importance.

Since 1902 no motion for the adjournment of the house can be made until all "questions" have been disposed of, and then, if 40 members support it, the debate takes place at 8.15 P.M. This alteration has much modified the character of the debates on such motions, which used to be taken when feelings were hot, whereas now there is time for reflection. In other respects the most noticeable thing in the recent evolution of the House of Commons has been its steady loss of power, as an assembly, in face of the control of the Government and party leaders In former times the private members had far larger opportunities for introducing and carrying bills, which now have no chance, unless the Government affords "facilities"; and the great function of debating "supply" has largely been restricted by the closure, under which millions of money are voted without debate The house is still ruled by technical rules of procedure which are, in the main, dilatory and obstructive, and hamper the expression of views which are distasteful to the Whips or to the Government, who can by them arrange the business so as to suit their convenience. The most striking feature in procedural development in recent years is the almost complete appropriation to "Government business" of parliamentary time. As an independent source of legislation, the private member has, in consequence, virtually disappeared and, unless the Government choose to adopt as their own a bill introduced by him, it has no chance of finding its way on to the statute-book. (H C.; X.)

PARLIAMENT SINCE 1910

The General Election of 1910 was fought on the issue, already placed before the Commons in a series of Resolutions which were moved by the Prime Minister during the summer of that year, of the legislative supremacy of the Commons over the Lords. The success of the Government at the polls decided the fate of the Upper House, the more decisively as it eventually became known that the Prime Minister had on asking for a dissolution obtained a contingent pledge from the King that he would in the event of his being returned to power at the General Election be authorized to "exercise the prerogative" in the event of the Lords rejecting the "Parliament Bill" which embodied the Government proposals. In other words the House of Lords were faced with the same coercion as that which confronted them in their opposition to the Reform Bill in 1832, namely an announcement, duly made by Lord Morley in the debate on the Bill in the Lords, that, if it were rejected, the Prime Minister would advise His Majesty to create such a number of new peers as would ensure its acceptance. Faced with this tremendous exercise of the prerogative, the Lords gave way, and a constitutional revolution of the first magnitude was effected The provisions of the Act may be summarized briefly as providing (1) that the House of Lords should have no power either to reject or amend "a money bill"; a term defined as meaning any bill which, "in the opinion of the Speaker," contains "only" provisions dealing with "the imposition, repeal, alteration or regulation of taxation," and "the provision of public money, supply, appropriation and regulation of public money"; (2) that any public bill (private bills are excluded) passed by the Commons in three successive sessions, whether with or without the intervention of a General Election, should, if rejected by the House of Lords in each successive session, on its third rejection be presented to His Majesty for his assent provided that a minimum period of 2 years had elapsed since the date of the second reading in the Commons in the first session These were the main provisions of the Act and, as they have been controverted ever since, and as the Conservative party is at the present moment committed to some amendment of the first of them, they will call for careful examination in a moment. Other provisions of the Act can be summarily disposed of. The maximum "life" of Parliament is reduced from seven years to five, the statute thus involving a repeal of the Septennial Act. This provision, of course, may be repealed by Parliament itself as it is inherent in the principle of "Parliamentary sovereignty" that what one Parliament has done, another Parliament can undo and, during the war, when conditions made a dissolution extremely undesirable, Parliament passed one Act after another extending its own duration, with the result that the Parliament elected in December 1910 was not dissolved for eight years. These Acts, prolonging the life of Parliament beyond five years, required, and received, the consent of the Lords, for the Parliament Act itself preserves their absolute veto in the one, and only the one, case of bills to extend the life of Parliament. It also provides that nothing in the statute is to "diminish or qualify the existing rights and privileges of the House of Commons." The object of this clause is to preserve the claims of the Commons to dispute the right of the Lords to amend "a money clause" in an ordinary bill· a claim which has always been an object of dispute between the two Houses and which is left unsettled by the Parliament Act The statute also provides, necessarily, that a bill, to take advantage of the automatic machinery of the statute when successively rejected, must be "the same bill"—a provision which has a constricting effect on the power of the Government to amend the Bill after the first session in which it has passed the House of Commons. No amendments can be made therein without the consent of the House of Lords itself.

It remains to consider more closely the two chief provisions of the Act It should be observed in the first place that the Bill was avowedly an emergency measure, designed to secure the immediate passage into law of the legislative programme, in particular the Home Rule Bill and the Welsh Church Bill, of the Liberal Government which introduced it and secured its enactment. The preamble of the Parliament Act itself recites that "whereas it is intended to substitute for the House of Lords as it at present exists a second chamber constituted on a popular instead of a hereditary basis but such substitution cannot be immediately brought into operation." This pledge, or condition subsequent, has never been redeemed, and, during the 18 years that have elapsed, a whole series of proposals have been put forward in the Lords for the "reform" of the Upper House Moreover in August 1917, namely during the party truce imposed by the war which found expression in the establishment of the "Coalition Government," a conference representative of all parties was instituted, under the presidency of Lord Bryce, by the Prime Minister to report not only on the composition and "legislative power" to be exercised by a reformed second chamber but on "the best mode of adjusting differences between the two Houses of Parliament" These terms of reference necessarily involved a reconsideration of the Parliament Act itself and in a Report (Cd 9038 of 1918) which constitutes far and away the most valuable contribution to this vexed subject, Lord Bryce's Committee did definitely recommend some amendment of the provisions of the statute which relate to "Money Bills" and at the same time proposed to substitute a system of joint conferences in place of the suspensory veto of the Lords over public bills other than money bills. Such a considerable restoration of the powers of the Upper House was only possible on the assumption that it become a representative body in the "popular" sense, and for this the Bryce scheme provided by substituting for the peerage qualification an elective element, amounting to no less than three-fourths of the House, to be elected by the House of Commons, while, even in the election by a "Joint Standing Committee" of both Houses of the remaining one-quarter, the peers selected by the Joint Committee were ultimately to be reduced to thirty. The scheme failed of acceptance, and the most recent proposals, put forward by Lord Cave on behalf of the Government in 1927, abandoned all idea of transforming the Upper House into a predominantly representative Chamber, and are confined, with the exception of some provision for a small number of Crown nominees for a term of years, to the adoption of the principle of "representative peers" already domesticated in our Constitution in the case of Scottish and Irish peerages—in other words the new chamber was to consist of a fixed number of peers elected by their fellow-peers.

The basis of the constitution of the House of Lords being left much where it was—namely the peerage qualification—these proposals did not suggest any such far-reaching revision of

the Parliament Act as that contained in the Bryce scheme, but were directed to the interposition of some very necessary safeguards against the abuse of the Parliament Act. Indeed Lord Lansdowne had already declared himself in 1925 as "wholly opposed to any attempt" to repeal the Parliament Act itself. The Government proposals of 1927 were, and are, therefore confined to two propositions, one of which is that no legislative proposals for further curtailing such powers, *e.g.*, the suspensory veto, as are conceded to the House of Lords by the Parliament Act, should be forced into law by the machinery of the Parliament Act itself but should require the assent of the House of Lords. The effect of this proposal, which is reasonable enough, would be to prevent an extremist majority in the House of Commons extinguishing, by a bill to that effect, the House of Lords altogether as an estate of the realm by forcing such a bill on to the statute-book in the three successive sessions provided for in the case of ordinary legislation under the Parliament Act The other proposition gave expression to the growing misgivings as to the possible misuse of the enormous powers conferred on the Speaker under the statute. By the terms of it, he is made the sole judge whether a bill is a money bill or not, and his certificate is not to be questioned in any court of law Now the power to tax is, or may be, in the words of Chief Justice Marshall, "the power to destroy" and a Socialist party could, easily enough, confiscate altogether, by a 100% estate duty, the capital of all deceased persons altogether or, equally, by a 100% income-tax duty on all incomes over a certain figure, introduce a considerable measure of "Socialism in our time" Such measures might be introduced as "money bills" in form, although their real object was not to raise revenue but to "nationalize" private capital without compensation. The rise of the Labour Party, since the Parliament Act was enacted, and its avowedly Socialistic aims had thus invested the Parliament Act with new significance, and Socialist publicists, as also the Trade Union Council at the General Election of 1924, have made no secret of the fact that they regard the office of the Speaker, and his omnipotent function of certifying under a Parliament Act any bill he pleases as a money bill and of thereby securing its immediate passage into law, as a "key position" to be "captured" if and when the party finds itself in a majority. In other countries, notably in Australia and the United States, the legislature has deliberately sought to pass industrial legislation in the form of "a money bill" by imposing a penal tax on all manufacturers who do not comply with its provisions In those countries a check is imposed on such abuse of legislative powers by the fact that they have a federal and "written" constitution, with the resulting power of the courts to declare such legislation *ultra vires*. No such check exists in this country, which might thus, under the Parliament Act, find itself exposed to almost instantaneous legislation, the motive of which, nominally fiscal, was in reality the revolution of the economic constitution of society. Hence the proposal of Lord Cave, following mainly the suggestion of the Bryce Committee, that this absolute power should be taken out of the hands of the Speaker and vested in a Joint Standing Committee of both Houses which, in "certifying" a bill as a money bill, shall have regard "not only to the form but to the substance and effect of the Bill" (*Hansard:* "Lords Debates," vol 67, No. 42, p. 779).

Up to the present moment political exigencies have not operated to put the Parliament Act in practice except on two occasions Only two measures, the Home Rule Bill and the Welsh Church Disestablishment Bill, have been forced through under its operation. In both cases their actual enforcement was suspended by a special statute during the war, while the rebellion in Ireland made an end of the Home Rule Act altogether. Moreover the Speaker, hitherto a member of one or other of the "constitutional" parties in the House, has exercised his despotic power of "certification" of money bills quite impartially and in complete independence of political considerations. He has always refused to lend any assistance to the Government party by declining to intimate beforehand what his ultimate opinion of the character of their bills would be (41 *Hansard:* "Commons Debates," 5 p. 2667) and his decisions afford little or no guide in the way of precedent. He has ruled that a bill originating in a Committee of the whole House on the recommendation of the Crown is not necessarily a money bill while, on one occasion, he has ruled that a bill not so originating is. A return, issued to the House of Commons in 1927, showed that no less than eight finance bills had been refused his certificate, although, needless to say, the House of Lords did not, having regard to the general character of these bills, avail itself of its powers to reject or amend them. The potentialities of the Parliament Act, as an instrument in the hands of a Government determined to secure revolution by "constitutional methods" in a single session of Parliament, will only become apparent if and when a Socialist Government is not only in office but in power

It had always been the practice of the Revenue authorities to collect "annual taxes," *e.g.*, customs duties and the income-tax, from the moment the "Budget resolutions" were passed in Committee of Ways and Means without waiting for the enactment of the Finance Bill which gave those resolutions retrospective sanction—the interval between the resolutions, passed in April, and the Finance Act being usually about four months. In the famous case of *Bowles* v. *the Bank of England* [1913], 1 Ch. 57, the plaintiff obtained a declaration and injunction restraining the Bank from deducting income-tax from his dividends in the interval in question In order to prevent vexatious litigation of this kind and to give what had become, until that case, an unchallenged custom the force of law, the Act of 1913 known as the Provisional Collection of Taxes Act was passed giving temporary statutory authority to the collection of any taxes voted under the Resolutions. The Act is chiefly important for the very stringent conditions it imposes on the necessity of the consent of the House to the Ways and Means Resolutions being given within a very narrow limit of time (10) days and being embodied in a second reading of the resulting bill (20 days after the consent to the resolution). Furthermore it limits the statutory force of the resolution to 4 months and provides that the resolution shall, in any case, cease to have effect immediately if Parliament is prorogued or dissolved.

The only other developments of note as regards legislative procedure during the last 18 years are some slight changes in the Standing Orders in the allocation of Parliamentary time to "private members" and the establishment of an Estimates Committee. Neither has done much, if anything, to diminish the growing ascendancy of the Cabinet over Parliament, an ascendancy which the late Sir William Anson regarded as finally consummated by the Parliament Act by which, in his view, "legislative sovereignty may be said to have passed to the Cabinet" But, even more decisive in this direction than the Parliament Act was the grant by His Majesty of the exercise of the prerogative of dissolution in 1924 to a Prime Minister, Ramsay MacDonald, who was actually in a minority in the Commons Earlier, in January of the same year, Asquith had questioned the right of a Prime Minister, so situated, to obtain a dissolution, but constitutional precedent, notably Lord Aberdeen's advisory opinion to Queen Victoria of May 15, 1858, was against Asquith's view and the grant of the dissolution of 1924 may be said definitely to establish the existence, in the hands of the Prime Minister, of this coercive power over the Commons Asquith himself had gone a long way in the direction of the assumption of this prerogative by the Prime Minister when, on November 15th, 1910, he not only "advised" His Majesty to dissolve Parliament but accompanied his advice with a request, which was granted, that the King should pledge himself beforehand to exercise the prerogative of creation of a sufficient number of peers to carry the Parliament Bill into law in the event of the Liberal party being returned to power (*Hansard*: "Commons Debates," Aug. 7, 1911.) The institution of the Estimates Committee in 1922 was due to the growing restiveness of members at the inadequate time (20 days) available in supply for the discussion of the vast and growing expenditure now submitted to the House by the Government. But the concession was jealously limited by the terms of reference to the Committee, as approved by the Government, which were "to report on what economies, if any, *consistent with the policy* implied in the Estimates, may be effected

therein." The establishment of the Committee has, in fact, effected little change. The exclusion of questions of policy excludes everything except details, and, in a debate of Aug. 1, 1922, on the Estimates Committee's Report, one of its members pointed out its futility in the words "the pity is that the reports are presented *after* supply is concluded, so that their interest is of quite a post-mortem character." Even the Public Accounts Committee, useful though it is as an independent examination by the Commons of "expenditure," as distinct from estimates, is restricted in its activities by the fact that it has "no right to go into questions of policy" (*Hansard:* "Commons Debates," vol. 152, p. 888).

A remarkable development in the direction of "democracy" was effected by the institution of "Payment of Members." It had been the honourable distinction of the House of Commons, almost alone among the legislatures of the modern world, that its members gave their services voluntarily in the representation of their constituents, although it had at one time been the practice, long fallen into disuse, for the boroughs to pay their members. In 1911 the Liberal Government of the day introduced, not in the form of a special statute but by a vote on the Estimates, an appropriation of £400 to be paid to each member of the House, and their vote has ever since been a standing feature of the annual Appropriation Bill. Thereby it is made a charge not on the constituency, as in the case of the boroughs in early times, but on the national Exchequer. No conditions as to attendance at the House are annexed to the receipt of the salary. (*Cf. Holinshed* v. *Hazelton* [1916] 85 L.J. [H.L.] p. 60.)

Turning to the constitution of Parliament itself, we find vast changes, alike in the franchise, the qualification of members and the distribution of constituencies. The Representation of the People Act of 1918 enfranchised women for the first time and, in so doing and also in simplifying the qualifications of men's votes, added no less than 13 million voters to the register. It also altered and simplified the law of registration, effected a redistribution of seats, abolished the property qualification and removed the pauper disqualification. At the same time it reduced the qualification for the exercise of a vote, in the case of men of at least 21 years of age, to the simple requirement of 6 months' residence or, in the alternative, occupation of business premises, either or both of which might confer the vote, not more than 2 votes being so conferred. In removing the "lodger" qualification, with its requirement of the tenancy of rooms of the annual value of £10, and substituting mere residence as sufficient, it operated as an Act for the enfranchisement of youth, and so it has proved to be. In 1928 the franchise was further extended by the removal of the age restriction (30 years of age under the 1918 Act) upon women voters and by making them eligible for a vote at the same age as men. The inevitable corollary of the grant of the franchise to women was the removal of their disability to be elected to Parliament; this was effected by the Parliamentary Qualification of Women Act. Strangely enough they are not yet qualified, when peeresses in their own right, to take their seats in the Lords—such was the judgment of a Committee of Privileges in *Viscountess Rhondda's petition* to the Lords [1922] 2 A.C., 330, where it was held that the sex Disqualification Removal Act, admitting women to public "offices" and "functions" had not altered their disability in the matter of succession to a seat in the Lords.

The redistribution of constituencies effected by the Franchise Act of 1918 was followed in 1922 by another and more radical change in the composition of the House of Commons. The grant of Dominion status to Southern Ireland, henceforth to be known as the Irish Free State, as embodied in subsequent legislation, was inevitably accompanied by the repeal of the clauses of the Act of Union providing for the representation of Ireland, with the exception of "Ulster" or Northern Ireland, in the House of Commons and the disappearance of all executive authority of the British Cabinet in the internal affairs of Southern Ireland. (See *Ex parte O'Brien* [1923] 2 K.B. 361.)

No discussion of the subject of Parliament would be complete without some reference to the General Strike of 1926. That movement, marking a return by the Labour party to "direct action," was, in effect, a challenge to the authority of Parliament as represented, in the executive sphere, by a Government responsible to it and having its confidence. It was, on a strict view of the law, very close to that statutory definition of treason, felony which embraces any attempt to "put any force or constraint upon" or "to intimidate or overawe both Houses or either House of Parliament" although the absence of "overt acts" amounting to "levying war," in other words of acts of violence, to effect this object, might be held to have saved the movement, or rather its leaders, from such a felonious character. The defeat of the movement was directly due, in the first instance, to public opinion but, secondly, to the prompt putting into operation of the drastic powers conferred on the Executive by the Emergency Powers Act of 1920. These powers are strictly subject to the positive approval, in the form of temporary but renewable resolutions, of both Houses of Parliament. In the case of the General Strike, the authority of Parliament was thus asked for and given, and the defeat of the movement may thus be regarded as a vindication of Parliamentary authority. The sequel was the Trade Union Act of 1927, making participation in a General Strike a criminal offence.

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PARLIAMENTARY LAW, as the term is ordinarily used in the United States, embodies the generally accepted rules, precedents and practices commonly employed in the government of deliberative assemblies. Its function is to maintain decorum, ascertain the will of the majority, preserve the rights of the minority and facilitate the orderly and harmonious transaction of the business of the assembly. While it had its origin in the early British parliaments from which it derives its name the modern system of general parliamentary law is, in many respects, at wide variance with the current systems of procedure of both the English Parliament and the American Congress. These legislative systems are designed for bicameral bodies, generally with paid memberships, meeting in continuous session, requiring a majority for a quorum and delegating their duties largely to committees. Their special requirements and the constantly increasing pressure of their business have produced highly complex and remarkably efficient systems peculiar to their respective bodies, but which are as a whole unsuited to the needs of the ordinary assembly. As a result there has been simultaneously developed through years of experiment and practice a simpler system of procedure adapted to the wants of deliberative assemblies generally which though variously interpreted in minor details by different writers is now in the main standardized and authoritatively established.

Organization.—Assemblies convene with the implied understanding that they will be conducted and governed in accordance with these fundamental principles. The routine ordinarily followed in the preliminary organization of an assembly includes the call to order by any of those present with a request for nominations for temporary chairman. The temporary chairman having been elected and having taken the chair, a temporary secretary is chosen and those addressing the chairman are recognized to explain and discuss the purposes of the meeting. If the assembly has convened for a single session only or is in the nature of a mass-meeting a presiding officer and recording officer will suf-

fice. If permanent organization is contemplated a committee is usually appointed to draft a Constitution and by-laws and on the adoption of its report, with or without amendments, the assembly proceeds to the election of the permanent officers thus authorized. In a permanent organization such officers commonly consist of a presiding officer known as the president, chairman, speaker or moderator; a vice-presiding officer; a recording officer, known as the secretary or clerk, who keeps the records, attends to the clerical work of the organization and in the absence of the presiding officers calls for the selection of a temporary president; a treasurer or bursar, who receives and disburses its funds; and a sergeant-at-arms, who preserves order and carries out the wishes of the assembly through the presiding officer.

It is the duty of the presiding officer to call the assembly to order at the appointed time, cause the journal or minutes of the preceding meeting to be read, call up the business of the assembly in the order provided by its rules and conduct its proceedings in accordance with parliamentary law. He is especially charged with the responsibility of ascertaining the presence of a quorum, the minimum number of members prescribed by the rules of the assembly as competent to transact business. In legislative assemblies a quorum is presumed to be present unless the question is raised, but where the by-laws of an ordinary assembly require a quorum it devolves upon the presiding officer to ascertain that a quorum is present before proceeding with business.

Motions.—The will of an assembly is determined and expressed by its action on proposals submitted for its consideration in the form of motions or resolutions offered by members recognized for that purpose. In order to make a motion a member must rise and address the chair and secure recognition. If the motion is in order and is seconded by another member it is "stated" by the presiding officer and is then subject to the action of the assembly. A second is not required in legislative assemblies but is requisite under general parliamentary law. Motions may be classified as main or principal motions, introducing a proposition; and secondary or ancillary motions, designed to affect the pending main motion or its consideration. A main motion is in order only when there is no other business before the assembly, and yields in precedence to all other questions. Secondary motions may be subdivided into subsidiary, incidental and privileged.

Subsidiary motions are applicable to other motions for the purpose of modifying the main question or affecting its consideration and disposition. They have precedence of the motion to which applied but yield to privileged and incidental motions. They take precedence among themselves in the following order: To lay on the table, for the previous question, to close or extend debate, to postpone to a day certain, to commit, recommit and refer, to amend and to postpone indefinitely.

Motion to Lay on the Table.—The motion to lay on the table is in effect a motion to suspend consideration of the question and if agreed to, also suspends consideration of all pending questions relating to the motion to which applied until such time as the assembly may determine to take it from the table for further consideration. The motion is not debatable and may not be amended, postponed, committed, divided or reconsidered.

Motion for the Previous Question.—The purpose of the motion for the previous question is to close debate peremptorily and bring the assembly to an immediate vote on the pending question. It may be ordered on a single question, a group of questions or any part of a pending question, as on an amendment. It precludes both debate and amendment and requires a majority vote only for passage. It yields to the motion to table, to the question of consideration and to privileged and incidental motions and may be reconsidered, but takes precedence of motions to postpone, amend and commit.

Motion to Close or Extend Debate.—The motion is not admitted in either house of the U.S. Congress when not sitting as committee of the whole but is in order under general parliamentary law and in so far as applicable is subject to the rules governing the previous question.

Motion to Postpone to a Day Certain.—This applies to the main motion and its pending amendments and is debatable only as to the advisability of the postponement proposed, and does not open to debate the subject matter of the motion to which applied. It is subject to amendment and reconsideration, to privileged and incidental motions, to motions for the previous question and to lay on the table but has precedence of all other subsidiary motions.

Motion to Commit, Recommit and Refer.—The motions to commit, recommit and refer are practically equivalent and provide for reference of the pending proposition to a committee. While the motion to recommit ordinarily applies to the whole subject including pending amendments, it may apply to certain features only. It may be amended as by adding instructions to the committee as to time and manner of report. Debate on the motion is limited to the question of reference and instructions. It takes precedence of motions to amend and indefinitely postpone but yields to other subsidiary motions and to all incidental and privileged motions. It may be tabled or postponed with the main question but no subsidiary motions except the motions to amend and for the previous question may be applied separately. It is subject to reconsideration at any time before the committee begins consideration of the question submitted to it but after that time the subject matter may only be reclaimed by a motion to discharge the committee.

Motion to Amend.—Changes in the text or terms of the proposition require a second and must be reduced to writing if requested by the chairman. There is no limit to the number of amendments which may be proposed and new amendments may be offered as rapidly as the pending amendment is disposed of. Amendments in the second degree, that is, amendments to amendments, are admissible but amendments in the third degree, that is amendments to amendments to amendments, are not in order. Only four amendments in the first and second degrees may be pending simultaneously, as follows: (*a*) amendment, (*b*) amendment to the amendment, (*c*) substitute for the amendment (*i.e.,* when it is desired to replace the entire pending amendment) and (*d*) amendment to the substitute. The amendment must, of course, be offered first and the substitute before the amendment to the substitute, but otherwise there is no rule governing the order in which the four amendments may be presented. They must, however, be voted on in the following order: First, amendments to the amendment; second, amendments to the substitute; third, the substitute; and last, the amendment. Debate on an amendment is in order only when the main motion is debatable, and is then limited to the proposed modification. An amendment which has been rejected may not be offered the second time in identical form, and no amendment may be proposed reversing the operation of an amendment previously adopted. Motions to amend will not be entertained unless germane or relevant to the main question, and no proposition different from that under consideration will be admitted under guise of amendment. This motion yields to all privileged, incidental and subsidiary motions except indefinite postponement. It is subject to amendment, to the operation of the previous question and to reconsideration, and when laid on the table carries with it the proposition proposed to be amended. Likewise when the main question is laid on the table, postponed or recommitted, all pending amendments accompany it. The motion to amend is not applicable to the motion to lay on the table or for the previous question, to adjourn or to suspend the rules.

Motion to Postpone Indefinitely.—The motion to postpone indefinitely provides for final adverse disposition for the session and amounts to summary rejection. It is debatable and opens to debate the question to which applied but is subject to no subsidiary motion except the motion for the previous question.

Incidental Motions.—Incidental motions include questions arising incidentally in the consideration of other questions and decided before disposition of the one to which they are incident. They have no relative rank and merely take precedence of the pending question in the consideration of which they have arisen. All are undebatable with the exception of appeal. They comprise motions to suspend the rules, withdraw motions, read papers, raise the question of consideration, questions of order and

appeal, reconsider, take up out of order, determine method of procedure, divide pending questions and questions relating to nominations.

The motion temporarily to suspend the rules may not be debated or reconsidered and is not subject to the application of any subsidiary motion. The vote required to pass the motion is ordinarily fixed by the rules of the assembly and in the absence of such provision is two-thirds of those present and voting.

Withdrawal or modification of a motion after it has been "stated" by the presiding officer is usually effected by unanimous consent but in event of objection by any member must be submitted to the assembly. Consent of the seconder is not required but if modified the seconder may withdraw the second. When applied to the main motion it includes all adhering motions, but when applied to amendments or adhering motions the main question is not affected. The reading of papers on which a vote is to be taken may be demanded by any member as a matter of right. Papers on which a vote is not required are usually read by unanimous consent but if objection is made the question must be submitted to the assembly.

The question of whether the assembly desires to take up a proposition regularly presented for its consideration may be tested by raising the question of consideration, which may be moved at any time before actual consideration commences and does not require a second. It is not in order after debate begins or after a subsidiary motion has been applied. When the question is properly raised the assembly may by a two-thirds adverse vote decline to take up any business it prefers not to consider.

Points of Order may be made while another has the floor, and when the question concerns the use of unparliamentary language the member so called to order must be seated pending disposition of the matter. The question must be raised at the time the proceeding giving rise to the objection occurs and will not be entertained after the assembly has passed to other business. If the point of order is overruled the member resumes the floor but if the objection is sustained he may proceed only by consent of the assembly. Debate on questions of order is for the information of the chair and may be closed by the presiding officer at any time. Any member may appeal from a decision by the chair and such appeal is debatable unless arising out of an undebatable question.

The motion to reconsider must be made by one who voted with the prevailing side but may be seconded by any member. It is only in order on the day or the next calendar day after the vote proposed to be reconsidered is taken. The motion is of the highest privilege and may be entered for record on the minutes while another has the floor, but can not be called up for consideration until the pending question is disposed of, when it takes precedence of all new business. If applied to a debatable question it reopens the entire subject to debate. The motion may not be amended, committed or indefinitely postponed and requires a majority vote for passage. If agreed to, the motion reopens the entire question for further action as if there had been no final decision. The motion to take up out of order is merely another form of the motion to suspend the rules and requires a two-thirds vote for enactment. It is not amendable and debate is limited to the specific question presented.

A motion to divide the question is in order where the pending question includes propositions so distinct that, one being taken away, a substantive proposition will remain. Such motions are applicable to main questions and their amendments only and no subsidiary motion except the motion to amend is admitted. The rules of the U.S. House of Representatives provide that any member may demand the division of a question as a matter of right, but under general parliamentary procedure the question must be submitted to the vote of the assembly.

Nominations do not require a second. Where the rules of an assembly fail to provide a method of nomination a motion for such provision is in order. The motion to close nominations is subject to none of the subsidiary motions save the motion to amend, and is decided by a two-thirds vote.

Privileged Motions relate to the needs and interests of the assembly and its members in matters of such urgent importance as to supersede temporarily pending business. They take precedence of all other motions and may be offered while other questions are pending. In this class of motions is the motion to fix the time to which to adjourn, to adjourn, to take a recess, raising questions of privilege and the call for the orders of the day, all of which are undebatable.

Other motions variously referred to as supplementary, miscellaneous and unclassified, are the motions to take from the table, to discharge a committee, to accept the report of a committee, to rescind, to repeal, to annul, to expunge and to permit a member to resume the floor after having been called to order for words spoken in debate.

Rules for Debate.—In order to debate a question, a member must rise and address the chair and be recognized by the presiding officer for that purpose. The presiding officer should first recognize the mover of a proposition or the member of a committee presenting a report and should endeavour to alternate recognitions between those favouring and those opposing a question. It is also customary, though not necessarily incumbent upon the chair, to permit the proponent of a proposition to close debate. A member may speak but once on the same question at the same stage of the proceedings if others desire recognition, but is entitled to speak on the main question and on each amendment as presented. Under general parliamentary procedure a member securing the floor may speak without limit and this practice still obtains in the U.S. Senate, but the House of Representatives by rule limits speakers to one hour in the House and to five minutes in the committee of the whole. Most assemblies and all legislative bodies provide a limit for debate and in conventions it is customary to adopt a rule at the opening session limiting debate to a specified number of minutes. In debate a member must confine himself to the question under consideration, must avoid personalities and must not arraign motives. Members should be silent and respectful while another has the floor and in questioning the speaker should first address the chair, who will in turn inquire if the speaker desires to yield. Where the presiding officer is a member of the assembly he has the right to debate and to participate in the proceedings but should call another to the chair before taking the floor and should not resume it again until the pending question has been decided.

Voting.—Voting may be by ballot; by division, that is a rising vote; *viva voce*, that is by acclamation, the presiding officer deciding by the volume of voices; by show of hands; by tellers, the members passing between tellers appointed from opposite sides to count them as they pass through; and by yeas and nays, the clerk calling the roll and recording each vote as given. If there is doubt as to the result of a *viva voce* vote any member may request a division and the presiding officer thereupon proceeds to take a rising vote. A member may change his vote at any time prior to announcement of the result. Only members in attendance may vote and voting by proxy is never permissible unless by operation of law. A tie vote defeats an affirmative motion. The presiding officer if a member of the assembly votes to break a tie but not to make one.

Committees.—Much of the work of assemblies and especially of legislative bodies, is transacted by committees. The committee system provides for a better division of labour and for a more detailed consideration than the assembly as a whole is ordinarily prepared to give. Committees are classified as standing committees, with fixed terms of office, rendering continuous service; and special committees serving temporarily and assigned to limited service. In the absence of a rule making other provision, committees are selected by the assembly. Frequently the chair is authorized to appoint committees. Or selection may be made by ballot, by resolution or by designation in motions of reference. If no chairman is designated the member first named acts as chairman until the committee elects a chairman. As far as applicable the rules of the assembly govern its committees. The chairman of the committee submits its report to the assembly and unless it is of elementary character is required to present it in writing. Members who do not concur in the report may submit minority views over their signatures. When called up for con-

sideration in the assembly such minority report is read in connection with the majority report unless there is objection, in which event the question of reading the minority views is submitted without debate to the vote of the assembly

The committee of the whole consists of the entire assembly acting as a general committee. In legislative assemblies it affords greater freedom of consideration, but in non-legal bodies is rarely used

Parliamentary Practice.—Use of motions to effect a purpose in the assembly or its committees when applicable may be summarized as follows: The body may protect itself against business which it does not wish to consider by invoking the motion to lay on the table, by raising the question of consideration, or by voting to postpone indefinitely. If it is desired to suppress debate, the motion to limit debate and the demand for the previous question are available Modification of a proposition may be secured through amendment or reference to a committee with or without instructions Action may be deferred by postponement to a day certain, by providing a special order or by the motion to table A question may be brought up a second time for consideration in the assembly by voting to take from the table, by reconsideration or by the motion to rescind, repeal or annul (C. CA)

PARLIAMENTARY PROCEDURE. In Great Britain the procedure of the imperial parliament—by which phrase is signified so much of the conduct of its business as is controlled by each House and is not regulated by statute—does not for the most part depend upon any established code, but is customary and, like the common law which it resembles, is based upon various decisions and precedents In the paragraphs that follow the procedure of the Imperial House of Commons is specially described but, except where otherwise stated, they may be taken as descriptive also of the procedure of the House of Lords

The earliest parliamentary journals now extant are those of the reign of King Edward VI, and an examination of them indicates that already at that time parliamentary procedure was established in its main principles As late as 1844 there were only 14 standing orders of the House of Commons and, although the number has now been increased to over 100, these orders are largely restrictive in character or deal with particular matters and would afford little help in an attempt to construct a code of procedure Recourse must therefore be had to the precedents entered in the journals, to the decisions of speakers and chairmen, sometimes recorded in the journals but more usually to be found in reports of parliamentary debates, to tradition and to the opinions of persons experienced in parliamentary proceedings From all these sources it becomes clear that parliamentary procedure, in its general form and in its details, is directed towards the reconciliation of two often conflicting objects, the progress of business and freedom of discussion

Parliament is summoned, prorogued and dissolved by the Crown, but the sittings of either House may be adjourned from time to time by order of that House, subject to the statutory right of the Crown to summon both Houses to meet, at not less than six days' notice, during such adjournment The daily sittings of each House, and the arrangement of its business, are controlled by that House Under present arrangements both Houses normally meet on Mondays, Tuesdays, Wednesdays and Thursdays, and the House of Commons meets also on Fridays, while parliament is in session In both Houses private business (*i e*, business connected with the passage of private bills) occupies the first part of the sitting, questions to ministers of the Crown concerning public affairs occupy the second part of the sitting, and public business and debate together occupy the remainder of the sitting At half-past eleven o'clock P M on Mondays, Tuesdays, Wednesdays and Thursdays, and at half-past four o'clock P M on Fridays, unless it has previously adjourned, the House of Commons stands adjourned by standing order. At four o'clock P M on Fridays the proceedings on any business then under consideration are interrupted. At eleven o'clock P M on the other four sitting days the proceedings on any business then under consideration are interrupted, unless it is exempt from the provisions of the standing order which regulates the hours of sitting. Thereafter, no opposed business may be taken, unless it is exempt from the provisions of this standing order.

Proceedings taken in pursuance of any act of parliament, or upon any bill originating in committee of ways and means, or upon the report of any committee authorizing the expenditure of public money other than the committee of supply, are exempt from the provisions of this standing order; and any other business may be so exempted by an order of the House made after notice by a minister of the Crown. After the interruption of business, or the conclusion of exempt business, any business appointed for the sitting may be taken, if unopposed: any business not disposed of before the end of the sitting stands over until the next sitting or until such other sitting as the member in charge of the business may appoint. The quorum of the House of Lords is three, and of the House of Commons 40.

The Speaker.—At the beginning of each new parliament the House of Commons elects, and submits to the Crown for its approval, a Speaker, who presides over the deliberations of the House, maintains order in its debates, decides doubtful points of order, puts questions for the decisions of the House and declares the decisions Every order or resolution of the House is based upon a question put from the chair, founded on a motion made by a member and agreed to by the House with or without amendment The Speaker has the power to decline to submit to the House a motion that obviously infringes the rules which govern its proceedings, or to put forthwith, without permitting debate thereon, a "dilatory" motion (*i e.*, a motion for the adjournment of the House or of the debate): he has the power to repress irrelevance or repetition in debate and to deal summarily with a claim for a division which, in his opinion, is unnecessarily made. he has the power to accept or to refuse to accept a motion "That the question be now put," which brings debate to a conclusion and compels the House to decide upon the matter under discussion: he has the power to maintain order in the House by calling members to order, by directing them to withdraw from the precincts of the House for the remainder of the day's sitting, or by naming them to the House. In the last case the House will immediately proceed to vote upon the question that the member so named be suspended from the service of the House The House further reserves to itself the right to deal with its members according to ancient usages, including the right of expulsion In addition to the powers already mentioned the Speaker has the power, in the case of grave disorder, to adjourn the House without question put or to suspend any sitting for a time to be named by him

LEGISLATION

Legislation by parliament, which in earlier times was founded upon petitions from the Commons, is now conducted by means of bills, which, unless they are governed by the Parliament Act, 1911, must be passed by both Houses and receive the royal assent Over what may, for the sake of convenience, be called delegated or subsidiary legislation parliament has retained to itself some control Thus measures of the National Assembly of the Church of England are only presented for royal assent after resolutions to that effect have been agreed to by both Houses; while, of the rules and orders made by departments, or statutory commissioners, some require an affirmative resolution of both Houses to make them operative and others, although they become operative at once, can be abrogated by a resolution or address of either House passed within the statutory period

Bills, which generally may originate in either House, are divided into the two classes of public and private bills. Public bills, relating to matters of public policy, are introduced directly by members of the House, and when introduced by unofficial members are commonly known as private members' bills, to distinguish them from Government bills: private bills, designed for the particular interest or benefit of any person or persons, are founded upon the petitions of the parties interested A public bill may be introduced on motion, or presented without any motion; the latter process is now usually adopted, and the bill is deemed, after its

presentation, to have been read the first time. After a bill has been introduced it is ordered to be read a second time upon some future day, and to be printed in order that its contents may be published and distributed to members. The first, second and third readings of a bill consist, not in any actual reading of words, but in the advancement by a stage in the passage of a bill. At its second reading the whole principle of the bill is at issue, to be affirmed or denied by a vote of the House. The opponents of the bill, instead of voting against the question "That the bill be now read a second time," ordinarily move that the question be amended by the omission of the word "now" and the addition at the end of the question of the words "upon this day three (*or* 'six') months" or any date beyond the probable duration of the session: the postponement of a proceeding upon a bill in this manner is regarded as the most courteous method of dismissing the bill from further consideration. The acceptance by the House of such an amendment is tantamount to the rejection of the bill and, even if the House be sitting upon the date to which the proceeding has been postponed, the bill is not further considered upon that date. It is also competent to a member to move a "reasoned" amendment to a motion for the second reading of the bill in the form of a resolution declaratory of some principle adverse to the principles, policy or provisions of the bill.

Committees.—After a bill has been read a second time it is considered by a committee of the whole House, a standing committee, or in exceptional circumstances a select committee, who go through it in detail, dealing separately with each of its clauses. If no amendment is offered to any part of a clause the chairman of the committee at once puts the question "That the clause stand part of the bill": if, however, an amendment is proposed the chairman puts the question upon the amendment. Amendments may be made in every part of the bill, whether in the preamble, the clauses or the schedules. Clauses and schedules may be omitted, and new clauses and schedules may be added. But all amendments must be coherent, consistent with the context of the bill and within the scope of the bill. When a clause has been amended the question put from the chair is "That the clause, as amended, stand part of the bill," and no other amendment to a clause can be proposed after this question has been proposed from the chair. If a new clause is offered, so long as it is not beyond the scope of the bill, inconsistent with clauses agreed to by the committee or substantially the same as a clause previously negatived by the committee, it is read the first time without question put. A question is then put for reading the clause a second time and, if this is agreed to, the clause may be amended before being added to the bill. In the House of Commons, new clauses are considered after the clauses of the bill, as printed, have been disposed of; but in the House of Lords new clauses are brought up and inserted in their proper places while the committee are going through the bill. Schedules to a bill are usually considered after the clauses of the bill, including new clauses, have been disposed of. After the clauses and schedules have been agreed to, the preamble of the bill is considered, and the bill is then reported to the House.

A bill, on being reported from a committee, is considered by the House as a whole and not clause by clause, but otherwise in much the same detail as by the committee, and thereafter passes to its third reading. If it is read the third time it is then sent to the other House and, after passing through the same stages there, is presented for royal assent.

Finance.—A characteristic feature of House of Commons procedure is the necessity for the recommendation by the Crown of any financial business, and for its consideration in committee of the whole House. When the main object of a bill is the creation of a charge upon the public revenue, a resolution, to which the royal recommendation has been signified, must be passed in committee of the whole House, and approved by the House, before the bill may be introduced. If the charge created by a bill is a subsidiary feature, resulting from the provisions it contains, a resolution sanctioning the charge must be passed by a committee of the whole House, appointed upon the recommendation of the Crown, and must be agreed to by the House, before the relevant provisions of the bill are considered in committee. In either case the financial provisions of the bill, and any amendments to the bill in committee, must be covered by the financial resolution. In the committee of supply and the committee of ways and means, which are both committees of the whole House, the financial duties of the House of Commons are mainly discharged. The committee of supply controls the public expenditure by considering the grants of money that will be required for the navy, army, air services and civil services during the current year, upon the estimates of that expenditure proposed by the ministers of the Crown. The committee of ways and means considers such taxation as is needed to meet the expenditure required for the service of the Crown, and votes the resolutions that authorize the issue out of the Consolidated Fund of the sums required to meet the grants made by the committee of supply. These latter resolutions are the preliminary stages of Consolidated Fund bills, while the resolutions imposing taxes form the basis of the Finance bill. The resolutions of the committee of supply and of ways and means are reported to the House and must be agreed to by the House. In contrast with many otherwise comparable assemblies, parliament has no executive committees. (C. L. F.)

PARMA, a town and episcopal see of Emilia, Italy, capital of the province of Parma, situated on the Parma, a tributary of the Po, 55 m. N.W. of Bologna by rail. Pop. (1921) 58,469 (town), 62,603 (commune). Parma lies in a fertile tract of the Lombard plain, within view of the Alps and sheltered by the Apennines, 170 ft. above sea-level. From south to north it is traversed by the channel of the Parma, crossed here by five bridges; and from east to west runs the line of the Via Aemilia, by which ancient Parma was connected on the one hand with *Ariminum* (Rimini), and on the other with *Placentia* (Piacenza). The old ramparts and bastions now converted into avenues make an enceinte of about 4½ m. The cathedral of the Assumption (originally S. Herculanus) (1058–74), is a Lombardo-Romanesque building in the form of a Latin cross. The west front has three rows of arches, and a central porch supported by huge red marble lions, sculptured with the rest of the façade by Giovanni Bono da Bissone in 1281. On the south side of the façade is a large Gothic brick campanile (1284–94), with the foundations of another on the north. The walls and ceiling of the fine Romanesque interior are covered with frescoes of about 1570; those of the octagonal cupola representing the Assumption of the Virgin are by Correggio. In the sacristy are fine intarsias. To the south-west of the cathedral stands the baptistery, designed by Benedetto Antelami; it was begun in 1196 and not completed till 1281.

The church of S. Giovanni Evangelista, which dates from 1510, has a façade of 1604–07. The frescoes of the cupola are by Correggio, and the arabesques on the vault of the nave by Anselmi. The Madonna della Steccata (Our Lady of the Palisade), a fine church in the form of a Greek cross (1521–39) contains the tombs and monuments of many of the Bourbon and Farnese dukes of Parma. In the Palazzo della Pilotta is a vast irregular group of buildings (16th and 17th centuries) with the academy of fine arts (1752) and the valuable picture gallery, library, and museum. The Teatro Farnese, a remarkable wooden structure erected in 1618 from Aleotti's designs, and capable of containing 4,500 persons, is also in this palace. There are other beautiful ceiling frescoes by Correggio in the former Benedictine nunnery of S. Paolo. The royal university of Parma, founded in 1601 by Ranuccio I., and reconstituted by Philip of Bourbon in 1768, has faculties in law, medicine and natural science, and possesses an observatory, and natural science collections. It had 440 students in 1925–26. A very considerable trade is carried on at Parma in grain, cattle and the dairy produce of the district, especially the cheese known as Parmesan. Railways run hence to Sarzana through the Apennines (part of the shortest route from Milan to Rome), to Piadena (for Cremona and Mantua) and Brescia, and to Suzzara.

History.—From archaeological discoveries it would appear that the ancient town was preceded by a prehistoric settlement of the bronze age, the dwellings of which rested upon piles—one, indeed, of the so-called *terremare,* which are especially frequent

in the neighbourhood of Parma. It became a Roman colony of 2,000 colonists in 183 B.C., four years after the construction of the Via Aemilia, on which it lay. A bishop of Parma is mentioned in the acts of the council of Rome of A.D. 378. It fell into the power of Alboin in 569 and became the seat of a Lombard duchy; it was still one of the wealthiest cities of Aemilia in the Lombard period. During the 11th, 12th and 13th centuries Parma had its full share of the Guelph and Ghibelline struggles, in which it mainly took the part of the former, and also carried on repeated hostilities with Borgo San Donnino and Piacenza. As a republic its government was mainly in the hands of the Rossi, Pallavicino, Correggio and Sanvitale families. In 1307 the city became a lordship for Giberto da Correggio, who laid the basis of its territorial power by conquering Reggio, Brescello and Guastalla, and was made commander-in-chief of the Guelphs by Robert of Apulia. The Correggio family never managed to keep possession of it for long, and in 1346 they sold it to the Visconti (who constructed a citadel in 1356), and from them it passed to the Sforza. Becoming subject to Pope Julius II. in 1512, Parma remained (in spite of the French occupation from 1515 to 1521) a papal possession till 1545, when Paul III. (Alexander Farnese) invested his son Pierluigi with the duchies of Parma and Piacenza. There were eight dukes of Parma of the Farnese line (*q.v.*). After the failure of the line in 1731, the duchy was chiefly in Spanish hands, though it twice passed temporarily under Austrian rule, until its conquest by the French revolutionary armies in 1796. At the congress of Vienna, Parma, Piacenza and Guastalla were assigned to Marie Louise (Napoleon's second consort). In 1860 Parma was formally incorporated with the new kingdom of Italy.

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PARMENIDES OF ELEA (Velia) in Italy, Greek philosopher. According to Diogenes Laertius he was "in his prime" 504–500 B.C., and would thus seem to have been born *c.* 539. Plato indeed (*Parmenides*, 127 B) makes Socrates hear Parmenides when the latter was about sixty-five years of age, in which case he cannot have been born before 519; but in the absence of further evidence this may be regarded as one of Plato's anachronisms. At all events Parmenides was a contemporary of Heraclitus. Parmenides attached himself for a time to the aristocratic brotherhood which Pythagoras had established at Croton; and accordingly the physical part of his system is apparently Pythagorean. The theological speculations of Xenophanes, the founder of Eleaticism, unquestionably suggested to him the theory of Being and Not-Being, of the One and the Many, by which he sought to reconcile Ionian "monism," or rather "henism," with Italiote dualism.

Parmenides embodied his tenets in a short poem, called *Nature*, of which about 160 lines have been preserved in the writings of Sextus Empiricus, Simplicius and others. It is traditionally divided into three parts—the "Proem," "Truth" (τὰ πρὸς ἀλήθειαν), and "Opinion" (τὰ πρὸς δόξαν).

Proem.—In the "Proem" the poet describes his journey from darkness to light. Borne in a chariot, attended by the daughters of the sun, he reaches a temple sacred to an unnamed goddess (variously identified by the commentators with Nature, Wisdom or Themis), by whom the rest of the poem is spoken. He must learn all things, she tells him, both truth, which is certain, and human opinions; for, though in human opinions there can be no "true faith," they must be studied for what they are worth.

Truth.—There are three ways of research, and three ways only. Of these, one asserts the non-existence of the existent and the existence of the non-existent; another, pursued by "restless" persons, whose "road returns upon itself," assumes that a thing "is and is not," "is the same and not the same." These are ways of error, because they confound existence and non-existence. In contrast to them the way of truth starts from the proposition that "what is, is; what is not, is not."

The what is is uncreated, for it cannot be derived either from *Ens* or from *Non-Ens;* it is imperishable, for it cannot pass into *Non-Ens;* it is whole, indivisible, continuous, for nothing exists to break its continuity in space; it is unchangeable (for nothing exists to break its continuity in time); it is perfect, for there is nothing which it can want; it never was, nor will be, but only is; it is evenly extended in every direction, and therefore a sphere, exactly balanced; it is identical with thought (*i.e.*, it is the sole object, of thought as opposed to sensation, sensation being concerned with variety and change).

As then the what is is one, invariable and immutable, all plurality, variety and mutation belong to the what is not. Whence it follows that all things to which men attribute reality, generation and destruction, being and not-being, change of place, alteration of colour are no more than empty words.

Opinion.—It remains in "Opinion" to describe the plurality of things, not as they are, for they are not, but as they appear. In the phenomenal world there are, it has been thought (and Parmenides accepts the theory, which appears to be of Pythagorean origin), two primary elements—namely, fire, which is gentle, thin, homogeneous, and night, which is dark, thick, heavy. Of these elements (which, according to Aristotle, were, or rather were analogous to, the what is and the what is not respectively) all things consist. The foundation for a cosmology thus being laid in dualism, the poem describes the generation of "earth and sun, and moon and air that is common to all, and the milky way, and furthest Olympus, and the glowing stars"; but the scanty fragments which have survived only show that Parmenides regarded the universe as a series of concentric spheres composed of the two primary elements and of combinations of them, the whole system being directed by an unnamed goddess established at its centre. Next came a theory of animal development, followed by a psychology, which made thought (as well as sensation, which was conceived to differ from thought only in respect of its object) depend upon the excess of the one or the other of the two constituent elements, fire and night. "Such, opinion tells us, was the generation, such is the present existence, such will be the end, of those things to which men have given distinguishing names."

In the truism "the what is, is, the what is not, is not," ὂν ἔστι, μὴ ὂν οὐκ ἔστι, Parmenides breaks with the physicists of the Ionian succession. Asking themselves—What is the material universe, they had replied respectively—It is water, It is μεταξύ τι, It is air, It is fire. Thus, while their question meant What is the single element which underlies the apparent plurality of the material world? their answers, Parmenides conceived, by attributing to the selected element various and varying qualities, reintroduced the plurality which the question sought to eliminate. If we would discover that which is common to all things at all times, we must exclude, he submitted, the differences of things, whether simultaneous or successive. Hence, whereas his predecessors had confounded that which is universally existent with that which is not universally existent, he proposed to distinguish between that which is universally existent and that which is not universally existent. The fundamental truism is the epigrammatic assertion of this distinction.

In short, the single corporeal element of the Ionian physicists was, to borrow a phrase from Aristotle, a permanent οὐσία having πάθη which change; but they either neglected the πάθη or confounded them with the οὐσία. Parmenides sought to reduce the variety of nature to a single material element; but he strictly discriminated the inconstant πάθη from the constant οὐσία and, understanding by "existence" universal, invariable, immutable being, refused to attribute to the πάθη anything more than the semblance of existence. Again, whereas the Ionians, confounding the unity and the plurality of the universe, had neglected plurality, and the Pythagoreans, contenting themselves with the reduction of the variety of nature to a duality or a series of dualities, had neglected unity, Parmenides, taking a hint from Xenophanes, made the antagonistic doctrines supply one another's deficiencies.

By his recognition of an apparent plurality supplementary to the real unity, Parmenides effected the transition from the

"monism" or "henism" of the first physical succession to the "pluralism" of the second. While Empedocles and Democritus are careful to emphasize their dissent from "Truth," it is obvious that "Opinion" is the basis of their cosmologies. The doctrine of the deceitfulness of "the undiscerning eye and the echoing ear" soon established itself, though the grounds upon which Empedocles, Anaxagoras and Democritus maintained it were not those alleged by Parmenides. Indirectly, through the dialectic of his pupil and friend Zeno and otherwise, the doctrine of the inadequacy of sensation for a time threatened to put an end to philosophical and scientific speculation. But the positive influence of Parmenides's teaching was not yet exhausted. To say that the Platonism of Plato's later dialogues, the *Parmenides*, the *Philebus* and the *Timaeus*, is the philosophy of Parmenides reconstituted, may perhaps seem paradoxical in the face of the severe criticism to which Eleaticism is subjected, but the criticism was preparatory to a reconstruction. Thus may be explained the selection of an Eleatic stranger to be the chief speaker in the *Sophist*, and of Parmenides himself to take the lead in the *Parmenides*. In the former, criticism predominates over reconstruction, the Zenonian logic being turned against the Parmenides metaphysic in such a way as to show that both the one and the other need revision: *see* 241 D, 244 B *seq.*, 257 B *seq.*, 258 D. In particular, Plato taxes Parmenides with his inconsistency in attributing to the fundamental unity extension and sphericity, so that "the worshipped ὄν is after all a pitiful μὴ ὄν" (W. H. Thompson). In the *Parmenides* reconstruction predominates over criticism—the letter of Eleaticism being here represented by Zeno, its spirit, as Plato conceived it, by Parmenides. Not the least important of the results obtained in this dialogue is the discovery that, whereas the doctrine of the "one" and the "many" is suicidal and barren so long as the "solitary one" and the "indefinitely many" are absolutely separated (127 C *seq.* and 163 B *seq.*), it becomes consistent and fruitful as soon as a "definite plurality" is interpolated between them (142 B *seq.*, 157 B *seq.*, 160 B *seq.*). In short, Parmenides could not in a true sense be regarded as an idealist, but Plato recognized in him, and rightly, the precursor of idealism.

Bibliography.—The fragments have been skilfully edited by H. Diels, in *Parmenides Lehrgedicht, griechisch u. deutsch* (Berlin, 1897), with commentary; in *Poetarum philosophorum fragmenta*, with brief Latin notes, critical and interpretative (1901); and in *Die Fragmente d. Vorsokratiker* (Bd. i. [4th ed. 1922], with German translation); Diels' text is reproduced with a helpful Latin commentary in Ritter and Preller's *Hist. phil. graecae* (ed. E. Wellmann, Gotha, 1898). The philosophical system is expounded by E. Zeller, *D. Philosophie d. Griechen* (Eng. trans., 1881); by T. Gomperz, *Greek Thinkers*, vol. i. (Eng. trans., 1901); and by J. Burnet, *Early Greek Philosophy* (3rd. ed. 1920). For the cosmology, *see* A. B. Krische, *D. theologischen Lehren d. griechischen Denker* (Göttingen, 1840). On the relations of Eleaticism and Platonism, *see* W. H. Thompson, "On Plato's *Sophist*," in the *Journal of Philology*, viii.; C. Reinhardt, *Parmenides und die Geschichte der griechischen Philosophie* (Bonn, 1916). For other texts, translations, commentaries and monographs *see* the excellent bibliography in Überweg's *Grundriss d. Geschichte d. Philosophie* Bd. i. (1926). (H. Jn.)

PARMENIO (*c.* 400–330 B.C.), Macedonian general in the service of Philip II. and Alexander the Great. During the reign of Philip Parmenio obtained a great victory over the Illyrians (356); he was one of the Macedonian delegates appointed to conclude peace with Athens (346), and was sent with an army to uphold Macedonian influence in Euboea (342). In 336 he was sent with Amyntas and Attalus to make preparations for the reduction of Asia. Before he left he declared for Alexander in the confusion that followed Philip's murder. In 335 Alexander recalled him, and Parmenio was his second-in-command throughout the conquest of Persia, commanding the left wing at Granicus, Issus and Gaugamela, at which last he was outmanoeuvred by Mazaeus, his formation was cut in half and he had to send to Alexander for help. When Alexander went on to Drangiana he left Parmenio behind to guard his communications in Media; on the campaign Philotas, Parmenio's son, was charged with conspiracy, tried by the army and put to death. Whatever Parmenio's loyalty, and there is some evidence that his reputation was falling with Alexander, it was impossible to leave him in charge of Alexander's communications after that. Alexander decided that his death was preferable to the risk of his defection, and sent orders, swiftly enough to outrun the news, for Parmenio to be killed (330).

See Arrian, *Anabasis;* Plutarch, *Alexander;* Diod. Sic. xvii.; Curtius vii. 2, 11; Justin xii. 5; for modern authorities *see* under Alexander III., the Great; also *Cambridge Ancient History*, vol. vi.

PARMIGIANO (1504–1540), Italian painter. Francesco Maria Mazzola, commonly called Parmigiano, and sometimes Parmigianino, from his birthplace, Parma, was born on Jan. 11, 1504. Losing his father, who was a painter, in early childhood, he was brought up by two uncles, also painters, Michele and Pier-Ilario Mazzola. His faculty for the art developed very young, and he followed the style of Correggio, who settled at Parma in 1518. He did not, however, become an imitator of Correggio; his style in its maturity may be regarded as a fusion of Correggio with Raphael, and thus fairly original. Even at the age of 14 (Vasari says 16) he had painted a "Baptism of Christ," surprisingly mature. Before the age of 19, when he migrated to Rome, he had covered with frescoes seven chapels in the church of S. Giovanni Evangelista, Parma.

Arrived in Rome, he presented specimen pictures to the pope, Clement VII., who assigned to him the painting of the Sala de' Pontefici, the ceilings of which had been already decorated by Giovanni da Udine. He was in Rome during the sack of the city by the soldiers of Charles V. in 1527, and at this date he was engaged in painting the "Vision of St. Jerome"—the earliest known picture by him. It displays the influence of Correggio only in the figure of St. Jerome; the composition shows the overpowering but only temporary influence on him of Michelangelo. Parmigiano left Rome shortly after for Bologna. Here he painted for the nuns of St. Margaret his most celebrated altarpiece (now in the Academy of Bologna), the "Madonna and Child, with Margaret and other Saints."

In 1531 he returned to Parma, and was commissioned to execute an extensive series of frescoes in the choir of the church of S. Maria della Steccata. These were to be completed in Nov. 1532; and half-payment, 200 golden scudi, was made to him in advance. A ceiling was allotted to him, and an arch in front of the ceiling; on the arch he painted six figures—two of them in full colour and four in monochrome—Adam, Eve, some Virtues, and the famous figure (monochrome) of Moses about to shatter the tables of the law. But, after five or six years from the date of the contract, Parmigiano had barely made a good beginning with his promised work and was imprisoned in default. Promising to amend, he was released; but instead of redeeming his pledge he decamped to Casal Maggiore, in the territory of Cremona, where he died on Aug. 24, 1540, before he had completed his 37th year. He was buried in the church of the Servites called La Fontana, near Casal Maggiore.

Grace has rightly been regarded as the chief artistic endowment of Parmigiano. "Un po' di grazia del Parmigianino" (a little or, as we might say, just a spice of Parmigianino's grace) was among the ingredients which Agostino Caracci's famed sonnet desiderates for a perfect picture. The proportions of his figures are over-long for the truth of nature; one of his Madonnas, now in the Pitti, is currently named "La Madonna del collo lungo."

Parmigiano is one of the first Italians to have practised etching; there are but a few prints extant, and they are characterized by his swift and sketchy style, which also appears in his pen drawings. These prints served as material for study to Paolo Veronese and Jacopo Bassano, Primaticcio and the school of Fontainebleau and Andrea Schiavone (Meldolla).

The most admired easel-picture of Parmigiano is the "Cupid Making a Bow," painted in 1536 for Francesco Baiardi of Parma, and now in the Gallery of Vienna. Of his portrait-painting, two interesting examples are the one of Amerigo Vespucci, in the Gallery of Naples, and the painter's own portrait in the Uffizi of Florence.

See Vasari, *Vita* (edit. Milanesi) v.; Affò, *Vita di F. Mazzola* (Parma, 1784); G. Ricci, *La Galleria di Parma* (1896); L. Frohlich-Bum, *Parmigianino* (1921).

PARMOOR, CHARLES ALFRED CRIPPS, 1st Baron (1852–), English lawyer and statesman, was born on Oct. 3, 1852, and educated at Winchester and New College, Oxford. He was called to the bar in 1877, in 1890 became a Q.C. and in 1893 a bencher. He made his reputation as a great ecclesiastical lawyer. In 1895 he was appointed attorney-general to the Prince of Wales, being reappointed in 1901 and 1912. He sat in the House of Commons as Conservative M.P. for various divisions between 1895 and 1914. He is a strong High-churchman, and was appointed chancellor and vicar-general to the province of York in 1900; he was vicar-general to the province of Canterbury (1902–24). In 1914 he was specially appointed a judicial member of the Privy Council and raised to the peerage, and in 1917 he became treasurer of the Middle Temple. Lord Parmoor was a strenuous worker for peace, and took a leading part in many pacifist organizations In the Labour governments of 1924 and 1929 he was Lord President of the Council, and in 1924 represented Great Britain at the Assembly of the League of Nations

He is the author of two standard works, *Law of Compensation* (1881, 5th ed. 1905) and *Law Relating to the Church* (6th ed 1886).

PARNAHYBA or **PARNAHIBA,** a port of the State of Piauhy, Brazil, on the right bank of the Parnahyba river, 250 m. below Therezina. Pop. of the municipality (1920) 24,152. It is the commercial entrepôt of the State, and exports hides, goatskins, cotton and tobacco, chiefly through the small port of Amarração, at the mouth of the Rio Iguarassú, 11 m distant.

PARNASSIANS, a name given to a group of French poets writing between 1866 and 1876 led by two poets in their early twenties, Catulle Mendès and Xavier de Ricart, who with the help of the young publisher, Lemerre, launched the *Parnasse Contemporain* on March 2, 1866. The title was a challenge to the old romantics of the generation of Hugo and Lamartine, and an appeal to the Latin and Hellenic tradition represented by J. du Bellay, André Chénier and the living *tétrarchat,* Leconte de Lisle, Banville, Gautier and Baudelaire, whom the young men took as their patrons. The first series ran to 18 weekly numbers and included poems by 37 writers, the majority unknown or little known to the public. Among them were poets so diverse in temperament as Coppée, Sully Prudhomme, Mallarmé and Verlaine A second series, projected in 1869 but interrupted by the war, appeared in 1871; the third and last in 1876. Impassibility was the movement's catch-word; its object was in general the plastic presentation of themes admitting romantic freedom and colour but excluding romantic sensibility and Byronic egoism; its method, a refined choice and manipulation of phrase, rhythm and stanza.

The spirit of Parnassianism, or the formula "Art for art's sake" and the *mot juste,* had its vogue outside France in the later years of the 19th century, notably in Spain where it found a fine poet in Rubén Darío, and in England where it fitted into the reaction against the ethical preoccupations of the Victorian classics, and produced in J. E. Flecker a belated but highly gifted representative of its central intention, the cultivation of a style at once clear-cut and suggestive. In France the classicizing impulse survived the departure of the symbolists and decadents and is a controlling force in poetry still.

See Catulle Mendès, *Rapport au Ministère d'instruction publique sur le développement de la poésie française* (1902), and *Le Mouvement poétique Français de 1867–1900* (1903).

PARNASSUS (mod *Liákoura* or *Likeri*), a mountain of Greece, 8,070 ft., in the south of Phocis, rising N. of Delphi. Parnassus was one of the most holy mountains in classical Greece, hallowed by the worship of Apollo, of the Muses, and of the Corycian nymphs Its chief peaks are Tithorea and Lycoreia. Two projecting cliffs, named the Phaedriadae, frame the gorge in which the Castalian spring flows out, and to the W. of this, on a shelf above the ravine of the Pleistus, is the site of the Pythian shrine of Apollo and the Delphic oracle. The Corycian cave is on the plateau between Delphi (*q.v.*) and the summit.

PARNASSUS PLAYS, a series of three scholastic entertainments performed at St. John's College, Cambridge, between 1597 and 1603. They are satirical in character and aim at setting forth the wretched state of scholars and the small respect paid to learning by the world at large, as exemplified in the adventures of two university men, Philomusus and Studioso. The first part, *The Pilgrimage to Parnassus,* describes allegorically their four years' journey to Parnassus, *i.e.,* their progress through the university course. The sequel *The Return from Parnassus,* which deals with the adventures of the two students after the completion of their studies at the university, and shows them discovering by bitter experience of how little pecuniary value their learning is

A further sequel, *The Second Part of the Return from Parnassus, or the Scourge of Simony,* is a more ambitious, and from every point of view more interesting, production than the two earlier pieces. In it on pretence of discussing a recently published collection of extracts from contemporary poetry, John Bodenham's *Belvedere,* one of the characters sums up a number of writers of the day, among them being Spenser, Constable, Drayton, John Davies, Marlowe, Jonson, Shakespeare and Nashe.

Their author is unknown, but the plays have generally been regarded as the work of a single writer—possibly John Day or one William Dodd (*see* full discussion in Ward's *Eng Dram. Lit.* ii. 640, note 2). The three pieces were evidently performed at Christmas of different years, and allusions to contemporary matters show that the first cannot have been earlier than 1598 nor the last later than 1602.

Bibliography.—The only part of the trilogy which was in print at an early date was *2 Return,* called simply *The Return from Parnassus, or the Scourge of Simony* (1606), two editions bearing the same date. This has been several times reprinted, the best separate edition being that of Professor Arber in the "English Scholars' Library" (1879) Manuscript copies of all three plays were found among T. Hearne's papers in the Bodleian by the Rev. W. D. Macray and were printed by him in 1886 (the last from one of the editions of 1606, collated with the ms). Prof Moore Smith in his article in *Mod. Lang Rev* x 162–170 gives a number of corrections of Macray's text All questions connected with the play have been elaborately discussed by Dr. W. Luhr in a dissertation entitled *Die drei cambridger Spiele vom Parnass* (Kiel, 1900). (R. B. McK.)

PARNELL, CHARLES STEWART (1846–1891), Irish Nationalist leader, was born at Avondale, Co Wicklow, on June 27, 1846, the son of John Henry Parnell and Delia Tudor, daughter of Commodore Charles Stewart of the U S navy The Parnell family came from Congleton, Cheshire, and counted various distinguished persons among its members. Thomas Parnell, who migrated to Ireland after the Restoration, had two sons, Thomas Parnell the poet and John Parnell, an Irish judge From the latter Charles Stewart Parnell was descended Sir John Parnell, chancellor of the exchequer in Grattan's parliament, and one of O'Connell's lieutenants in the parliament of the United Kingdom, was the grandson of Parnell the judge The estate of Avondale was bequeathed by him to his youngest son, William, grandfather of Charles Stewart Parnell. His second son was Sir Henry Parnell (Baron Congleton), who held office under Grey and Melbourne, and died by his own hand in 1842 Charles Stewart Parnell was much influenced by his mother, who inherited a hatred of England from her father. He was, however, of English extraction, a landowner and a Protestant Educated at private schools in England and at Magdalene College, Cambridge, his temperament and demeanour were singularly un-Irish on the surface—reserved, cold, repellent and unemotional As a schoolboy he was fond of cricket and devoted to mathematics, but had little taste for other studies or other games. He was subject to somnambulism, liable to severe fits of depression, and invincibly superstitious. He was as little at home in an English school or an English university as he was afterwards in the House of Commons. "These English," he said to his brother at school, "despise us because we are Irish, but we must stand up to them That's the way to treat an Englishman—stand up to him "

Parnell took no interest in politics in his early years, but he was deeply moved by stories related to him by servants and peasants of certain revolting cruelties perpetrated by English landlords in the not distant past. He was passionately stirred by the execution of the "Manchester Martyrs" in 1867, but did not yet think seriously of politics, though his sister Fanny was already writing patriotic verse. In the meanwhile he paid a lengthened visit to the United States. At the general election of 1874 he

desired to stand for the county of Wicklow, of which he was high sheriff at the time. The lord-lieutenant declined to relieve him of his disqualifying office, and his brother John stood in his place, but was unsuccessful at the poll. Shortly afterwards a by-election occurred in Dublin, and Parnell stood as a supporter of Isaac Butt, but was beaten He was elected for Meath in 1875.

Butt had scrupulously respected the traditions and courtesy of debate, and disapproved of the obstructive tactics invented by certain members of the Conservative party in opposition to the first Gladstone Administration. Parnell entered parliament as a virtual rebel who knew that physical force was of no avail, but believed that political exasperation might attain the desired results. He resolved to make obstruction in parliament do the work of outrage (he hated outrage and cruelty) in the country, to set the church-bell ringing—to borrow Mr. Gladstone's metaphor—and to keep it ringing in season and out of season in the ears of the House of Commons He would not condemn outrages to gratify English members of parliament. He accepted the alliance of the physical force party. He invented and encouraged "boycotting" as a substitute for outrage In the course of the negotiations in 1882, which resulted in what was known as the Kilmainham Treaty, he wrote to Captain O'Shea: "If the arrears question be settled upon the lines indicated by us, I have every confidence that the exertions we should be able to make strenuously and unremittingly would be effective in stopping outrages and intimidation of all kinds."

In 1877 Parnell entered on an organized course of obstruction He and Joseph Biggar were gradually joined by a small band of the more advanced Home Rulers, and occasionally assisted up to a certain point by one or two English members Butt was deposed William Shaw, a "transient and embarrassed phantom," was elected in his place, but Parnell became the real leader of a Nationalist party. After the general election of 1880 the more moderate section of the Nationalist party ceased to exist. Obstruction in Parnell's hands was a calculated policy, the initial stage of a campaign designed to show the malcontents in Ireland and the Fenian Brotherhood in America that strictly correct parliamentary methods were useless, but that the parliamentary machine could be so handled as to secure Irish legislative independence. The Fenians were hard to convince, but in the autumn of 1877 Parnell persuaded the Home Rule Confederation of Great Britain to depose Butt from its presidency and to elect himself in his place. Parnell's opportunity came with the general election of 1880, which displaced the Conservative government of Lord Beaconsfield and restored Mr Gladstone to power. Parnell would have no alliance with either English party. He would support each in turn with a sole regard to the balance of political power in parliament and a fixed determination to hold it in his own hands if he could. From the time that he became its leader the Home Rule party sat together in the House of Commons and always on the Opposition side. From the first Parnell imposed on the parliamentary party an iron discipline. It was there to obey orders and to vote straight Members, if required, were to speak at indefinite length, to carry out feats of endurance at all-night sittings; to paralyse parliament under the directions of Parnell, who had the eye of genius for the proper action in any emergency.

In the autumn of 1879 Parnell, after some hesitation, had given his sanction to the Land League founded by Michael Davitt. He then crossed to the United States. There the "new departure" —the alliance of the open and the secret organizations—was confirmed and consolidated Parnell obtained the countenance and support of the Clan-na-Gael, a revolutionary organization of the American-Irish, and the Land League began to absorb all the more violent spirits in Ireland, though the Fenian Brotherhood still held officially aloof from it. As soon as the general election of 1880 was announced Parnell returned to Ireland in order to direct the campaign in person. Though he had supported the Liberals at the election, he soon found himself in conflict with the Gladstone government, represented in Ireland by Earl Cowper and W. E. Forster. Parliament was summoned at an early date, and a Coercion Bill for one year, practically suspending the Habeas Corpus Act and allowing the arrest of suspects at the discretion of the government, was introduced, to be followed shortly by Harcourt's Arms Bill. Parnell regarded the measure as a declaration of war. It was doggedly obstructed at every stage, and on one occasion the debate was only brought to a close, after lasting for forty-one hours, by the Speaker's claiming to interpret the general sense of the house and resolving to put the question without further discussion. The rules of procedure were then drastically amended, and as soon as the bill was passed Mr. Gladstone introduced a new Land Bill, which occupied the greater part of the session. Parnell accepted it with many reserves. The Land League at his instigation determined to "test" the act by advising tenants in general to refrain from taking their cases into court until certain cases selected by the Land League had been decided. The government treated this policy as a deliberate attempt to wreck the working of the act On this and other grounds—notably the attitude of the League and its leaders towards crime and outrage—Parnell was arrested under the Coercion Act and lodged in Kilmainham gaol (Oct 17, 1881).

Parnell in prison at once became more powerful than he had ever been outside. Moreover imprisonment gave him rest which his nervous temperament badly needed Several of his leading colleagues followed him into Kilmainham, and the Land League was dissolved, its treasurer, Patrick Egan, escaping to Paris and carrying with him its books and accounts Before it was formally suppressed the League had issued a manifesto, signed by Parnell and several of his fellow-prisoners, calling upon the tenants to pay no rents until the government had restored the constitutional rights of the people. Discouraged by the priests, the No-Rent manifesto had little effect, but it embittered the struggle and exasperated temper on both sides of the Irish Channel.

A *modus vivendi* was desired on both sides. Negotiations set on foot through the agency of Captain O'Shea—at that time and afterwards a close agent of Parnell—resulted in what was known as the Kilmainham Treaty. Parnell and two of his friends were to be released at once, the understanding being, as Gladstone stated in a letter to Cowper, "that Parnell and his friends are ready to abandon 'No Rent' formally, and to declare against outrage energetically, intimidation included, if and when the government announce a satisfactory plan for dealing with arrears" Parnell and his friends were released, and Cowper and Forster resigned.

The Phoenix Park murders (May 6, 1882) followed. (*See* IRELAND. *History.*) Parnell was prostrated by this catastrophe. In a public manifesto to the Irish people he declared that "no act has ever been perpetrated in our country, during the exciting struggle for social and political rights of the past fifty years, that has so stained the name of hospitable Ireland as this cowardly and unprovoked assassination of a friendly stranger" Privately to his own friends and to Mr Gladstone he expressed his desire to withdraw from public life A new Crimes Bill was introduced and made operative for a period of three years, and England was exasperated by a succession of dynamite outrages organized chiefly in America, which Parnell was powerless to prevent. The Phoenix Park murders did more than any other incident of his time and career to frustrate Parnell's policy.

For more than two years after the Phoenix Park murders Parnell's influence in parliament, and even in Ireland, was only intermittently and not very energetically exerted. His health was bad, his absences from the House of Commons were frequent and mysterious, and he had already formed those relations with Mrs. O'Shea which were ultimately to bring him to the divorce court. His nervous and passionate temperament found relaxation in the society of Mrs. O'Shea and in his laboratory where he carried out intricate experiments in assaying. He became a figure more remote and mysterious than ever. The Phoenix Park murderers were arrested and brought to justice early in 1883. Forster seized the opportunity to deliver a scathing indictment of Parnell in the House of Commons. In an almost contemptuous reply Parnell repudiated the charges in general terms, disavowed all sympathy with dynamite outrages, their authors and abettors, declined to plead in detail before an English tribunal, and declared that he sought only the approbation of the Irish people. The Irish people responded by a subscription known as the "Parnell Tribute,"

amounting to £37,000, presented to Parnell, partly for the liquidation of debts he was known to have contracted, but mainly in recognition of his public services. The Irish National League, a successor to the suppressed Land League, was founded in the autumn of 1882 at a meeting over which Parnell presided, but he looked on it at first with little favour.

The Crimes Act, passed in 1882, was to expire in 1885; in May notice was given for its partial renewal and the second reading was fixed for June 10. On June 8 Parnell, with thirty-nine of his followers, voted with the Opposition against the budget, and the government was defeated by 264 votes to 252. Gladstone resigned. Salisbury undertook to form a government, and Carnarvon became viceroy. Carnarvon sought an interview with Parnell, explicitly declared that he was speaking for himself alone, heard Parnell's views, expounded his own, and forthwith reported what had taken place to the prime minister. In the result the new cabinet refused to move in the direction apparently desired by Lord Carnarvon.

Parnell opened the electoral campaign with a speech in Dublin, in which he expressed the hope that "it may be possible for us to have a programme and a platform with only one plank, and that one plank National Independence." Parnell invited Gladstone in a public speech to declare his policy and to sketch the constitution he would give to Ireland subject to the limitations he had insisted on. To this Gladstone replied, "through the same confidential channel," that he could not consider the Irish demand before it had been constitutionally formulated, and that, not being in an official position, he could not usurp the functions of a government. Thereupon Parnell instructed Irish Nationalists in Great Britain to give their votes to the Tories. In these circumstances the general election was fought, and resulted in the return of 335 Liberals, four of whom were classed as "independent," 249 Conservatives and 86 followers of Parnell.

Mr. Gladstone's return to power at the head of an administration conditionally committed to Home Rule marks the culminating point of Parnell's influence on English politics and English parties. And after the defeat of the Home Rule ministry in 1886, Parnell more than once found measures, which had been contemptuously rejected when he had proposed them, ultimately adopted by the government; and the comparative tranquillity which Ireland enjoyed at the close of the 19th century may be ascribed partly to legislation inspired and recommended by himself. In 1886 Parnell introduced a comprehensive Tenants' Relief Bill. The Salisbury government would have none of it, though in the following session they adopted and carried many of its leading provisions. Its rejection was followed by renewed agitation in Ireland, in which Parnell took no part. He was ill—"dangerously ill," he said himself at the time—and some of his more hot-headed followers devised the famous "Plan of Campaign," on which he was never consulted and which never had his approval. Ireland was once more thrown into a turmoil of agitation, turbulence and crime. In the course of the spring of 1887 *The Times* had begun publishing a series of articles entitled "Parnellism and Crime," on lines following Mr. Forster's indictment of Parnell in 1883, though with much greater detail of circumstance and accusation. On April 18 appeared an article accompanied by the facsimile of a letter purporting to be signed but not written by Parnell, in which he apologized for his attitude on the Phoenix Park murders, and specially excused the murder of Mr. Burke. On the same evening, in the House of Commons, Parnell declared the letter to be a forgery. He was not believed, and the second reading of the Crimes Act followed. Later in the session Sir Charles Lewis, an Ulster member and a bitter antagonist of the Nationalists, moved that the charges made by *The Times* constituted a breach of privilege. The government met this proposal by an offer to pay the expenses of a libel action against *The Times* on behalf of the Irish members incriminated. This was refused. Gladstone proposed a select committee of inquiry into the charges, including the letter attributed to Parnell, and to this Parnell assented. But the government rejected the proposal. For the rest, Parnell maintained almost superhuman reticence.

The Parnell Commission.—F. H. O'Donnell, an ex-M.P. and former member of the Irish party, now brought an action against *The Times* for libel. His case was a weak one, and a verdict was obtained by the defendants. But in the course of the proceedings the attorney-general, counsel for *The Times,* affirmed the readiness of his clients to establish all the charges advanced, including the genuineness of the letter which Parnell had declared to be a forgery. Parnell once more invited the House of Commons to refer this particular issue—that of the letter—to a select committee. This was again refused; but after some hesitation the government resolved to appoint by act of parliament a special commission, composed of three judges of the High Court, to inquire into all the charges advanced by *The Times.* This led to what was in substance, though not perhaps in judicial form, the most remarkable state trial of the 19th century. The commission began to sit in September 1888, and issued its report in February 1890. The report of the commission was a voluminous document reporting on the whole of the questions arising out of the relation between parliamentary action and outrage; it was variously interpreted by different parties to the controversy.

The specific charges brought against Parnell personally were thus dealt with by the commissioners:—

(*a*) That at the time of the Kilmainham negotiations Mr. Parnell knew that Sheridan and Boyton had been organizing outrage, and therefore wished to use them to put down outrage.
We find that this charge has not been proved.

(*b*) That Mr. Parnell was intimate with the leading Invincibles; that he probably learned from them what they were about when he was released on *parole* in April 1882; and that he recognized the Phoenix Park murders as their handiwork.
We find that there is no foundation for this charge. We have already stated that the Invincibles were not a branch of the Land League.

(*c*) That Mr. Parnell on 23rd January 1883, by an opportune remittance, enabled F. Byrne to escape from justice to France.
We find that Mr. Parnell did not make any remittance to enable F. Byrne to escape from justice.

Pigott's Forgery.—The argument of Parnell's insincerity based on the facsimile letter alleged to have been written by Parnell condoning the Phoenix Park murders broke down altogether. It had been purchased with other documents from one Richard Pigott, who afterwards tried to blackmail Archbishop Walsh by offering, in a letter which was produced in court, to confess its forgery. Cross-examined by Charles Russell on this letter to the archbishop, Pigott broke down utterly. Before the commission sat again he fled to Madrid, and there blew his brains out. He had confessed the forgery to Labouchere in the presence of G. A. Sala, but did not stay to be cross-examined on his confession. The attorney-general withdrew the letter on behalf of *The Times,* and the commission pronounced it to be a forgery. Shortly after the letter had been withdrawn, Parnell filed an action against *The Times* for libel, claiming damages to the amount of £100,000. The action was compromised out of court by a payment of £5,000.

Practically, the damaging effect of some of the findings of the commission was neutralized by Parnell's triumphant vindication in the matter of the facsimile letter and of the darker charges levelled at him. Towards the close of 1889, before the commission had reported, but some months after the forged letter had been withdrawn, Parnell visited Hawarden to confer with Mr. Gladstone on the measure of Home Rule to be introduced by the latter should he again be restored to power. What occurred at this conference was afterwards disclosed by Parnell, but Mr. Gladstone vehemently denied the accuracy of his statements on the subject.

Divorce Case.—But Parnell's fall was at hand. In December 1889 O'Shea filed a petition for divorce on the ground of his wife's adultery with Parnell. Parnell's intimacy with Mrs. O'Shea had begun in 1881, though at what date it became a guilty one is not in evidence. O'Shea had in that year challenged him to a duel, but was pacified by the explanations of Mrs. O'Shea. It is known that O'Shea had been Parnell's confidential agent in the negotiation of the Kilmainham Treaty, and in 1885 Parnell had strained his personal authority to the utmost to secure O'Shea's return for Galway. It is not known why O'Shea suddenly took action in 1889. No defence being offered, a decree of divorce was pronounced, and in June 1891 Parnell and Mrs. O'Shea were married.

At first the Irish party determined to stand by Parnell. The decree was pronounced on Nov. 17, 1890 On the 20th a great meeting of his political friends and supporters was held in Dublin, and a resolution that in all political matters Parnell possessed the confidence of the Irish nation was carried by acclamation. But the Irish party reckoned without its English allies. At a meeting of the National Liberal Federation held at Sheffield on Nov. 21, John Morley was privately told that the Nonconformists would insist on Parnell's resignation. Parliament was to meet on the 25th. Mr. Gladstone tried to convey to Parnell privately his conviction that unless Parnell retired the cause of Home Rule was lost. But the message never reached Parnell. Gladstone then requested John Morley to see Parnell, but he could not be found. Finally, on the 24th, Gladstone wrote to Morley the famous and fatal letter, in which he declared his conviction "that, notwithstanding the splendid services rendered by Mr Parnell to his country, his continuance at the present moment in the leadership would be disastrous in the highest degree to the cause of Ireland," and that "the continuance I speak of would not only place many hearty and effective friends of the Irish cause in a position of great embarrassment, but would render my retention of the leadership of the Liberal party, based as it has been mainly upon the presentation of the Irish cause, almost a nullity" This letter was not published until after the Irish parliamentary party had met in the House of Commons and re-elected Parnell as its chairman without a dissentient voice. A few days later Parnell was requested by a majority of the party to convene a fresh meeting. It took place in Committee Room No. 15, and after several days of angry recrimination and passionate discussion, during which Parnell, who occupied the chair, scornfully refused to put to the vote a resolution for his own deposition, 45 members retired to another room and there declared his leadership at an end. The remainder, 26 in number, stood by him The party was thus divided into Parnellites and anti-Parnellites, and the schism was not healed until several years after Parnell's death.

This was practically the end of Parnell's political career in England. The scene of operations was transferred to Ireland, and there Parnell fought incessantly a bitter and a losing fight, embittered by the hostility of the Church, which had never approved of a Protestant leader The campaign ended only with his death. An attempt at reconciliation in the party was made in the spring, at what was known as "the Boulogne negotiations," where William O'Brien endeavoured to arrange an understanding; but it came to nothing. Probably Parnell was never very anxious for its success. The life he led, the agonies he endured, the labours he undertook from the beginning of 1891, travelling weekly to Ireland and intoxicating himself with the atmosphere of passionate nationalism in which he moved, would have broken down a much stronger man He who had been outwardly the most impassive of men became restless, nervous, almost distracted at times. He visited Ireland for the last time in September, and the last public meeting he attended was on the 27th of that month. The next day he sent for his friend Dr. Kenny, who found him suffering from acute rheumatism and general debility He left Ireland on the 30th, promising to return on the following Saturday week He did return on that day, but it was in his coffin He died at Brighton on Oct. 6. His remains were conveyed to Dublin, and on the following Sunday they were laid to rest in the presence of a vast assemblage of the Irish people in Glasnevin Cemetery, not far from the grave of O'Connell

The principal materials for a biography of Parnell and the history of the Parnellite movement are to be found in *Hansard's Parliamentary Debates* (1875–91); in the *Annual Register* for the same period; in the *Report of the Special Commission* issued in 1890; in *The Life of Charles Stewart Parnell*, by R. Barry O'Brien; in *The Parnellite Movement*, by T. P O'Connor, M P.; and in a copious biography of Parnell contributed by an anonymous but well-informed writer to the *Dict of Nat. Biog.*, vol xlii. *See* also Mrs. C S. Parnell, *Charles Stewart Parnell; his love story and political life* (2 vols., 1914); J. H. Parnell, *Charles Stewart Parnell* (1916); M. M. O'Hara, *Chief and Tribune; Parnell and Davitt* (1919); St. John G. Ervine, *Parnell* (1925, pop. ed. 1928); A. F. Robbins, *Parnell: the last five years* (1926). (J. R. Th.; X.)

PARNELL, THOMAS (1679–1718), Anglo-Irish poet, born in Dublin, was educated at Trinity college, Cambridge, and in 1700 took his M.A. degree, being ordained deacon in the same year. In 1704 he became minor canon of St. Patrick's cathedral and in 1706 archdeacon of Clogher. In 1713 he was one of the contributors to the *Poetical Miscellanies* edited for Tonson by Steele, and published his *Essay on the Different Styles of Poetry*. He was a member of the Scriblerus Club, and he wrote the "Essay on the Life and Writings and Learning of Homer" prefixed to Pope's translations. In 1716 Parnell was presented to the vicarage of Finglass, when he resigned his archdeaconry. In the same year he published *Homer's Battle of the Frogs and Mice. With the remarks of Zoilus. To which is prefixed, the Life of the said Zoilus.* Parnell died at Chester, where he was buried on the 24th of October, 1718 Parnell's best known poem is "The Hermit."

In 1770 *Poems on Several Occasions* was printed with a life of the author by Oliver Goldsmith. His *Poetical Works* were printed in Anderson's and other collections of the *British Poets*. See *The Poetical Works* (1894) ed. by George A. Aitken for the *Aldine Edition of the British Poets*. His correspondence with Pope is published in Pope's *Works* (ed. Elwin and Courthorpe, vii. 451–467).

PÄRNU, a seaport and watering place of Estonia in 58° 23′ N, 24° 30′ E., on the left bank of the Pärnu river, ½ m. above its entrance into Pärnu Bay, the northern arm of the Gulf of Riga. Pop. (1926), 21,000 There are two government and three private quays, with good anchorage for large vessels, a railway on the quays, extensive warehouses and an icebreaker working from November to April. The imports are salt, herrings, coal, manure and cork wood and the exports flax, timber and woodpulp

Founded on the right side of the river in 1255 by one of the bishops of Saare Maa, Pärnu was in the 16th century occupied in succession by the Swedes, the Poles and the Teutonic Knights After 1599 the Poles transferred the town to the left side of the river; and in 1642 the Swedes, who had been in possession since 1617, strengthened it with regular fortifications In 1710 it was taken by the Russians, and in 1918 was included in Estonia

PAROCHIAL SCHOOLS. In the United States a parochial school is a private elementary school maintained by a Roman Catholic parish Elementary schools conducted by the Roman Catholic Church are generally known in the United States by this name to distinguish them from public schools supported by taxation.

Parochial schools in the United States date from the early 17th century, the first schools having been founded at that time in Florida and New Mexico Prior to 1776, 70 Roman Catholic schools existed within the present confines of the United States The increased immigration, especially from Germany and Ireland, and the consequent expansion of the church after 1840 were the principal factors making for the development of the Roman Catholic school system. The Third Plenary Council of Baltimore (1885) made it obligatory for every parish to maintain a school From 1880 to 1920 the attendance at Roman Catholic schools increased from 405,234 to 1,795,673, the percentage of total increase for the 40 year period being 343·12%

Parochial schools are supported financially by each parish, but form a diocesan system administered by a diocesan superintendent who is subject immediately to the bishop or to the diocesan board of education. Each school has a principal and a supervisor belonging, as a rule, to the religious community. The curriculum of the parish school has practically the same content as that of the public elementary school, to which is added religious education in its many phases The number of hours and the length of the term are the same as in the public school. The text-books used are those ordered by law, or in use in the public school, or texts especially designed for Roman Catholic schools.

The majority of elementary school teachers in parish schools are men and women members of a religious community or order These teachers are required to undergo a professional preparation, in the main the same as that required of public school teachers In order to prepare these teachers, various Roman Catholic universities maintain departments of education. A great number of religious communities have established their own training schools. Teachers' institutes, summer courses and summer school work are offered to teachers in service. Wherever necessary, the teach-

ers obtain State certificates; in other cases they are certified by the Diocesan Board of Education. Over 75% of the teachers in parochial schools are above the age of 25.

The 1926 statistics for Roman Catholic parochial schools are as follows: schools, 7,449; teachers, 55,155 (religious, 50,931; lay, 4,224); attendance, 2,111,560.

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PARODOS, the open space or passage at either side of a Greek theatre, between the stage with its subsidiary buildings and the curved cavea or place for the audience; also an ode sung by the chorus at its entrance, which was always made through the parodos.

PARODY, in the strict meaning of the word, implies a comic imitation of a serious poem (παρῳδία is "a song sung beside"). To ridicule the grandiose is a primary impulse, not confined to any one form of art, or indeed to art at all. It is of this stuff that satire is made, but poetic parody, partly through the accidents of history, has acquired a small literature of its own The Greek epic, the Greek drama, amongst a people quick-witted and politically-minded, were especially liable to this kind of critical assault. Thus, though the true father of parody may well have been the neighbour of the first man who sang, Aristotle is able to attribute the origin of parody as a definite art to Hegemon of Thasos, whose imitation of *The Battle of the Giants* appears to have consoled the Athenians for the disasters of their expeditionary force in Sicily

We have, however, other examples of early Greek parody. There is a fragment of several hundred lines still extant, by Matron, in which the dishes of an Athenian banquet are introduced in the epic style of Homer, and the *Batrachomyomachia*, or *Battle of the Frogs and Mice,* a travesty once ascribed to Homer himself, is certainly far older than Hegemon of Thasos, or Hipponax of Ephesus, another claimant to the title of first parodist Hipponax, a man himself embittered by the rude caricatures of sculptors, wrote a parody of the *Iliad*, of which the four opening lines have been preserved by Athenaeus But the Greek parodist *par excellence* is Aristophanes, who imitates Aeschylus and, with greater gusto, Euripides. His attack upon the latter poet in *The Acharnians* embraces all that is possible in the realm of parody, being a brilliant burlesque not only on mannerisms but on spirit and modes of thought There is no exact parody so penetrating and acute, or rather, none that has been preserved, until we come down to comparatively modern times

It should be remembered, however, that rigid forms of metre and an eagerly sophisticated period of letters are the forcing-ground for the parodist, while burlesque and satire flourish abundantly, especially in light drama, on every kind of soil Roman literature produces the satires of Persius, which contain interludes of parody, some of which are supposed to have been modelled on the verses of Nero Mediaeval romance is mocked in Cervantes' *Don Quixote,* but the verbal felicities here are plainly not so important as the great conception of the satire as a whole. Scarron's *Vergile Travesti,* written about the middle of the 17th century, was borrowed from the Italian Lalli's *Aeneid Travestita*, and part of it was translated into English by Charles Cotton This poem is a coarse burlesque, and not in the true sense parody. In England Shakespeare mimicked Marlowe, and was himself parodied by Marston, who wrote a travesty of *Venus and Adonis.* John Philips, who composed *The Splendid Shilling,* a burlesque of *Paradise Lost,* is described on his monument in Westminster Abbey as a "second Milton" But the epithet, even if humorously intended, is flattering in the extreme.

The English Parodists.—The golden age of English parody may be said to begin with Isaac Hawkins Brown, who wrote very passable imitations of Pope, Thomson and Young. Thenceforward English parody flows in a direct stream, and the popularity of the exercise amongst scholars and wits in this country is in all probability due to the practice of setting compositions after the manner of classical poets as a task for pupils in public schools. It is an easy step from compulsory imitations of the Greek dramatists, of Virgil, Horace and Ovid, to critical imitations of contemporary verse. The *Rejected Addresses* of Horace and James Smith, written as dedicatory odes on the occasion of the re-opening of Drury Lane theatre in 1812, are models of excellent parody, and are even said to have caused no annoyance to the poets on whose work they were based. This is a severe criterion. The authors of the *Bon Gaultier Ballads* created an imaginary contest for the poet laureateship, an office at that time rendered vacant by the death of Southey, and this fashion was followed with great skill by Sir Owen Seaman (during the interregnum between Lord Tennyson and Sir Alfred Austin), in *The Battle of the Bays* C. S. Calverley and J. K Stephen, the former aided not a little by the mediocre quality of the muses finding favour with mid-Victorian readers, wrote parodies which can scarcely be surpassed. Since the triumph of the novel as a form of literary self-expression there have been many amusing imitations of prose romance, notably by Bret Harte, Max Beerbohm and Stephen Leacock, the American parodists, however, paying far more attention to matter than to form

It should be noted that parody, if it is to be worth while, must be criticism It is not by virtue of its self-imposed limitations absolved from the duty of showing some fair cause for ridicule But the target aimed at by the parodist is not always the poet whose dress he wears Satire of current manners, politics, or morals may be conveyed by using parody as a vehicle more powerful and more authoritative than the author's unassisted pen In such cases of borrowed thunder the original author is obviously receiving the tribute of flattery either to his greatness, or to his popularity, or to both Where, however, imitation involves also criticism of the model imitated, adoration is less easily combined with mirth, and there are those who find all parodies of well-loved poets painful to read, if not blasphemous

As an example of parody pressed to its extreme limit as a direct form of literary criticism, the following lines may be quoted:—

Two voices are there: one is of the deep;
It learns the storm-cloud's thunderous melody,
Now roars, now murmurs with the changing sea,
Now bird-like pipes, now closes soft in sleep
And one is of an old half-witted sheep
Which bleats articulate monotony,
And indicates that two and one are three,
That grass is green, lakes damp and mountains steep;
And, Wordsworth, both are thine. at certain times
Forth from the heart of thy melodious rhymes,
The form and pressure of high thoughts will burst:
At other times—Good Lord! I'd rather be
Quite unacquainted with the A B C
Than write such hopeless rubbish as thy worst

This mock sonnet by J K. Stephen will be seen to embody a very general, if rather too sweeping, estimate of the poetry of Wordsworth, whilst copying alike the nobler and the less exalted mannerisms of that poet, turn by turn; yet it preserves throughout these variations the authentic cadence of the sonnet form, serenely undisturbed

Parody then, if well executed, has this merit, that it pours criticism swiftly into an unforgettable mould But much that is written in the name of parody is either on the one hand clownish mimicry, or, on the other, of no more value than a school exercise neatly performed by an assiduous student. It may be added that several famous English poets have parodied their own poetry as a *tour de force*. But they have not done it well. (E V K.)

PAROS or **PARO,** an island in the Aegean sea, 37° N lat. and 25° 10′ E. long., one of the largest of the Cyclades, with a population of 7,725 It lies to the west of Naxos, from which it is separated by a channel about 6 m. broad Its greatest length from north-east to south-west is 13 m., and its greatest breadth 10 miles. It is formed of a single mountain about 2,500 ft high, sloping evenly down on all sides to a maritime plain, which is broadest on the north-east and south-west sides. The island is composed of marble, though gneiss and mica-schist are to be found in a few places. The capital, Paroekia or Parikia (Italian, *Parechia*), on a bay on the north-west of the island, occupies

the site of the ancient capital. Its harbour admits small vessels; but the entrance is dangerous.

By the sea is a mediaeval castle built almost entirely of ancient remains. Similar traces of antiquity are numerous in the town, and on a terrace to the south is a precinct of Asclepius. Outside the town is the church of Katapoliani (Ἡ Ἑκατονταπυλιανή) "of the hundred gates," said to have been founded by the empress Helena; one of the two adjoining churches is of very early form, and there is a baptistry with a cruciform font.

On the north side of the island is the bay of Naoussa (Naussa) or Agoussa, a safe roomy harbour; in ancient times closed by a chain or boom. Another good harbour is that of Drios on the south-east, where the Turkish fleet used to anchor on its annual voyage through the Aegean. The three villages of Tragoulas, Marmora and Kepidi (pronounced Tschipidi), in an open plain on the eastern side of the island, rich in remains of antiquity, probably occupy the site of an ancient town.

Parian marble, white and semi-transparent, with coarse grain and beautiful texture, was the chief source of wealth to the island. The quarries lie on the northern side of Mt. Marpessa (afterwards Capresso). The marble, exported from the 6th century B.C., and used by Praxiteles and other sculptors, came from subterranean quarries driven horizontally or descending into the rock; being won by lamplight it had the name Lychnites, Lychneus (from *lychnos,* a lamp), or Lygdos (Plin. *H. N.* xxxvi. 5, 14; Plato, *Eryxias,* 400 D; Athen. v. 2050; Diod. Sic. 2, 52). Several of these tunnels are still to be seen. At the entrance to one of them is a bas-relief dedicated to Pan and the Nymphs. Attempts to work the marble have been made in modern times.

History.—In tradition Paros was colonized with Arcadians by Paros of Parrhasia. From Athens came Ionians later. Parian colonies were sent to Thasos and Parium on the Hellespont. In the former, founded in the 15th or 18th Olympiad, the poet Archilochus, native of Paros, is said to have taken part. As late as 385 B.C. the Parians, in conjunction with Dionysius of Syracuse, founded a colony on the Illyrian island of Pharos. In the 6th century Parians were invited by Miletus to reform its constitution. Shortly before the Persian War Paros seems to have been a dependency of Naxos. In the Persian War Paros joined the Persians and sent a trireme to Marathon. In retaliation, its city was besieged by an Athenian fleet under Miltiades, who demanded a fine of 100 talents. But the town offered a vigorous resistance, and the Athenians were obliged to withdraw. Paros also sided with Xerxes against Greece, but after the battle of Artemisium its contingent remained in Cythnos. For this unpatriotic conduct Themistocles exacted a heavy fine (Herod. viii. 112). In the Delian League Paros paid the highest tribute of all the islands—30 talents. Little is known of the constitution of Paros. In 410 B.C. the Athenian general Theramenes found an oligarchy at Paros and restored the democracy (Diod. Sic. xiii. 47). Paros joined the Athenian confederacy of 378 B.C., but withdrew about 357 B.C. along with Chios. Later, the island lost political importance, passing with other Cycladic islands to the Ptolemies of Egypt, and thence to Roman rule. When the Latins made themselves masters of Constantinople, Paros, like the rest, became subject to Venice. In 1537 it was conquered by the Turks. It now belongs to Greece and forms a province with Naxos.

Among the most interesting discoveries made in the island is the Parian Chronicle (*q.v.*).

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PARR, CATHERINE (1512–1548), the sixth queen of Henry VIII., was a daughter of Sir Thomas Parr (d. 1517). of Kendal, an official of the royal household. When only a girl she was married to Edward Borough, and after his death in or before 1529 to John Neville, Lord Latimer, who died in 1542 or 1543. Latimer had only been dead a few months when, on the 12th of July 1543, Catherine was married to Henry VIII. at Hampton Court. The new queen, who was regent of England during the king's absence in 1544, acted in a very kindly fashion towards her stepchildren; but her patience with the king did not prevent a charge of heresy from being brought against her. Henry, however, would not permit her arrest, and she became a widow for the third time on his death in January 1547. In the same year she married a former lover, Sir Thomas Seymour, now Lord Seymour of Sudeley. Soon after this event, on the 7th of September 1548, she died at Sudeley castle. Catherine was a pious and charitable woman and a friend of learning; she wrote *The Lamentation or Complaint of a Sinner*, which was published after her death.

PARR, THOMAS (*c.* 1483–1635), English centenarian, known as "Old Parr," is reputed to have been born in 1483, at Winnington, Shropshire. When 130 years old he is said to have threshed corn. In 1635 his fame reached Thomas Howard, 2nd earl of Arundel, who had him conveyed to London. Here he was presented to King Charles I., but the change of air and diet soon affected him, and the old man died at Lord Arundel's house in London, on Nov. 14, 1635. He was buried in the south transept of Westminster Abbey where the inscription over his grave reads: "Tho: Parr of ye county of Salopp Born in Ao 1483. He lived in ye reignes of Ten Princes viz. K. Edw. 4, K. Ed. V. K. Rich. 3. K. Hen. 7. K. Hen. 8. K. Edw. 6. Q. Ma. Q. Eliz. K. Ja. and K. Charles, aged 152 yeares and was buried here Nov. 15. 1635."

PARR, the name given to young fish of the salmon family, which have a series of dark bars along the side of the body, termed parr marks. They generally lose the parr marks and migrate to the sea when about 6 in. long, but parr up to 10 in. are not uncommon. (*See* SALMON and SALMONIDAE.)

PARRAMATTA: *see* SYDNEY.

PARRATT, SIR WALTER (1841–1924), English organist, was born at Huddersfield on Feb. 10, 1841. He was educated privately, and displayed his musical aptitude at a very early age. He is said, indeed, to have played the whole of Bach's 48 preludes and fugues, by heart, at the age of ten. In 1872 he became organist of Magdalen college, Oxford, and in 1882 organist of St. George's chapel, Windsor. From 1908–18 he was professor of music at Oxford, and from 1916–20, dean of the faculty of music in London university. He was knighted in 1892. He died at Windsor on March 27, 1924.

PARRHASIUS, of Ephesus, one of the greatest painters of Greece. He settled in Athens, and may be ranked among the Attic artists. He was certainly distinguished as a painter before 399 B.C. He is said to have been interested in the study of proportion. Many of his drawings on wood and parchment were preserved and highly valued by later painters for purposes of study. His picture of Theseus adorned the Capitol in Rome. His other works are chiefly mythological groups. A picture of the Demos, the personified People of Athens, is famous.

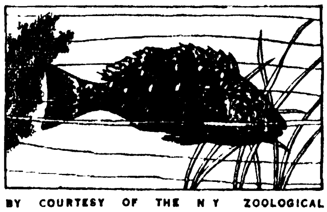
PARROT, the name of a large group of birds, which for centuries have attracted attention by their gaudy plumage and by the readiness with which many of them learn to repeat all kinds of sounds, including words and phrases of human speech. It must not be thought that this implies anything more than a mimetic power, or that the bird understands what it is saying. The parrots form the family *Psittacidae* of the order *Psittaci.* This order includes also the cuckoos and honey-eaters (qq.v.).

Although the majority of parrots are tropical, the Carolina parakeet (*Conurus carolinensis*) at the beginning of last century ranged as high as the shores of lakes Erie and Ontario, while *C. patagonus* reaches the Straits of Magellan. Two genera are peculiar to New Zealand. The region containing the greatest number of parrots in proportion to its area is that covered by the islands from Celebes to the Solomon group (Wallace, *Geogr. Distr. of Animals*). The species with the widest range is the ring-necked parakeet (*Palaeonis torquatus*), which extends from the mouth of the Gambia across Africa to the Red Sea, throughout

India, Ceylon and Burmah to Tenasserim. Parrots are gregarious and monogamous. The sexes are usually alike in appearance. The flight is low and undulating but powerful. The food is largely vegetable and is held in the claws—a unique feature. The voice is usually harsh. Parrots lay their eggs in holes in trees and rocks, or on the ground, and the eggs are white, from one to twelve forming the clutch. Perhaps the best talker is the African grey parrot (*Psittacus erithacus*), which has a red tail.

See also MACAW; COCKATOO; KEA; LORY; NESTOR; LOVE-BIRD; KAKAPO; BIRD.

PARROT-FISHES, more correctly PARROT-WRASSES, marine fishes of the family *Scaridae* closely allied to the wrasses or *Labridae*. The principal genera are *Scarus, Pseudoscarus, Odan* and *Sparisama*. They have large scales, nine spines and ten rays in the dorsal fin and two spines with eight rays in the anal, and a singular dentition. The teeth of the jaws are soldered together, and form a sharp-edged beak similar to that of a parrot; the upper and lower beak are divided into two lateral halves by a median suture. By this sharp and hard beak parrot-fishes are enabled to bite off those parts of coral-stocks which contain the polyps or to cut off branches of fucus. The process of triturating the food is performed by the pharyngeal teeth, which likewise are united, and form plates with broad masticatory surfaces. Of these plates there is one pair above, opposed to and fitting into the single one which is coalesced to the lower pharyngeal bone. Nearly one hundred species of parrot-fishes are known from the tropical and sub-tropical parts of the Indo-Pacific and Atlantic oceans; like other coral-feeding fishes, they are absent on the tropical west coasts of America and Africa. Beautiful colours prevail in this group of wrasses, but are subject to great variations in the same species. The majority of parrot-fishes are eatable. Many attain to 3ft. in length.



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THE RED PARROT-FISH

PARRY, SIR CHARLES HUBERT HASTINGS, 1ST BART. cr. 1903, English musical composer (1848–1918), second son of Thomas Gambier Parry, of Highnam Court, Gloucester, was born at Bournemouth on Feb. 27, 1848. He was educated at Malvern, Twyford, near Winchester, Eton (from 1861), and Exeter College, Oxford. While still at Eton he wrote music, two anthems being published in 1865. He studied music successively with H. H. Pierson (at Stuttgart), Sterndale Bennett and Macfarren; but the most important part of his artistic development was due to Edward Dannreuther. Among the larger works of this early period may be mentioned an overture, *Guillem de Cabestanh* (Crystal Palace, 1879); a pianoforte concerto in F sharp minor, played by Dannreuther at the Crystal Palace and Richter concerts in 1880; his first choral work, *Scenes from Prometheus Unbound,* produced at the Gloucester Festival, 1880; and a symphony in G given at the Birmingham Festival in 1882. A setting of Shirley's ode, *The Glories of our Blood and State,* brought out at Gloucester, in 1883, attracted general attention and laid the foundation of his reputation. After this with a noble eight-part setting of Milton's *Blest Pair of Sirens* (Bach Choir, 1887) began a fine series of compositions set to sacred or semi-sacred words. These include *Judith* (Birmingham, 1888), *Ode on St. Cecilia's Day* (Leeds, 1889), *L'Allegro ed il penseroso* (Norwich, 1890), *De Profundis* (Hereford, 1891), *The Lotus Eaters* (Cambridge, 1892), *Job* (Gloucester, 1892), *King Saul* (Birmingham, 1894), *Invocation to Music* (Leeds, 1895), *Magnificat* (Hereford, 1897), *A Song of Darkness and of Light* (Gloucester, 1898), and a *Te Deum* (Hereford, 1900). In his *Symphonic Variations* (1897), he displayed his power as an instrumental composer, while his incidental music to *The Birds* of Aristophanes (Cambridge, 1883) and *The Frogs* (Oxford, 1892) afforded opportunity for the display of that abounding sense of humour which was such an essential part of his genial and engaging disposition. He also wrote much admirable chamber music and many beautiful songs and part songs including a setting of Blake's "Milton" which under the title "Jerusalem" has become universally known and loved.

Parry's writings include: the popular *Studies of Great Composers, The Evolution of the Art of Music* (1896), a volume (*The Seventeenth Century*) of the *Oxford History of Music, Johann Sebastian Bach* (1909) and *Style in Musical Art* (1911). At the opening of the Royal College of Music in 1883 he was appointed professor of composition and of musical history, and in 1894, on the retirement of Sir George Grove, Parry succeeded him as principal. He was appointed Choragus of Oxford University in 1883, succeeding Stainer in the musical professorship of the university in 1900. Parry retired from his professorship in 1908 and died at Rustington, Sussex, on Oct. 7, 1918.

See C. L. Graves, *Hubert Parry* (2 vols., 1926).

PARRY, SIR WILLIAM EDWARD (1790–1855), English rear-admiral and Arctic explorer, was born in Bath on Dec. 19, 1790, the son of a doctor. At the age of 13 he joined the flagship of Admiral Cornwallis in the Channel fleet as a first-class volunteer, in 1806 became a midshipman, and in 1810 became lieutenant in the "Alexander" frigate, which was employed for the next three years in the protection of the Spitzbergen whale fishery. He made many astronomical observations in northern latitudes, and afterwards published the results of his studies in a small volume on *Nautical Astronomy by Night* (1816). From 1813–17 he served on the North American station. In 1818 he was given the command of the "Alexander" brig in the Arctic expedition under Captain (afterwards Sir) John Ross. This expedition returned to England without success, but in the following year Parry obtained the chief command of a new Arctic expedition, consisting of the two ships "Griper" and "Hecla." This expedition returned to England in Nov. 1820 after a successful Arctic voyage (*see* POLAR REGIONS), having accomplished more than half the journey from Greenland to Bering strait, the completion of which solved the ancient problem of a North-west Passage. A narrative of the expedition, entitled *Journal of a Voyage to discover a North-west Passage,* appeared in 1821. In May 1821 Parry set sail with the "Fury" and "Hecla" on a second expedition to discover a North-west Passage, but was compelled to return to England in Oct. 1823 without achieving his purpose. Meanwhile he had in Nov. 1821 been promoted to post rank, and shortly after his return he was appointed acting hydrographer to the navy. His *Journal of a Second Voyage,* etc., appeared in 1824.

With the same ships he undertook a third expedition on the same quest in 1824, but was again unsuccessful, and the "Fury" being wrecked, he returned home in Oct. 1825 with a double ship's company. Of this voyage he published an account in 1826. In 1827 the Admiralty sanctioned an attempt on the North Pole from the northern shores of Spitzbergen, and Parry reached 82° 45′ N. latitude. He published an account of this journey under the title of *Narrative of the Attempt to reach the North Pole,* etc. (1827). In April 1829 he was knighted. He became comptroller of the newly created department of steam machinery of the navy, retiring in 1846, when he was appointed captain-superintendent of Haslar hospital. He became a rear-admiral in 1852, and in 1853 a governor of Greenwich hospital. He died on July 8, 1855.

See *Memoirs of Rear-Admiral Sir W. E. Parry,* by his son, Rev. Edward Parry (3rd ed., 1857).

PARSEC, the unit in which distances of stars are measured, officially adopted by the International Astronomical Union in 1922. A parallax of one second of arc corresponds to a distance of one parsec. It is equal to 31 billion kilometres ($3{\cdot}1.\ 10^{13}$), 19 billion miles, or 3·3 light-years.

PARSEES or PARSIS, the followers in India of Zoroaster (Zarathustra), being the descendants of the ancient Persians who emigrated to India on the conquest of their country by the Arabs in the 8th century. They first landed at Din in Kathiawar (A.D. 76), and 19 years later moved to Sanjan on the coast of Gujarat, where the Hindu ruler received them. To this day their vernacular language is Gujarati. Their settlement in Bombay dates from 1640.

The men have light olive complexions, a fine aquiline nose, bright black eyes, a well-turned chin, heavy arched eyebrows, thick lips, and usually wear a light curling moustache. The women have small hands and feet, fair complexions, beautiful black eyes,

finely arched eyebrows, and long black hair, which they ornament with pearls and gems. They appear freely in public.

The head is covered with a turban, or a cap made of stiff material, something like the European hat, without any rim, and has an angle from the top of the forehead backwards. It would not be respectful to uncover in presence of an equal, much less of a superior. The colour is chocolate or maroon. The priests wear a white turban and are wholly dressed in white Men and women wear the sacred shirt, *sadra,* and the girdle, *kusti. See* ZOROASTER.

Sects.—The Parsees of India are divided into two sects, the Shahanshahis and the Kadmis They differ as to the correct chronological date for the computation of the era of Yazdegerd, the last king of the Sassanian dynasty, who was dethroned by the caliph Omar about A D 640. This led to the variation of a month in the celebration of the festivals The Parsees compute time from the fall of Yazdegerd. Their calendar is divided into twelve months of thirty days each; the other five days, being added for holy days, are not counted Each day is named after some particular angel of bliss, under whose special protection it is passed On feast days a division of five watches is made under the protection of five different divinities In midwinter a feast of six days is held in commemoration of the six periods of creation About March 21, the vernal equinox, a festival is held in honour of agriculture, when planting begins In the middle of April a feast is held to celebrate the creation of trees, shrubs and flowers On the fourth day of the sixth month a feast is held in honour of Sahrevar, the deity presiding over mountains and mines On the sixteenth day of the seventh month a feast is held in honour of Mithra, the deity presiding over and directing the course of the sun, and also a festival to celebrate truth and friendship On the tenth day of the eighth month a festival is held in honour of Farvardin, the deity who presides over the departed souls of men. This day is especially set apart for the performance of ceremonies for the dead The people attend on the hills where the "towers of silence" are situated, and in the *sagris* pray for the departed souls The Parsee scriptures require the last ten days of the year to be spent in doing deeds of charity

On the day of Yazdegerd, or New Year's Day, the Parsees rise early, and after having performed their prayers and ablutions don a new suit of clothes, and go to the "fire-temples," to worship the sacred fire, which is perpetually burning on the altar Unless they duly perform this ceremony they believe their souls will not be allowed to pass the bridge "Chinvad," leading to heaven. Then they visit their relations and friends, when the ceremony of *hamijur,* or joining hands, is performed, a kind of greeting by which they wish each other "a happy new year." Their relatives and friends are invited to dinner, and they spend the rest of the day in feasting and rejoicing

There are only two distinct classes among the Parsees—the priests (*dasturs,* or high priests, *mobeds,* or the middle order; and *herbads,* or the lowest order) and the people (*behadin, behdin,* or "followers of the best religion"). The priestly office is hereditary, and no one can become a priest who was not born such

The secular affairs of the Parsees are managed by an elective committee, or *panchayat,* composed of six *dasturs* and twelve *mobeds,* making a council of eighteen

Their religion teaches them benevolence as the first principle, and they practise it with liberality The sagacity, activity and commercial enterprise of the Parsees are proverbial

See Menant, *Les Parsis* (1898), Dosabhai Framji Karaka, *History of the Parsees* (1884), Seervai and Patel, *Gujarat Parsees from the Earliest Times* (Bombay, 1898); *Tribes and Castes of Bombay* (1922).

PARSLEY, a hardy biennial herb known botanically as *Petroselinum sativum* (family Umbelliferae), the leaves of which are much used for garnishing and flavouring. It occurs as a garden escape in waste places in Britain and it is doubtful if it is known anywhere as a truly wild plant; A. de Candolle, however (*Origin of Cultivated Plants*) considers it to be wild in the Mediterranean region. It grows best in a partially shaded position, in good soil of considerable depth and not too light; a thick dressing of manure should be given before sowing For a continuous supply three sowings should be made, as early in February as the weather permits, in April or early in May and in July—the last for the winter supply in a sheltered position with southern exposure. Sow thinly in drills from 12 to 15 in. apart and about 1 in. deep; thin out to 3 in. and finally to 6 in. each.

PARSNIP, botanically known as *Pastinaca sativa,* a member of the family Umbelliferae, found wild in roadsides and waste places in England and throughout Europe and temperate Asia, and as an introduced plant in North America. It has been cultivated since the time of the Romans for the sake of its long fleshy whitish root, which has a peculiar but agreeable flavour. The wild form, with a tough, pungent, somewhat poisonous root, has become extensively naturalized in North America, especially in the Eastern States and Canada and on the Pacific coast, sometimes becoming a troublesome weed

BY COURTESY OF THE IOWA EXPERIMENTAL STATION

PARSNIP (PASTINACA SATIVA) UMBELLED FLOWER CLUSTERS AND COMPOUND LEAF, ALSO MATURE FRUIT

PARSON, a technical term in English law for the clergyman of the parish The word is properly used only of a rector (*See* RECTOR; VICAR; BENEFICE, and TITHES)

PARSONS, ALFRED (1847–1920), English painter, was born at Beckington, Somerset, on Dec 2, 1847 He was educated privately, and in 1865 entered the General Post Office as a clerk, but adopted painting as a career two years later He was pre-eminently a painter of flowers and gardens, and was also interested in designing gardens. His picture of an orchard "When Nature Painted All Things Gay" (now in the Tate gallery, London), was purchased by the Chantry fund in 1887, and he exhibited frequently at the Royal Academy, the Grosvenor and New Gallery exhibitions He was elected A R A. in 1897, and R A in 1911 From 1914 till his death on Jan. 16, 1920, he was president of the Royal Society of Painters in Water Colours

Many of Parson's illustrations appeared in *Harper's Magazine;* while among the books he illustrated are *She Stoops to Conquer* (1887), Herrick's *Hesperides and Noble Numbers* (1882, with E A Abbey); and *The Danube, from the Black Forest to the Black Sea* (with F. D Millet, 1893) Parsons also wrote and illustrated *Notes in Japan* (1896), after a visit to that country in 1892–94

PARSONS, HON. SIR CHARLES ALGERNON (1854–), K.C B. (1911), O M (1927), British engineer, born in London, June 13, 1854, fourth son of the 3rd earl of Rosse Educated privately and at St John's college, Cambridge, he entered the Armstrong works at Elswick in 1877 In 1884, having served for a year on the experimental staff of Messrs Kitson, of Leeds, he entered into partnership with Messrs Clarke, Chapman and Co, of Gateshead On the dissolution of the partnership in 1889, Parsons, whose invention of the Parsons steam turbine was bringing him into considerable prominence, established his own works at Heaton, Newcastle-upon-Tyne, for the manufacture of steam turbines, dynamos and other electrical apparatus (*see* STEAM ENGINE *Parsons Turbines*) Besides the chairmanship of C A. Parsons and Co, he occupied important positions on the directorate of various electrical supply and engineering companies He was made F R S in 1898, was awarded the Royal Society's Rumford medal in 1902, was president of the Institute of Marine Engineers 1905–6 and of the British Association 1919–20; he has been awarded a number of medals and several honorary degrees He collected and republished in 1926 his father's papers, *The Scientific Papers of William Parsons, Third Earl of Rosse (1800–67)*

PARSONS (or PERSONS), **ROBERT** (1546–1610), English Jesuit and political agitator, son of a blacksmith, was born at Nether Stowey, Somerset, on June 24, 1546 Educated at Balliol College, Oxford, he was fellow, bursar and dean of his college, but

in 1574 he resigned or was dismissed from his fellowship and offices, for reasons which have been disputed. He went to London, and thence to Louvain, where he entered the Roman Catholic Church and spent some time in the company of Father William Good, a Jesuit. In July 1575 he entered the Jesuit Society at Rome. In 1580 he was selected, along with Edmund Campion, a former associate at Oxford, and others, to undertake a secret religious and political mission to England. The two emissaries engaged in political intrigue in England and on the Continent. In 1581 Campion was arrested, but Parsons made his escape to Rouen, whence he returned to Rome, where he continued to direct the English mission. In 1588 he went to Spain, where he remained for nine years. He founded seminaries for the training of English priests at Valladolid, Lucar, Seville, Lisbon and St. Omer. He was made rector of the English college at Rome in 1597, and died there on April 18, 1610.

Parsons was the author of over 30 polemical writings, including *A Conference about the Next Succession to the Crowne of Ingland* (1594), *Treatise of the Three Conversions of England* (1603–04, 3 parts) an answer to Foxe's *Acts and Monuments*.

PARSONS, THEOPHILUS (1750–1813), American jurist, was born in Byfield (Mass.), on Feb. 24, 1750. He graduated from Harvard college in 1769, was a schoolmaster at Falmouth (now Portland) (Me.), from 1770 to 1773, studied law, and was admitted to the bar in 1774. In 1800 he removed to Boston. He was chief justice of the supreme court of Massachusetts from 1806 until his death in Boston on Oct. 30, 1813. In politics he took an active part as one of the Federalist leaders in the State. He was a member of the Essex county convention of 1778, called to protest against the proposed State constitution, and as a member of the "Essex Junto" was probably the author of *The Essex Result,* which helped to secure the rejection of the constitution at the polls. He was a member of the State constitutional convention of 1779–80, and one of the committee of 26 which drafted the constitution; he was also a delegate to the State convention of 1788 which ratified the Federal constitution; and according to tradition was the author of the famous "Conciliatory Resolutions," or proposed amendments to the constitution, which did much to win over Samuel Adams and John Hancock to the side of ratification. His *Commentaries on the Laws of the United States* (1836) contains some of his more important legal opinions.

PARSONS, WILLIAM BARCLAY (1859–), American engineer, was born in New York city on April 15, 1859. He entered the service of the Erie railroad, but resigned to take up general practice in New York city in 1885 as consulting engineer. He became deputy chief engineer in 1891 to the rapid transit commission of New York city and was chief engineer of the commission, 1894–1904. As such he designed and supervised the construction of the first part of the subway system there. He was connected professionally with railway construction in various parts of the world, and with many hydro-electric developments. He was a member of the Isthmian Canal commission, 1904; advisory engineer to the Royal commission on London traffic, 1904; a member of the board of consulting engineers of the Panama canal, 1905; chief engineer of the Cape Cod canal, 1912–14, and chairman of the Chicago transit commission, 1916. He served during the Spanish-American War as chief of engineers, National Guard of New York, and in the World War was major and later lieutenant-colonel and colonel of the 11th U.S. Engineers attached to the B.E.F. and A.E.F. in France. After the war he was made brigadier-general of engineers and placed on the retired list.

His publications include *Turnouts* (1885); *Track* (1886); *Rapid Transit in Foreign Cities* (1895); *An American Engineer in China* (1900); *The American Engineers in France* (1920); *Robert Fulton and the Submarine* (1923).

PARSONS, WILLIAM EDWARD (1872–), American architect and city planner, was born at Akron (O.), June 9, 1872. He graduated from Yale university in 1895 and Columbia university in 1898, where he was awarded the McKim fellowship in 1899. He attended the École des Beaux Arts, Paris, and studied under Laloux. He entered the office of J. C. Howard, architect, New York city, in 1901, and was appointed consulting architect to the U.S. Government in the Philippines, 1905. He designed many buildings in the Philippines, including the Manila hotel, Philippine General hospital, the University hall, the Manila club and the Manila Normal school. He developed and directed the execution of a number of city plans for Manila, Baguio, Cebu, and other cities and instituted the conservation of the old fortifications of the city of Manila as public parks. In 1914 he returned to the United States, opening practice in Chicago in 1919 with E. H. Bennett as partner.

PARSONS, a city of Labette county, Kansas, U.S.A., near the south-east corner of the State. It is on Federal highway 73, and is served by the Frisco, the Missouri-Kansas-Texas, and electric railways. Pop. (1920), 16,028 (88% native white); estimated locally, 1928, 20,000. It is near the gas and coal-fields; building stone is quarried in the vicinity, and there are large deposits of brick shale and clay. The city has railroad shops, a reclamation plant, car and bridge-building works, creameries, cold-storage plants, packing-houses for poultry and eggs, a super-power plant and other manufacturing and distributing industries. The factories have over 1,100 employees, and an output in 1925 valued at $5,171,705. The city was founded in 1869 and chartered in 1871. It was named after Levi Parsons (1822–87) the first president of the Missouri-Kansas-Texas railroad.

PARSONS' TURBINE: *see* TURBINE, STEAM.

PARTABGARH, an Indian state in the Rajputana agency. Area, 886 sq.m.; pop. (1921) 67,110. The inhabitants are mostly Bhils and other aboriginal tribes. The chief, who has the title of Maharawat and a salute of 15 guns, belongs to the Sisodia clan of Rajputs: and the state, formerly a tributary to Indore, came under British protection in 1818. The town of Partabgarh (pop., 9,182) is connected by a metalled road (20 m.) with the station of Mandasor on the Rajputana railway.

PARTABGARH, a district of British India in the Fyzabad division of the United Provinces. The administrative headquarters are at Bela. Area, 1,443 sq.m.; pop. (1921), 855,130. The Ganges forms the south-western boundary line, while the Gumti marks the eastern boundary for a few miles. The only mineral products are salt, saltpetre and *kankar* or nodular limestone. The principal crops are rice, barley, pulse, millets, sugar-cane and poppy. There are manufactures of sugar and a little silk; and grain, oil-seeds, hemp and hides are exported.

PARTHENAY, a town of western France, capital of an arrondissement in the department of Deux-Sèvres, 27 m. N.N.E. of Niort, on the railway between that town and Saumur. Pop. (1926) 5,831. Considerable portions of the 13th century ramparts remain, including the Porte St. Jacques, a fortified gateway guarding an old bridge over the Thouet. The church of Ste. Croix, 12th century, restored in 1885, has a 15th century belfry; the church of St. Laurent has portions dating from the 11th century; Notre-Dame de la Couldre has a ruined Romanesque portal and 1 m. S.W. of the town is the ancient church (12th century) of Parthenay-le-Vieux. Parthenay is the seat of a sub-prefect. It manufactures woollen goods.

PARTHENIUS, of Nicaea in Bithynia, Greek grammarian and poet. He was taken prisoner in the Mithradatic War and carried to Rome (72 B.C.); subsequently he visited Neapolis, where he taught Virgil Greek. His Ἐρωτικὰ παθήματα contains a collection of 36 love-stories, which are valuable as affording information on the Alexandrian poets and grammarians.

See E. Martini in *Mythographi graeci*, vol. ii. (1902, in Teubner Series); poetical fragments in A. Meineke, *Analecta alexandrina* (1853).

PARTHENOGENESIS, the development of an egg-cell that has not been fertilized by a male element or sperm-cell. Thus, as Bonnet discovered in 1762, the summer generations of green-flies or aphids are all parthenogenetic, no males occurring for months. A drone-bee develops from an unfertilized egg, thus having a mother, the queen, but no father. Parthenogenesis is a secondary simplification of ordinary sexual reproduction, in which fertilization is an essential condition of development. This secondary nature of parthenogenesis is indicated (1) by its sporadic occurrence in diverse classes of organisms; (2) by its occasional occurrence along with ovum-fertilization in the same animal, as in

the queen-bee; (3) by its not uncommon alternation with typical sexual reproduction in the course of generations; (4) by the fact that there is often polar-body formation in parthenogenetically developing ova, though part of its significance is wrapped up with the occurrence of fertilization; (5) by the facts of artificial parthenogenesis (*see* FERTILIZATION).

Occurrence of Parthenogenesis in Animals.—(*a*) In three classes of animals there is a frequent exhibition of parthenogenesis, namely in rotifers, crustaceans and insects. In most rotifers parthenogenesis prevails; the males are usually relatively small and degenerate, and in some cases where insemination occurs, there is no fertilization In some types males are unknown

In Crustacea, among 3,000 specimens of the brine-shrimp *Artemia* only one male was found, and von Siebold repeatedly investigated every member of a colony of *Apus* (once over 5,000 strong) without finding a single male At other times he found 1%; in other conditions many males were present In daphnids there are three kinds of eggs—(*a*) large, thick-shelled, resistant eggs, which require fertilization and always develop into females, (*b*) small, thin-shelled eggs, which can develop without being fertilized, and then give rise to females, (*c*) eggs similar to the last, but producing males. Among the cyprids nearly related forms may show (1) a rare occurrence of males, parthenogenetic generations following one another for months; (2) a frequent presence of males, but occasional occurrence of parthenogenesis, (3) an abundance of males all the year round, and parthenogenesis unknown.

Among insects parthenogenesis occurs in many gall-flies (Cynipidae) and saw-flies (Tenthredinidae). In some of these no males have been found; and this negative evidence of parthenogenesis has been confirmed by isolating females and rearing their eggs The unfertilized eggs may develop into females only (thelyotoky), or into males only (arrhenotoky) for a limited period, or into both sexes. In aphids the parthenogenetic development of females may continue for at least four years, but no case is known where males do not eventually occur, also arising from parthenogenetic ova. Among scale-insects (Coccidae) parthenogenesis often occurs, even though males are present In most cases the male is still unknown, but this does not necessarily prove parthenogenesis, for the known males are very minute and short-lived In *Lecanium hesperidum,* the pigmy male was discovered in an ovarian cul-de-sac within the female In many gall-flies the successive generations show parthenogenetic and spermic development in regular alternation, but some species are perpetually parthenogenetic In some saw-flies the parthenogenetic ova develop into females only; in others into males only (thus implying that fertilized ova developing into females also occur); in others the progeny are of both sexes. There are stray occurrences of parthenogenesis among other insects, as in species of *Solenobia,* a wingless relative of clothes-moths Among nematode worms there are many instances of parthenogenesis.

Parthenogenesis in Plants.—Of parthenogenesis in the strict sense there are few examples among plants, for it must be distinguished from relapses into asexuality, as in many Fungi (*q v*) The development of an egg-cell without fertilization is seen in *Chara crinita,* one of the water-stoneworts, represented in Northern Europe by female plants only Parthenogenesis is the rule in the dandelion, and also occurs in some hawkweeds (*Hieracium*) and in species of *Alchemilla* and *Antennaria*, etc

Grades of Parthenogenesis.—(*a*) What may be called pathological parthenogenesis is illustrated when the ovum, of a bird for instance, exhibits without fertilization a number of cleavages, but with no further development (*b*) The term casual parthenogenesis may be used for exceptional aspermic development, as in silk-moths (*c*) The workers of ants, bees and wasps, not normally reproductive, may exhibit occasional parthenogenesis, the eggs apparently always developing into males. (*d*) The queen bee exhibits partial parthenogenesis, for it rests with her whether the deposited egg is fertilized from her store of spermatozoa, received during the nuptial flight from the inseminating drone. (*e*) The term seasonal parthenogenesis may be applied to cases like green-flies and some Entomostraca. (*f*) In a few strange cases, as in some species of the gall-midge (*Miastor*) the larval form becomes precociously reproductive, and illustrates juvenile or paedogenic parthenogenesis. The female lays a few, very large eggs, which develop into larvae. But inside these there arise other larvae which eat their way out. The same thing happens through several generations which succeed one another through autumn, winter and spring. In the following summer, however, the last set of larvae become pupae, which metamorphose into sexually perfect midges. The parthenogenetically-reproducing larvae have no ovaries, and their offspring arise from peculiar cells which occur in association with the fatty body. (*g*) This leads on to what is familiar in the life-history of the liver-fluke and related forms, where rediae arise inside the sporocyst, and cercariae within the rediae. The precociously reproductive sporocyst is a transformation of the sexually-produced free-swimming larva or miracidium, while the rediae and cercariae arise from "spore-cells," which are undoubtedly primitive germ-cells homologous with ova, but requiring no fertilization. (*h*) Such cases lead on to the sporogony common in plants, and familiar in ferns. But spore-formation is probably a persistent primitive mode of uni-parental reproduction, whereas the parthenogenetic development of ova seems in all cases to be secondary and derivative. (*i*) The series ends in total parthenogenesis—for one generation, as in many Cynipidae; for several successive generations, as in many Entomostraca; or perpetually, as in many rotifers

Chromosomes in Parthenogenetic Ova.—The animal ovum typically undergoes a process of maturation, in which, by meiotic or reducing division, the normal number of ordinary chromosomes (*q v.*) is halved (*see* CYTOLOGY) A similar reduction occurs in the maturation of the sperm-cells, and thus in fertilization the normal number will be restored (*see* SEX) Now in regard to parthenogenetic development, the broad fact is that the reduction process occurs in some types and not in others It may be noted further that parthenogenesis without reduction may be due (*a*) to the fact that only one polar-body is formed and no reducing division occurs (*Cypris reptans*); or (*b*) to the return of the polar-body nucleus to fuse with the ovum-nucleus (some individuals of *Artemia*); or (*c*) to the fact that both the maturation divisions are equational, neither meiotic (saw-fly *Nematus;* gall-wasp *Rhodites*). In a case like the dandelion, the egg-cell undergoes no reduction of chromosomes, while in *Chara crinita* the number is in the parthenogenetic strain permanently half the normal.

General.—There is no known general peculiarity characterizing those ova able to develop without fertilization. There is no necessary degeneration associated with long-continued or perpetual parthenogenesis Besides much non-inherited variability, mutations (*i e* , inherited variations) are known to occur in parthogenetically reproduced strains Although parthenogenesis may favour rapid multiplication, so that forms exhibiting it would tend to survive, and although it may be of use in species where males are few or where fertilization is difficult, it is not at present possible to find a utilitarian justification of every occurrence of this departure.

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PARTHENON, the name generally given, since the 4th century B C, to the chief temple of Athena on the Acropolis at Athens (*e.g* , Demosthenes, *c Androt* 13, 76) The name is applied in the official inventories of the 5th and early 4th centuries to one compartment of the temple, and this was probably its original meaning It is certainly to be associated with the cult of Athena Parthenos, "the Virgin "

The most convenient position for a temple upon the natural rock-platform of the Acropolis was occupied by the early temple of Athena. When it was decided to supersede this by a larger and more magnificent temple, it was necessary to provide a site for this new temple by means of a great substructure, which is on its south side about 40 ft. high. This substructure was built for an earlier temple, probably dating from the 6th century B.C.

The extant temple was the chief among the buildings with

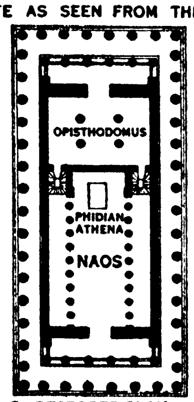
A A METOPE

B A RESTORATION OF THE EXTERIOR

C A METOPE

D PRESENT STATE AS SEEN FROM THE NORTH-WEST

E FROM THE FRIEZE OF THE PANATHENAIC PROCESSION



F RESTORED PLAN

G ANOTHER FRIEZE FRAGMENT

H A METOPE

I RESTORATION OF THE INTERIOR SHOWING A POSSIBLE METHOD FOR LIGHTING

J A METOPE

BY COURTESY (A, C, E, G, H, J,) OF THE BRITISH MUSEUM; (I) FROM A DRAWING BY CHIPIEZ

THE PARTHENON, SHOWING DETAILS AND PROPOSED RESTORATIONS

The Parthenon was begun 447 B.C. and dedicated 438 B.C. Designed by the architects Ictinus and Kallikrates, with sculpture by Phidias, it represents the culmination of the Periclean period in Greek architecture. Perhaps nowhere else in classic building were such perfection and subtlety, alike of design and execution, achieved. The columns are slightly inclined inward to give an impression of stability, and all of the horizontal lines are delicately curved, to compensate for any possible optical illusion of concavity. Originally all of the sculpture and many of the architectural features were brilliantly coloured

which Pericles adorned the Acropolis. The supervision of the whole work was in the hands of Pheidias, and the architects of the temple were Ictinus and Callicrates. The actual building was not begun until 447 B.C., though the decision to build was made ten years earlier (Keil, *Anonymus argentorensis*). The temple must have been structurally complete by the year 438 B.C., in which the gold and ivory statue of Athena Parthenos was dedicated; but the work of decoration was still going on in 433 B.C. The temple designed by Ictinus was about 15 ft. shorter and about 6 ft. wider than the building for which the foundations were intended; it thus obtained a proportion of length to breadth of exactly 9:4. It is the most perfect example of the Doric order. The plan was peculiar. The cella, which was exactly 100 ft long, kept the name and traditional measurement of the old Hecatompedon It was surrounded on three sides by a Doric colonnade, and in the middle of it was the great basis on which the statue was erected This cella was probably lighted only by the great doorway and by the light that filtered through the marble tiles The common notion that there was a hypaethral opening is erroneous At the back of the cella was a square chamber, not communicating with it, but entered from the west end of the temple; this was the Parthenon in the narrower sense. It seems to have been used only as a store-house, though it may have been originally intended for a more important purpose. The Prodomus and the Opisthodomus were enclosed by bronze gratings fixed between the columns, and were thus adapted to contain valuable offerings and other treasures We have inventories on marble of the contents of these four compartments of the temple The opisthodomus, in particular, probably served as a treasury. The metopes over the outer colonnade were all sculptured, and represented on the east the battle of gods and giants, on the west, probably, the battle of Greeks and Amazons, on the south Greeks and Centaurs; those on the north are almost lost The east pediment represented the birth of Athena, the west pediment her contest with Poseidon for the land of Attica The frieze, which was placed above the cella wall at the sides, represented the Panathenaic procession, approaching on three sides the group of gods seated in the middle of the east side These sculptures are admirably adapted to their position on the building.

The Parthenon probably remained intact until the 5th century of our era, when the colossal statue was removed, and the temple is said to have been transformed into a church dedicated to S Sophia. In the 6th century it was dedicated to the Virgin Mother of God (Θεοτόκος). The adaptation of the building as a church involved the removal of the inner columns and roof, the construction of an apse at the east end, and the opening of a door between the cella and the chamber behind it These alterations involved some damage to the sculptures In 1456 Athens was captured by the Turks, and the Parthenon was changed into a mosque, apparently without any serious structural alterations except the addition of a minaret. In this state it was described by Spon and Wheler in 1676 and the sculpture was drawn by the French artist Carrey in 1674 In 1687 the Turks used the building as a powder magazine during the bombardment of the Acropolis by a Venetian army under Morosini, and a shell caused the explosion which blew out the middle of the temple

Still further damage to the sculptures was done by Morosini's unsuccessful attempt to lower from the west pediment the chariot of Athena. Later a small mosque was constructed in the midst of the ruins; but nothing except gradual damage is to be recorded during the succeeding century except the visits of various travellers, notably of James Stuart (1713–88) and Nicholas Revett (1720–1804), whose splendid drawings are the best record of the sculpture as it existed in Athens In 1801 Lord Elgin obtained a firman authorizing him to make casts and drawings, and to pull down extant buildings where necessary, and to remove sculpture from them He caused all the remains of the sculpture that was found on the ground or in Turkish houses, and a certain amount—notably the metopes—that was still on the temple, to be transported to England The Elgin marbles were bought by the British Government in 1816, and are now in the British Museum Certain other sculptures from the Parthenon are in the Louvre. Copenhagen or elsewhere, and much is still in Athens.

The most accurate measurements of the temple, showing the exactness of its construction and the subtlety of the curvature of all its lines, were made by F. C. Penrose.

The perfection of the proportions and details of the parthenon has so impressed modern critics that many attempts, frequently fantastic, have been made to discover in it some geometric or mathematical system of related sizes that could thus furnish some infallible rule of beauty. The fact that so many different systems have been found to apply is a sufficient criticism of each of them. The most elaborate is the extremely ingenious analysis of Robert W Gardner, who claims to have discovered that all dimensions are based on sides of squares with related areas; the same system accounting not only for the Parthenon and its details, but also for its position, the placing of many monuments in Athens, the walls from Athens to Piraeus and the layout of Piraeus itself It seems, however, more probable that the situation of a good harbour and the requirements of military defense controlled these matters, rather than any esoteric mathematical system

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PARTHIA, the mountainous country south-east of the Caspian sea, which extends from the Elburz chain eastwards towards Herat, and is bounded on the north by the fertile plain of Hyrcania (about Astrabad) at the foot of the mountains in the corner of the Caspian and by the Turanian desert, on the south by the great salt desert of central Iran It corresponds to the modern Khorasan. It was inhabited by an Iranian tribe, the *Parthava* of the inscriptions of Darius; the correct Greek form is Παρθυαῖοι. Parthia became a province of the Achaemenian and then of the Macedonian empire Seleucus I and Antiochus I founded Greek towns: Soteira, Charis, Achaea, Calliope (Appian, *Syr* 57; Plin vi 15; *cf.* Strabo xi 516); the capital of Parthia, the ruins of which are around the present town Damghan, is known only by its Greek name Hecatompylos ("The Hundred-gated"), from the many roads which met there (Polyb. x 28), and was, according to Appian, founded by Seleucus I. (*cf* Curtius vii. 2) In 208 many Greek inhabitants are found in the towns of Parthia and Hyrcania (Polyb x 31, 11).

When about 255 B.C. Diodotus had made himself king of Bactria (*q.v.*), and tried to expand his dominions, the chieftain of a tribe of Iranian nomads (Dahan Scyths) east of the Caspian, the Parni or Aparni, who bore the Persian name Arsaces, fled before him into Parthia.[1] Here the satrap Andragoras appears to have shaken off the Seleucid supremacy, as he struck gold and silver coins in his own name, on which he wears the diadem, although not the royal title (Gardner, *Numism. Chronicle*, 1870–81) He was slain by Arsaces (Justin xli 4), who occupied Parthia and became the founder of the Parthian kingdom (248 B.C.). The origin and early history of the Parthian kingdom, of which we possess only very scanty information, is surrounded by fabulous legends, narrated by Arrian in his *Parthica* (preserved in Photius, *cod.* 58, and Syncellus, p 539 *seq.*) Arsaces ruled for many years The troubles of the Seleucid empire, and the war of Seleucus II against Ptolemy III. and his own brother Antiochus Hierax, enabled him not only to maintain himself in Parthia, but also to conquer Hyrcania; but he was constantly threatened by Diodotus of Bactria (Justin xli. 4) When, about 238 B.C., Seleucus II was able to march into the east, Arsaces fled to the nomadic tribe of the Apasiacae (Strabo xi. 513; *cf* Polyb x. 48). But Seleucus was soon recalled by a rebellion in Syria, and when Diodotus died, Arsaces returned victorious to Parthia; "the day of this victory is celebrated by the Parthians as the beginning of their independence" (Justin xli 4) Arsaces was proclaimed king at Asaak in the district of Astauene, now Kuchan,

[1]Strabo xi. 515; *cf.* Justin xli 4; the Parni are said by Strabo (*ibid.*) to have immigrated from southern Russia, a tradition wrongly transferred to the Parthians themselves by Justin xli. 1, and Arrian *ap.* Phot. *cod* 58

in the upper Atrek (Attruck) valley (Isidor. Charac.), and built his residence Dara on a rock in a fertile valley in Apavarktikene (Justin xli. 5; Plin. vi. 46), now Kelat still farther eastward; the centre of his power evidently lay on the borders of eastern Khorasan and the Turanian desert. The principal institutions of the Parthian kingdom were created by him (*cf.* Justin xli. 2). The Scythian nomads became the ruling race; they were invested with large landed property, and formed the council of the king, who appointed the successor. They were archers fighting on horseback, and in their cavalry consisted the strength of the Parthian army; the infantry were mostly slaves, bought and trained for military service, like the janissaries and mamelukes. But these Scythians soon amalgamated with the Parthian peasants. They adopted the Iranian religion of Zoroaster, and "their language was a mixture of Scythian and Median" (*i e* , Iranian). Therefore their language and writing are called by the later Persians ("Pehlevi"), *i e.,* Parthian (Pehlevi is the modern form of Parthawa) and the magnates themselves Pehlevans; *i.e.,* "Parthians," a term transferred by Firdousi to the heroes of the old Iranian legend But the Arsacid kingdom never was a truly national State; with the Scythian and Parthian elements were united some elements of Greek civilization.

To Arsaces I. probably belong the earliest Parthian coins; the oldest simply bear the name Arsaces; others, evidently struck after the coronation in Asaak, have the royal title (βασιλέως Ἀρσάκου). The reverse shows the seated archer, or occasionally an elephant, the head of the king is beardless and wears a helmet and a diadem; only from the third or fourth king do they begin to wear a beard after the Iranian fashion

Of the successors of Arsaces I we know very little. His son, Arsaces II , was attacked by Antiochus III , the Great, in 209, who conquered the Parthian and Hyrcanian towns but at last granted a peace The next king, whom Justin calls Priapatius, ruled 15 years (about 190–175), his successor, Phraates I , subjected the mountainous tribe of the Mardi (in the Elburz). He died early, and was succeeded not by one of his sons but by his brother, Mithridates I , who became the founder of the Parthian empire. Mithridates I (*c* 170–138) had to fight hard with the Greeks of Bactria, especially with Eucratides (*q v.*); at last he was able to conquer a great part of eastern Iran. Soon after the death of Antiochus IV. Epiphanes (163) he conquered Media, where he refounded the town of Rhagae (Rai near Teheran) under the name of Arsacia, and about 141 he invaded Babylonia. He and his son Phraates II. defeated the attempts of Demetrius II (139) and Antiochus VII (129) to regain the eastern provinces, and extended the Arsacid dominion to the Euphrates

For the later history of the Parthian empire reference should be made to PERSIA· *Ancient History*, and biographical articles on the kings The following is a list of the kings, as far as it is possible to establish their succession The names of pretenders not generally acknowledged are put in brackets.—

Arsaces I. (perhaps Tiridates I)	248–*c*. 211	(Tiridates III.	36)
Arsaces II.	*c* 211–190	(Cinnamus	38)
Priapatius	*c* 190–175	(Vardanes I.	40–45)
Phraates I	*c*. 175–170	Gotarzes	40–51
Mithridates I	*c* 170–138	Vonones II.	51
Phraates II	*c* 138–127	Vologaeses I.	51–77
Artabanus I	*c* 127–124	(Vardanes II	55)
Mithridates II. the Great	*c* 124–88*	Vologaeses II.	77–79, 111–147
Sanatruces I.	76–70	Pacorus	78–*c* 105
Phraates III	70–57	(Artabanus III.	80–81)
Orodes I.	57–37	Osroes	106–129
(Mithridates III.	57–54)	(Mithridates IV and his son Sanatruces II , 115; Parthamaspates, 116–117; and other pretenders.)	
Phraates IV.	37–2	Mithridates V	*c* 129–147
(Tiridates II	32–31 and 26)	Vologaeses III	147–191
Phraates V. (Phraataces)	2 B C–A D. 5	Vologaeses IV	191–209
Orodes II.	A D. 5–7	(Vologaeses V.	209–*c*. 222)
Vonones I.	8–11	Artabanus IV	209–227
Artabanus II.	*c*. 10–40		

*The names of the following kings are not known; that one of them was called Artabanus II. is quite conjectural.

BIBLIOGRAPHY.—Persian tradition knows very little about the Arsacids, who by it are called Ashkanians (from Ashak, the modern form of Arsaces). Of modern works on the history of the Parthians (besides the numismatic literature), the most important are. G. Rawlinson, *The Sixth Oriental Monarchy* (1873), and A. von Gutschmid, *Geschichte Irans und seine Nachbarlander von Alexander d Gr bis zum Untergang der Arsaciden* (1888). The principal works on the Arsacid coinage are (after the earlier pub of Longpérier Prokesch-Ostan, etc.): Percy Gardner, *The Parthian Coinage* (1877), and esp. W Wroth, *Catalogue of the Coins of Parthia* in British Museum (1903), who revised the statements of his predecessors *Cf* also Petrowicz *Arsacidenmunzen* (Vienna, 1904), and Allotte de là Fuye, "Classement des monnaies arsacides," in *Revue numismatique*, 4 *série*, vol. viii., 1904.

(ED M)

PARTIES: *see* PRACTICE AND PROCEDURE

PARTITION, in law, the division between several persons of land or goods belonging to them as co-proprietors It was a maxim of Roman law, followed in modern systems, that *in communione vel societate nemo potest invitus detineri* Partition was either voluntary or was obtained by the *actio communi dividendo* In English law the term partition applies only to the division of lands, tenements and hereditaments, or of chattels real between coparceners, joint tenants (*q v*) or tenants in common (*q v*) Partition is either voluntary or compulsory, and has been regulated from time to time by various acts of parliament Since the Law of Property Act, 1925, it applies also to chattels (s 188). The English acts have been substantially adopted by many of the colonies

Partition is not a technical term of Scots law In Scotland all heritable or movable property in joint ownership may at the instance of any of the joint owners be brought to a division, failing consent, by an action of division, in which action failing the practicability of division, the property will be sold judicially and the price distributed among the joint owners Commonty lands in the perpetual joint use of the commoners as accessories of lands held by them on exclusive titles are also divisible by action The act of 1695, c 38, made all commonties, except those belonging to the king or royal burghs, divisible, on the application of any having interest, by action in the court of session By the Sheriff Courts (Scotland) Act 1907, s 5, the action for division of common property or commonty is competent in the sheriff court, but when the subject in dispute exceeds in value £50 by the year, or £1,000 value the action may on the motion of either party be removed into the court of session

In the United States, "it is presumed," says Chancellor Kent (4 *Comm* , lect lxiv) "that the English statutes of 31 & 32 Henry VIII have been generally re-enacted and adopted, and probably with increased facilities for partition " In a large majority of the States, partition may be made by a summary method of petition to the courts of common law In the other States the courts of equity have exclusive jurisdiction As between heirs and devisees the probate courts may in some States award partition The various State laws with regard to partition will be found in Washburn, *Real Property*

PARTNERSHIP, in general, the voluntary association of two or more persons for the purpose of gain, or sharing in the work and profits of any enterprise This general definition requires to be restricted, in law, according to the account given below

Though the English law of partnership is based upon Roman law, there are several matters in which the two systems differ (1) There was no limit to the number of partners in Roman law (2) In *societas* one partner could generally bind another only by express *mandatum*, one partner was not regarded as the implied agent of the others (3) The debts of a *societas* were apparently joint, and not joint and several (4) The *heres* of a deceased partner could not succeed to the rights of the deceased, even by express stipulation There is no such disability in England (5) In actions between partners in Roman law, the *beneficium competentiae* applied—*i.e* , the privilege of being condemned only in such an amount as the partner could pay without being reduced to destitution (6) The Roman partner was in some respects more strictly bound by his fiduciary position than is the English partner For instance, a Roman partner could not retire in order to enjoy alone a gain which he knew was awaiting him

Previous to the Partnership Act 1890 the English law of partnership was to be found only in legal decisions and in text-

books. It was mostly the result of judge-made law, and as distinguished from the law of joint stock companies was affected by comparatively few Acts of parliament.

In 1890 the Partnership Act of that year was passed to declare and amend the law of partnership; the Act came into operation on Jan. 1, 1891. With one important exception (s. 23), it applies to the whole United Kingdom. It is not a complete code of partnership law, it contains no provisions regulating the administration of partnership assets in the event of death or bankruptcy, and is silent on the subject of goodwill. The existing rules of equity and common law continue in force, except so far as they are inconsistent with the express provisions of the Act Indeed, the Act of 1890 has to be read in the light of the decisions which have built up these rules

Nature of Partnership.—Partnership is defined to be the "relation which subsists between persons carrying on a business in common with a view of profit." Co-ownership of property does not of itself create a partnership, nor does the sharing of gross returns The sharing of profits, though not of itself sufficient to create a partnership, is *prima facie* evidence of one To illustrate the rule that persons may share profits without being partners, the Act gives statutory expression to the decision in *Cox* v *Hickman* (1860, 8 H L C , 268), viz , that the receipt by a person of a debt or other fixed sum by instalments, or otherwise, out of the accruing profits of a business does not of itself make him a partner; and it re-enacts with some slight modification the repealed provisions of Bovill's Act (28 and 29 Vict c. 86), which was passed to remove certain difficulties arising from the decision in *Cox* v *Hickman* Partners are called collectively a "firm"; the name under which they carry on business is called the firm name Under English law the firm is not a corporation, nor is it recognized as distinct from the members composing it, any change amongst them destroys the identity of the firm In Scotland a firm is a legal person distinct from its members, but each partner can be compelled to pay its debt

At common law there is no limit to the number of partners, but by the Companies Act 1862 (25 and 26 Vict c 89, s 4), not more than ten persons can carry on the business of bankers, and not more than 20 any other business, unless (with some exceptions) they conform to the provisions of the Act. (*See* COMPANY, and also *Limited Partnerships* below)

Relations of Partners to Persons Dealing with Them.—Every partner is an agent of the firm and of his co-partners for the purpose of the partnership business; if a partner does an act for carrying on the partnership business in the usual way in which businesses of a like kind are carried on he thereby *prima facie* binds his firm. The partners may by agreement between themselves restrict the power of any of their number to bind the firm. If there be such an agreement, no act done in contravention of it is binding on the firm with respect to persons who have notice of the agreement Such an agreement does not affect persons who have no notice of it, unless indeed they do not know or believe the person with whom they are dealing to be a partner; in that case he has neither real, nor, so far as they are concerned, apparent authority to bind his firm, and his firm will not be bound

A firm is liable for loss or injury caused to any person not a partner, or for any penalty incurred by any wrongful act or omission of a partner acting in the ordinary course of the partnership business, or with the authority of his co-partners; the extent of the firm's liability is the same as that of the individual partner. The firm is also liable to make good the loss (*a*) where one partner, acting within his apparent authority, receives money or property of a third person and misapplies it, and (*b*) where a firm in the course of its business receives money or property of a third person, and such money or property while in the custody of the firm is misapplied by a partner. To fix the other partners with liability, notice of the breach of trust must be brought home to them individually

The liability of partners for the debts and obligations of their firms arising *ex contractu*, is joint, and in Scotland several also; the estate of a deceased partner is also severally liable in a due course of administration, but subject, in England or Ireland, to the prior payment of his separate debts. The liability of partners for the obligations of their firm arising *ex delicto*, is joint and several. A partner who retires from a firm does not thereby cease to be liable for debts or obligations incurred before his retirement.

Relations of Partners to One Another.—The mutual rights and duties of partners depend upon the agreement between them. Many of these rights and duties are stated in the Partnership Act; but, whether stated in the Act or ascertained by agreement, they may be varied by the consent of all the partners; such consent may be express or inferred from conduct. Subject to any agreement, partners share equally in the capital and profits of their business, and must contribute equally to losses, whether of capital or otherwise, they are entitled to be indemnified by their firm against liabilities incurred in the proper and ordinary conduct of the partnership business, and for anything necessarily done for its preservation; they are entitled to interest at 5% on their advances to the firm, but not on their capital Every partner may take part in the management of the partnership business, but no partner is entitled to remuneration for so doing. The majority can bind the minority in ordinary matters connected with the partnership business, but cannot change its nature nor expel a partner, unless expressly authorized so to do No partner may be introduced into the firm without the consent of all the partners The partnership books must be kept at the principal place of business, and every partner may inspect and copy them. Partners must render to each other true accounts and full information of all things affecting the partnership A partner may not make private use of anything belonging to his firm nor may he compete with it in business

Partners may agree what shall and what shall not be partnership property, and can by agreement convert partnership property into the separate property of the individual partners, and vice versa Subject to any such agreement, all property originally brought into the partnership stock, or acquired on account of the firm or for the purposes and in the course of its business, is declared by the Act to be partnership property Property bought with money of the firm is *prima facie* bought on account of the firm Partnership property must be applied exclusively for partnership purposes and in accordance with the partnership agreement. The legal estate in partnership land devolves according to the general law, but in trust for the persons interested therein

When no fixed term has been agreed upon for the duration of the partnership, it is at will, and may be determined by notice at any time by any partner If a partnership for a fixed term is continued after the term has expired without any express new agreement, the rights and duties of the partners remain as before, so far as they are consistent with a partnership at will

A partner may assign his share in the partnership either absolutely or by way of mortgage The assignee does not become a partner; during the continuance of the partnership he has the right to receive the share of profits to which his assignor would have been entitled, but he has no right to interfere in the partnership business, or to require any accounts of the partnership transactions, or to inspect the partnership books.

Since the Act came into operation no writ of execution may issue in England or Ireland against any partnership property, except on a judgment against the firm If in either of these countries a judgment creditor of a partner wishes to enforce his judgment against that partner's share in the partnership, he must obtain an order of court charging such share with payment of his debt and interest. The court may appoint a receiver of the partner's share, and may order a sale of such share

Dissolution of Partnership.—A partnership for a fixed term, or for a single adventure, is dissolved by the expiration of the term or the termination of the adventure. A partnership for an undefined time is dissolved by notice of dissolution, which may be given at any time by any partner. The death or bankruptcy of any partner dissolves the partnership as between all its members If a partner suffers his share in the partnership to be charged under the Act for his separate debts, his partners may dissolve the partnership The foregoing rules are subject to any agreement there may be between the partners. A partnership is in every case dissolved by any event which makes the partnership or its business

unlawful. The court may order a dissolution in any of the following cases, viz.: When a partner is found lunatic or is of permanently unsound mind, or otherwise permanently incapable of performing his duties as a partner; when a partner has been guilty of conduct calculated to injure the partnership business, or wilfully or persistently breaks the partnership agreement, or so conducts himself in partnership matters that it is not reasonably practicable for his partners to carry on business with him; when the partnership can only be carried on at a loss; and lastly, whenever a dissolution appears to the court to be just and equitable. A dissolution usually is not complete as against persons who are not partners, until notice of it has been given; until then such persons may treat all apparent partners as still members of the firm. Notice is not necessary to protect the estate of a dead or bankrupt partner from partnership debts contracted after his death or bankruptcy; nor is notice necessary when a person not known to be a partner leaves a firm. Notice in the *Gazette* is sufficient as regards all persons who were not previously customers of the firm; notice in fact must be given to old customers.

The Act makes no mention of goodwill, but the rights of a seller in this respect were fully discussed in the House of Lords in *Trego* v. *Hunt* (L.R. 1896, App Cas. 7). In the absence of special agreement, the seller may set up business in competition with, and in the immediate neighbourhood of, the purchaser, and advertise his business and deal with his former customers, but may not represent himself as carrying on his former business, nor canvass his former customers The purchaser may advertise himself as carrying on the former business, canvass its customers, and trade under the old name, unless that name is or contains the name of the vendor, and the purchaser by using it without qualification would expose the vendor to the liability of being sued as a partner in the business If, on a dissolution or change in the constitution of a firm, the goodwill belongs under the partnership agreement exclusively to one or more of the partners, the partner who is entitled to the goodwill has the rights of a seller. Those to whom the goodwill does not belong have the rights of a purchaser.

If a partner ceases to be a member of a firm, and his former partners continue to carry on business with the partnership assets without any final settlement of accounts, he, or, if he be dead, his estate, is, in the absence of agreement, entitled to such part of the subsequent profits as can be attributed to the use of his share of the partnership assets, or, if he or his representatives prefer it, to interest at 5% on the amount of his share If his former partners have by agreement an option to purchase his share, and exercise the option, he is not entitled to any further or other share in profits than that given him by the agreement.

Limited Partnerships.—In the law of partnership as set out above, the Limited Partnership Act 1907 introduced a considerable innovation. By that Act power was given to form limited partnerships, like the French *société en commandite*; *i.e.*, a partnership consisting not only of general partners, but of others whose liability is limited to the amount contributed to the concern. Such a limited partnership must not consist, in the case of a partnership carrying on the business of banking, of more than ten persons, and in the case of any other partnership of more than 20 persons There must be one or more persons called general partners who are liable for all the debts and obligations of the firm, and limited partners, who on entering into partnership contribute a certain sum or property valued at a stated amount, beyond which they are not liable. Limited partners cannot withdraw or receive back any of their contributions; any withdrawal brings liability for the debts and obligations of the firm up to the amount withdrawn. A body corporate may be a limited partner No limited partner can take part in the management of a partnership business; if he does so he becomes liable in the same way as a general partner, but he can at all times inspect the books of the firm and examine into the state and prospects of the business. Every limited partnership must be registered with the registrar of joint stock companies, and the statutory particulars must be given. If any change occurs in these particulars, a statement signed by the firm and specifying the nature of the change, must be sent within seven days to the registrar An advertisement must also be inserted in the *Gazette* of any arrangement by which a general partner becomes a limited partner or under which the share of a limited partner is assigned. The law of private partnership applies to limited partners except where it is inconsistent with the express provisions of the Limited Partnership Act.

See Lindley, *A Treatise on the Law of Partnership* (7th ed. 1905); Pollock, *A Digest of the Law of Partnership* (8th ed. 1905).

Scots Law.—The law of Scotland as to partnership agrees in the main with the law of England and the Act of 1890 applies. The principal difference is that Scots law recognizes the firm as distinct from the individuals composing it. The name of the company may be either personal or descriptive. A firm with a personal name may sue or be sued under that name, but a firm with a descriptive name may sue and be sued only with the addition of the names of three at least (if there are so many) of the partners A consequence of this view of the company as a separate person is that an action cannot be maintained against a partner personally without application to the company in the first instance, the individual partners being in the position of cautioners for the company rather than of principal debtors. But, though the company must first be discussed, diligence must necessarily be directed against the individual partners. Heritable property cannot be held in the name of a firm; it can only stand in the name of individual partners. Notice of the retirement of even a dormant partner is necessary The law of Scotland draws a distinction between joint adventure and partnership Joint adventure or joint trade is a partnership confined to a particular adventure or speculation, in which the partners, whether latent or unknown, use no firm or social name, and incur no responsibility beyond the limits of the adventure. In the rules applicable to cases of insolvency and bankruptcy of a company and partners, Scots law differs in several respects from English. Thus a company can be made bankrupt without the partners being made so as individuals. And, when both company and partners are bankrupt, the company creditors are entitled to rank on the separate estates of the partners for the balance of their debts equally with the separate creditors. But in sequestration, by the Bankruptcy Scotland Act 1913, s. 62, the creditor of a company, in claiming upon the sequestrated estate of a partner, must deduct from the amount of his claim the value of his right to draw payment from the company's funds, and he is ranked as creditor only for the balance. (*See* Erskine's *Inst.* bk iii tit iii ; Bell's *Comm.* ii. 500–562; Bell's *Principles*, ss. 350–403) (X.)

United States.—In the United States, though the basis of the law of partnership was the English common law, there have been significant legislative changes dealing with partnership rights and liabilities Prior to 1914 the legislation was special in character and numerous diversities were to be found in the law of the various States In that year the conference of commissioners on uniform State laws approved a draft act for a uniform partnership law which has since been adopted by the legislatures of about one-third of the States Two divergent legal theories as to the nature of the partnership had been developed by the American courts, one adhering to the old common law conception that the partnership was simply an aggregate of individuals, and the other building up the newer conception that the partnership existed as an entity distinct from the partners In the divergent problems peculiar to the United States and centring in the enforcement of a judgment obtained against a partnership in one State as against partners resident in another State, the issue between the entity and aggregate theory of a partnership has become a problem of important legal significance.

The Uniform Partnership Act, with some exceptions, is an attempt to codify the existing common law on the subject of partnership. In its major provisions it conforms with the law as found in the English Partnership Act. Like the English act its provisions must be read in the light of the earlier common law decisions The tests for establishing the existence of a partnership are essentially similar to those in the English act, though greater emphasis is laid upon the fact of the sharing of the profits of a business as being an indication that such person is a partner in the business The act lays down no limit as to the

number of persons that may comprise a partnership nor the types of business in which a partnership may engage. Such limitations may, however, be commonly found in other legislation. Partners are the agents of the partnership to carry on the partnership business but specific authority from all the partners must be had in order that a partner may bind the partnership in a limited class of transactions. Partnership liability in contract is made joint, but in tort is joint and several. Prior to the act there had been a manifest tendency in the various States to make all partnership obligations joint and several. The act restores the common law rule. Partners may be created by estoppel, as where a person gives credit to a partnership upon the representation by one who is not a partner but represents himself or consents to others representing that he is a partner. In contradistinction to the English rule a person admitted to the partnership is liable to the extent of the partnership property for any liabilities incurred before he became a member.

The relations of the partners to one another are substantially those prevailing in England. Liberal variations of these rights by mutual agreement between the partners are permitted. The fiduciary relationship between the partners is retained with full vigour. The extent of partnership property and its devolution upon the death of a partner are regulated in detail. Assignment of a partner's interest does not operate to dissolve the partnership. In the dissolution and winding up of a partnership, the act even more closely follows its English model. The causes for dissolution are identical, notification of dissolution to third parties is essential in order that the limited authority of any partner to bind the partnership shall be effectual. Special provision is made for the continuation of the partnership business with the aid of the partnership assets in cases where the dissolution is caused in contravention of the partnership agreement, those partners who have not wrongfully caused the dissolution being permitted to carry on the business.

Limited partnerships are wholly a creation of statute law, originating from the need of new commercial ventures for increased capital. In 1822 New York passed the first statute permitting their creation. It was followed by similar legislation in other States. The desire of the legislatures, however, to safeguard the interests of persons dealing with an association and relying upon the individual liabilities of the associates as well as the joint assets, led them to subject the limited partner to an unlimited liability for the slightest infraction of the statutory rules. By the Uniform Limited Partnership Act drafted in 1916 and since then enacted by almost a third of the States, the limited partner was given a greater protection. Such legislation has undoubtedly stimulated the organization of limited partnerships. To give publicity to the limitation of liability, a device of registering that fact is employed together with complete details as to the organization of the partnership The limited partner is given the character of an investor rather than a general partner and does not participate in the management of the business No limitations exist as to the character of the business that can be conducted by a limited partnership, except as other special legislation excludes this form of associate enterprise from particular enterprises.

See Burdick, *Law of Partnership* (3d ed. 1917); Warren, *Corporate Advantages without Incorporation* (1929); Magruder and Foster, "Jurisdiction over Partnerships," 27 *Harvard Law Review*, 793 (1924).

(J. M. La.)

PARTON, JAMES (1822–1891), American biographer, was born in Canterbury, England, Feb. 9, 1822. He was taken to the United States when he was five years old, studied in and near New York, and was a schoolmaster in Philadelphia and New York. He removed (1875) to Newburyport (Mass.), where he died on Oct. 17, 1891. Parton's best known books were *Life of Horace Greeley* (1855), *Life and Times of Aaron Burr* (1857), and *Life of Andrew Jackson* (1859–60) Among his other publications were: *General Butler in New Orleans* (1863), *Famous Americans of Recent Times* (1867) and *Captains of Industry* (2 ser., 1884 and 1891), for young people. His first wife Sara (1811–72), sister of N. P. Willis, attained considerable popularity as a writer under the pen-name "Fanny Fern"

PARTONOPEUS DE BLOIS, hero of romance. The French romance dates from the 13th century, and is in fact a variation of *Cupid and Psyche*. Partonopeus is represented as having lived in the days of Clovis. He was seized while hunting, and carried off to a castle, the inhabitants of which were invisible. Melior, empress of Constantinople, came to him at night, stipulating that he must not attempt to see her for two years and a half. After successful fighting against Sornegur of Denmark, he returned to the castle, armed with an enchanted lantern which broke the spell. The tale ends happily. It had a continuation giving the adventures of Fursin or Anselet, nephew of Sornegur

Bibliography.—The French romance was edited by G. A. Crapelet, with an introduction by A. C. M. Robert, as Partonopeus de Blois (2 vols., 1834); an English *Partonope of Blois*, by W. E. Buckley for the Roxburghe club (1862), and another fragment for the same society in 1873; the German *Partonopier und Melior* of Konrad von Würzburg by Bartsch (1871); the Icelandic *Partalópa saga* by Klockhoff in *Upsala Universitets Arsskrift* for 1887 *See* also H. L. Ward, *Catalogue of Romances*, i. 689, etc. (1883, 1910 etc.); E. Kölbing, *Die verschiedenen Gestaltungen der Partonopeus-Sage*, in *Germ Stud* (vol. ii, 1875), in which the Icelandic version is compared with the Danish poem *Persenober* and the Spanish prose *Historia del conde Partinobles;* E. Pfeiffer, "Über die MSS. des Part. de Blois" in Stengel's *Ausg. in Abh. phil.* (No. 25, Marburg, 1885).

PARTRIDGE, SIR BERNARD (1861–), British artist, born in London on Oct 11, 1861, was educated at Stonyhurst, and after matriculating at London University entered the office of Dunn & Hansom, architects He then joined for a couple of years a firm of stained-glass designers (Lavers, Barraud & Westlake), learning drapery and ornament; and then studied and executed church ornament under Philip Westlake, 1880–1884 He began illustration for the press and practised water-colour painting, but his chief success was derived from book illustration In 1891 he joined the staff of *Punch*, and became one of its most famous artists. He was knighted in 1925.

PARTRIDGE, WILLIAM ORDWAY (1861–), American sculptor, was born at Paris, France, on April 11, 1861 He received his training as a sculptor in Florence (under Galli), in Rome (under Welonski), and in Paris He became a lecturer and writer, chiefly on art subjects, and from 1894 to 1897 was professor of fine arts in Columbia university (now the George Washington university), Washington (D.C) His sculptural works include the statue of Shakespeare, Lincoln park, Chicago; the bronze statues of Alexander Hamilton and Thomas Jefferson, Columbia university; and the equestrian statue of Gen Grant, Grant Square, Brooklyn, N Y.

PARTRIDGE, any one of certain game-birds The name was originally applied to the grey partridge (*Perdix cinerea*), the only species indigenous to Britain The excellence of its flesh at table has been esteemed from the time of Martial For the sport of partridge-shooting *see* Shooting

The grey partridge has largely increased in numbers in Great Britain in the last century During incubation the normal scent of the hen is suppressed Allied species occur in eastern Siberia and in Tibet.

The common red-legged partridge of Europe, generally called the French partridge, *Caccabis rufa*, is considered the type of a separate group. This bird was introduced into England in the last quarter of the 18th century. It prefers heavy clay soils or the most infertile heaths.

In Africa north of the Atlas is the Barbary partridge, *C petrosa;* in southern Europe another, *C. saxatilis*, which extends eastward till it is replaced by *C chukar*, which reaches India. Two desert forms are *Ammoperdix heyi* of North Africa and Palestine and *A bonhami* of Persia. The francolins and snow-partridges are generally furnished with strong but blunt spurs. Of the former, *Francolinus vulgaris* used to be found in many parts of the south of Europe; it extends to India, where it is known as the black partridge. The snow-partridges (*Tetraogallus*) are the giants of their kin, and nearly every considerable range of mountains in Asia seems to possess its specific form.

The name "partridge" has been loosely applied in North America to the ruffed grouse (*Bonasa umbellus*), the Virginia quail (*Ortyx virginianus*) and other species. In South America

the name is given to various tinamous (q.v.).

PARTRIDGE BERRY (*Mitchella repens*), a North American plant of the madder family (Rubiaceae), growing in dry woods from Nova Scotia to Minnesota and southward to Florida and Texas. It is evergreen, with a trailing stem, round, often whitish veined leaves, and white flowers, often borne in pairs, which are replaced by scarlet, edible berries. The flowers are dimorphic, long-styled and short-styled forms occurring, as in the primrose. The plant is also called checkerberry, squaw-vine and twin flower.

PARTS OF SPEECH: *see* GRAMMAR.

PARTY WALL, a building term, which in England and the United States, means a solid dividing wall between two houses, to be used by each as an exterior wall without any exclusive use by either Two views as to the rights of adjoining owners in the property wall are commonly held. one that they are tenants in common of the wall, each owning an undivided moiety therein, the other that each owns in severalty the part thereof on his side of the line and possesses an easement of support in the other part. The creation of rights in party walls, apart from statute, results from contract or prescription, that is, long continued use giving a right to an easement of support. Statutes, such as the London Building Act, 1894, commonly govern the creation of party walls in cities and towns, permitting an adjoining owner to rest one half of a party wall upon the land of his neighbour and enter the land for that purpose Some statutes impose a duty upon the neighbour to contribute to the cost of erecting a party wall. Neither owner may interfere with the wall to the detriment of the other and the expenses of repairing it are commonly to be shared by both. The easements of reciprocal support continue as long as the wall is sufficient for the purposes and as long as the necessity for the exercise of the easement exists.

PASADENA, a city of Los Angeles county, California, U S A, in the foot-hills of the Sierra Madre mountains, overlooking the San Gabriel valley; 11 m N E of the business centre of Los Angeles and touching its boundaries at several points. It is served by the Santa Fe, the Southern Pacific, and the Union Pacific railways, and by inter-urban electric and motor-coach lines. Pop. 45,354 in 1920 (82% native white); estimated locally at 80,000 in 1928. The city occupies 17 sq m., at an altitude of 800–1,200 ft, with the pine-clad heights of Mt. Wilson (6,666 ft) and Mt. Lowe (6,100 ft) for background. It is primarily a residential city and year-round resort, noted for its own beauty and the varied charm of the surrounding scenery. Roses bloom through the winter, and on New Year's Day is held the "Tournament of Roses," a festival attended by 700,000 visitors During the preceding week a rare spectacle is offered in the suburb of Altadena by the illumination every night of "the street of the Christmas-trees," an avenue lined for more than a mile on both sides with Himalayan cedars, or deodars. An outdoor amphitheatre seating 70,000 (called the Rose Bowl) has been constructed in a dry canyon, and is the scene of many pageants, festivals and athletic events. The city has an art institute, a Community playhouse (one of the earliest and most successful of the "little theatres" of the country), and a beautiful new public library (1927) with outdoor reading-rooms. It is the seat of the California Institute of Technology. Busch Gardens, privately owned but open to the public, comprise 30 ac. of rare horticultural specimens and beautiful landscape-gardening. In the suburb of San Marino is the Henry E. Huntington library (one of the finest collections of first editions and manuscript literary material in the world), and the Huntington art gallery, both administered for the public under a trust established by Henry Huntington before his death. A mile above Pasadena, on Mt. Wilson, is the Solar observatory of the Carnegie Institution, equipped with the largest reflecting telescope (1928) in the world and other powerful and delicate instruments. Manufacturing is relatively unimportant, but there were 162 plants in 1928, with an annual output valued at $9,000,000. The assessed valuation of property for 1927 was $155,732,710. Bank debits in 1927 amounted to $481,058,000 There were over 34,000 telephones in use in 1928, and the number of automobiles registered from the city in 1927 (28,782) was more than one for each three of the population.

Pasadena was founded in 1874 by a colony of fruit-growers from Indianapolis, Ind, who settled on its site. The city was chartered in 1886. Since 1921 it has had a commission-manager form of government.

PASARGADAE, a city of ancient Persia, situated in the modern plain of Murghab, some 30 m N E of the later Persepolis. The name originally belonged to one of the tribes of the Persians, which included the clan of the Achaemenidae, from which sprang the royal family of Cyrus and Darius (Herod. i. 125; a Pasargadian Badres is mentioned, Herod iv 167). According to the account of Ctesias (preserved by Anaximenes of Lampsacus in *Steph. Byz.* *s v* Πασσαργάδαι; Strabo xv. 730, *cf.* 729; Nic. Damasc. fr. 66, 68 *sqq*; Polyaen vii. 6, 1. 9. 45, 2), the last battle of Cyrus against Astyages, in which the Persians were incited to a desperate struggle by their women, was fought here. After the victory Cyrus built a town, with his palace and tomb, which was named Pasargadae after the tribe (*cf.* Curt. v. 6, 10; x 1, 22) Every Persian king was, at his accession, invested here, in the sanctuary of a warlike goddess (Anaitis?), with the garb of Cyrus, and received a meal of figs and terebinths with a cup of sour milk (*Plut Artax.* 3), and whenever he entered his native country he gave a gold piece to every woman of Pasargadae in remembrance of the heroic intervention of their ancestors in the battle (Nic Damasc. *loc cit.*; Plut *Alex* 69) According to a fragment of the same tradition, preserved by Strabo (xv. 729), Pasargadae lay "in the hollow Persis (*Coele Persis*) on the bank of the river Cyrus, after which the king changed his name, which was formerly Atradates" (in Nic Damasc. this is the name of his father) The river Cyrus is the Kur of the Persians, now generally named Bandamir; the historians of Alexander call it Araxes, and give to its tributary, the modern Pulwar, which passes by the ruins of Murghab and Persepolis, the name Medos (Strabo xv. 729; Curt. v. 4, 7).

The capital of Cyrus was soon supplanted by Persepolis, founded by Darius; but in Pasargadae remained a great treasury, which was surrendered to Alexander in 336 after his conquest of Persis (Arrian iii 18, 10; Curt v. 6, 10) After his return from India he visited Pasargadae on the march from Carmania to Persepolis, found the tomb of Cyrus plundered, punished the malefactors, and ordered Aristobulus to restore it (Arrian vi. 29; Strabo xv. 730). Aristobulus' description agrees exactly with the ruins of Murghab on the Bandamir, about 30 m. upwards from Persepolis; and all the other references in the historians of Cyrus and Alexander indicate the same place The identity of the ruins of Murghab with Pasargadae has lately been established beyond doubt by the discovery of the sculpture of Cyrus, bearing the trilingual inscription "Cyrus, the great King, the Achaemenian" which can refer to none but the founder of the Achaemenian dynasty The conjecture of Oppert, that Pasargadae is identical with Pishiyauvāda, where (on a mountain Arakadri) the usurper Gaumāta (Smerdis) proclaimed himself king, and where his successor, the second false Smerdis Vahyazdāta, gathered an army (inscrip. of Behistun, i. 11; iii 41), is hardly probable. T. Markwart proposed another etymology, "pas-arkadrish," that is, "Behind the (mount) Arkadrish."

The principal ruins of the town of Pasargadae at Murghab are a great terrace like that of Persepolis, and the remainders of three buildings, on which the building inscription of Cyrus, "I Cyrus the king the Achaemenid" (*sc.* "have built this"), occurs five times in Persian, Susian and Babylonian. They were built of bricks, with a foundation of stones and stone door-cases, like the palaces at Persepolis; and on these fragments of a procession of tribute-bearers and the figure of a winged demon (wrongly considered as a portrait of Cyrus) are preserved. Outside the town is one tomb in the form of a tower, and the tomb of Cyrus himself, a stone house on a high substructure which rises in seven surrounded by a court with columns The remains of a portico, which are discernible around the tomb, belong to a mosque constructed about A.D 1300

See Sir W. Gore-Ouseley, *Travels in Persia* (1811); Morier, Ker

Porter, Rich and others; Texier, *Description de l'Arménie et la Perse;* Flandin and Coste, *Voyage en Perse,* vol. ii.; Stolze, *Persepolis;* Dieulafoy, *L'Art antique de la Perse;* and E. Herzfeld, " Pasargadae," in *Beiträge zur alten Geschichte,* vol. viii. (1908), who has in many points corrected and enlarged the earlier descriptions and has proved that the buildings as well as the sculptures are earlier than those of Persepolis, and are, therefore, built by Cyrus the Great. New photographs of the monuments are published by Fr. Sarre, *Iranische Felsreliefs* (unter Mitwirkung von E. Herzfeld, Berlin, 1908).

PASCAL, BLAISE (1623–1662), French religious philosopher and mathematician, was born at Clermont Ferrand, in Auvergne, on June 19, 1623, son of Étienne Pascal, president of the Court of Aids at Clermont; his mother's name was Antoinette Bégon. His mother died when he was about four years old, and left him with two sisters—Gilberte, who afterwards married M. Périer, and Jacqueline. When Pascal was about seven years old his father gave up his post at Clermont, and settled in Paris. It does not appear that Blaise, who went to no school, but was taught by his father, was at all forced, but rather the contrary. But he was a precocious child, whose precocity was followed by great performance at maturity.

Étienne Pascal incurred the displeasure of Richelieu by protesting against the reduction of the rate of interest on some Paris municipal bonds, and to escape the Bastille had to go into hiding. He is said to have been restored to favour owing to the success of Jacqueline in a representation of Scudéry's *Amour tyrannique* before the cardinal. In any case Richelieu gave Étienne Pascal (in 1639) the important intendancy of Rouen, which he held for nine years. At Rouen they became acquainted with Corneille. The year 1646 is a landmark in Pascal's life. His father was confined to the house in consequence of an accident, and was visited by persons who had come under the influence of Saint-Cyran and the Jansenists. The Pascal family had hitherto paid due respect to religious matters, but they had not regarded religion as all-absorbing; but they now became converts to Jansenism.

But though his family, and especially his sister Gilberte, now Madame Périer, became strict devotees, it does not appear that Pascal had yet accepted the full consequences of the new doctrine. He continued to be indefatigable in his mathematical work in spite of nearly continuous illness. In 1647 he published his *Nouvelles expériences sur le vide,* and in the next year the famous experiment with the barometer on the Puy de Dôme was carried out for him by his brother-in-law Périer, and repeated on a smaller scale by himself at Paris, to which place by the end of 1647 he and his sister Jacqueline had removed, to be followed shortly by their father. In a letter of Jacqueline's, dated Sept. 27, an account of a visit paid by Descartes to Pascal is given. Descartes and Torricelli had suggested the principle of the barometer, but Pascal's experiments were the first complete demonstration.

Port Royal.—As early as May 1648 Jacqueline Pascal was strongly drawn to Port Royal, and her brother frequently accompanied her to its church. She desired indeed to join the convent, but her father, who returned to Paris with the dignity of counsellor of state, disapproved of the plan, and took both brother and sister to Clermont, where Pascal remained for the greater part of two years. He, his sister and their father returned to Paris in the late autumn of 1650, and in September of the next year Étienne Pascal died. Almost immediately afterwards Jacqueline joined Port Royal—a proceeding which led to some soreness, finally healed, between herself and her brother and sister as to the disposal of her property. It has sometimes been supposed that Pascal, from 1651 or earlier to the famous accident of 1654, lived a dissipated, extravagant, worldly, luxurious (though admittedly not vicious) life with his friend the duc de Roannez and others. His *Discours sur les passions de l'amour,* assigned to this period, has been supposed, on quite insufficient grounds, to indicate a hopeless passion for Charlotte de Roannez, the duke's sister. What is certain is that the winter of 1653–54 was one of hard scientific work and saw the production of some of his most important treatises. At the same time he sought some other than the Christian solution to the problem of existence, and made a close study of Epictetus and of Montaigne. He found satisfaction in neither. He began to visit his sister at Port Royal. After two months of seeking God, Pascal suddenly, when alone in his room on Nov. 22, underwent conversion, the mystic experience suffered and described by many of the great religious thinkers. His record of it, written in disjointed sentences, he wore thenceforward as a kind of amulet. At the time he said nothing of his conversion, but he presently decided (Jan. 7, 1655) to go into retreat for a time at Port Royal. He was thirty-two, prematurely aged by suffering.

Though Pascal lived much at Port Royal, and partly at least observed its rule, he was never of it. At the end of 1655 a motion was brought forward to expel Antoine Arnauld from the Sorbonne, the immediate cause of the attack being Arnauld's *Lettres à un duc et pair* on the refusal of absolution by his parish priest to the duc de Liancourt on account of his alleged Jansenist leanings. Pascal undertook Arnauld's defence against the Jesuits. The first of the *Provinciales* (*Provincial Letters,* properly *Lettres écrites par Louis de Montalte à un provincial de ses amis*) was written in a few days. It appeared on Jan. 27, 1656, and was followed by others to the number of eighteen. The *Provincial Letters* are the first example of French prose which is at once considerable in bulk, varied and important in matter, perfectly finished in form. They owe not a little to Descartes, for Pascal's indebtedness to his predecessor is unquestionable from the literary side, whatever may be the case with the scientific. The first example of polite controversial irony since Lucian, the *Provinciales* have continued to be the best example of it during more than two centuries in which the style has been sedulously practised, and in which they have furnished a model to generation after generation.

Last Years.—Shortly after the appearance of the *Provinciales,* on May 24, 1656, occurred the miracle of the Holy Thorn, a fragment of the crown of Christ preserved at Port Royal, which cured the little Marguerite Périer of a fistula lacrymalis. The Jesuits were much mortified by this Jansenist miracle, which, as it was officially recognized, they could not openly deny. Pascal and his friends rejoiced in proportion. The details of his later years after this incident are somewhat scanty, though in 1658 he lectured to the leaders of Port Royal on Christian apologetics, embodying the substance of a work which he had been considering since the *Provinciales.* Two drafts of the lecture were made by friends, and one of these, by his nephew Étienne Périer, is preferred to the Port Royal editions of the *Pensées.* For years before his death we hear only of acts of charity and of, as it seems to modern ideas, extravagant asceticism. Thus Mme. Périer tells us that he disliked to see her caress her children, and would not allow the beauty of any woman to be talked of in his presence. What may be called his last illness began as early as 1658, and as the disease progressed it was attended with more and more pain, chiefly in the head. In June 1662, having given up his own house to a poor family who were suffering from small-pox, he went to his sister's house to be nursed, and never afterwards left it. His state was, it seems, mistaken by his physicians, so much so that the offices of the Church were long put off. For the last year of his life he had relinquished his questions, and had been preparing himself, as a humble Christian, for death. He was able, however, to receive the Eucharist, and soon afterwards died in convulsions on Aug. 19. A post mortem examination was held, which showed not only grave derangement in the stomach and other organs, but a serious lesion of the brain.

Pensées.—Eight years after Pascal's death, in 1670, appeared what purported to be his *Pensées.* The editing of the book was peculiar. It was submitted to a committee of influential Jansenists, with the duc de Roannez at their head. It does not appear that there was much suspicion of the garbling which had been practised, but as a matter of fact no more entirely factitious book ever issued from the press. The fragments which it professed to give were in themselves confused and incoherent enough, nor is it easy to believe that they all formed part of any single and coherent design. The editors omitted, altered, added, separated, combined at their pleasure. This rifacimento remained the standard text with a few unimportant additions for nearly two

centuries, except that, by a truly comic revolution of public taste, Condorcet in 1776 published, after study of the original, which remained accessible in manuscript, another garbling, conducted this time in the interests of *un*orthodoxy. In 1842 Victor Cousin drew attention to the absolutely untrustworthy condition of the text, and in 1844 A. P. Faugère edited that text from the ms. in something like a condition of purity, though, as subsequent editions have shown, not with absolute fidelity. The subjects dealt with concern more or less all the great problems of thought on what may be called the theological side of metaphysics—the sufficiency of reason, the trustworthiness of experience, the admissibility of revelation, free will, foreknowledge, and the rest. Speaking generally, the tendency of the *Pensées* is towards the combating of scepticism by a deeper scepticism, or, as Pascal himself calls it, Pyrrhonism, which occasionally goes the length of denying the possibility of any natural theology. Pascal explains all the contradictions and difficulties of human life and thought by the doctrine of the Fall, and relies on faith and revelation alone to justify each other.

Natural Philosopher and Mathematician.—Pascal was a great mathematician in an age which produced Descartes, Fermat, Huygens, Wallis and Roberval His precocity in mathematics is established by the fact that he had completed before he was sixteen years of age a work on the conic sections, in which he had laid down a series of propositions, discovered by himself, of such importance that they may be said to form the foundations of the modern treatment of that subject. This work (like many others by the same master hand) was never published We know something of what it contained from a report by Leibnitz, who had seen it in Paris, and from a *résumé* of its results published in 1640 by Pascal himself, under the title *Essai pour les coniques*. The method was that of Girard Desargues, viz , the transformation of geometrical figures by conical or optical projection. In this way he established the famous theorem that the intersections of the three pairs of opposite sides of a hexagon inscribed in a conic are collinear This proposition, which he called the mystic hexagram, he made the keystone of his theory; from it alone he deduced more than 400 corollaries, embracing, according to his own account, the conics of Apollonius, and other results innumerable.

Pascal also worked on the infinitesimal calculus, then in the embryonic form of Cavalieri's method of indivisibles. The cycloid was a famous curve in those days; it had been discussed by Galileo, Descartes, Fermat, Roberval and Torricelli, who had in turn exhausted their skill upon it. Pascal solved the hitherto refractory problem of the general quadrature of the cycloid, and proposed and solved a variety of others relating to the centre of gravity of the curve and its segments, and to the volume and centre of gravity of solids of revolution generated in various ways by means of it He published a number of these theorems without demonstration as a challenge to contemporary mathematicians. Solutions were furnished by Wallis, Huygens, Wren and others; and Pascal published his own in the form of letters from Amos Dettonville (his assumed name as challenger) to Pierre de Carcavy. His initiative led to a great extension of our knowledge of the properties of the cycloid, and indirectly hastened the progress of the differential calculus

The mathematical theory of probability and the allied theory of the combinatorial analysis were in effect created by the correspondence between Pascal and Fermat, concerning certain questions as to the division of stakes in games of chance, which had been propounded to the former by the gaming philosopher De Méré. Of the treatise *De aleae geometria* all that actually appeared was a fragment on the arithmetical triangle (*Traité du triangle arithmétique*, "Properties of the Figurate Numbers"), printed in 1654, but not published till 1665, after his death.

Pascal's work as a natural philosopher was not less remarkable than his discoveries in pure mathematics. His experiments and his treatise (written before 1651, published 1663) on the equilibrium of fluids entitle him to rank with Galileo and Stevinus as one of the founders of the science of hydrodynamics The idea of the pressure of the air and the invention of the instrument for measuring it were both new when he made his famous experiment, showing that the height of the mercury column in a barometer decreases when it is carried upwards through the atmosphere. This experiment was made by himself in a tower at Paris, and was carried out on a grand scale under his instructions by his brother-in-law Florin Périer on the Puy de Dôme in Auvergne. Its success greatly helped to break down the old prejudices, and to bring home to the minds of ordinary men the truth of the new ideas propounded by Galileo and Torricelli.

Whether we look at his pure mathematical or at his physical researches we see the strongest marks of a great original genius creating new ideas, and seizing upon, mastering, and pursuing farther everything that was fresh and unfamiliar in his time. We can still point to much in exact science that is absolutely his; and we can indicate infinitely more which is due to his inspiration.

Bibliography —Editions of Pascal's works are those by Bossut (5 vols. 1779), Renouard (1803), Lefèvre (1819), and Lahure (1858) The standard edition is by Brunschwig and Boutroux in the *Grands écrivains de la France* (14 vols., Paris, 1908–14). There is also a separate edition of the *Pensées* by Brunschwig (1904). Among other modern editions of the *Pensées* may be mentioned that of Molinier (1877–79), a carefully edited and interesting text, the important corrections of which have been introduced into Havet's last edition, and that of G. Michelant (Freiburg, 1896). The main original source for the biography of Pascal is P. Faugère, *Lettres, opuscules et mémoires de Mme Périer et de Jacqueline, soeurs de Pascal, et de Marguerite Périer, sa nièce* (Paris, 1645) Works on Pascal are innumerable· Sainte-Beuve's *Port Royal,* Cousin's writings on Pascal and his *Jacqueline Pascal,* and the essays of the editors of the *Pensées* first mentioned are the most noteworthy. Recent handlings are, in French, E. Boutroux's *Pascal* (Paris, 1903), and, in English, R. H. Soltau, *Pascal· The Man and the Message* (1927), which contains a selected bibliography.

PASCAL, JEAN LOUIS (1837–1920), French architect, was born in Paris June 4, 1837. At the age of 16 he became a pupil of Gilbert. Later, when in the studio of Questel, he entered the École des Beaux-Arts, and amongst other distinctions gained the *Grand Prix de Rome* in 1866 On his return to Paris in 1870, after his four years at the Villa Medici, he was appointed inspector of works at the Louvre and the Tuileries. He became a member of the council of the Beaux-Arts and of the Institut de France, and was made a commandeur of the Legion of Honour. Pascal's work ranged from the commemorative monuments, erected to Henri Regnault at the École des Beaux-Arts and President Carnot at Bordeaux, to public and private buildings of every description He lived long enough to see the completion of his great work, the Bibliothèque Nationale, Paris With M Gaudet, he is responsible for the splendid edition of Blondel's *Architecture Française*, published under the auspices of the French Government. The celebrated *atelier,* of which he was for so many years the head, is responsible for the training of architects from every country in Europe, the United States and Canada Pascal died in Paris in 1920.

PASCHAL I., pope from 817 to 824, a native of Rome, was raised to the pontificate by the acclamation of the clergy, shortly after the death of Stephen IV., and before the sanction of the emperor (Louis the Pious) had been obtained—a circumstance for which it was one of his first cares to apologize. His relations with the imperial house, however, never became cordial; and he failed to win over the Roman nobles. He died in Rome while the imperial commissioners were investigating the circumstances of the murder of two important Roman personages seized at the Lateran The successor of Paschal I was Eugenius II.

PASCHAL II. (Ranieri), pope from Aug. 16, 1099, to Jan. 21, 1118, a native of Bieda, near Viterbo, was a Cluniac monk. He was created cardinal-priest of S Clemente by Gregory VII. about 1076, and was consecrated pope in succession to Urban II. on Aug. 14, 1099. In the long struggle with the emperors over investiture, he zealously carried on the Hildebrandine policy, but with only partial success. In 1104 Paschal instigated the emperor's second son to rebel against his father, but soon found Henry V. even more persistent in maintaining the right of investiture than Henry IV. had been. The imperial Diet at Mainz invited (Jan. 1106) Paschal to visit Germany and settle the trouble, but the pope in the Council of Guastalla (Oct. 1106) simply renewed the prohibition of investiture. In the same year he ended the investiture struggle in England. At the close of 1106 he

sought in vain the mediation of King Philip and Prince Louis in the imperial struggle, but, his negotiations remaining without result, he returned to Italy in Sept. 1107.

When Henry V. advanced with an army into Italy in order to be crowned, the pope agreed to a compromise, but the Romans rose in revolt against the compact, and Henry retired taking with him pope and curia. After sixty-one days of harsh imprisonment, Paschal yielded and guaranteed investiture to the emperor. Henry was then crowned in St. Peter's on April 13, and withdrew beyond the Alps. The Hildebrandine party was aroused to action, however; a Lateran council of March 1112 declared null and void the concessions extorted by violence; a council held at Vienna in October actually excommunicated the emperor, and Paschal sanctioned the proceeding. Towards the end of the pontificate trouble began anew in England. On the death of the countess Matilda, who had bequeathed all her territories to the Church (1115), the emperor at once laid claim to them as imperial fiefs and forced the pope to flee from Rome. Paschal returned after the emperor's withdrawal at the beginning of 1118, but died within a few days on Jan. 21, 1118. His successor was Gelasius II.

The principal sources for the life of Paschal II. are his Letters in the *Monumenta Germaniae historica, Epistolae,* vols. 3, 6, 7, 13, 17, 20–23, 25, and the *Vita* by Petrus Pisanus in the *Liber pontificalis,* ed. Duchesne (Paris, 1892). Important bulls are in J. A. G. von Pflugk-Harttung, *Die Bullen der Päpste bis zum Ende des zwölften Jahrhunderts* (Gotha, 1901), and a valuable digest in Jaffé-Wattenbach, *Regesta pontif. roman.* (1885–88). There is an exhaustive bibliography with an excellent article by Carl Mirbt in Herzog-Hauck, *Realencyklopädie* (3rd ed., 1904). *See* the *Catholic Encyclopaedia.* (C. H. H.)

PASCHAL III., anti-pope from 1164 to 1168, was elected the successor of Victor IV. on April 22, 1164. He was an aged aristocrat, Guido of Crema. Recognized at once by the emperor Frederick I. he soon lost the support of Burgundy, but the emperor crushed opposition in Germany, and gained the co-operation of Henry II. of England. Supported by the victorious imperial army, Paschal was enthroned at St. Peter's on July 22, 1167, and Pope Alexander III. became a fugitive. Suddenly imperial reverses, however, made Paschal glad in the end to hold so much as the quarter on the right bank of the Tiber, where he died on Sept. 20, 1168. He was succeeded by the anti-pope Callixtus III.

See A. Hauck, *Kirchengeschichte Deutschlands,* Bd. IV. (Leipzig, 1903, 259–276); H. Böhmer in Herzog-Hauck, *Realencyklopädie,* Bd. XIV., 724 *seq.;* and Lobkowitz, *Statistik der Päpste* (Freiburg i. B., 1905).

PASCHAL CHRONICLE (Chronicum Alexandrinum or Constantinopolitanum; Fasti Siculi), so called from being based on the Easter canon, an outline of chronology from Adam to A.D. 629, with historical and theological notes. The work, which has lost some parts, has an introduction on Christian chronology and the Easter cycle. It was written under Heraclius (610–641), and is generally attributed to an unknown Byzantine cleric and friend of the patriarch Sergius, who is alluded to as the author of certain ritual innovations. The so-called Byzantine or Roman era (which continued in use in the Greek Church until its liberation from the Turkish rule) was adopted in the *Chronicum* for the first time as the foundation of chronology, in accordance with which the date of the creation is given as March 21, 5507. The author is merely a compiler from earlier works except in his history of the last 30 years.

Editions: Dindorf (1832) with Ducange's preface and notes, in *Corp. scriptorum hist. byzant.;* Migne, *Patrolog. graeca.* xcii.; *see* also Wachsmuth, *Einl. ins Studium der alten Geschichte* (1895); Gelzer, *Sextus Africanus,* ii. 1 (1885); v. der Hagen, *Observationes in Heraclii methodum paschalem* (1736, but still indispensable); Schwarz in Pauly-Wissowa, *Realencyclop.* iii., pt. 2 (1899); Krumbacher, *Gesch. der byzant. Litt.* (1897).

PASCOLI, GIOVANNI (1855–1912), Italian poet, was born at San Mauro di Romagna on Dec. 31, 1855. He studied at the college of the Scolopi fathers at Urbino, and at the University of Bologna. He then became a secondary school teacher. In 1891 he published his first volume of verse, *Myricae.* He then held chairs successively at the Universities of Bologna, Messina and Pisa, and, finally, was appointed to succeed Carducci as professor of Italian literature at Bologna. He published other volumes of poetry, *Primi poemetti* (1912), *Nuovi poemetti, Canti di Castelvecchio, Poemi conviviali, Poemi del Risorgimento, Canzoni di Re Enzio* (1908) and *Carmina* (in Latin). Pascoli was a mystic, given to meditation and solitude, and his poetic output faithfully reflects the characteristics of his melancholy and extremely sensitive temperament. He died at Bologna on April 6, 1912.

See A. Galletti, *La poesia e l'arte di G. Pascoli* (1918); J. J. Hartman, *De Joanne Pascoli poeta Latino* (1920); F. Morabito, *Il Misticismo di Giovanni Pascoli* (1920); A. Valentin, *I Pascoli, Les thèmes de son inspiration* (1925).

PAS-DE-CALAIS, a maritime department of northern France, formed in 1790 of nearly the whole of Artois and the northern maritime portion of Picardy including Boulonnais, Calaisis, Ardrésis, and the districts of Langle and Bredenarde, and bounded north by the Straits of Dover ("Pas de Calais"), east by the department of Nord, south by that of Somme, and west by the English channel. Pop. (1926) 1,171,912; area 2,606 sq.m. Except in the neighbourhood of Boulogne-sur-Mer with its *côtes de fer* or "iron coasts," the seaboard of the department, which measures 65 m., consists of dunes. From the mouth of the Aa (the limit towards Nord) it trends west-south-west to Gris Nez, the point of France nearest to England; in this section lie the port of Calais, Cape Blanc Nez, rising 440 ft. above the sandy shores, and the port of Wissant (Wishant). The seaside resorts include Boulogne, Berck-sur-Mer, Paris-Plage, Wimereux, etc. Beyond Griz Nez the direction is due south; in this section are the small port of Ambleteuse, Boulogne at the mouth of the Liane, and the two bays formed by the estuaries of the Canche and the Authie (the limit towards Somme).

The dominant feature of the department is the Cretaceous scarp extending north-westward towards the sea, and revealing, between Boulogne and Calais, lower Cretaceous, Jurassic and a little Palaeozoic rock in what is really the eastern end of the Wealden dome of south-east England. The greatest height reached by the scarp in the department is about 710 ft. in the north-west. The scarp overlooks the plains of Flanders on the north and is the source of the Aa, Lys, Scarpe, Sensée and Escant. It is the defensible line of France in the north, and most of it remained in the possession of the Franco-British armies throughout the World War, but the ridges of Vimy and Bapaume were the scenes of very severe fighting, and the German armies penetrated across the continuation of the scarp farther to the south-east. To the north of the hills running between St. Omer and Boulogne, to the south of Gravelines and the south-east of Calais, lies the district of the Wattergands, fens now drained by means of canals and dikes, and turned into highly productive land. The climate is free from extremes of heat and cold, but damp and changeable. At Arras the mean annual temperature is 47°; on the coast it is higher. The rainfall varies from 24 to 32 in., though at Cape Gris Nez the latter figure is much exceeded. Cereals are largely grown and also potatoes, sugar-beets, forage, oil-plants and tobacco. Market gardening flourishes in the Wattergands. Livestock and poultry are reared, and the horses of the Boulonnais are famous.

The department is the chief in France for the production of coal, its principal coal-basin, a continuation of that of Valenciennes, centring round Béthune. The manufacture of beetroot-sugar, oil and alcohol distilling, iron-working, dyeing, brewing, paper-making, and various branches of the textile manufacture, are the chief industries. Boulogne, Calais and Étaples equip vessels for the cod, herring and mackerel fisheries. Calais and Boulogne are important ports of passenger-transit for England; and Boulogne also carries on a large export trade in the products of the department. The canal system comprises part of the Aa, the Lys, the Scarpe, the Deûle (a tributary of the Lys passing by Lille), the Lawe (a tributary of the Lys passing by Béthune), and the Sensée (an affluent of the Scheldt), as well as the canals of Aire to Bauvin, Neuffossé, Calais, Calais to Ardres, etc., and thus a line of communication is formed from the Scheldt to the sea by Béthune, St. Omer and Calais, with branches to Gravelines and Dunkirk. The department is served by the Northern railway.

Pas-de-Calais forms the diocese of Arras (archbishopric of Cambrai), belongs to the district of the I. army corps, the edu-

cational division (académie) of Lille; the appeal court is at Douai. There are five arrondissements (Arras, Béthune, Boulogne, Montreuil-sur-Mer and St. Omer) with 46 cantons and 905 communes. The chief towns are Arras, the capital, Boulogne, Calais, St. Omer, Béthune, Lens, Montreuil-sur-Mer, Bruay, Berck, Étaples and Aire-sur-la-Lys (*qq.v.*). Liévin (24,054), Hénin-Liétard (21,370), in the neighbourhood of Lens, are large centres of population. Lillers (pop. 5,453) carries on boot-making and has a fine 12th century Romanesque church; Hesdin owes its regular plan to Charles V, by whom it was built; and St Pol has the remains of medieval fortifications and castles and gave its name to the famous counts of St. Pol.

PASDELOUP, JULES ÉTIENNE (1819–1887), French conductor, was born in Paris, and educated in music at the *conservatoire*. He founded in 1851 a "société des jeunes artistes du conservatoire," and, as conductor of its concerts, produced many new works and introduced many classical works hitherto not heard in Paris His "popular concerts" at the Cirque d'hiver, from 1861 till 1884, much improved French taste in music

PASHA, also written "pacha" and formerly "pashaw," etc., a Turkish title, superior to that of bey (*q.v.*), borne by persons of high rank and placed after the name. The title appears, originally, to have been bestowed exclusively upon military commanders, but it is now given to any high official, and also to unofficial persons whom it is desired to honour A pashalik was a province governed by or under the jurisdiction of a pasha

The word is variously derived from the Persian *pādshah,* Turkish *pādishah,* equivalent to king or emperor, and from the Turkish *bash,* in some dialects *pash,* a head, chief, etc In old Turkish there was no fixed distinction between *b* and *p*. As first used in western Europe the title was written with the initial *b* The English forms bashaw, bassaw, bucha, etc, of the 16th and 17th centuries, were derived through the med Lat and Ital *bassa.*

PAŠIČ, NICHOLAS (1846?–1926), Serbian statesman, was the son of a merchant at Zaječar, close to the Bulgarian frontier He studied engineering first at Belgrade and then, with the help of a State bursary, at the University of Zürich, where he and other young Serbs came under the influence of Bakunin. Pašič was one of a small group who surrounded Svetozar Marković, and on the latter's early death in 1875 became one of the chief exponents of his views, which were of capital importance for the political development of Serbia. He became a deputy in 1878, and was in 1881 one of the founders of the Radical party.

A popular rising which broke out at Zaječar in 1883 led to the arrest of most of the Radical leaders and fresh repressive measures. Pašič fled across the Danube and was condemned to death *in absentia,* remaining in exile till after King Milan's abdication in 1889 On his return he became president of the Skupština and on two occasions mayor of Belgrade. He was premier for the first time from Feb. 1891 to Aug. 1892, and as foreign minister accompanied the young King Alexander on his first visit to the Tsar. As a strong Russophile he was made Serbian minister in St. Petersburg, but resigned as a mark of protest against the illegal return of King Milan to Serbia in 1894 The Radicals were now in keen opposition, and when an attempt was made on the ex-king's life in 1899 the Government rid itself of their leaders by trumped-up charges of engineering the crime, and imposed savage sentences of forced labour. Pašić, thanks to Russian remonstrances, received only five years and was then amnestied on condition of leaving the country. He returned only after Milan's final withdrawal. After the fall of the Obrenović dynasty in 1903 the Radical party became dominant, and Pašić was foreign minister in 1904 and premier in 1906 and again from 1908–10. He shared in Milovanović's negotiations for a Balkan league and on Milovanović's death in 1912 became the dominant figure in the Radical party, resuming the premiership on the very eve of war with Turkey. He remained in office throughout the two Balkan wars, and contributed materially towards the alliance with Greece and the *rapprochement* with Rumania. While his foreign policy was essentially Russophile, he, on two occasions, in 1912–13 made overtures to Vienna, which were rejected.

The murder of the Archduke at Sarajevo brought the already strained relations with Austria-Hungary to a head. But so absorbed was Pašič in internal politics that he was absent from Belgrade when the fateful ultimatum was presented, and even then was preparing to visit Venizelos at Salonica when an urgent message recalled him. Party discord was silenced by the national danger, the elections were postponed and the already dissolved Parliament reassembled at Niš. In November, a coalition cabinet was formed, but Pašič remained premier, and when in 1917 the Opposition again seceded, he once more formed a purely Radical Government

The revolution of March 1917 and the fall of Tsardom weakened Pašić's position both at home and abroad, forcing him to recede from his strictly Pan-serb and Orthodox attitude, and to negotiate, upon equal terms, with the Yugoslav committee under Dr Trumbić, the so-called "declaration of Corfu" (July 1917), which laid down the broad lines of the future unified Yugoslav State But his relations with the committee became increasingly strained, and he stubbornly denied to them any status in the allied camp and refused to admit them to a coalition cabinet. This attitude was the main reason why the Entente governments withheld from the Yugoslavs that recognition which they accorded in Aug 1918 to the much less favourably situated Czechoslovaks. The result was that Austria-Hungary collapsed before any agreement had been reached among the Allies on the Yugoslav problem, and that Italy, abandoning the compromise reached at the Roman Congress of Oppressed Nationalities in the previous April, reasserted her full territorial claims under the secret Treaty of London Despite this dangerous situation Pašič maintained his obstructive tactics not merely towards the Yugoslav committee but also towards the new provisional Government which had been formed in Zagreb and which had at once nominated Trumbić as its spokesman in Paris Finally, a certain compromise was reached, and while Protić became the first premier of Yugoslavia, Pašič was made first delegate to the Peace conference, with Trumbić and Vesnić as his colleagues

In Jan 1921 Pašič again became premier, and thanks partly to his skilful bargaining with the minor groups and partly to the foolish abstention of the Croat Peasant party, he was able to manoeuvre the new centralist constitution through parliament (June 28, 1921), and to suppress the Communist Party In the following winter he manoeuvred his Democratic allies out of the Government and formed a purely Radical cabinet At the elections of March 1923 he failed to secure a majority, but was again saved by the blunders of the Opposition Though from July to Oct. 1924 he had to give place to a coalition cabinet under Davidović, he returned to power stronger than ever

In Feb. 1925 he again dissolved parliament, threw Radić and his colleagues into prison, and by the adoption of extremely drastic electoral measures secured a small working majority. Radić hereupon made his famous recantation (*see* RADIĆ, STJEPAN) and entered the cabinet in October The two strongest parties in Yugoslavia were now temporarily united; but the situation became increasingly difficult On April 4, 1926 Pašič, whose health was failing, handed the premiership over to Ouzounović. He died on Dec 10, 1926

PASIG, a municipality (with administration centre and 24 *barrios* or districts) and the capital of the province of Rizal, Luzon, Philippine Islands, about 6 m. E S E of Manila Pop. (1918), 16,767, of whom 21 were whites. Pasig is located on the Pasig river (the outlet of Laguna de Bay which reaches the sea at Manila) and its tributary the Mariquina Ft. McKinley, a large military post established for the troops from the United States, lies in the south-west part of the municipality The principal industries are rice farming, the manufacture of a cheap red pottery and fishing The language spoken is Tagalog.

PASKEVICH, IVAN FEDOROVICH (1782–1856), count of Erivan, prince of Warsaw, Russian field marshal, was born at Poltava on May 19, 1782 He entered the army through the imperial institution for pages in 1800, saw much active service, and by 1828 had reached the rank of field marshal. In 1830 he subdued the mountaineers of Daghestan. In 1831 he suppressed the

revolt of Poland, and after the fall of Warsaw, which gave the death-blow to Polish independence, he was raised to the dignity of prince of Warsaw, and created viceroy of the kingdom of Poland. On the outbreak of the insurrection of Hungary in 1848 he commanded the Russian troops sent to the aid of Austria, and compelled the surrender of the Hungarians at Világos. In April 1854 he commanded the army of the Danube, but on June 9, at Silistria, he was defeated. He died on Feb. 13, 1856 at Warsaw.

See Tolstoy, *Essai biographique et historique sur le feld-maréchal Prince de Varsovie* (Paris, 1835); *Notice biographique sur le Maréchal Paskévitch* (Leipzig, 1856); and Prince Stcherbatov's *Life* (St. Petersburg, 1888–94).

PASQUE-FLOWER, the name applied to two species of *Anemone* (*q.v.*), of the family Ranunculaceae (*q.v.*). They are low, stemless, densely silky-hairy perennial herbs, rising from thick rootstocks, and bearing long-stalked, digitately-divided leaves and large purple or lavender flowers, followed by a fruiting head of silky achenes with long feathery tails (styles). The European pasque-flower (*A. Pulsatilla*), with violet purple flowers, wide-spread on the Continent, grows in chalky pastures in England. The American pasque-flower (*A. patens* var. *Wolfgangiana*), with light bluish or pale lavender flowers, is abundant on prairies from Illinois to Alberta and southward in the Great Plains to Texas; it occurs also in British Columbia. Both species are more or less planted in gardens. By some botanists the pasque-flowers have been placed in a separate genus *Pulsatilla*, the European plant becoming *P. vulgaris* and the American, *P. hirsutissima*.

PASQUIER, ÉTIENNE (1529–1615), French lawyer and man of letters, was born at Paris, on June 7, 1529, by his own account, according to others a year earlier. He was called to the Paris bar in 1549. In 1560 he published the first book of his *Recherches de la France*. In 1565, when he was 36, his fame was established by a great speech still extant, in which he pleaded the cause of the University of Paris against the Jesuits, and won it. Meanwhile he pursued the *Recherches* steadily. He left accounts of the jests of himself and his colleagues at the *Grands Jours* of Poitiers in 1579 (the celebrated collection of poems on a flea) and Troyes in 1583. In 1585 Pasquier was appointed by Henry III. advocate-general at the Paris cour des comptes. He died on Sept. 1, 1615.

Pasquier's work was considerable, and it has never been fully collected or indeed printed. The standard edition is that of Amsterdam (2 vols., 1723). But for ordinary readers the selections of Léon Feugère, published at Paris (2 vols., 1849), with an elaborate introduction, are most accessible. As a poet Pasquier is chiefly interesting as a minor member of the Pléiade movement. As a prose writer he is of much more account. The three chief divisions of his prose work are his *Recherches*, his letters and his professional speeches. *See* H. Gaudrillait, "Etienne Pasquier," in the *Séance publique* of the Institut Royal for 1839.

PASQUIER, ÉTIENNE DENIS, Duke (1767–1862), French statesman, was born on April 22, 1767. He was a counsellor of the Paris parlement. Napoleon in 1810 made him prefect of police. He was captured in the strange conspiracy of the republican general, Malet (Oct. 1812), who, giving out that Napoleon had perished in Russia, managed to surprise and capture some of the ministers and other authorities at Paris. He soon, however, regained his liberty.

When Napoleon abdicated in April 1814 Pasquier resigned the prefecture of police, whereupon Louis XVIII. allotted to him the control of roads and bridges. He held various ministerial offices under Louis XVIII., but refused to join the reactionary cabinets of the close of the reign of Charles X. After the July Revolution (1830) he became president of the Chamber of Peers —a post which he held through the whole of the reign of Louis Philippe (1830–48). In Feb. 1848, Pasquier retired from active life. He died in 1862.

See *Mémoires du Chancelier Pasquier* (6 vols., 1893–95; partly translated into English, 4 vols., 1893–94). Also Louis de Viel-Castel, *Histoire de la Restauration*, vols. i.–iv. (20 vols., 1860–77).

PASSAGE RITES. The social and religious orders are concerned with, interpret, explain, and exploit the facts of the biological order. Man passes from one stage of life to another continuously. Yet there are breaks, moments of discontinuity. All the various moments of discontinuity in the social life are the occasions of passage rites. Time and place, age and status, social ideas, determine their detail, but all exhibit a common form because all serve a common purpose. What is new is dangerous. What is new may be necessary or inevitable, fore-ordained and foreseen. The nearest source of strength for the individual is found in the solidarity of his society. The cake of custom constrains and protects him. All passage rites consist of a period of separation marked by formal acts of severance, physical or symbolic. This is followed by a period of delay, sometimes of some length, and is completed by a series of rites uniting the individual to his society; indeed they make him a member of his society. Other ends may be served by subordinate ancillary rites which often acquire such prominence as to obscure the primary purpose. Thus marriage rites contain various elements but as a whole are typically passage rites. Birth rites, naming rites, initiation rites, marriage rites, and funeral rites, exhibit these essential features. The common purpose is to effect and to mark a change in the status of the individual, to affirm and to confirm the solidarity of society, and to protect the individual at the moments when by social or physical necessity he is subjected to abnormal emotional stress, and therefore dangerous.

See Consecration, Initiation, Mana, Marriage, Ritual, Tabu.

Bibliography.—A. Van Gennep, *Les Rites de Passage* (1909); A. R. Brown, *The Andaman Islanders* (1922).

PASSAIC, a city of Passaic county, New Jersey, U.S.A., on the Passaic river, 9 m. above Newark and 4 m. below Paterson. It is served by the Erie, the Lackawanna and the New York, Susquehanna and Western railways, interurban trolleys and motor-bus lines. Pop. (1920) 63,541; 1928 est. 71,800. The city has an area of 3·26 sq.m.; an assessed valuation for 1927 of $103,482,677; and a commission form of government. It shares in the water-supply from the Wanaque watershed and empties its sewage into the great Passaic Valley drain. (*See* Newark.) Passaic has long been an important manufacturing centre, with highly diversified industries, and the output of its factories in 1925 was valued at $94,724,897. A settlement was established here by the Dutch in 1679. Until the middle of the 19th century it was called Acquackanonk or Paterson Landing. In 1873 it was chartered as a city. Between 1880 and 1910 the population increased from 6,532 to 54,773, doubling in each of the three decades.

PASSAU, a town and episcopal see of Germany, in the republic of Bavaria, situated at the confluence of the Danube, the Inn and the Ilz, close to the Austrian frontier, 89 m. N.E. from Munich and 74 S.E. of Regensburg by rail. Pop. (1925) 24,428, nearly all being Roman Catholics. On the site of the present Innstadt there was a pre-Roman settlement, *Boiudurum*. Afterwards the Romans established a colony of Batavian veterans, the *castra batava* here. It received civic rights in 1225. The bishopric was founded by St. Boniface in 738 and included until 1468 not only much of Bavaria, but practically the whole of the archduchy of Austria. About 1260 the bishop became a prince of the empire. In 1803 the bishopric was secularized, and in 1805 its lands came into the possession of Bavaria. The area, which was diminished in the 15th, and again in the 18th century, was then about 350 sq.m., and the population about 50,000. A new bishopric of Passau, with ecclesiastical jurisdiction only, was established in 1817.

Passau consists of the town proper, lying on the rocky tongue of land between the Danube and the Inn, and of suburbs, lying along the other rivers. Of the 11 churches, the most interesting is the cathedral of St. Stephen. The two linked fortresses, the Oberhaus and the Niederhaus, are the remains of the fortifications. The former was built early in the 13th century by the bishop in consequence of a revolt on the part of the citizens; the latter is mentioned as early as 737. The chief industries are the manufacture of tobacco, beer, leather, porcelain, machinery, paper, iron founding and the quarrying of graphite and granite. Large quantities of timber are floated down the Ilz. Passau is a tourist centre, and has an important river trade, especially since

the construction of the Rhine-Main-Danube canal.

See W. M. Schmidt, *Gesch. der Stadt Passau* (1928).

PASSCHENDAELE, BATTLE OF, 1917. This protracted operation formed part of the still more prolonged offensive known as and described under *Ypres, Battles of, 1917*. But because of its unhappy significance as the final stage and ultimately the final goal of these operations, the term "Passchendaele Offensive" is often used to denote not merely the part but the whole.

PASSERAT, JEAN (1534–1602), French poet, was born at Troyes, on Oct. 18, 1534. He studied at the university of Paris, and is said to have worked in a mine. He taught at the Collège de Plessis, and was made professor of Latin in 1572 in the Collège de France. Passerat composed much agreeable poetry in the Pléiade style, the best being his short ode *Du Premier jour de mai,* the charming villanelle, *J'ai perdu ma tourterelle,* and the famous political song, *Sur la journée de Senlis.* His share in the *Satyre ménippée* (Tours, 1594), the manifesto of the *politique* or Moderate Royalist party when it had declared itself for Henry of Navarre, is doubtful. He died in Paris on Sept. 14, 1602.

See a notice by P. Blanchemain prefixed to his edition of Passerat's *Poésies françaises* (1880). Among his Latin works should be noticed *Kalendae januariae et varia quaedam poemata* (2 vols., 1606), addressed chiefly to his friend and patron Henri de Mesmes. For the *Satyre ménippée* see the edition of Charles Read (1876).

PASSERES or **PASSERIFORMES,** the largest order of birds, containing most of the highest forms. They are the true perching birds, with three toes directed forwards and one backwards; the latter is long and is moved by a separate tendon from that moving the front ones. There are between 5,000 and 6,000 species, mostly small birds; they fall into two sections, the Mesomyodi, with a simple syrinx (*see* Song in Birds) and hence songless, and the Acromyodi with a complex syrinx and including all the true song-birds, besides others. In size, passerines range from the minute wrens, sun-birds and flower-peckers (*qq.v.*) to the relatively large crows and birds of paradise (*qq.v.*). The order includes songsters such as the nightingale, mocking-bird, bulbul, skylark, song and hermit thrushes and brilliantly coloured forms such as the cocks of the rock, birds of paradise, the cardinals, pittas, etc. (*See* Ornithology, Bird.)

PASSION, a term used in two main senses: (1) the suffering of pain, and (2) feeling or emotion. The first is chiefly used of the suffering of Jesus Christ, extending from the time of the agony in the garden until His death on the Cross. In this sense, *passio* (late Lat.), was used by the early Christian writers, and the term is also applied to the sufferings and deeds of saints and martyrs. Passion Week is the name given to the fifth week in Lent, beginning with Passion Sunday. One of the earlier forms of oratorio, developed from the ancient church usage of reciting in Holy Week the story of the Passion, to appropriate plain-song music.

PASSION-FLOWER (*Passiflora*), the typical genus of the family Passifloraceae, to which it gives its name. The name passion-flower—*flos passionis*—arose from the supposed resemblance of the corona to the crown of thorns, and of the other parts of the flower to the nails, or wounds, while the five sepals and five petals were taken to symbolize the ten Apostles—Peter, who denied, and Judas, who betrayed, being left out of the reckoning. There are about 300 species, mostly natives of western tropical South America; others are found in various tropical and sub-tropical districts of both hemispheres. The tacsonias, by some considered to form part of this genus, inhabit the Andes at considerable elevations. They are mostly climbing plants having a woody stock and herbaceous or woody branches, from the sides of which tendrils are produced. Some few form trees of considerable stature destitute of tendrils, and with broad magnolia-like leaves in place of the more or less palmately-lobed leaves which are most generally met with in the family.

The inflorescence is usually of a cymose character. The flower consists of a receptacle varying in form from that of a shallow saucer to that of a long cylindrical or trumpet-shaped tube, and giving off from its upper border the five sepals, the five petals (rarely these latter are absent), and the threads or membranous processes constituting the "corona." This corona forms the most conspicuous and beautiful part of the flower of many species, and consists of outgrowths from the tube formed subsequently to the other parts; it is physiologically useful in favouring the cross-fertilization of the flower by means of insects. From the base of the inner part of the tube of the flower, but quite free from it, uprises a cylindrical stalk surrounded below by a small cup-like outgrowth, and bearing above the middle a ring of five flat filaments each attached by a thread-like point to an anther. Above the ring of stamens is the ovary itself, upraised on a prolongation of the same stalk which bears the filaments, or sessile. The stalk supporting the stamens and ovary is called the "gynophore" or the "gynandrophore," and is a characteristic of the family.

FROM BAILLON, "HISTOIRE DES PLANTES" (COPR. H BONNAIRE)

PASSION-FLOWER (PASSIFLORA CERULEA), SHOWING (A) FLOWERS AND CLIMBING HABIT, (B) LONGITUDINAL SECTION THROUGH THE FLOWER

The ovary of passion-flowers is one-celled with three parietal placentas, and bears at the top three styles, each terminating by a large button-like stigma. The ovary ripens into a berry-like, very rarely capsular, fruit with the three groups of seeds arranged in lines along the walls, but imbedded in a pulpy arillus derived from the stalk of the seed. This succulent berry is in some cases highly perfumed, and affords a delicate fruit for the dessert-table, as in the case of the "granadilla" *P. quadrangularis,* also *P. edulis, P. macrocarpa,* and various species of *Tacsonia* known as "curubas" in Spanish South America; *P. laurifolia* is the water-lemon, and *P. maliformis* the sweet calabash of the West Indies. The fruits do not usually exceed in size a hen's or a swan's egg, but that of *P. macrocarpa* is a gourd-like oblong fruit attaining a weight of 7 to 8 pounds.

In the United States about 10 native species of *Passiflora* occur, chiefly in the South and South-west. The passion-vine (*P. incarnata*), climbing 10 to 30 ft. high, with pink and white flowers and a yellow, berry-like, edible fruit, 2 in. long, is found from Virginia to Missouri south to Florida and Oklahoma. The yellow passion-flower (*P. lutea*), of similar range, is a smaller plant, with greenish-yellow flowers and purple fruit.

The tacsonias, which in cultivation are often regarded as distinct, differ from *Passiflora* in having a long cylindrical calyx-tube, bearing two crowns, one at the throat, the other near the base; they are stove or greenhouse plants; *T. pinnatistipula,* with pale rose-coloured flowers, a native of Chile and Peru, has long been in cultivation; *T. Van-Volxemii* and *T. manicata,* with handsome scarlet flowers, are among the finest species.

PASSIONISTS, a congregation of men of the Roman Catholic Church comprising priests, seminarists and lay auxiliaries. Its official title is The Congregation of the Discalced Clerks of the most Holy Cross and Passion of our Lord Jesus Christ. It was founded by St. Paul of the Cross whose name was Paul Francis Daneo. He was born at Ovado, Italy, Jan. 3, 1694; died at Rome, Oct. 18, 1775; and was canonized, June 29, 1867. The Passionists were established at Castelazzo, Italy, 1720.

The Passionist congregation endeavours to unite the active and the contemplative forms of the religious life. Passionists take the three customary vows of poverty, chastity and obedience to which a fourth is added, that of promoting in the hearts of the faithful a devotion to the Passion and Death of Jesus Christ. The vows made are *simple,* not *solemn,* and are perpetual from their final profession. Their houses are not endowed, although

they are allowed to possess in common, buildings with a few acres of land attached.

During the lifetime of St. Paul of the Cross 12 houses of his institute were established in Italy and this number was greatly augmented during the ensuing years until 1810, when, by the order of Napoleon, they were suppressed together with all other religious institutions. From the time of the restoration of the congregation under Pius VII., the institute has spread throughout the world. At present houses of the congregation are found in Italy, France, Germany, Austria, England, Scotland, Ireland, Spain, Holland, Belgium, Poland, United States, Canada, Mexico, Colombia, Cuba, Argentine, Chile, Peru, Brazil, Australia, China, Rumania and Bulgaria.

See Father Pius, *The Life of St. Paul of the Cross* (Dublin, 1868); Felix Ward, *The Passionists* (Benziger, New York, 1923).

PASSOVER, a spring festival celebrated by the Jews in commemoration of the Exodus from Egypt by a family feast in the home on the first evening, and by abstaining from leaven during the seven days of the feast. According to tradition, the first Passover ("the Passover of Egypt") was preordained by Moses at the command of God. The Israelites were commanded to select on the tenth of Abib (Nisan), a he-lamb of the first year, without blemish, to kill it on the eve of the fourteenth, and to sprinkle with its blood the lintel and side post of the doors of their dwellings so that the Lord should "pass-over" them when he went forth to slay the first-born of the Egyptians. The lamb thus drained of blood was to be roasted and entirely consumed by the Israelites, who should be ready with loins girded, shoes on feet and staff in hand so as to be prepared for the Exodus. In memory of this the Israelites were for all time to eat unleavened bread (Mazzoth) for seven days, as well as keep the sacrifice of the Passover on the eve between the fourteenth and the fifteenth of Nisan. This evening meal was not to be attended by any stranger or uncircumcised person. "On the morrow of the Sabbath" a wave-offering of a sheaf of barley was to be made.

Various theories have been from time to time proposed to account for this complex of enactments. J. Spencer in his *De legibus Hebraeorum* (1685) saw in the Passover a practical protest against the Egyptian worship of Apis. Vatke considered it a celebration of the spring solstice, Bauer a means of removing the impurity of the old year. Lengerke recognized a double motive: the lamb for atonement, the unleavened bread as a trace of the haste of the early harvest. Ewald regarded the Passover as an original pre-Mosaic spring Festival made to serve the interest of purity and atonement.

Investigations based on minute literary analysis of the Pentateuch, were begun by Graf, continued by Kuenen, and culminated in the work of Wellhausen and Robertson Smith. The modern view claims to determine the respective ages and relative chronological position of the various passages in which the Passover is referred to in the Pentateuch, and assumes that each successive stratum represents the practice in ancient Israel at the time of composition, laying great stress upon the omissions as implying non-existence. The main passages and their contents are arranged chronologically in the following way:—

A. In the Elohist Book of the Covenant (Exod. xxiii.).
B. In the Yahwist Source (Exod. xxxiv. 18–21, 25).
C. In the Yahwistic History (Exod. xii. 21–27, 29–36, 38–39, xiii. 3–16).
D. The Deuteronomist (Deut. xvi. 1–8, 16–17).
E. In the Holiness Code (Lev. xxiii. 4–8, 9–14).
F. In the Priestly History (Exod. xii. 1–20, 28–31, xiii. 1–2).
G. In the Secondary Sources of the Priestly Code (Exod. xii. 40–41, 43–50, ix. 1–14, xiv. 16–25).

Many discrepancies have been observed by critics in the different portions of this series of enactments. Thus in the Elohist and in Deuteronomy the date of the festival is only vaguely stated to be in the month of Abib, while in the Holiness Code and in the Priestly History the exact date is given and so on.

As regards the character and significance of the two feasts it may be noted that the Passover (Nisan 15) is taken back to the beginning of the national history. It originally connoted a pastoral feast celebrating the birth of the lambs. It goes back to the desert period, whereas the Feast of Unleavened Bread is an agricultural observance and cannot have been practised before the entry into Palestine. The "sheaf of first-fruits of your harvest" mentioned in Lev. xxiii. 10, is associated in Jewish tradition with the barley harvest (Mishna, *Menachoth* x.).

The folk-etymology of the word Passover given in Exod. xii. 23 seems to connect the original of the feast with a threshold covenant (*see* Trumbull, *Threshold Covenant,* 1902); the daubing of the side-posts and lintel with blood at the original Passover, which finds its counterpart in Babylonian custom (Zimmern, *Beit. z. Bab. Rel.* ii. 126–7) and in Arabic usage (*Wakidi,* ed. Kremer, p. 28), implies a blood covenant.

The feast is connected both in later Jewish tradition and among the Samaritans with the sacro-sanctity of the first-born. Hebrew tradition further connects the revelation of the sacred name of the God of the Hebrews with the festival, and thus connects it with the Exodus, the beginning of the theocratic life of the nation. There seems no direct connection between the Paschal sacrifice and an agricultural festival; the Hebrew tradition, to some extent, dissociates them by making the sacrifice on 14th of Nisan and beginning the Feast of Unleavened Bread on 15th.

Wellhausen and Robertson Smith suggested that the Passover was, in its original form, connected with the sacrifice of the firstlings, and the latter points to the Arabic annual sacrifices called *'atair,* which some of the lexicographers interpret as firstlings. These were presented in the month of Rajab, corresponding to Nisan (Smith, *Religion of Semites*). But the real Arabic sacrifice of firstlings was called *fara;* it might be sacrificed at any time, as was also the case with the Hebrews (Exod. xxii. 30). The paschal lamb was not necessarily a firstling, but only in the first year of its life (Exod. xii. 5). The suggestion of Wellhausen and Robertson Smith confuses the offering of firstlings (Arabic *fara*) and that of the first yearlings of the year in the spring (Arabic *'atair*). It is possible that the Passover was originally connected with the latter (*cf.* Wellhausen, *Reste arab. Heidentums*). As regards the feast of Unleavened Bread, now indissolubly connected with the Paschal sacrifice, no satisfactory explanation has been given either of its original intention or of its connection with the Passover. It has been suggested that it was originally a *ḥag* (*ḥajj*) or pilgrimage feast to Jerusalem, of which there were three in the year connected with the agricultural festivals (Exod. xxxiv. 17 *seq.*). But the real agricultural occasion was not the eating of unleavened bread but the offering of the first sheaf of the barley harvest on the "morrow of the Sabbath" in the Passover week (Lev. xxiii. 10 *seq.*). This occasion determined the second agricultural festival, the Feast of Weeks, fifty days later (Deut. xvi. 9; Lev. xxiii. 16; *see* PENTECOST). It still remains possible therefore, that the seven days' eating of unleavened bread (and bitter herbs) is an historical reminiscence of the incidents of the Exodus where the normal commissariat did not begin until a week after the first exit. On the other hand, the absence of leaven may recall primitive practice before its introduction as a domestic luxury.

According to Robertson Smith, the development of the various institutions connected with the Passover was as follows. In Egypt the Israelites, as a pastoral people, sacrificed the firstlings of their flocks in the spring, and, according to tradition, it was a refusal to permit a general gathering for this purpose that caused the Exodus. When the Israelites settled in Canaan they found there an agricultural festival connected with the beginnings of the barley harvest, which coincided in point of date with the Passover and was accordingly associated with it. At the time of the reformation under Josiah, represented by Deuteronomy, the attempt was made to turn the family thank-offering of firstlings into a sacrificial rite performed by the priests in the Temple with the aid of the males of each household, who had to come up to Jerusalem but left the next morning to celebrate the Feast of Unleavened Bread in their homes. During the exile this was found impossible, and the old home ceremonial was revived and was kept up even after the return from the exile. There appears to have been at first considerable variety in the mode of keeping the Passover, but the earliest

mention in the historical narratives (Josh. v. 11) connects the Paschal sacrifice with the eating of unleavened bread.

At any rate the Samaritans have throughout their history observed the Passover with all its Pentateuchal ceremonial and still observe it down to the present day. They sacrifice the paschal lamb, which is probably the oldest religious rite that has been continuously kept up. In two important points they differ from later Jewish interpretation. The term "between the evenings" (Lev. xxiii. 5) they take as the time between sunset and dark, and "the morrow of the Sabbath" (v. 11) they take literally as the first Sunday in the Passover week; wherein they agree with the Sadducees, Boethusians, Karaites and other Jewish sectaries. The Paschal Lamb is no longer eaten, but represented by the shank bone of a lamb roasted in the ashes; unleavened bread and bitter herbs (*haroseth*) are eaten; four cups of wine are drunk before and after the repast, and a certain number of Psalms are recited.

The Passover among the Jews is regarded as the Festival of Freedom. It seems probable in any case that the ritual of the Mass has grown out of that of the Passover service (*see* Bickell, *Messe und Pascha*, trans. W. F. Skene, Edinburgh, 1891). Up to the Nicene Council the Church kept Easter (*q.v.*) coincident with the Jewish Passover, but after that period took elaborate precautions to dissociate the two.

BIBLIOGRAPHY.—The commentaries on Exodus and Leviticus; that of Kalisch on the latter book (vol. ii., London, 1871) anticipates much of the critical position. The article in Winer's *Bibl. Realwörterbuch* gives a succinct account of the older views. A not altogether unsuccessful attempt to defend the Jewish orthodox position is made by Hoffmann in his *Commentary* on Leviticus (Berlin, 1906). Wellhausen's views are given in his *Prolegomena*. A critical yet conservative view of the whole question is given by R. Schaefer, *Das Passah-Mazzoth-Fest* (Gutersloh, 1900) which has been partly followed above. For the general attitude towards the comparative claims of institutional archaeology and literary criticism adopted above *see* J. Jacobs, *Studies in Biblical Archaeology* (London, 1895). *See* also I. Abrahams, *Annotated Jewish Prayer Book* (London, 1914), and Oesterley, *Jewish Background of the early Christian liturgy* (London, 1926).

(J. JA.; G. H. B.)

PASSOW, FRANZ LUDWIG CARL FRIEDRICH (1786–1833), German classical scholar and lexicographer, was born at Ludwigslust in Mecklenburg-Schwerin on Sept. 20, 1786, was professor of ancient literature at Breslau, and died there on March 11, 1833. He aroused great opposition by his advocacy of gymnastic exercises. Passow's great work was his *Handwörterbuch der griechischen Sprache* (1819–24), originally a revision of J. G. Schneider's lexicon, which appeared in the fourth edition (1831) as an independent work, without Schneider's name (new ed. by Crönert, 1901). It formed the basis of Liddell and Scott's lexicon.

See L. and A. Wachler, *Franz Passow's Leben und Briefe* (1839), which contains a full bibliography.

PASSPORT, or safe-conduct in time of war, a document granted by a belligerent Power to protect persons and property from the operation of hostilities. In the case of the ship of a neutral Power, the passport is a requisition by the Government of the neutral State to suffer the vessel to pass freely with the crew, cargo, passengers, etc., without molestation by the belligerents. A passport is also a document authorizing a person to pass out of or into a country, or a licence or safe-conduct to the person specified therein and authenticating his right to aid and protection. Passports are usually granted by the foreign office of a State, or by its diplomatic agents abroad. They may be granted to naturalized as well as natural-born British subjects.

In the United States, passports are issued by the Department of State at Washington, and, for the benefit of American citizens abroad, where there is no question of their citizenship, at a large number of American consular offices.

See N. W. Sibley, "The Passport System," *Jour. Comp. Leg.* new series, vol. vii.

PASSY, FRÉDÉRIC (1822–1912), French economist and pacifist, was born in 1822 and was a nephew of the economist Hippolyte Passy (1793–1880), finance minister to Louis Philippe and to Louis Napoleon's republican Government. His first work, *Mélanges économiques,* appeared in 1857. He was an ardent free-trader and an admirer of Cobden. In 1867 he founded the Ligue Internationale de la Paix, afterwards known as the Société Française pour l'Arbitrage entre Nations, and devoted himself to the promotion of international peace. From 1881 to 1899 he was deputy for the Seine department. In 1901 he shared the Nobel Peace prize with Dunant. He died in Paris on June 12, 1912.

His published works include *De la Propriété Intellectuelle* (1859), *Leçons d'économie politique* (1860–61); *La Démocratie et l'Instruction* (1864); *L'Histoire du Travail* (1873), *Malthus et sa Doctrine* (1868); *La Solidarité du Travail et du Capital* (1875), and *Le Petit Poucet du XIX^me siècle; George Stephenson* (1881).

PASTEBOARD: *see* CARDBOARD.

PASTEL, the simplest of all methods of laying colour upon a flat surface. The colours used consist practically of the pure powder colours; whereas in other methods, the colours have to be mixed with some medium, the immediate result often being that the tone of the colour is lowered; and even if on drying the original tone is restored, as in fresco (*q.v.*), the artist while at work can only calculate what the picture will look like when dry. In pure pastel as the colour is put on so it remains. The disadvantage of pastel is that its life is precarious, not because its colours are more fugitive than in other methods but because it remains on the surface of the paper, liable, unless protected by glass, to be rubbed off by any chance touch. On the other hand, if certain precautions are observed during the course of applying the colour it is able to resist violent shocks, even if ordinary powder colour is applied direct; as it may be at times.

Pastels are made up into cylinders or pencils with the least amount of adhesive (a gum) necessary to hold the particles of colour together in the lightest possible manner, so that a touch of the pencil on the surface of the paper leaves an impression. Pastels, as sold by the modern dealer, are usually arranged in a series of tones, the darkest pencil consisting of the pure colour; all the other pencils of the series are mixed with white to a greater and greater degree as they ascend the scale toward the lightest. Thus the artist has a certain number of tones ready to use at once. The white used is either precipitated chalk or pipe-clay. Pastels can be applied to any paper but some seem to hold the powdered colour much better than others. The paper may be of any colour.

If white paper is decided upon, a good one is a medium "Whatman," but even here the papers of different years vary considerably, and if the artist finds one he likes he will be wise to lay in a considerable stock as he may find it impossible to buy exactly the same again. He should also avoid certain papers of almost a felt-like character, which take up a considerable amount of powder and are liable to shed it again on very slight provocation. It is a curious thing that this powder will adhere to a comparatively smooth surface, so long as the artist, while at work on the picture, blows, at intervals, the superfluous powder away, and, occasionally, taps the back of the board upon which the paper is laid. Pastels should not be done upon canvas or sand paper.

Pastel can be applied as a pencil, *i.e.*, by means of lines or short touches, or it may be rubbed. By far the best way of rubbing pastel is with the pad of the tip of the finger; if stumps are used they are apt to remove most of the powder. Speaking generally pastel should not be fixed, the use of the fixatives at once alters its character; it is converted into a painting and all the tones are lowered, and the beauty of the surface is at once destroyed. It becomes like a butterfly's wing dipped in water. No fixative is satisfactory, but one, which serves its purpose, is a weak solution of parchment, size and water blown on with a spray diffuser from a considerable distance.

Sometimes a very little fixative may be used in the early stage as this prevents a heaping up of the powder, the fixative making what is there firmly and thinly adhere to the paper, but the final touches must be pure pastel. It is easy by loading pastel upon the paper to reach the end of the possibility of this method, therefore, above all, the artist must learn to apply the powder very thinly and to keep the colours as much as possible clear and defined. A dirty mess is the end of a good many pastels.

Pastel has most distinctly a character of its own and should be used with an understanding of what it can do and what it cannot do. It should not be used to imitate oil-painting which it certainly cannot do without entirely altering its natural character.

It should be considered as a method of applying colour, which owing to the practical absence of a medium is higher in tone than in any other method, thinly to the surface of the paper so that as in water-colour the actual paper itself may occasionally play a part in the design. With this knowledge of its proper use, very beautiful results can be obtained. It is an excellent method to use when a portrait is required, but better for small portraits than large; a life-sized head in pastel is seldom satisfactory and generally becomes overloaded with colour. It cannot pretend to the carrying power of oil-painting; it may be described as a more humble medium and, therefore, is not to be employed in large designs. (H. To.)

HISTORY

The invention of pastel, which used to be generally called "crayon," has frequently been accredited to Johann Alexander Thiele (1685–1752), landscape-painter and etcher of distinction, as well as to Mme. Vernerin and Mlle. Heid (1688–1753), both of Danzig. But the claim cannot be substantiated, as drawing in coloured chalks had been practised long before, *e.g.*, by Guido Reni (1575–1642), by whom a head and bust in this manner exists in the Dresden Gallery. Thiele was perhaps the first to carry the art to perfection, but his contemporary, Rosalba Carriera of Venice (1675–1757), is more completely identified with it. The Dresden Museum contains 157 examples of her work in this medium, portraits, subjects and the like. Thiele was followed by Anton Raphael Mengs (1728–1779) and his sister Theresia Mengs (afterwards Maron, 1725–1806), and by Johann Heinrich Schmidt (1749–1829).

Holbein, Watteau, Boucher, Greuze, John Raphael Smith and Sir Thomas Lawrence all made use of the coloured chalk. In 1747 Nattier (1685–1766) showed a pastel portrait of M. Logerot in the Paris Salon, and his son-in-law, Louis Tocqué (1696–1772), soon followed with similar work. Hubert Drouais (1699–1767) had preceded his rival Nattier in the Salon by a single year with five pastel portraits, and Chardin (1699–1779) followed in 1771. This great master set himself to work in emulation of Quentin de la Tour (1704–1788), who in spite of the ability of his rivals may be regarded as the most eminent pastellist France has produced. His full strength as a portrait-pastellist is to be gauged in the collection of eighty-five of his principal works now in the museum of St. Quentin. Then followed Simon Mathurin Lantara (1729–1778), who was one of the first to paint pastel-pictures of landscapes.

Two Swiss painters had considerable influence in spreading the use of pastel—the experimentalist Dietrich Meyer (1572–1658), one of the first to make designs in coloured chalks (and reputed inventor of soft-ground etching), and Jean Étienne Liotard (1702 or 1704–1788), one of the most brilliant pastellists who ever lived. Two of his works are world-famous, "La Belle Chocolatière de Vienne," executed in 1745, now in the Dresden Museum, and "La Belle Liseuse" of the following year at the museum at Amsterdam. The latter is a portrait of his niece, Mlle. Lavergne.

Crayon-painting was practised in England at an early date, and John Riley (1646–1691), many of whose finest works are attributed to Sir Peter Lely, produced numerous portraits in that medium. Francis Knapton (1698–1778), court painter, was a more prolific master, and he, with William Hoare of Bath (?1707–1792) who had studied pastel in Italy, prepared the way for the triumph of Francis Cotes (?1725–1770). Then for the first time pastel-painting was fully developed by an English hand. Before he became a painter in oil Cotes had worked under Rosalba Carriera, and, although he was rather cold and chalky in his tones, he produced portraits, such as his "Mr. and Mrs. Joah Bates" and "Lord Hawke," which testify to his high ability. He was, however, far surpassed by his pupil, John Russell, R.A. (1745–1806), who brought the art to perfection, displaying grace and good expression in all his pastel work, whether portrait, fancy picture, historical subject, group, or "conversation-piece." Romney (1734–1802) in his single pastel portrait, a likeness of William Cowper the poet, showed that he might have excelled in this medium, which, indeed, was particularly suited to his tender manner. Hugh D. Hamilton (*c.* 1734–1806) of the Royal Hibernian Academy, Ozias Humphry, A.R.A. (1742–1810), Richard Cosway, R.A. (1742–1821) and his wife Maria Cosway (1759–1838) are among the better known English pastellists. Daniel Gardner (?1750–1805), whose pictures in oil have often been mistaken for Reynolds's and Gainsborough's, gave rein to his exuberant fancy and his rather exaggerated taste in compositions. Gardner marked the deterioration of the art, which thereafter declined, Henry Bright (1814–1873) being almost the only pastellist of real power who followed him. Bright's landscapes have probably in their own line never been surpassed.

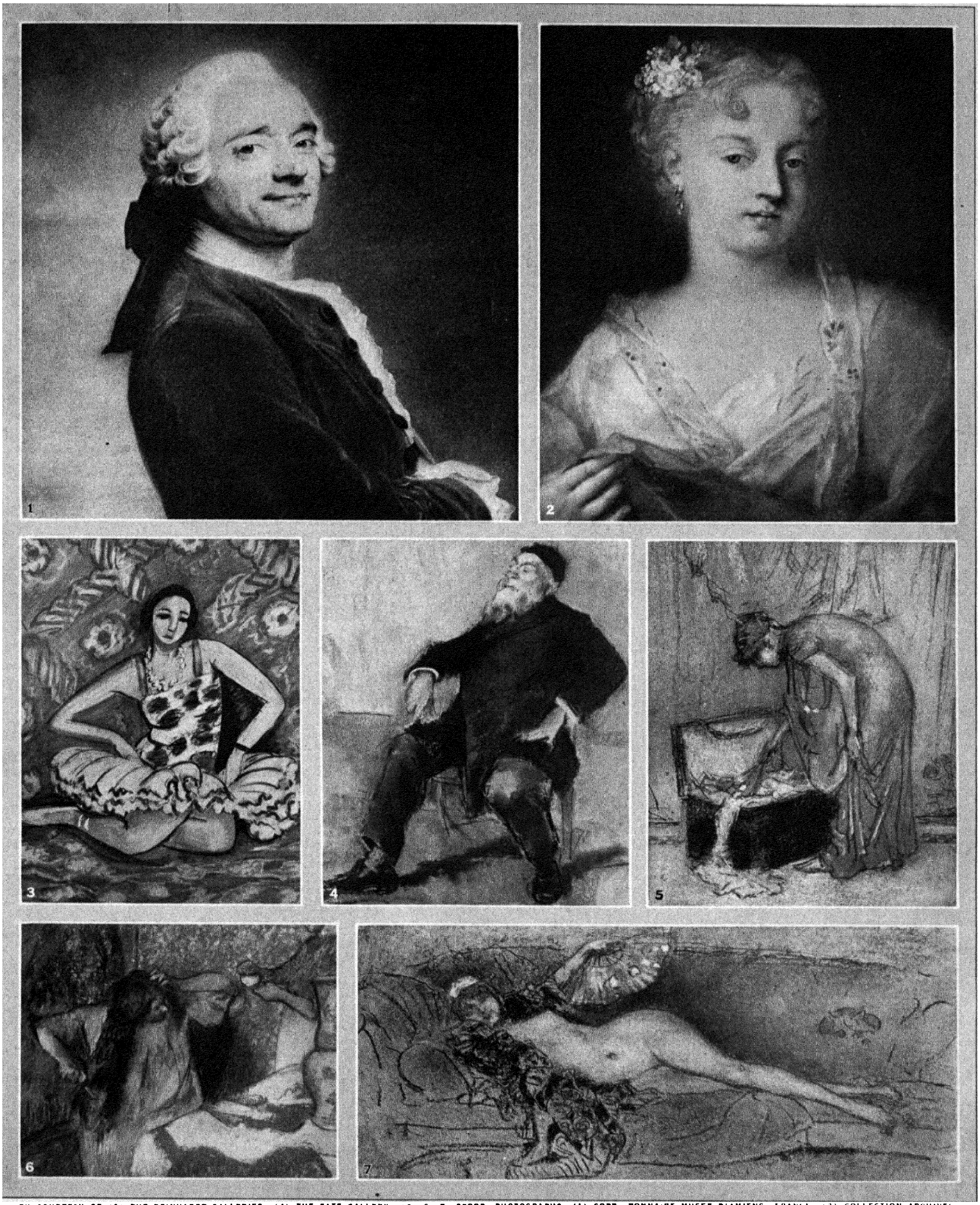
Since 1870 there has been a revival of the art of pastel, the result of a better understanding and appreciation on the part of the public. The art of pastel, as M. Roger Ballu expressed it, "was slumbering a little," until in 1870 the Société des Pastellistes was founded in France and met with ready appreciation. With many artists it was a matter of "coloured chalks," as, for example, with Millet, Lhermitte and Degas in France, and with Whistler in England. With the majority the full possibilities were seized, and a great number of artists abroad then practised the art for the sake of colour, among whom may be mentioned Adrien Moreau, A. Besnard, Émile Lévy, Machard, Pointelin, Georges Picard, de Nittis, Iwill, René Billotte, Jozan, Nozel, Raffäelli, Brochard (mainly upon vellum) and Lévy-Dhurmer in France; in Belgium, Émile Wauters (who has produced a great series of life-sized portraits of both men and women of amazing strength, vitality and completeness) and Fernand Khnopff; in Italy, C. Laurenti, P. Fragiacomo and Giovanni Segantini; in Holland, Josselin de Jong; in Germany, F. von Lenbach, Max Liebermann and Franz Stück; and in Norway, Fritz Thaulow.

America has also been closely identified with the revival of the art. Among the American painters who have been successful in the use of pastel are: August Renoir, Mary Cassatt, Thomas W. Dewing, Robert Blum, Jerome Myers, W. J. Glackens, Albert Sterner, Everett Shinn, J. Wells Champney and James Alden Weir.

In England the revival of pastel dates from 1880, when the first exhibition of the Pastel Society was held in the Grosvenor Gallery. The exhibition was a *succès d'estime*, but after a while the society languished until, in 1899, it was reconstituted, and obtained the adhesion of many of the most distinguished artists practising in the country, as well as of a score of eminent foreign painters. In that year, and since, it has held exhibitions of a high order; and intelligent public appreciation has been directed to the work of the most noteworthy contributors. Among these are E. A. Abbey, R.A.; M'Lure Hamilton, J. M. Swan, R.A.; J. Lorimer, R.S.A.; A. Peppercorn, R. Anning Bell, J. J. Shannon, R.A.; Sir James Guthrie, P.R.S.A.; H. Brabazon, Walter Crane, Melton Fisher, Edward Stott, A.R.A.; S. J. Solomon, R.A.; and W. Rothenstein.

See Karl Robert [Georges Meusnier], *Le Pastel* (Laurens, Paris, 1890); J. L. Sprinck, *A Guide to Pastel Painting* (Rowney, London); Henry Murray, *The Art of Painting and Drawing in Coloured Crayons* (Winsor and Newton, London). Among early works are: John Russell, R.A., *Elements of Painting with Crayons* (1776); M.P.R. de C.C., *Traité de la peinture au pastel avec les moyens de prévenir l'altération des couleurs* (Paris, 1788); Rosalba Carriera, *Diario degli anni 1720 e 1721 scritto di propria mano in Parigia*, etc. (Giovanni Vianelli, Venice, 1793, 4to); Girolamo Zanetti, *Elogio di Rosalba Carriera, pittrice* (*Venice*, 1818, 8vo). *See* also Henri Lapauze, *Les Pastels de M. Quentin de la Tour à St. Quentin*, preface by Gustave Larroumet (Paris); George C. Williamson, *John Russell, R.A.* (London, 1894). (M. H. S.)

PASTEUR, LOUIS (1822–1895), French chemist, was born on Dec. 27, 1822, at Dôle, Jura, the son of a tanner. Shortly afterwards his family moved to Arbois, where Louis attended the primary and secondary schools. In Oct. 1838 he was sent to a school in the Quartier Latin of Paris, preparatory to the École normale, but his health broke down and he yearned for home. "If only I could smell the tannery once more," said he, "I should feel well." He was allowed to return to Arbois, but soon left to enter the Royal College of Besançon, where in 1840 he won his "bachelier ès lettres." He then became assistant mathematical master in the college, securing in 1842 the "baccalauréat ès sciences" with "mediocre" in chemistry attached to his diploma. Even in these



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EXAMPLES OF PASTEL

1. Self-portrait by Quentin de La Tour (1704–1788), French. 2. "Portrait of a Lady with Flowers in her Hair" by Rosalba Carriera (1675–1757), Italian. 3. "The Ballet Dancer" by Henri Matisse (1869–), French. 4. "Auguste Rodin" by Henry Tonks (1862–), English. 5. "The Violet Note" by J. A. M. Whistler (1834–1903), American. In the Isabella Stewart Gardner Collection, Boston. 6. "The Toilet" by Hilaire G. E. Degas (1834–1917), French. 7. "Lapis Lazuli" by J. A. M. Whistler (1834–1903), American. In the Isabella Stewart Gardner Collection, Boston

early days the dominant note in Pasteur's life was sounded. To his sisters he writes: "These three things, will, work and success, between them fill human existence." Throughout his entire life, work was his constant inspiration. On his deathbed he turned to his devoted pupils and exclaimed: "Oú en êtes-vous? Que faites-vous?" ending with his favourite words, "Il faut travailler."

In 1843 Pasteur was admitted fourth on the list to the École normale. He now attended the lectures of J. B. Dumas at the Sorbonne, and thereby received his first incentive to the serious study of chemistry. Shortly afterwards, to his great joy, he became laboratory assistant to A. J. Balard In 1848, having been successful at the examinations for the *licence,* the *agrégation* and the doctorate, he accomplished his first startling piece of research, on racemic acid. Mitscherlich had shown in 1844 that the ordinary commercial acid rotated the plane of polarized light to the right, while the paratartrate or racemic acid possessed no rotary power. Being interested in crystals, Pasteur soon realized that the paratartrate contained two types of crystals. He separated them and found that their solutions when tested with a polariscope gave two contrary deviations. He then mixed an equal number of each kind and was able to procure the desired optical neutrality of racemic acid Thus he had proved that this mysterious acid was made up of a right-hand tartaric acid and a left-hand one, and had incidentally discovered a new class of isomeric substances. (*See* ISOMERISM.)

In the autumn of 1848 Pasteur moved to Dijon as professor of physics, but in the beginning of the following year was transferred as professor of chemistry to Strasbourg, where he soon married Mlle Laurent, who proved herself a devoted and noble helpmeet. While at Strasbourg he was awarded the ribbon of the Legion of Honour for having artificially produced from the ordinary commercial acid that racemic acid which up to then had only once been produced, and that by accident. Pasteur's appointment in 1854 as professor and dean of the new Faculté des sciences at Lille placed him in a district where his interest in fermentation could be applied to the manufacture of alcohol from grain and beet-sugar, and his energies were now bent towards discovering the causes of the diseases of beer and wine On examining the yeasts of sound and unsound beer under the microscope, he at once saw that the globules of the sound beer were nearly spherical, whilst those of the sour beer were elongated. He continued his researches, and, after his removal in 1857 to the École normale as director of scientific studies, definitely proclaimed that fermentation is the result of minute organisms, and that when a fermentation failed, either the necessary organism was absent or unable to grow properly Hitherto all explanations of the phenomenon of fermentation had been obscure and without experimental foundation, but Pasteur supported his contention by showing that milk could be soured by injecting a number of the organisms from buttermilk or beer kept unchanged if similar organisms were excluded. "The chemical act of fermentation," wrote Pasteur, "is essentially a correlative phenomenon of a vital act beginning and ending with it." (*See* FERMENTATION.)

The recognition of the fact that both lactic and alcohol fermentations were hastened by exposure to air naturally led Pasteur to wonder whether his invisible organisms were always present in the atmosphere or whether they were spontaneously generated By a series of intricate experiments, including the filtration of air and the famous exposure of unfermented liquids to the pure air of the high Alps, he was able to declare with certainty in 1864 that the minute organisms causing fermentation were not spontaneously generated, but came from similar organisms with which ordinary air was impregnated. Pasteur was now acknowledged the leading chemist of his day and the recipient of honours both from his own country and abroad Lord Lister, who saw the applicability of these discoveries to surgery, was able to revolutionize surgical practice by utilizing in 1865 carbolic acid to exclude the atmospheric germs and thus prevent putrefaction in compound fractures.

In June 1865, after much persuasion from his old teacher, J. B. Dumas, Pasteur went to the south of France to investigate the disease of silkworms which was ruining the French silk industry. (*See* SILK.) Three years later he was able to announce that he had isolated the bacilli of two distinct diseases and that he had found a method of preventing contagion as well as of detecting diseased stock. These results not only saved the prosperity of the French silk industry but that of all silk-producing countries. In the October of 1868 Pasteur was struck with semi-paralysis, but he was able to return to Paris and continue his experiments on fermentation. The war of 1870 made him more desirous than ever of devoting himself to the perfecting of French brewing In 1872 he wrote his famous paper on fermentation, and in 1873 he became a member of the French Academy of Medicine In 1874 he received a life-pension from the National Assembly. Three years later Pasteur, who had already revolutionized the production of alcohols, established the germ theory and saved the silk industry, turned his attention to the fatal cattle scourge known as anthrax, and within two years had demonstrated the entire natural history of the disease. In 1880, however, his researches were diverted to chicken cholera, an epidemic which destroyed 10% of the French fowls. He was soon able to isolate the germ of this disease, and by cultivating an attentuated form of the germ and inoculating fowls with the culture, he proved that they were rendered immune from virulent attacks of cholera. He now returned to his researches on anthrax, a disease upon which Davaine and Koch had been working Following the same methods that he had used in cholera, he isolated the bacillus, and by cultivating it in oxygen at a temperature of 42°C produced a successful inoculation material which, by inducing a mild attack of anthrax, rendered the inoculated animal immune for a time against a culture of full strength. These methods Pasteur called vaccination, because of his desire to render homage to Jenner, who had discovered means for protecting man against smallpox by inoculating with cowpox. (*See* ANTHRAX and VACCINATION.) As to the money values of these discoveries, which had brought Pasteur world fame, T. H. Huxley expressed the opinion that it was sufficient to cover the whole cost of the war indemnity paid by France to Germany in 1870. He himself chose to remain poor and to set an example of simplicity.

Perhaps the most interesting of Pasteur's investigations concerned the curative and preventive treatment of hydrophobia in man and of rabies in dogs After prolonged experiments with inoculations of saliva from infected beings, he came to the conclusion that the virus had its seat in the nerve centres, and demonstrated that a portion of the matter of the spinal column of a rabid dog when injected into the body of a healthy animal produced the symptoms of rabies. By further work on the dried tissues of infected animals and the effect of time and temperature on these tissues, he was able to obtain a weakened form of the bacillus which could be used for inoculation On July 6, 1885, Pasteur was bold enough to inoculate a human being, a child who had been badly bitten by an infected dog The experiment was so successful that by Nov 1888 the Institut Pasteur was founded Thousands suffering from hydrophobia have been treated there and the mortality from this disease has been reduced to less than 1%. (*See* HYDROPHOBIA.) At the inauguration of the institute, Pasteur closed his oration with the following words.—

"Two opposing laws seem to me now in contest. The one, a law of blood and death, opening out each day new modes of destruction, forces nations to be always ready for the battle. The other, a law of peace, work and health, whose only aim is to deliver man from the calamities which beset him. The one seeks violent conquests, the other the relief of mankind. The one places a single life above all victories, the other sacrifices hundreds of thousands of lives to the ambition of a single individual. The law of which we are the instruments strives even through the carnage to cure the wounds due to the law of war. Treatment by our antiseptic methods may preserve the lives of thousands of soldiers Which of these two laws will prevail, God only knows But of this we may be sure, that science, in obeying the law of humanity, will always labour to enlarge the frontiers of life."

Rich in years and in honours, this simple and devout Catholic, this great human benefactor, whose scientific acumen and profound sagacity enabled him to solve the problems of the world of the infinitely small (as he called it), passed quietly away

near St. Cloud on Sept. 28, 1895.

See *Oeuvres de Pasteur,* ed. by P. Vallery-Radot, 2 vols. (1922); René Vallery-Radot, *Vie de Pasteur,* Eng. trans. by Mrs. R. L. Devonshire (1919); L. Descour, *Pasteur and his work,* Eng. trans. by A. F. Wedd (1922) and E. Duclaux, *Pasteur, the History of a Mind,* Eng. trans. by E. F. Smith (Philadelphia, 1920).

PASTO, a city of Colombia and capital of the department of Nariño, about 36 m. from the boundary line with Ecuador, on one of the inland trade routes with that republic, and on a principal line of communication with the great forested regions of the Caquetà (Japurà), Putumayo and Napo. Pop. (1918) 29,035. It stands on an elevated plain, 8,347 ft. above the sea, at the eastern foot of the Pasto volcano, which rises above the city to a height of 13,990 feet. Wool is produced to some extent and is woven for the local market in the woollen factories of Pasto.

PASTON LETTERS, an invaluable collection of the correspondence of the Paston family and others, from 1422 to 1509, including State-papers and other documents. Most of these were sold by the 2nd earl of Yarmouth, the last representative of the family, to the antiquary Le Neve early in the 18th century. On his death in 1729 they were acquired by Thomas Martin of Palgrave, who married Le Neve's widow; and on Martin's death in 1771 they were purchased by John Worth of Diss, whose executors sold them to John Fenn of East Dereham. In 1787 Fenn published two volumes of selections, the originals of which he presented to George III.; in 1789 he issued two more volumes, and when he died in 1794 had prepared a fifth, which was issued in 1823 by his nephew Serjeant Frere. The originals unfortunately all disappeared; and some doubt was cast upon the genuineness of the letters, notably by Herman Merivale in the *Fortnightly* (1865). It was, however, defended by James Gairdner in the same periodical, and established within a year by the discovery of the originals of the fifth volume by Frere's son Philip in his house at Dungate, Cambridgeshire. Ten years later those of the third and fourth volumes were found at Roydon Hall, Norfolk, the chief seat of the Freres; and in 1889 the originals of the remaining two (those presented to George III.) were unearthed at the seat of Captain E. G. Pretyman. It is probable that they had been given to Bishop Pretyman Tomline, friend and tutor of William Pitt.

Among these discoveries were many documents not printed by Fenn; and there are still others. When the 2nd earl of Yarmouth died in 1732 many papers referring to his family were found at his seat, Oxnead Hall. Some of these came into the hands of the Rev. Francis Blomefield, who meant, but failed, to unite his collection with that of Martin. This section of the letters was scattered, part being acquired by the antiquary Ives. Most of the documents are now in the British Museum; but some are at Orwell, others in the Bodleian, others at Magdalen college, Oxford, and a few at Pembroke, Cambridge.

In 1872 Gairdner published the first volume of a new edition. Taking Fenn's work as a basis, he included in his three volumes (1872–75) over 400 hitherto unprinted letters and a valuable Introduction. As a supplement he was able to give an account of the Roydon discovery of 1875, and in later editions he printed the Roydon papers in full. Finally, in 1904, he re-edited the whole; and the six volumes of this edition, with their 1,088 documents and most erudite Introduction, are the chief authority on the subject.

The Paston family takes its name from a village about 20 m. N. of Norwich, and the first known member of the family was living there early in the 15th century. This was Clement Paston (d. 1419), a peasant holding about 100 acres. His son William (1378–1444), to whom Clement had given an excellent legal education, and who is described as "a right cunning man in the law," became in 1429 a justice of the common pleas. He bought land in Norfolk, some of it in Paston, and improved his position by his marriage with Agnes (d. 1479), heiress of Sir Edmund Berry of Harlingbury, Hertfordshire. When he died he left a large inheritance to his son John, who was already married to Margaret (d. 1484), daughter of John Mauteby. At this time England was under a weak king, and only the strong man armed could hope to keep his goods. Paston, a lawyer like his father, lived much in London, and many of the most important of the letters are from Margaret to her husband describing the state of affairs in Norfolk. In 1448 Paston's manor of Gresham was seized by Lord Moleyns, and though it was recovered, the owner could obtain no redress. More serious troubles were caused by the ambiguities of the will of Sir John Fastolf (apparently a relative of Margaret), which involved Paston not only in lawsuits, but in actual warfare, with many neighbouring magnates, among whom were the duke of Suffolk and the (3rd) duke of Norfolk. Paston died in 1466, leaving the affair still unsettled, although in 1461 the king and council had decided in favour of his claim. His son Sir John (1442–79) and the dowager Margaret carried on the struggle, which was marked by repeated captures and recaptures of Caister Castle. A peace was patched up by Waynflete, bishop of Winchester, in 1474, and the death of the (4th) duke of Norfolk paved the way for the restoration of Caister; but a fresh dispute arose with the duke of Suffolk. The intricate story is given in full in Gairdner's introduction. Through these quarrels and Sir John's extravagance the lands were much diminished; yet he left a goodly inheritance to his younger brother, whose name was also John (d. 1503). At this point the letters begin to be scanty and uninteresting; but the family still flourished. Robert Paston was created earl of Yarmouth in 1679. His son William died, aged 80, in 1732, leaving no heir; and his titles became extinct.

The *Letters* are of high historic importance, especially for the reign of Henry VI. The weakness of the king had disorganized the whole administration; the succession itself was contested; the great nobles did what was right in their own eyes; and the prevailing discontent found expression in the rebellion of Jack Cade and the Wars of the Roses. The correspondence reveals the Pastons in a great variety of relations, friendly or hostile, with their neighbours; and abounds with illustrations of the course of public events, as well as of manners and morals. Nothing is more remarkable than the acquaintance of educated persons, both men and women, with the law—an acquaintance which they plainly found indispensable.

All editions are superseded by Gairdner's 6 vols. of 1904; but Blomefield and Parkin's *History of Norfolk* (1805–10) may be consulted, and the article *Paston* in *Dict. Nat. Biog.,* where other authorities are quoted. Some references to the 2nd earl of Yarmouth will be found in the *Lives of the Norths* (edit. Jessopp, 1890). (X.; E. E. K.)

PASTORAL, the name given to a certain class of modern literature derived ultimately from the "idyll" of the Greeks, the "eclogue" of the Latins and their 15th century imitator, J. B. Spagnuoli (Mantuanus) and the late Greek romances. It was a growth of humanism at the Renaissance, and its first home was Italy. Pastoral *poetry,* as it appeared in Tuscany in the 16th century, was really an allegorical eclogue and the idyll could be expanded from a single scene into a drama. The first dramatic pastoral which is known to exist is the *Favola di Orfeo* of Politian, which was represented at Mantua in 1472. But this poem led the way rather to tragedy than to pastoral, and it is the *Il Sagrifizio* of Agostino Beccari, which was played at the court of Ferrara in 1554, that is always quoted as the beginning of sentimental pastoral in European literature. Torquato Tasso followed Beccari after an interval of 20 years, and by the success of his *Aminta,* which was performed before the court of Ferrara in 1573, secured the popularity of dramatic pastoral. Guarini produced in 1590 his famous *Pastor Fido,* and Ongaro his fishermen's pastoral of *Alceo* in 1591. During the last quarter of the 16th century pastoral drama was really a power in Italy. Some of the best poetry of the age was written in this form, to be acted privately on the stages of the little court theatres, that were everywhere springing up. In a short time music was introduced, and rapidly predominated, until the little forms of tragedy, and pastoral altogether, were merged in opera.

Pastoral *romance* dates from the publication, in 1504, of the famous *Arcadia* of J. Sannazaro, a work which passed through 60 editions before the close of the 16th century, and left its mark upon every literature in Europe. This remarkable romance, the type of so many succeeding pastorals, is written in musical prose, into which are inserted passages of verse. The characters live an innocent voluptuous existence, with no hell or heaven in the

background: the narrative, the adventures, the dialogue are equally exalted and unreal.

In Spain the influence of the *Arcadia* made itself rapidly felt through Jorge de Montemayor, whose *Diana* (1524) was founded on Sannazaro. Gaspar Gil Polo, after the death of Montemayor in 1561, completed his romance, and published in 1564 a *Diana enamorada.* Both these works are mentioned with respect, in their kind, by Cervantes. The author of *Don Quixote* himself published an admirable pastoral romance, *Galatea,* in 1584. Lope de Vega made a pastoral of the Nativity introducing much of the Old Testament in narrative episodes related by the characters.

The typical French pastoral, the *Astrée* of Honoré d'Urfé (1610), has almost more connection with the knightly romances which Cervantes laughed at than with the pastorals which he praised. The famous *Astrée* was the result of the study of Tasso's *Aminta* on the one hand and Montemayor's *Diana* on the other, with a strong flavouring of the romantic spirit of the *Amadis.* To remedy the pagan tendency of the *Astrée* a priest, Camus de Pontcarré, wrote a series of Christian pastorals. Racan produced in 1625 a pastoral drama, *Les Bergeries,* founded on the *Astrée* of D'Urfé.

In England the chief example of the form is Sir Philip Sidney's *Arcadia* (written in 1580), published in 1590). In 1584 were published two pastoral dramas, the *Gallathea* of Lyly and the *Arraignment of Paris* of Peele. Greene became more and more imbued with the Italian spirit of pastoral. His *Menaphon* and his *Never too Late* are pure bucolic romances. In *Rosalynde* (1590) Lodge made an interesting contribution to English literature in general, and to Arcadian poetry in particular. This beautiful and fantastic book is modelled more exactly upon the masterpiece of Sannazaro than any other in our language. In 1598 Bartholomew Young published an English version of the *Diana* of Montemayor.

In Spain, France and England there was a strong native tradition of bucolic verse which blended easily, though in differing proportions, with classical impulses from Theocritus, Virgil and the Italians. The Spanish poet Garcilaso de la Vega (d. 1536) is Virgilian, the lyrics of Gil Vicente are of the soil, like the songs of Shakespeare. In the *Bergerie* of Rémy Belleau the new art of Sannazaro joins hand with the simplicity of the Old French *pastourelle.* It was probably the study of the eclogues of Clément Marot that led Spenser to the composition of what is the finest example of pastoral in the English language, the *Shepherd's Calendar,* printed in 1579. This famous work is divided into 12 months, and it is remarkable because in it Spenser turns from the artificial Latin style of pastoral and brings upon the pastoral stage actual rustics using their own peasant dialect, a departure from precedent for which Sidney blamed him.

After Spenser, Drayton is the first pastoral poet who deserves mention. His *Idea: The Shepherd's Garland* bears the date 1593, but was probably written rather earlier. In 1595 he produced *Endimion and Phoebe,* and then turned his fluent pen to the other branches of poetic literature; but after more than 30 years, at the very close of his life, he turned to this early love, and published in 1627 two pastorals, *The Quest of Cynthia* and *The Shepherd's Sirena.* The general character of all these pieces, as of the *Queen's Arcadia* of Daniel, is rich, but vague and unimpassioned. Marlowe's pastoral lyric "Come live with Me," although not printed until 1599, has been attributed to 1589. Barnfield's singular production *The Affectionate Shepherd* was printed in 1594.

With the close of the 16th century pastoral literature was not extinguished in England as suddenly or as completely as it was in Italy and Spain. Throughout the romantic Jacobean age the English love of country life asserted itself under the guise of pastoral sentiment, and the influence of Tasso and Guarini was felt in England just when it had ceased to be active in Italy. In 1606 Day dramatized part of Sidney's *Arcadia* in his *Isle of Gulls,* and about 1625 Thomas Goffe composed his *Careless Shepherdess,* which Ben Jonson designed to imitate in the opening of his *Sad Shepherd.* In 1610 Fletcher produced his *Faithful Shepherdess* in emulation of the *Aminta* of Tasso. This is the principal pastoral play in the language, and in the *Sad Shepherd,* which was perhaps written about 1635, and in his pastoral masques, we see Ben Jonson following along the track that Fletcher had pointed out. The last pastoral drama in the 17th century was Settle's *Pastor Fido* (1677).

Still more characteristic are the lyrical eclogues, usually in short measure, a class of poetry peculiar to the nation and to that age. The lighter staves of *The Shepherd's Calendar* were the model from which all these graceful productions were drawn. Nicholas Breton came first with his *Passionate Shepherd* in 1604. Wither followed with *The Shepherd's Hunting* in 1615, and Braithwaite, an inferior writer, published *The Poet's Willow* in 1613 and *Shepherd's Tales* in 1621. Wither's friend William Browne published in 1613–16 his beautiful collection of Devonshire idylls called *Britannia's Pastorals.* These were in heroic verse and less distinctly Spenserian in character than those eclogues recently mentioned. In 1614 Browne, Wither, Christopher Brook and Davies of Hereford united in the composition of a little volume of pastorals entitled *The Shepherd's Pipe.* The masterpieces of this native school are *L'Allegro* and *Il Penseroso,* as *Lycidas* is the masterpiece of the Virgilian manner.

This sub-Spenserian poetry led in another generation to a rich growth of lyrics which may be roughly called pastoral, but are not strictly bucolic. Carew, Lovelace, Suckling, Stanley and Cartwright are lyrists who all contributed to this harvest of country song, but by far the most copious and the most characteristic of the pastoral lyrists is Herrick. He has, perhaps, no rival in modern literature in this particular direction. His originality and observation, his interest in recording homely facts of country life, combine with his extraordinary gift of song to place him in the very first rank among pastoral writers; in Herrick's hands the pastoral becomes real and modern. From him we date the recognition in poetry of the humble beauty that lies about our doors.

Pastoral came into fashion again early in the 18th century. The quarrel between Philips and Pope gives 1708 a considerable importance in the annals of bucolic writing. Pope had written his idylls first, and it was a source of infinite annoyance to him that Philips contrived to precede him in publication. He succeeded in throwing ridicule on Philips, however, and his own pastorals were greatly admired. Yet there was some nature in Philips, and, though Pope is more elegant, he is not one whit more bucolic. A far better writer of pastoral than either is Gay, whose *Shepherd's Week* was a serious attempt to break with the Arcadian tradition and to copy Theocritus in his simplicity. Swift proposed to Gay that he should write a Newgate pastoral in which the swains and nymphs should talk and warble in slang. This Gay never did attempt; but a northern admirer of his and Pope's achieved a veritable and lasting success in Lowland Scotch, a dialect then considered no less beneath the dignity of verse. Allan Ramsay's *Gentle Shepherd* (1725) was the last, and remains the most vertebrate and interesting, bucolic drama produced in Great Britain. It remained a favourite, 150 years after, among Lowland reapers and milkmaids. With the *Gentle Shepherd* and Johnson's denunciation of the whole pastoral convention (including *Lycidas*) the chronicle of pastoral in England practically closes.

The taste of the 18th century was very agreeably tickled by the religious idylls of Salomon Gessner, who died in 1787. His *Daphnis und Phillis* and *Der Tod Abels* were read and imitated throughout Europe. Jean Pierre Clovis de Florian, who began by imitating the *Galatea* of Cervantes, continued with an original bucolic romance entitled *Estelle.* But pastoral is a form of literature which disappears before a breath of ridicule. Neither Gessner nor his follower Abbt were able to survive the laughter of Herder. Since Florian and Gessner there has been no reappearance of bucolic literature properly so-called. Throughout Europe the Romantic interest in nature and the humanitarian interest in the poor combined in the 19th century to produce a new form, the rustic stories of Auerbach, of George Sand and of Hardy, which are the modern equivalent of the pastoral, stripped of Arcadian convention and merging in the larger *genera* of realist or romantic fiction.

PASTORAL EPISTLES, THE. This is a title given to three New Testament epistles which purport to have been written

by St. Paul to Timothy (two) and Titus. From the second century onwards it was recognised that these three epistles bore specially upon church work and orders; but it was not until the eighteenth century that some German scholars devised the convenient term "Pastoral" to denote the group. "How people ought to bear themselves in the household of God" (I. Tim. iii.15) is the general subject of all three, and special stress is laid upon the responsibilities of Christian ministers in their pastoral care of the Church. The epistles contain much personal information, especially 2 Timothy, but their common aim differentiates them from a semi-private letter like Philemon. In outlook, diction and style, they stand by themselves in the New Testament canon.

1. First Timothy is a pastoral letter in the form of counsels from St. Paul to his younger colleague Timothy (i.1–2), but the plural "you" in the final greeting (vi.21) reveals the fact that all along the writer has the Church in his mind. After reminding Timothy that he had been left at Ephesus to safeguard the faith of local Christians, the writer proceeds to contrast the antinomian practices of the errorists with the Pauline gospel as the norm of faith and morals (i.3f). To this apostolic trust and tradition Timothy is bidden adhere. Then follow a series of regulations on various aspects of church-life (ii.1f); for whom and by whom prayer is to be offered in worship, the latter counsel (8f) drifting into a word on the subordination of women; the qualifications of a bishop (iii.1f), of deacons and deaconesses (9f); the general advice at the close of this section (14f) implies that even organisation and worship cannot altogether eliminate heresies and moral aberrations, so that the writer passes (iv.1f) to the need for Timothy meeting such dangers by a faithful ministry. This includes wise behaviour towards individual groups in the church (v.1f), such as widows (3–16), presbyters (17f) and slaves (vi.1f). A brief conclusion (vi.3f) contrasts the true "man of God" with the errorists who profaned religion by their quarrelsomeness and self-seeking.

Second Timothy is less loosely knit and less discursive. After (i.1f) warning Timothy against false shame, when his chief was imprisoned and suffering, he urges the younger man (13f) to follow the heroic example of a certain Onesiphorus, who had proved himself loyal to Paul and the Pauline cause, and to uphold at all costs (ii.1f) the gospel of his chief, transmitting the apostolic tradition to subordinate agents, teaching and practising it himself, and maintaining a firm position against (16f) controversial errorists of the period. After exposing their methods and spirit (iii.1f), the writer warns Timothy again (iii.10f) by his own example that suffering is inevitable in the service of the gospel, and that the apostolic gospel must be upheld (13f) unflinchingly (iv.1f). The final paragraphs (iv.6f) solemnly describe the critical position of the apostle as he faces a martyr's death, and the epistle closes with a number of personal messages.

Titus is on the whole more of a unity than either of the others. After the greeting (i.1–4), the writer recalls the duties of Titus in the island of Crete, where presbyters have to be appointed with care, and the local errorists dealt with sharply. Then come instructions on the sound doctrine which Titus is to convey to various classes of people (ii.1f), in the light of the true gospel (10f); these general counsels are reiterated (iii.1f) in view of the outside world, believers being expected to rise above worldliness and wrangling. A few personal remarks (iii.12f) conclude the epistle.

The only passage in Titus which seems out of place is i.7–9, which reads like a later interpolation, breaking the connection between ver.6 and ver.10; it may be a marginal gloss added by the writer himself, or inserted by some editor who was interested in the monarchical episcopate. Such additions were not uncommon in writings used for ecclesiastical procedure. "It is very probable that the Pastoral Epistles contain many interpolations in which statements about errors and even directions about discipline have been somewhat altered to suit the requirements of the middle of the second century" (Lindsay, *Church and Ministry in the Early Centuries*, p. 141). Thus it is possible that the formula "Faithful is the saying" (I. Tim. i.15, etc.) is an appended phrase. I. Tim. v.23 also reads like a marginal gloss, unless it originally lay elsewhere. That some passages have been displaced is a fair hypothesis; *e.g.* I. Tim. i.12–17 would come better between ver.2 and ver.3, whilst vi.17–21 is either a later edition or misplaced from the vicinity of ver.8, and the correct place for v.16 is after v.4. In 2 Tim. iv.9f the heterogeneous character of the text is most apparent; there is no good reason to doubt the authenticity of the contents, but it is hardly possible to take them as they stand, and the general conclusion is that we have here two or three notes written at various times, which have been put side by side by the editor, and which refer to some earlier phases in the apostle's life.

2. This raises the problem of the literary origin of the epistles. Were they written by the apostle Paul himself, or in his name by some disciple who sought to convey what he believed to be his master's mind on a religious situation of later date? The Pastorals were suspected in some quarters of the early Church; they were rejected, for example, by Marcion as being private letters, as well as by Basilides and others, including Tatian, who retained only Titus. But such rejections were probably due to dislike of their teaching and cannot be held to reflect any reasoned belief in their post-Pauline origin. The reasons which have led an increasing number of scholars to place them after the life-time of St. Paul are drawn from internal evidence of style and subject, style including diction. There are, however, differences between the vocabulary of the earlier and later Pauline letters which must be taken into account in handling the Pastorals. They remind us of no writer so much as St. Paul. Yet neither differences of subject-matter nor a fresh emphasis on certain topics, much less any supposed change of amanuensis, avail to weaken the inferences drawn from the language of the Pastorals, which is distinctive, and not distinctive of the Paul we otherwise know. An examination of the Greek vocabulary shows not only a remarkable proportion of words used for the first time by the writer, but new compounds, an absence of characteristically Pauline terms, the substitution of one word for another used in the same or a similar sense by the apostle, and an independent use of the Greek particles, which is of much significance. The philologist Th. Naegeli, in a monograph on the language of the apostle (*Der Wortschatz der Apostels Paulus*, 1905, pp. 85f), deduces from such phenomena that the Pastorals cannot have been written by him—a conclusion which is all the more significant that he does not come to this conclusion about any other Pauline letter.

The theological outlook is by itself also. It is not easy to suppose that in three epistles the apostle, for example, would ignore such fundamental truths of his gospel as the fatherhood of God, the union of the believing man with Jesus Christ, and the power of the Holy Spirit in the Christian experience. The only explanation of this seems to be that the epistles were written by a disciple of St. Paul who, in the name of his master, and on the basis of some authentic fragments of Pauline correspondence, wrote against tendencies which threatened the later church, denouncing incipient forms of gnosticism, for example, roundly and indiscriminately. The writer fully believed he was giving what was his master's mind, as an historian would compose a speech in the name of a hero—perhaps as his contemporary Luke composed some of the Pauline speeches in Acts. He felt rightly that Paul would have been anti-gnostic, and that the maintenance of the apostolic gospel was essential for the Churches. His spirit was that of the apostle himself in the prediction of Acts xx.28f. It is no longer tenable to identify the errorists with any school of second century gnostics, but it is equally impossible to find them in any party which Paul is known to have encountered in his lifetime. Also, the spirit in which they are attacked is not in line with St. Paul's method. His way of enforcing ethical requirements and of insisting on organisation is different from that followed by the author of the Pastorals—a shrewd man, who writes with excellent sagacity and point, but hardly with the sustained insight and creative vigour of his master. We might say that this author possesses the intuition of authority rather than the authority of intuition.

The alternatives are (i.) to regard the epistles as genuine on the whole, containing extracts from Paul's correspondence, but largely expanded and edited, or (ii.) to read them as Pauline *in toto*. The

latter hypothesis has to meet the difficulty of placing them in his life-time; either they must be viewed as written after his supposed release from the first imprisonment at Rome, or they must be somehow relegated to his career as outlined in Acts. The latter view is extremely hard to present satisfactorily, for although there are gaps in his life as it is recorded, it is almost incredible that he should have suddenly written in this strain and then dropped into the strain familiar to us in the other epistles Furthermore, the historical setting is hard to reconstruct. That Titus went to Crete, and that Timothy had a responsible position at Ephesus, is indeed likely, for apart from such tradition the setting of the Pastorals would be incredible; even a pseudonymous author would not be likely to invent freely such a framework. But to find any place for such activities during the lifetime of the apostle is not easy! Indeed the majority of those who defend the traditional hypothesis relapse on the view that the Pastorals represent a period in the apostle's life subsequent to the career described in the Acts of the Apostles It is a moot point whether the apostle was ever released from his imprisonment, however, and even if he was, the problem of fitting the Pastorals into this closing period of his career involves considerable historical ingenuity.

To sum up—the data of the Pastorals are so conflicting and ambiguous that they seem to justify us in supposing that "a writer, believing himself to be in accord with St Paul's teaching, and possessing some remains of his correspondence, expanded such into these letters, in order to combat erroneous speculations in the Church by opposing to them sound teaching and an objective standard of belief. He probably lived at a time when ecclesiastical organisation was growing in importance, and seems to offer a safeguard against the spread of moral and intellectual error. Timothy and Titus are thus representative figures, standing for those whom the writer really wished to admonish and instruct" (G. W. Wade, *New Testament History*, 1922, p 303) It does not follow, however, that he wrote the epistles in their canonical order. The likelihood is that 2 Timothy was the earliest, 1 Timothy betrays a more advanced situation, and by the time he had come to write it the author had used up nearly all his Pauline fragments, in 1 Timothy he is more of an author than an editor. As the epistles had no titles, it was natural that when they were incorporated in the canon, 2 Timothy, with its richer and more detailed outlook on the last days of the apostle, should be placed second.

Bibliography.—The most adequate editions in English are by Ellicott (4th edition, 1864), J H Bernard (*Cambridge Greek Testament*, 1899), N. J. D. White (*Expositor's Greek Testament*, 1910), R S J Parry (Cambridge, 1920), and W Lock (*International Critical Commentary*, 1924), though the expositions by A. E Hillard (1919) and A. Plummer (*Expositor's Bible*, 1888) are also valuable for insight into the religious spirit of the epistles, as is the commentary by E F Brown (*Westminster Commentaries*, 1917) on the English text All these represent the conservative position upon the authorship. In German scholarship this position is best represented by B Weiss (Meyer's *Commentar*, 7th edition, 1902) and Wohlenberg (Zahn's *Commentar*, third edition, 1923), otherwise the German editions of importance reflect the non-Pauline authorship, *e g.*, Holtzmann's *Pastoralbriefe* (1880), von Soden's (*Handcommentar*, 1891), and M Dibelius' (in Lietzmann's *Handbuch*, 1913), which are the outstanding editions

Schleiermacher's tract *Ueber den sogenannten ersten Brief des Paulus an d. Tim.* (1807) really started the critical movement, which Holtzmann stated fully; later upholders are Renan (*S. Paul* pp xxiif, *L'Eglise Chrétienne* ch. v), Weizsaecker (*Apostolic Age*, ii pp 163f, 259f), McGiffert (*Apostolic Age*, pp 398f, 423f), and P N Harrison (*The Problem of the Pastoral Epistles*, Oxford, 1921), which may be said to have settled the linguistic case against the Pauline authorship. The opposite side is put by writers like Bertrand (*L'Authenticité des épîtres Pastorales*, 1888), W E Bowen (*Dates of the Pastoral Epistles*, 1900), J. D. James (*Genuineness and Authorship of the Pastoral Epistles*, 1906), and Zahn in his *Einleitung in das Neue Testament* (sections 33f). R. A. Falconer's article in the *Dictionary of the Apostolic Church* (ii. pp. 583f) sums up the traditional position adequately, as opposed to the present writer's conclusions in the *Encyclopaedia Biblica* (5079f).

Special monographs on points of importance are C. W Otto's *Geschichtliche Verhaeltnisse der Pastoralbriefe* (1860), W Mangold's *Irr lehrer der Pastoralbriefe* (Marburg, 1856), W. Lutgert's *Irrlehrer d. Pastoralbriefe* (1909), and H. H. Mayer's *Ueber die Pastoralbriefe* (Gottingen, 1913), the last-named emphasizing the later church-orders implied in the epistles, a point already treated by J. Reville in his *Origines de l'épiscopat* (i. pp. 262f).

On First Timothy, since Melanchthon's special commentary (*Enarratio*, 1561), there have been a series of works, including Koelling's (1882, f) and Liddon's *Analysis* (1897); on Second Timothy, Bahnsen's *Sogenannte Pastoralbriefe* (1876), and on Titus monographs from Mosheim's *Erklarung* (1779) to Kuinoel's *Explicatio* (1812); but the epistles have been commonly edited together. (J Mof)

PASTORAL STAFF, in the Christian Church, an ensign of office or dignity It is some five feet long, ending at the top in a crook (*volute*) bent inwards, and made of metal, ivory or wood If of metal, it is hollow; if of wood, it is usually covered with metal The crook is usually richly ornamented, and is divided from the shaft by a boss; the shaft is commonly separated into sections by rings, so that it can be taken to pieces.

The pastoral staff is the ensign proper of cardinals (except cardinal-deacons) and bishops; but the former are entitled to use it only in the churches from which they derive their titles, the latter only in their dioceses. The pope so early as the time of Innocent III did not carry the pastoral staff, and it would seem never to have been his custom The *ferula* that the Ordo of Cencius Sabellius (ch 48) speaks of was not a pastoral staff, but the symbol of authority over the papal palace, with which by its transference he was invested Abbots carry the pastoral staff only when specially empowered by the pope to do so, and then only in the territory under the jurisdiction of their monastery and in the churches subordinated to it With certain restrictions the pastoral staff is also sometimes conceded to dignitaries of cathedral and collegiate churches.

Bibliography.—*See* Ch. Cahier et A. Martin, *Mélanges d'archéologie* (1856), iv 145 *seq*; Rohault et Fleury, *La Messe* (1889), vii 75 *seq* For the Anglican usage *see* the Report of the Sub-committee of Convocation on the Ornaments of the Church, etc. (1908). *See* also *Catholic Encyclopaedia* s v.

PASTRY, HOME MADE. General rules for the making of pastry are: wash hands in cold water. Work in a cool place Use dry sifted flour Mix with very cold water Roll away from you and the same way, then, if necessary, across Roll firmly but lightly Lift paste to see that it does not stick to board Flour hands, board and roller but not the paste Add liquid by degrees: it is impossible to say exactly what amount will be required as the mixture-absorbing quality of flour varies Mix with knife or fork Use hands as little as possible Pieces scraped from board, roller and hands should not be used. Trimmings may be rolled out again but after several rollings will not be as light as the original pastry.

Plain Short Crust.—For tarts, tartlets, pastries: 1 lb. flour, 6 oz clarified dripping, margarine or half lard and half butter, 1 teaspoonful baking powder, ½ teaspoonful salt, cold water Sieve dry ingredients Rub in fat with floured finger-tips until flour resembles bread crumbs Mix to a stiff dough Roll Bake in a moderately hot oven For a rather richer paste use 8 oz fat and mix with milk and water.

Rich Short Crust.—1 lb flour, 12 oz butter or margarine, 1 teaspoonful baking powder, 1 or 2 eggs, 2 teaspoonfuls castor sugar, a pinch of salt Sift dry ingredients Rub in butter as in plain short crust Mix yolks of eggs and water Mix to smooth stiff paste Roll Bake in a moderately hot oven If used for a tart, five minutes before serving brush over with egg white and sprinkle with sugar For savoury short crust proceed as before, but omit sugar and white of egg

Flaky Pastry.—For sweets or for meat pies and sausage rolls ½ lb flour, pinch of salt, 6 oz margarine and lard mixed, cold water Divide lard and margarine into three portions Sieve dry ingredients Rub in one-third fat Mix to fairly stiff paste Roll into long thin strip Place one-third of fat all over this in little lumps, dredge with flour and fold in three Press edges carefully together and turn fold to left hand Roll out again, put on the remainder of the fat as before, flour and fold After three folds and three rolls, roll into required shape Bake in quick oven.

Puff Paste.—For vol-au-vents, patties, pies, tarts ¾ lb flour, ¾ lb butter or margarine, yolk of 1 egg, 1 dessertspoonful lemon juice, pinch of salt, cold water Sieve flour and salt, rub in 1 oz of fat Put flour on board in a heap Make a hollow in centre

Mix egg yolk and liquids. Mix into flour with a fork, then with fingers to a firm paste. Knead with floured hand until paste leaves board clean: dust with flour as necessary until you have a smooth firm paste. Fold over into the middle. Roll into a square. Hold up so that its own weight helps to pull paste into right shape. Divide fat into four parts. Cut one part into small pieces. Place on paste at regular intervals. Fold the four corners over until they meet in centre. Turn folded side down. Roll twice to form a square. Repeat with fat portions two and three. Wrap paste in cloth, leave in cold place 15 minutes. Add fourth portion of fat as before. Roll and fold into three. The paste should now be firm and spongy. Roll as required for use. This pastry may be made on previous day except for the fourth portion of fat and put away in cloth in a cold place. Bake in a hot oven. Reduce heat gradually.

Suet Pastry.—For boiled or steamed meat or fruit puddings and dumplings: ½ lb. flour, ½ teaspoonful baking powder, pinch of salt, 4 oz. suet. Sieve dry ingredients. Remove skin and strings from suet. Chop very finely on a floured board. Add to flour. Make a well in centre. Stir in flour with a knife from sides of basin. Make a smooth soft dough which leaves the sides of basin clean. Knead lightly until free from cracks. Place on floured board. Roll as required.

Cheese Pastry.—For cheese straws and biscuits: 2 oz. butter, 2½ oz. flour, 2 oz. Parmesan cheese, 1 oz. Cheshire or Cheddar cheese, yolk of 1 egg, salt and cayenne pepper. Mix flour and grated cheese together. Rub in butter, season with salt and cayenne pepper. Form into stiff paste with egg yolk and water, adding liquid gradually. Roll as required. Bake in moderate oven.

(D. C. Pe.)

PASTURE: *see* Grass and Grasslands.

PASURUAN, a residency of Java, Dutch East Indies, area, 8,782 sq. kilometres. It is in the south-east of the island, and is bounded on the west by Surabaya and Kediri, on the east by Besuki, north by the Java sea and south by the Indian ocean. It is extremely mountainous, the whole of its central portion being occupied by the Tengger plateau and its mountains with heights of over 12,000 ft., and the Welirang-Arjuna mountain group (heights over 10,000 ft.), with the valley of the Brantas river between them, and part of the Ijen highlands, whilst most of the southern coastal land is hilly, the level portion being in the east. The northern coastal lands however, form a wide plain with rich volcanic soil, of great fertility, and, with the Malang plain, one admirably suited to the growth of sugar-cane, of which culture Pasuruan is one of the leading centres in Java. Tobacco is another product, also coffee, cassava, coca and maize, whilst rice, coco-nut palms, and the usual other native crops flourish. In the forest of Pasuruan are wild cattle (*banteng*), which are used to improve the breed of the humped Java cattle, also for food and agricultural purposes, and the hides are made into leather. The population is 2,231,832, almost entirely Javanese, and including 11,886 Europeans and Eurasians. Pasuruan, on the north coast, is the capital, and seat of the resident: it has a sugar production experimental station, and with Probolinggo (26,040) further along the coast, is a port of call for Royal Packet Navigation Company vessels. Other towns are the mountain health resorts of Tosari and Nongkajajar, Malang, on the Brantas, a military settlement, Lawang, which has an assistant-resident, Bangil, a railway junction, and Pasirian, near the south coast. The railway from Surabaya to Banyuwangi passes through Pasuruan, first along the coast, and then inland, between the Ijen and Tengger plateaux, with a branch to Pasirian, and another to Kediri.

PATAGONIA, a regional name applied to the southern part of South America south of approximately 40° S. lat. Physiographically, it is divided into two longitudinal sections—the cordilleras of the Andes (including the islands of the Chilean archipelago) and the Patagonian table-land between the Andes and the Atlantic ocean. It is as a regional name for this table-land region that the term Patagonia is now most commonly used. The term, in this sense, is usually applied to that section of the Argentine Republic between the Negro river and its tributary the Limay, on the north, and the Beagle channel, on the south, together with that section of southern Chile in the region of the Strait of Magellan which lies east of the Andes. Actually the Patagonian table-land extends considerably north of the Negro river and, in addition to the Argentine territories of Tierra del Fuego, Santa Cruz, Chubut and Rio Negro, includes the southern part of the territories of Neuquen and La Pampa. There is no sharp line of division, but the chief characteristics of the table-land (a surface cover of rounded pebbles or shingle, and volcanic materials in place of the clays of the pampa) appear a short distance north of the Colorado river.

General Description.—The general aspect of the table-land is that of vast steppe-like plains rising terrace-fashion from high coastal cliffs to the foot of the Andes; but their true aspect is by no means so simple as such a general description would imply. Along the Negro river they rise by a series of fairly level plains from 300 ft. at the coast to about 1,300 ft. at the junction of the Limay and Neuquen rivers and 3,000 ft. at the base of the Andes. South of the Negro river they are much more irregular. There volcanic eruptions have occurred down to fairly recent times. Basaltic sheets, apparently only recently cooled, cover the table-land east of Lake Buenos Aires and Lake Pueyrredon. On the Chico and Santa Cruz rivers they have spread to within about 50 m. of the coast and reach almost to the coast south of the Coyle and Gallegos rivers. Basaltic massifs like Añecon Grande east of Lake Nahuel Huapi and those along the railway south of Maquinchao, in the Somuncurra region west of the Gulf of San Antonio, and south of Lake Musters, are the salient features of the landscape. The coast consists in large part of high cliffs separated from the sea by a narrow coastal plain.

Deep, wide valleys bordered by high cliffs cut the table-lands from west to east. All are the beds of former rivers which flowed from the Andes to the Atlantic, but only a few now carry permanent streams of Andean origin (the Colorado, Negro, Chubut, Senguerr, Chico, Santa Cruz). The majority either have intermittent streams like the Chalia, Coyle and Gallegos, which have their sources east of the Andes, or, like the Deseado, are completely dry except for salt ponds in the deeper depressions and so altered by the combined effect of wind and sand as to afford little surface evidence of the rivers that once flowed in them. In the past many observers have classed with these true river valleys the numerous other long depressions without outlet, known as *bajos,* that are scattered over the table-land, but more recent observers have found no evidence that they were once river channels. A part of them at least are considered as caused by local faulting. Wind erosion has undoubtedly contributed to their present form and it is due to the aridity of the region that they have not been filled in by the normal processes of erosion. They serve an important purpose in the collection of the scanty surface water. Alluvial soils of considerable depth have been built up in them. In the larger of them ranches are located. Along the main routes they are of great value as pasturing grounds for droves of cattle and sheep on their way to seaport or railhead. The shingle (rounded pebbles of granite and eruptive rock), although of glacial origin, is the product of the destruction of old moraines carried out over the table-land before the transverse valleys were cut and the circulation of water from the glaciers localized in them. Its concentration on the surface is due to the action of the wind in sorting the pebbles from the finer and more easily moved materials.

The line of contact between the Patagonian table-land and the folds of the Andes is marked by a line of lakes. From Lake Aluminé northward these lakes are not of glacial origin but have been dammed up by lava flows. South of Lake Aluminé they are long lakes of Alpine form that reach back fiord-like into the cordillera. Their beds have been deepened by glacial action and in most cases are continued across the table-land by the broad transverse valleys described above, through which all the lakes at some former time drained to the Atlantic. From Lake Nahuel Huapi northward the lakes, except for Lake Lacar, still drain to the Atlantic. South of Lake Nahuel Huapi all of the lakes except Viedma and Argentino now drain to the Pacific through deep canyons cut across the cordillera; and the interoceanic divide

follows the terminal moraines of the old glaciers to the east of the present lake beds, leaving the majority of the transverse valleys without streams. Lakes Viedma and Argentino, which drain to the Atlantic by the Santa Cruz river, lie opposite that part of the cordillera which is still effectively covered by inland ice. The lakes from Nahuel Huapi southward are frequently described as lying wholly or in part in a longitudinal depression that separates the table-land from the cordillera. This depression, however, is by no means continuous, and, in many places, the table-land butts directly against the cordillera.

In the Argentine Territory of Neuquen the Andes lower rapidly toward the south, Cerro Domuyo east of the upper basin of the Neuquen river being the last peak that exceeds 12,000 feet. The cordillera there consists of a broad zone of mountain chains and narrow valleys. The crests that have a fairly uniform elevation have been carved by erosion from the older Andean rocks. Above them rise isolated volcanic peaks. From Lake Buenos Aires southward the Andes are known in detail only on their eastern border. Two great fields of inland ice fill all the central part of the cordillera from about 46° S. lat. to 51° S. lat., separated only at the 48th parallel by the Baker canal where the Baker river, draining Lake Buenos Aires from the north, and the Pascua river, draining Lake San Martin from the south, break through the cordillera. From these ice-fields great glaciers flow down to the lake region on the eastern border of the cordillera and to the fiords of the western border. At the time of writing this article these ice-fields have never been crossed, although the southernmost field has recently been penetrated for some distance by expeditions working in from Lake Argentino and Lake Viedma. On the Chilean side the coast and the fiords that thrust far into the cordillera have been examined and mapped by British, Chilean and other hydrographic surveys and the snouts of numerous glaciers that flow down to the fiord heads have been noted.

Geology.—The deep sedimentary cover of the table-land contains a Triassic Series, an Upper Cretaceous and a Tertiary, through which outcrops in places (particularly along the Atlantic coast in the territory of Rio Negro) the core of ancient granites and porphyries. North of the basaltic massif of Añecon Grande the granites rise to over 5,000 feet. On the lower Negro river, Tertiary tufas and grey sandstones form the cliffs that border the river valley, while at the foot of the Andes the table-land is of variegated marls and red sandstones of Cretaceous age Here and there throughout the whole table-land are evidences of an extensive peneplain which dates from the end of the Pliocene. This peneplain has not been base-levelled uniformly throughout but is warped and broken by local faulting. The basalt flows and intrusions that are the characteristic features of so many sections of the table-land have been mentioned.

The central part of the Andes of Patagonia consists of a granite core which thrusts through the folded sedimentary cover to form the crests of the cordilleras. Recent volcanic rocks (andesites and basalts) cover the sedimentaries and the granitic core over large areas throughout this section of the Andes and have spread far out over the eastern table-land. In the north the andesites are of Miocene age and covered by Pliocene basalts. Farther south the andesite intrusions continued well into and probably through the Pliocene. The folded sedimentaries do not reach across to the western slopes of the Andes north of 52° S. lat. Fiords and valleys, longitudinal and transverse, some of which cut across the cordillera and drain the lakes of the eastern side to the Pacific, divide the Patagonian Andes into blocks that have their lowest average altitude (about 6,500 ft.) in the north and in Tierra del Fuego and rise to 13,000 ft. between 46° and 50° S. lat. A line of active volcanoes stands along the Chilean shore in the north completely separated from the main ranges of the cordillera, and isolated cones, all of which are of contemporary origin, while some are of recent eruption, form the outstanding peaks throughout the Patagonian Andes. (For geological history of Patagonia *see* SOUTH AMERICA.)

Climate.—There is abundant rainfall on the west coast and the Chilean archipelago. In the Andes the precipitation, a large part of which is snow, is very heavy. The annual mean increases from 80 to 200 in. on the islands and the coast of the mainland to over 200 in. on the upper western slopes of the high cordilleras. In the cordilleras, as on the west coast, the greater part of the rain or snow falls in winter and this seasonal distribution prevails throughout the Argentine table-land north of the Santa Cruz river. Only along a narrow strip at the foot of the Andes is there plentiful rainfall on the table-land. East of this sub-Andine zone the table-land is semi-arid with the rainfall diminishing rapidly from west to east. South of the Santa Cruz river the rainfall increases somewhat and the rainy season changes from winter to early summer, December being the rainiest month at Puerto Gallegos. Winds from the Atlantic ocean bring some rain to the coast, but they rarely penetrate far inland on account of the great prevalence of westerly winds throughout the whole of Patagonia. On the table-land these west winds are particularly violent and diminish only slightly in winter. On the west coast the mean summer temperatures are low—58° F at Puerto Montt (41° 28′ S. lat.) in the month of January, and 38° F on the Evangelistas islands (52° 24′ S. lat.). The winters are mild, the mean temperature for July being 45° F at Puerto Montt and 38° F on the Evangelistas. Winters are fairly cold in the sub-Andine zone; the mean temperature for July at the valley of 16 de Octubre (43·9 S. lat., 71° 25′ W. long.), the most southerly station in the zone for which there are weather records, is 35·7° F. The summers are moderately warm, the mean temperature for January at 16 de Octubre being 57° F; but no month of the year is free from frosts. On the coast the mean temperature for January at San Antonio is 72·6° F, at Comodoro Rivadavia 66·5° F, at Santa Cruz 60·6° F. For July the mean temperatures at these points are 43·5° F, 44·6° F and 33° F, respectively. (For fauna and flora *see* ARGENTINA.)

Population.—The original inhabitants of Patagonia are now nearly extinct. Occasional families or groups of Alakalufs and Yahgans are still to be found on the islands of the Chilean archipelago. (*See* TIERRA DEL FUEGO.) On the Patagonia table-land one may still find small encampments of Tehuelches and other aboriginal tribes and there is still a small colony of mixed Tehuelches and Araucanians in the Senguerr valley south of San Martin, but pure bloods are very scarce. The Tehuelches, remarkable for their great stature (they average 6 ft. to 6 ft. 4 in.) were the dominant race. Other tribes were the Pehuenches, Ranqueles, Pampas and Araucanians.

Except on Chiloé island the precipitous coasts of the islands and the dense forests that come down to the water's edge on the mainland have prevented white settlement west of the Andes other than the temporary camps of wood-cutters at the most accessible points. Since the founding of Punta Arenas (now Magallanes) in 1843 settlement in that section has developed rapidly. The town itself has grown to a population of 20,000 and is the commercial centre, not only of that section of Chile but of the southern part of the Argentine Territory of Santa Cruz as well. Cattle-raising was the original industry in the Punta Arenas region, but sheep were introduced in 1879 and since 1885 sheep-raising, which is better adapted than cattle-raising to the climate here as in most parts of Patagonia, has spread rapidly until sheep ranches cover all of the northern part of Tierra del Fuego and the mainland not only as far as the international boundary but beyond into the southern part of Santa Cruz whose settlement was effected by colonists working northward from the Punta Arenas region. Considerable gold has been mined in this section of Chile, but operations have now practically ceased. Coal is mined near Magallanes and the sawing of lumber, chiefly for the Argentine trade, from logs brought from as far north as the Peninsula of Taitao is an important and growing industry.

Settlement.—Spanish settlements were started at several points on the Atlantic coast toward the end of the 18th century. Carmen de Patagones near the mouth of the Negro river was the only one of these early settlements that was at all permanent and the fact that this settlement did not disappear like the others was due to the collection and exportation of salt from salt ponds in the vicinity. Cattle raising was beginning there also when the revolution against Spain broke out. The herds were scattered dur-

ing the revolution but re-establishment began shortly after its close. The Indians, however, were for the most part hostile and, until after the 1879–1883 campaign which decisively ended their power, not only prevented any colonization beyond the coast but checked practically all exploration of the interior.

After the close of the Indian campaign, exploration and settlement proceeded rapidly. Settlement south of the Negro river came from two directions. Colonists from the north followed the coast southward, establishing settlements first at river mouths and then pushing gradually back into the interior. Meanwhile the sheep ranches were pushing northward from the nucleus at Magallanes (Punta Arenas) and by 1896 had reached the Santa Cruz river. In the north along the eastern border of the Andes, at Lake Nahuel Huapi, in the upper valleys of the Limay and Neuquen rivers, and northward far beyond the limits of Patagonia, Chilean colonists (mainly of mixed white and Araucanian blood, but with some Germans from the Llanquihue colonies) began to settle at an early date. The migration from Chile probably originated in the practice of the native inhabitants as well as of the European settlers in the Chilean lake region of driving their cattle back and forth through the passes of the Andes following the pasturage seasons. It is believed that Jesuit missionaries had established themselves in the region as early as the latter part of the 16th century. A number of villages, of which San Martin de los Andes and Junín de los Andes in the southern part of the Territory of Neuquen and Chos Malal in the northern part are the most important, have developed in this section in the wider of the lake basins or river valleys. The Zapala ranch at the end of the Southern railway of Buenos Aires is the railhead for all of these mountain villages.

Previous to the campaigns against the Indians the permanent settlers from Chile held their concessions from the Indian chiefs. They increased rapidly until 1890 when the Argentine Government closed the frontier for a five-year period. After the Chile-Argentine boundary dispute had been settled the Chilean Government attempted to get the Chilean settlers back to lands in the Chilean lake region, but there is still a very large Chilean element in the population of the region. The first Argentine colonists in this section, except the Welshmen from Rawson who established themselves in the 16 de Octubre valley as early as 1886, came from Mendoza and San Juan. They were followed after 1890 by settlers of many nationalities and particularly by foreign land companies whose first concessions in Patagonia were located along the Negro and Neuquen rivers. It is in this northern section along the lower slopes of the Andes between the headwaters of the Chubut and Neuquen rivers that the most varied resources of Patagonia are to be found. Wheat, rye and potatoes are grown on irrigated lands on the valley floor, not only for local consumption but to some extent for export. Considerable gold has been placered along the Neuquen river and there has been some exploitation of the timber resources for local needs although many of the forested areas have been destroyed by fire. In the Andean zone of abundant rainfall sheep do not do well and it is there that the cattle-raising industry of Patagonia is concentrated. As one goes eastward into drier regions one finds sheep-raising combined more and more with cattle-raising until on the truly arid table-land cattle give way entirely to sheep. Here and there along the Negro and Chubut rivers the raising of farm crops is practiced under irrigation in limited areas while some favourably located ranches on the table-land have small areas planted with forage crops for the horses that are used on the ranches. Dams constructed on the upper Neuquen now permit the regulation of the flow of water for irrigation purposes to the Cuenca Vidal depression and agricultural villages surrounded by fields of grain, alfalfa and grapes are rapidly developing there.

Land and Water Problem.—Much land in Patagonia has been granted by the Government to Argentina and foreign proprietors but the public lands are still extensive. These public lands are not to be considered as unpopulated. They furnish grazing land for the *pobladores,* sheep raisers who own no land and must shift from place to place as new concessions of public land pass into private ownership. The earlier Government grants were very large, but the Government has now changed its policy and limits its grants to groups of settlers which it is now endeavouring to locate in various sections of the table-land to 625 hectares to each settler. The Government also desires now to break up the earlier concessions into smaller holdings. Holdings of this size are not suited to sheep-raising, since the average capacity on the table-land is from 30 to 50 head per 100 hectares.

Water for the flocks is a matter of much concern. Its complete absence accounts for those few areas which are still unoccupied. The *manantiales,* pools of water concentrated in depressions from rain and snow, are important but most of them do not long survive the rainy season. There are permanent pools in many of the larger depressions but they are mostly saline. Along the dry lower courses of intermittent streams, underground streams are frequently found. Lines of wells follow these underground streams as along the course of the Picun Leufu above the confluence of its bed (now dry for several miles from its mouth) with the Limay river. On both sides of the lower Negro deep wells have been sunk over the Tertiary platform and windmills for pumping water are a feature of every ranch. The red sandstone areas are completely without available water but water issues from the base of the volcanic rock in those sections where the underlying rock is impermeable.

Wool was until quite recently the only export from the sheep ranches but refrigerating plants have now been built at Puerto Deseado, San Julian, Puerto Gallegos and at Rio Grande on Tierra del Fuego. Their combined output in 1927 was 631,249 animals. Of this number 608,911 were exported. On the Chilean side of the boundary there are refrigerating plants on the Strait of Magellan, at Rio Seco and at Puerto Sara, 8 m. and 80 m. respectively, north from Magallanes (Punta Arenas). The driving of the sheep to the refrigerating centres is a difficult task for the distances are great and the problem of feed and water is serious.

Railways.—The Southern railway of Buenos Aires has constructed a 5 ft. 6 in. gauge line for about 860 m. from Bahia Blanca which crosses the Colorado river to the famous Choele-Choele agricultural region of the lower Negro river and then runs up the Negro, serving the numerous agricultural colonies in the irrigated oasis of the river valley; passes through Neuquen, the capital of the Territory of Neuquen at the confluence of the Neuquen and Limay rivers; and extends west for about 150 m. to the Zapala ranch in south-central Neuquen. The Zapala ranch has become the rail centre for the whole of the sub-Andean cattle-raising zone of Neuquen. From San Antonio the Argentine Government has built about 280 m. of a railway which now serves important ranches in the Valcheta and Maquinchao depression and will eventually reach Bariloche on Lake Nahuel Huapi. Viedma, the capital of the Territory of Rio Negro near the mouth of the Negro river has no rail connection, but a line swung south from Bahia Blanca is about two-thirds completed. Rawson, the capital of the Territory of Chubut, near the mouth of the Chubut river, has also no direct rail connection but a short line of meter gauge runs from Puerto Madryn to Trelew (a few miles west of Rawson) and continues for about 35 m. through the Welsh settlements of the lower Chubut. Its terminus is connected by cart roads with the Welsh colony in the 16 de Octubre valley and important holdings of various land companies in the same region. In southern Chubut a short railway of 5 ft. 6 in. gauge connects the Sarmiento colony near Lake Musters with Comodoro Rivadavia. It is proposed to extend this line to Lake Buenos Aires. In northern Santa Cruz a 5 ft. 6 in. gauge railway has been built from Puerto Deseado north-westward over the table-land north of the dry bed of the Deseado river for about 180 miles. Plans for this line call for an extension north-west to Lake Nahuel Huapi through the 16 de Octubre valley. Puerto Gallegos, capital of the Territory of Santa Cruz, a growing settlement that is competing with the Chilean port of Magallanes as a centre for the sheep-raising region of southern Patagonia, has no rail connections.

Administrative Divisions.—Chile in the early days of the republic claimed a large part of the eastern table-land and as early as 1843 founded the town of Punta Arenas (Magallanes) on the Strait of Magellan. No attempt at settlement, however,

was made by the Chilean Government north of the present boundary along the 52nd parallel of latitude and in 1881 a boundary treaty was signed which followed in the main the course of the present boundary in this region. On account of the erroneous knowledge of the topography of the boundary zone the location of the line was not definitely established until 1902 (by arbitral sentence of the king of England) and it was not until 1907 that the demarcation was completed. In 1884 the Argentine Government divided the Patagonian region south of the Negro river into four territories or *gobernaciones;* Rio Negro (capital, Viedma), Chubut (capital, Rawson), Santa Cruz (capital, Puerto Gallegos), Tierra del Fuego (capital, Ushuaia). Chilean Patagonia up until 1927 was divided into the provinces of Chiloé and Llanquihue (the latter extended somewhat farther north than the limits of Patagonia as used in this article) and the Territory of Magallanes. In Dec. 1927 the Chilean Government decreed a new arrangement of administrative divisions over the greater part of the republic and divided the Patagonian region into the province of Chiloé (capital Puerto Montt), and the territories of Aysen (capital Puerto Aysen) and Magallanes (capital Magallanes). (*See* also CHILE and ARGENTINA.) (R. R. P.)

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PATANI, an administrative division of Siam, includes the seven Malay states of Nawng Chik, Patani, Jering, Yala, Sai, Raman and Ra-nge. Each retains its Malay ruler, who governs jointly with a Siamese officer under the direction of the Siamese high commissioner, and many of the ancient privileges and customs of Malay government are preserved. The total area of the combined states is about 5,000 sq.m. The country is mountainous except close to the coast. The population is about 335,000, of whom the great majority are Malays. Each state has its capital, but Patani (the headquarters of the high commissioner) is the only town of importance. Communications are poor and are chiefly by river. The area under cultivation is small except round about Patani and in Nawng Chik, where much rice is grown. Tin mining is a growing industry; many Chinese own mines and several European syndicates are at work prospecting for, or mining, this metal. Fishing and salt-evaporation occupy a large proportion of the population. The annual export of tin is about 400 tons, and dried fish, salt, cattle and elephants are other exports. Steamers up to 300 tons maintain frequent communication with Bangkok and Singapore, and the Patani roads afford good anchorage at all seasons. Mohammedan law is followed in the settlement of inherited property disputes and of matrimonial affairs; otherwise the laws of Siam obtain. Law courts have been established in each state, and there is a force of gendarmerie recruited from amongst Malays and Siamese alike. The revenue amounts to about 600,000 ticals, or £45,000 a year, one-third being payable to the rulers as private income for themselves and their relatives, one-third expended on the administration, and one-third reserved for special purposes, but usually also devoted to administration.

PATARENES or PATARELLI, a name apparently first used in Milan about 1058 to denote the extreme opponents of clerical marriages. In the 13th century the name was appropriated by the Cathari, who said it came from *pati* (to suffer), because they endured hardship for their faith but originally it was derived from *pates*, Milanese for a rag. *See* BOGOMILS.

PATAS MONKEY, a West African species of guenon monkey characterized by its large size, the foxy-red colour of the upper parts, blue face and white belly. Its scientific name is *Cercopithecus patas*. (*See* PRIMATES and GUENON.)

PATAVIUM, an ancient city of Venetia, Italy, 55 m. E. of Verona by road (mod. *Padova*, Eng. Padua, *q.v.*). One road led from it south-west to Ateste, Hostilia (where the Po was crossed) and Bononia; another east-north-east to Altinum and Concordia. It was also accessible by canals from the sea (30 m.). The old town (40 ft. above sea-level) lay on a peninsula surrounded by the Bacchiglione except on the south, where it was protected by a canal. Of the bridges which cross the canals by which Padua is now intersected, four go back to Roman times. Remains of a public building were found in the centre of the modern city, outside which lies the ancient amphitheatre, measuring 325 by 205 ft. The name of the town is probably connected with Padus (Po). Under Augustus, Patavium surpassed all the cities of the north in wealth, and in the number of Roman knights among its citizens was only equalled by Gades.

Its commercial importance was also great, being especially due to its trade in wool. The importance of Patavium as a literary centre was also considerable. Livy, Q. Asconius Pedianus and Thrasea Paetus were natives of the town; and Quintilian speaks of the directness and simplicity of their diction as *Patavinitas*, comparing it with the artificial obscurity of the writers of Rome.

After the 2nd century A.D. it seems to have been outstripped by Milan and Aquileia. It was destroyed by the Lombards (601) and lost all its Roman monuments.

PATAY, BATTLE OF (1429). King Henry V. of England died in August 1422, and though after his death the English won several battles, the siege of Orléans, in 1428, saw a turn of the tide due to the smallness of the English army, its dispersion, the uncertain support of the Burgundian faction, and the enthusiasm aroused by the appearance of Joan of Arc.

In February 1429, accompanied by six men-at-arms, the Maid set out for the dauphin's court at Chinon. Having convinced him of her divine mission, clothed in a coat of mail and carrying a sword, said to have belonged to Charles Martel, she headed for Orléans. The siege was badly maintained, the English force being far too small for the purpose. In place of raising the siege and meeting Joan and her 5,000 followers, the English held on, with the result that their lines were broken, for all the French garrison required was enthusiasm to rouse them into activity. Suffolk, a most incapable leader, then distributed his army in small detachments to hold certain towns on the Loire, namely, Jargeau, Meung and Beaugency, and this in spite of the fact that Bedford, the regent, was sending him reinforcements from Paris under Lord Talbot. The garrisons of these towns, utterly demoralized by superstitious terror, surrendered them, and Talbot hearing of these disasters determined to retreat to Paris and hold the city. At Patay on June 18 he was surprised by Joan and her captains the Duke of Alençon and Lahire. The English archers, who throughout the Hundred Years' War had depended for their success on defensive tactics, attempted to fix their stakes and deploy behind them, but the French fired by a religious enthusiasm gave them no time, and charging down on them slew more than a third and captured Talbot. The strategical results of this victory were great; not only were the English driven beyond the Loire, but Charles, the dauphin, took Chalons, Troyes and Reims, and entering the last mentioned city at the head of 12,000 men was crowned king of France. The moral effect was still greater, because Bedford, fearing the demoralizing influence of the Maid's miraculous banner, dared not take the offensive.

See A. Lang, *The Maid of France* (1908); Michelet, *Histoire de France;* C. Oman, *The Art of War in the Middle Ages* (1924). (J. F. C. F.)

PATCHOGUE, a village of Suffolk county, New York, U.S.A., on Great South bay on the south shore of Long Island, 50 m. E. of the Brooklyn Borough Hall; served by the Long Island railroad. Pop. (1925) 5,116 (State census). The village ships large quantities of fish and oysters, is an important trading centre and has a number of factories. It was founded in 1665 and incor-

porated in 1893.

PATEL, FRAMJEE NASARWANJEE (1804–1894), Parsee merchant and philanthropist, was born in 1804, and received a vernacular education, with a little English in Bombay. In 1819 he entered upon a business career, and in 1827 became a partner in the firm of Frith, Bomanjee & Co. Banking facilities being then exceedingly scanty, such Parsees as had any capital at command acted as bankers and brokers to the rising English firms. Patel raised the status of his compatriots to the higher level of independent merchants, and he founded in 1844 a business house under the name of Wallace & Co., from which he retired in 1848 to found in 1849 Framjee, Sands & Co.

Patel's most remarkable public service was performed in connection with the Parsee Law Association, of which he was president. The domestic affairs of the Parsees having fallen into confusion since their exodus from Persia, the adjudication of disputes relating to matrimonial obligations and the rights of succession in cases of intestacy, was left to the elders of the community who lacked both knowledge and principles on which to base their judgment, and the authority to enforce their decisions. The case of *Ardesir Cursetjee* v. *Peeroxebai*, which came up on appeal before the privy council in England, brought to light the fact that the supreme court of Bombay had no jurisdiction over matrimonial and ecclesiastical disputes among Parsees. This state of lawlessness being recognized as intolerable, agitation ensued which led to the appointment of a commission, of which Sir Joseph Arnould was the president and Framjee Patel the chief Parsee member. The Parsee Law Association, under the guidance of Patel and Sorabjee Bengallee, rendered invaluable help to the commission, and their joint efforts resulted in the passing by the government of India of the Parsee Marriage and Divorce Act and the Parsee Intestate Succession Act (15 and 21 of 1865). These acts form the charter of matrimonial and ecclesiastical status for the Parsees.

At the time of his death in 1894, Framjee Patel was the most revered and best beloved of the distinguished natives of India, having during an eventful public life extending over sixty years worked in co-operation with three generations of the most prominent of his compatriots to better the condition of their country. His family surname refers to the title of *patel*, that is, "mayor," of Bombay, conferred on its founder for services rendered to the English in 1692. (M. M. Bh.; X.)

PATENTS, properly documents conferring some privilege, right, etc., short for "letters patent" (*q.v.*). Patents for inventions, instruments which formerly bore the great seal of the United Kingdom, are now issued at the Patent Office in London under the seal of that office. By their means inventors obtain a monopoly in their invention for 16 (formerly 14) years, a term which, if insufficient to remunerate the inventor, may be extended.

ENGLISH PATENTS

Formerly the reigning prince considered himself entitled, as part of his prerogative, to grant privileges of the nature of monopolies to any one who had gained his favour. These grants became so numerous that they were oppressive and unjust to various classes of the commonwealth; and hence, in the reign of James I., a statute was wrung from that king which declared all monopolies that were grievous and inconvenient to the subjects of the realm to be void. (*See* Letters Patent; Monopoly.) There was, however, a special exception from that enactment of all letters patent and grants of privileges of the "sole working or making of any manner of new manufactures within the realm to the true and first inventor and inventors of such manufactures which others at the time of making such letters patents and grants shall not use, so as also they be not contrary to the law nor mischievous to the State by raising of the prices of commodities at home or hurt of trade or generally inconvenient." Upon these words hangs the whole law of letters patent for inventions. Many statutes were afterwards passed, but these were all repealed by the Patent Act of 1883 (46 and 47 Vict., c. 57) which modified the law in several particulars. There were subsequently several Amending Acts, which with certain savings were repealed by a Consolidating Act, the Patents and Designs Act 1907, which also introduced new provisions into English patent law. It was slightly amended in 1914 (apart from War legislation) and has been substantially amended by the Patents and Designs Act 1919. A further amendment has been made by the Patents and Designs (Convention) Act, 1928.

Patentable Inventions.—The inventions for which patents are obtained are chiefly either vendible articles formed by mechanical or chemical operations, or machinery and apparatus or processes. It may be remarked here that a scientific principle cannot form the subject of a valid patent, but its application to a practical and useful end and object may do so. An abstract notion, a philosophical idea, may be extremely valuable in the realm of science, but before it is allowed to form a sound basis for a patent the world must be shown how to apply it so as to gain therefrom some immediate material advantage.

The principal classes of patentable inventions seem to be these: (1) new contrivances applied to new ends, (2) new contrivances applied to old ends, (3) new combinations of old parts, whether relating to material objects or processes, (4) new methods of applying a well-known object. In the case of inventions relating to substances prepared or produced by chemical processes or intended for food or medicine a claim cannot be made for the substance itself, except when prepared or produced by the special methods or processes of manufacture described and claimed or by their obvious chemical equivalents (Act of 1919 s. 11).

With regard to a patent for the new application of a well-known object it may be remarked that there must be some display of ingenuity, some amount of invention, in making the application, otherwise the patent will be invalid. For example, a fish-plate, used before the introduction of railways to connect wooden beams, could not be patented to connect the rails of a railway (*Harwood* v. *Great Northern Railway Co.*, 1860–65, 11 H.L.C. 654) nor can a spring long used in the rear of a carriage be patented for use in the front (*Morgan* v. *Windover*, 1890, 7 R.P.C. 131). But a small amount of invention will suffice, so long as the improvement is manifest, either as saving time or labour or having other utility (*Rickmann* v. *Thierry*, 1896, 14 R.P.C. 105: *Patent Exploitation Ltd.* v. *Siemens and Co.*, 1904, 21 R.P.C. 549: *Teste* v. *Coombes*, 1923, 41 R.P.C. 88).

Whatever be the nature of the invention, it must possess the incidents of utility and novelty, otherwise any patent obtained in respect of it will be invalid. The degree of utility need not, however, be great. Commercial success is not necessary but may be an important item in considering whether there was invention. The affording of a new and useful choice of means for effecting a known object is sufficient. As to novelty, if it can be shown that other persons have used or published the invention before the date of the patent, it will fall to the ground, although the patentee was an independent inventor deriving his ideas from no one else. Thus, where the patent sued on was for a lock, it was proved that a similar lock had been in use on a gate adjoining a public road for 16 years prior to the patent, which was accordingly invalidated (*Carpenter* v. *Smith*, 1842, I. Web. P.C. 540). It is sometimes a subject of enquiry whether an invention has so been previously used as to have been publicly used in the sense attached by the courts to this phrase. The mere use of an apparatus in a car driven along a public way, without opportunity for any one to see it, was held not to be a public user, and the use in question being a mere casual accidental use in the course of a different investigation was held not to be an anticipation (*Boyce* v. *Morris Motors Ltd.*, 1927, 44 R.P.C. 105). But whereas "user" in public is sufficient prior publication to invalidate a subsequent patent for the invention so used, publication in books, etc., will not be a bar to novelty unless its effect is to make the invention actually a part of public knowledge; and in dealing with alleged anticipations by specifications of patents for inventions that have never come into general use it has been said that a patent will not be invalidated unless a person of ordinary knowledge of the subject, on having the alleged anticipation brought under his notice, would at once perceive, understand, and be able practically to apply the invention without making experiments or seeking for further

information. But while this is the text to be applied in considering whether a specification is sufficient in respect of working directions, an invention may be sufficiently published if the document alleged to anticipate is sufficient to convey to men of science and employers of labour information which will enable them without any exercise of inventive ingenuity to understand the invention and to give a workman the specific directions necessary to carry it out (*King, Brown & Co.* v. *Anglo-American Brush Co.*, 1892, A.C. 367, p. 378, *Savage* v. *Harris*, 1896, 13 R.P.C. 364, at p. 368). The inventor himself, by the use of his invention even in secret, with a view to profit, may, it would seem, invalidate the patent. Thus, if he manufactures an article by some new process, keeping the process an entire secret, but selling the produce, he cannot probably afterwards obtain a patent in respect of it. If he were allowed to do this, he might in many cases easily obtain a monopoly in his invention for a much longer period than that allowed by law (*Morgan* v. *Seaward*, 1837, 1. Web, P.C. 192). The sale of the article may, of course, involve the publication of the invention. The rule that an inventor's use of the invention invalidates a subsequent patent does not, however, apply to cases where the use was only by way of experiment with a view to improve or test the invention (*Elias* v. *Grovesend Tinplate Co.*, 1890, 7 R.P.C. 466).

S. 45 of the Patents Act 1907 provides that the exhibition of an invention at an industrial or international exhibition certified as such by the Board of Trade, or the publication of any description of the invention during the period of the holding of the exhibition, or its use for the purpose of the exhibition in the place where it is held, or during the period of the exhibition by any person elsewhere, without the privity or consent of the inventor, shall not prejudice the right of the inventor or of his legal personal representative to apply for and obtain a patent, or the validity of any patent granted on the application, provided that two conditions are complied with, viz., (a) the exhibitor must, before exhibiting the invention, give the comptroller-general a prescribed notice of his intention to do so; and (b) the application for the patent must be made before or within six months from the date of the opening of the exhibition. A like saving has been given by the Act of 1919 to the reading of a paper by an inventor before a learned society and to the publication of the paper in the society's transactions subject to a like provision as to notice by the person reading such paper or permitting such publication and as regards (c) the substitution of the date of the reading or publication of the paper for that of the opening of the exhibition.

When an invention is the joint production of more persons than one, they must all apply for and obtain a joint patent, for a patent is rendered invalid on showing that a material part of the invention was due to some one not named therein. But under some circumstances the patent may be actually granted to one or more of the joint applicants. The mere suggestion of a workman employed by an inventor to carry out his ideas will not require that he should be joined, provided that the former adds nothing substantial to the invention, but merely works out in detail the principle discovered by his employer.

Procedure.—The Patents Act 1907, re-enacting former provisions, requires an application to be made in a prescribed form (the forms and stamps are on sale at all postal money order offices in the United Kingdom) and left at or sent by post to the patent office in the prescribed manner. The application must contain a declaration that the applicant is the true and first inventor, and it must be accompanied by either a provisional or complete specification. A provisional specification describes the nature of an invention, and a complete specification particularly describes and ascertains the nature of the invention and the manner in which it is to be performed and must end with a distinct statement of the invention claimed. Since the introduction of the patent specification, it has been necessary that an invention protected by patent should be accurately described by the inventor. The task of preliminary disclosure falls to the provisional specification introduced by the Patent Law Amendment Act 1852 and continued by the later Acts, but an applicant may dispense with a provisional specification if he thinks proper to file a complete one in the first instance. Where, however, these two specifications are filed, it becomes of vital moment to an inventor that the true relation between them should be maintained as defined above. The object of the provisional specification is to secure immediate protection, and to enable a patentee to work at and improve his invention without the risk of his patent being invalidated by premature publication. He is therefore entitled to embody in his complete specification any improved method of working his invention which he may discover in the interval; and he is indeed bound to do so, since, as we have said, the price that a man who desires a patent has to pay to the public for the privilege is that he should make a full disclosure of his invention in his complete specification. But there is a limit to what the patentee may do in this respect. He must not describe in his complete specification an invention not substantially the same as that declared in the provisional. If he falls into this error there is said to be a "variance" or "disconformity" between the two specifications. It is by s. 6 of the Patents Act 1907 made the duty of the examiner of the Patent Office to consider the question of disconformity between specifications on applications for patents, and, if he reports that there is disconformity, the comptroller may refuse to accept the complete specification until it has been amended to his satisfaction, or (with the consent of the applicant) cancel the provisional specification and treat the application as having been made on the date at which the complete specification was left. Moreover, if the complete specification includes an invention not included in the provisional specification, the application may be divided, and the claim for the additional invention included in the complete specification be regarded as an application for that invention made on the date at which the complete specification was left. After a complete specification has been left, an examiner makes an examination or search as to novelty, such investigation dealing with British complete specifications published and dated within 50 years prior to the date of the application (Act of 1907, s. 7) and power is given to the comptroller to refuse the grant of a patent in cases in which the invention had been wholly and specifically claimed in specifications to which his search had extended. If it is wholly or partly so claimed or described, he may require a reference to be made to the prior specification. Opportunities of amendment are, however, given to an applicant. When a complete specification has been accepted, the acceptance is advertised, and the specification is open to inspection, and the grant may be opposed on certain grounds, some of which are personal to the opponent.

The term for which a patent is originally granted is now 16 years and by the Patents Act 1919 the terms of existing patents were extended to that length subject to certain conditions (s. 6). A patentee may, after advertisement according to the rules of the Supreme Court, apply for an extension of the original term. The court, in considering its decision, pays regard to the nature and merit of the invention in relation to the public, of the profits made by the patentee as such, and of all the circumstances of the case. If it appears to the court that the patentee has been inadequately remunerated by his patent, it may extend the term of the patent to a further term not exceeding five, or, in exceptional cases, ten years, or may order the grant of a new patent for a certain term, with any restrictions or provisions it may think fit (Act of 1907, s. 18, and Act of 1919, s. 7). Loss or damage suffered by the patentee by reason of hostilities between His Majesty and a foreign State affords a special ground for extension (Act of 1919, s. 7).

A patentee may elect to have his patent endorsed "licences of right," with the result that any person may thereafter claim to have a licence under it on terms fixed by agreement or settled by the comptroller. The advantage to the patentee is that renewal fees are halved.

The Act of 1907.—A very useful new feature was introduced by the Act of 1907 by the provision as to patents of addition. An applicant for a patent or a patentee may apply for a further patent in respect of any improvement in or modification of his invention and request that the term limited in the new patent be the same as that of the original patent or so much of that term as is

unexpired. The new patent, if granted, becomes a patent of addition remaining in force only so long as the original patent, and has the advantage that no renewal fees are payable. If the original patent is revoked, the patent of addition may be ordered to become an independent patent, and the fees payable and the dates when they shall become payable are to be determined by its date, but its duration is not to exceed the unexpired term of the original patent (s. 19 of the Act of 1907 as amended by the Act of 1919).

Patent privileges, like most other rights, can be made the subject of sale. Partial interests can also be carved out of them by means of licences, instruments which empower other persons to exercise the invention, either universally and for the full time of the patent (when they may be tantamount to an assignment of the patentee's entire rights) or for a limited time, or within a limited district. By an exclusive licence is meant one that restrains the patentee from granting other licences to any one else. By means of a licence a patentee may derive benefit from his patent without entering into trade and without running the risks of a partnership.

One of the regulations of the Act of 1883 was that a patentee could be compelled by the Board of Trade to grant licences to persons who were able to show that the patent was not being worked in the United Kingdom, or that the reasonable requirements of the public with respect to the invention could not be supplied, or that any person was prevented from working or using to the best advantage an invention of which he was possessed. This regulation, however, remained practically a dead letter. By s. 3 of the Act of 1902, the hearing of petitions for a grant of compulsory licences was transferred to the Judicial Committee of the Privy Council, but the Act of 1907 substituted the High Court as the tribunal in the place of the judicial committee. The Act introduced considerable amendments in the law as to the grant of compulsory licences which, as stated below, have now been replaced by provisions in the Act of 1919. S. 38 of the Act of 1907 contains also a further remedy for the improper exercise of patent rights, making it unlawful in any contract in relation to the sale or lease of, or licence to use or work, any patented article or process to insert conditions prohibiting or restricting the use of articles supplied by a third person or requiring the purchaser or lessee to acquire from the seller or lessor other articles not protected by the patent. Such conditions are declared "null and void as being in restraint of trade and contrary to public policy."

Another new and very important provision of the Act of 1907 was that dealing with the revocation of patents worked outside the United Kingdom. It had been a common practice to take out patents in the United Kingdom (especially in the dyeing industry) in order to close the British market to all except the patentees and their licensees, the patented articles or processes being worked entirely abroad. S. 27 of the Act of 1907 enacted that at any time not less than four years after the date of a patent any person might apply to the comptroller for the revocation of a patent on the ground that the patented article or process was manufactured or carried on exclusively or mainly outside the United Kingdom. The comptroller was given power to make an order revoking the patent forthwith or after a reasonable interval, unless the patentee could show satisfactory reasons.

The Act of 1919 substituted new provisions for those contained in the Act of 1907 as to compulsory licences and the revocation of patents worked outside the United Kingdom, such matters being now treated under the heading of provisions being for the prevention of abuse of monopoly rights. (S. 1 enacting a new s. 27.) Those rights are to be deemed to have been abused in any of five sets of circumstances which may be shortly stated as follows:—(a) After the fourth year of the patent, non-working of the invention in the United Kingdom on a commercial scale and without a satisfactory reason for such non-working. (b) Working of the invention within the United Kingdom on a commercial scale prevented or hindered by importation from abroad of the patented article by the patentee or persons claiming under or through him or by other persons against whom he is not taking proceedings for infringement. (c) If the demand for the patented article in the United Kingdom is not being met to an adequate extent or on reasonable terms. (d) If by refusal of a licence or licences the trade or industry of the United Kingdom or the trade of any person or class of persons in the United Kingdom, or the establishment of any new trade or industry in the United Kingdom is prejudiced and it is in the public interest that a licence or licences should be granted. (e) If any trade or industry in the United Kingdom, or any person or class of persons engaged therein, is unfairly prejudiced by conditions attached by the patentee before or after the Act, to the purchase, hire, license or use of the patented article or the using or working of the patented process.

Any person interested may at any time apply to the comptroller for relief under the section, alleging in the case of any patent an abuse of the monopoly rights. Under (a), which does not apply to an invention not capable of being worked in the United Kingdom, power is given to the comptroller to adjourn the application if he is of opinion that the time which has elapsed since the date of the patent has been insufficient to enable the invention to be worked within the United Kingdom on a commercial scale. The section contains the important statement that for the purpose of determining whether there has been any abuse of monopoly rights, it shall be taken that patents for new inventions are granted not only to encourage invention but to secure that new inventions shall so far as possible be worked on a commercial scale in the United Kingdom without undue delay. "Working on a commercial scale" means the manufacture of the article or the carrying on of the process described and claimed in a specification of a patent in or by means of a definite and substantial establishment or organization, and on a scale which is adequate and reasonable under all the circumstances. Relief may be given under the section by the exercise by the comptroller of any of the following powers, stating them shortly:—(a) He may order the patent to be endorsed "licences of right" (*see* above); (b) he may order the grant to the applicant of a licence on such terms as he may think expedient; (c) he may, if he is satisfied that the invention is not being worked on a commercial scale within the United Kingdom, and under specified circumstances, requiring capital, order the grant of an exclusive licence to the applicant or a person able and willing to provide such capital subject as provided in the section; (d) he may, if satisfied that the objects of the section cannot be attained by any of the foregoing methods, order the patent to be revoked either forthwith or after an interval unless conditions prescribed in the order are fulfilled, but no such order is to be made which would be at variance with any treaty, convention, arrangement or engagement with any foreign country or British possession; (e) if he is of opinion that the objects of the section will be best attained by making no order, he may refuse the application. Under (a) an existing licensee may apply for an order entitling him to surrender his licence in exchange for one to be settled by the comptroller. Under (b) a licensee may call on the patentee to take proceedings to prevent infringement and in default by the patentee may himself institute such proceedings. The course to be taken by the comptroller if he is satisfied that the applicant has a *bona fide* interest and the procedure is laid down by the section. There is a right of appeal from the comptroller to the court. By consent, or under specified circumstances, the comptroller can order the proceedings or any question or issue of fact to be referred to an arbitrator, with a similar right of appeal. "Patented article" includes articles made by a patented process.

Legal Remedies.—A patentee's remedy for an infringement of his rights is by civil suit, there being no criminal proceedings in such a case. No proceedings can be taken in respect of an infringement committed before the acceptance of the complete specification (s. 13 of Act of 1907 as amended by Act of 1919). In prosecuting such a suit the patentee subjects those rights to a searching examination, for the alleged infringer is at liberty to show that the invention is not new, that the patentee is not the true and first inventor, etc., as well as to prove that the alleged infringement is not really an infringement. But it may here be remarked that a patentee is not bound down (unless he has chosen so to be) to the precise mode of carrying the invention into effect described in the specification. If the principle is new, it is not to be expected

that he can describe every mode of working it; he will sufficiently secure the principle by giving some illustrations of it; and no person will be permitted to adopt some mode of carrying the same principle into effect on the ground that such mode has not been described by the patentee. On the other hand, when the principle is not new, a patentee can only secure the particular method which he has invented, and other persons may safely use other methods of effecting the same object. Again, where the invention patented consists of a combination of parts, some old and some new, the whole constituting a new machine or a new process, it is not open to the world to copy the new part using other old parts. A man is not permitted to allege that the patent is for a combination and that, the identical combination not having been used, there has been no infringement. If he has taken the substance of the invention, it will be held that he has infringed the patent (*Clark* v. *Adie,* 2 App. Cas. 315).

In a successful action relief may be given by damages and an injunction against infringement of the patent, but a defendant who proves that at the date of the infringement he was not aware nor had reasonable means of making himself aware of the existence of the patent is not liable to damages.

At common law a person who, alleging that he has a patent, threatens his rivals in trade, is liable to an action for damages, but the plaintiff cannot succeed without showing that the threats were made maliciously. The Patents Act 1907 s. 36 provides another remedy in what is known as "the threats action." The statute makes the good faith of the patentee threatening legal proceedings no answer to an action brought against him by any person aggrieved by his threats if the acts complained of are not in fact an infringement of the patent; but if an action for infringement is commenced and prosecuted with due diligence, the section does not apply.

Extent and Construction.—The patent when sealed has effect in the United Kingdom and the Isle of Man. The patent business of the United Kingdom is transacted at the Patent Office in London under the superintendence of the comptroller, an officer appointed by the Board of Trade, under whose direction he performs his duties. At this office is kept a register of all patents issued, of assignments of patents, licences granted under them, etc. An illustrated journal of patent inventions is published at the same office, where printed copies of all specifications can also be obtained. The fees payable to government on patents are those laid down by the Patents Rules and are as follows:—On application accompanied by provisional specification £1; on filing complete specification thereafter £3; on application accompanied by complete specification £4; on sealing of patent £1. Before the expiration of the fourth year from the date of the patent £5; of the fifth year £6; of the sixth year £7, and so on increasing by £1 every year, each such payment being in respect of the following year. Where an extension of time is given, extra fees are payable.

The official publications of the Patent Office deserve some notice, as, apart from official investigation into novelty, the onus of search rests with the applicant or his agent. The procedure has been greatly simplified by the publication, on a uniform system and at a low rate, of illustrated abridgments of specifications. From 1877 practically to date the searcher obtains a chronological digest of all specifications falling within a given class. To these classes there is a reference index, known as the "abridgment class and index key," which at once directs the searcher to his proper class and index heading. The office also publishes reports of Patent, Design and Trade Mark Cases, the reference to which is R.P.C.

Patent Agents.—Patents are usually, although not necessarily, obtained through the intervention of "patent agents" who devote themselves to this branch of business. Their position has for many years been regulated by statute. The existing enactment which is more stringent than that which it displaced is the new s. 84 of the Patents and Designs Act, 1907, substituted for the original section 84 by s. 18 of the Act of 1919. It provides that no person shall practise, describe himself, or hold himself out, or permit himself to be described or held out, as a patent agent, unless:—(a) In the case of an individual he is registered as a patent agent in the register of patent agents; (b) in the case of a firm every partner of the firm is so registered; (c) in the case of a company which commenced to carry on business as a patent agent after Nov. 17, 1917, every director and the manager (if any) of the company is so registered; (d) in the case of a company which commenced to carry on business as a patent agent before that date, a manager or a director of the company is so registered. In the last mentioned case the name of such manager or director must be mentioned as being a registered patent agent in all professional advertisements, circulars or letters in which the name of the company appears. There is a provision which enabled any individual not registered as patent agent before July 15, 1919, to be registered on proof that before Aug. 1, 1917, he was *bona fide* practising as a patent agent. The penalty for contravention of the provisions is a maximum sum of £20, and in the case of a company any officer knowingly a party to the contravention is liable. "Patent Agent" means a person, firm or company carrying on for gain in the United Kingdom the business of applying or obtaining patents in the United Kingdom or elsewhere. Unless registered before July 15, 1919, a person cannot be registered unless he is a British subject. The Board of Trade has power under s. 86 to make rules for regulating the keeping of the register of Patent Agents and has delegated this duty to the Chartered Institute of Patent Agents. Notwithstanding these provisions an ordinary agent duly authorized to the satisfaction of the comptroller may be employed in some matters (but not including the signing of applications for patents and certain other documents which must be signed by the applicant himself; *see* s. 85 and Rule 9).

BRITISH DOMINIONS

The following notes on the laws of the Dominions give the salient facts. Prior to 1852 British letters patent extended to all the colonies, but the Act of 1852 restricted the rights granted to the United Kingdom, Channel islands and the Isle of Man. The present Acts extend to the United Kingdom (including Northern Ireland) and the Isle of Man. As to the Dominions which are parties to the International Convention, *see* p. 373, *International Convention.*

Protection is obtainable in a number of the smaller dominions by way of the registration of the British letters patent. There is a limit of three years from the date of the sealing of the British letters patent within which to apply in most of the countries. The dominions in which such protection can be obtained are:—Bermuda, British Guiana, British Honduras, British North Borneo, British Solomon isles, Brunei, Cyprus, Falkland isles, Fiji isles, Gambia, Gibraltar, Gilbert and Ellice isles, Gold Coast, Grenada, Guernsey, Hong Kong, Jersey, Johore, Kenya, Leeward isles, Federated Malay States, Mauritius, Nigeria, Palestine, Northern Rhodesia, St. Helena, St. Lucien, St. Vincent, Sarawak, Siam, Sierra Leone, Somaliland, Straits Settlements, Uganda and Zanzibar.

Australia.—The Commonwealth Acts are No. 21 of 1903, No. 19 of 1906, No. 17 of 1909, No. 10 of 1910 (as to administration) and No. 24 of 1921. They are founded on the English Act of 1883 and amending Acts.

They provide for a department of patents controlled by a commissioner "under the minister" (s. 10 of 1903). Any person, whether a British subject or not, may apply for a patent. There is an examination as to the novelty (s. 41 of 1903). The term of a patent is 16 years (s. 3 of 1921). The Commonwealth or a State may acquire patents compulsorily (ss. 93, 94 of 1903). Provisional patents (9 months) may be obtained. There are provisions as to non-working to an adequate extent in the Commonwealth (not enforceable until 4 years from the date of the patent have expired), provisions as to compulsory licences and provisions corresponding to those of s. 38 of the British Act of 1907, avoiding certain conditions attached to the sale, etc., of patented articles (s. 87 A added by s. 15 of 1909). International arrangements are dealt with in s. 121 of the Act 1903, as amended by s. 5 of the Act of 1921. The fees payable are: on application, £1; on acceptance of complete specification, £2; on grant, £5; and £5 before the end of the seventh year.

Canada.—Patent legislation belongs exclusively to the Dominion parliament (B.N.A. Act, 1867, s. 91 [22]). The existing Act is the consolidating Act called "The Patent Act" (c. 23 of 1923). The duration of a patent is 18 years. The fee on application is $15 and within six months after notice of allowance $20; there are no subsequent fees. The Patent Office is under the control of the commissioner for patents. A Patent may be obtained if the invention was new when made and has not been patented or described in any printed publication in Canada or any foreign country more than two years prior to the application and has not been in public use or on sale in Canada more than that period (s. 7). Applications by persons who have obtained or applied for a patent in a foreign country, and who wish to obtain priority of date of such application, are regulated by s. 8. There are provisions as to inventions relating to substances prepared or produced by chemical process and intended for food or medicine similar to those of the British Act (s. 17). A patent is void, in whole or in part, if obtained on an untrue statement, or if the specification has an omission or added statement which is wilfully misleading (s. 31). A patentee must adequately manufacture the patented article or carry on the patented process in Canada, otherwise compulsory licences may be ordered, but not until three years from the date of the patent have expired; after the same period a patent may be revoked if the patented article or process is manufactured or carried on exclusively or mainly outside Canada (ss. 40, 41). Patented articles sold by the patentee are required to be marked or labelled with the year of the date of the patent (s. 51). A register of attorneys is kept at the Patent Office (s. 57). Appeals from the commissioner under the Act are to the exchequer court (s. 62).

India.—The Act in force is the Indian Patents and Designs Act 1911, with amending Acts of 1915, 1920 and 1923. The Act of 1920 relates to reciprocal arrangements with the United Kingdom and other parts of His Majesty's dominions. The Act of 1911 appears to be founded on the British Patents and Designs Act 1907 and contains provisions as to compulsory licences if the reasonable requirements of the public are not satisfied. The term of a patent is 14 years which may, in proper cases, be extended by seven or, in exceptional cases, 14 years. The fees are: on filing, 10 R.; on sealing, 30 R.; before commencement of each of fifth to ninth years, 50 R., and of each of tenth to fourteenth years, 100 R.

Irish Free State.—The patent law is contained in the Industrial and Commercial Property (Protection) Act 1927. The provisions of the Act, so far as regards patents, are, in the main, on the same lines as the British Patents and Designs Act 1907 as amended by the Act of 1919, including the provisions as to the abuse of monopoly. The term of a patent is 16 years. A British patent, existing at the date of the Act (Oct. 1, 1927) is to be deemed to be a patent granted under the Act as of the date the patent actually bears, but, to be effective, must be validated. The fees are: on application, £3; on sealing, £1; before and after the fourth year, £3.15.0, increasing, by 15s. annually, to £12.

New Zealand.—The Acts in force are the Patents, Designs and Trade Marks Act, 1921 (No. 18 of 1921) and an amending Act (No. 40 of 1924) containing provisions for patents, endorsed "licences of right" and for prevention of abuse of monopolies, similar to those in the British Act of 1919. Generally speaking, the statutory law now corresponds closely to that of British Acts. The term of a patent is 16 years. The fee, on application with provisional specification, is £1 or, with complete specification, £2; on sealing, £1, and before the expiration of third year, £3; before that of the sixth year, £6.

Newfoundland.—The law is contained in an Act passed on Sept. 6, 1927. The term of a patent is 14 years.

South Africa (Union of).—The law as to patents is governed by the Patents, Designs, Trade Marks and Copyrights Act 1916. The term of a patent is 14 years. Compulsory licences may be granted if the reasonable requirements of the public are not satisfied, or the patent may be revoked, but not until three years from the date of the patent have expired. "Inventor," as defined, does not include a person importing an invention from outside the Union, but an assignee of an inventor may apply for a patent. By s. 41(2) the grant of a patent for an invention to an inventor or his assignee or legal representative outside the Union is not a bar to a grant of a patent for the same invention within the Union to the same person, provided that an application is made within 12 months of the date of application for the foreign patent; but the subsection only applies to a foreign country as to which a proclamation has been made. Such a proclamation was made as to the United Kingdom on July 1, 1918, on which date an Order in Council was made applying s. 91 of the British Act of 1907 to the Union. At present the provision is only applicable to the United Kingdom, Canada, India, Australia, New Zealand, Irish Free State and the United States of America. The fees are: on application, £4; on sealing, £1; before commencement of third year, £4; seventh year, £6; and tenth year, £10.

Bibliography.—1. General. *Patent Laws of the World* (published by the Institute of Patent Agents, 3 vols., 1911–12) and supplements; W. P. Thompson, *Handbook of Patent Law of All Countries* (1912); R. Jungmann, *Das internationale Patentrecht* (1924).

2. Great Britain. H. S. Cunynghame, *English Patent Practice* (1894); L. Edmunds, *The Law and Practice of Letters Patent for Inventions* (2nd ed., T. M. Stevens, 1897); W. N. Lawson, *Law and Practice under the Patent Acts* (1898); R. W. Wallace and J. B. Williamson, *Law and Practice relating to Letters Patent* (1900); R. Frost, *Law and Practice relating to Letters Patent* (1912); R. Haddan, *The Inventor's Advisor* (12th ed., 1924); T. Terrell, *Law and Practice relating to Letters Patent* (7th ed. 1927). (F. G. U.)

UNITED STATES

Article 1, sec. 8 of the Constitution of the United States provides that Congress shall have power "to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive rights to their respective writings and discoveries." The first act of Congress, passed April 10, 1790, placed the granting of patents in the hands of the secretary of State, the secretary of War and the attorney general. Thomas Jefferson, as secretary of State, personally examined many petitions for patent. By act of July 4, 1836, the Patent Office was established under a commissioner of patents and the present general outline of the patent law fixed. When the Department of the Interior was established by act of March 3, 1849, the Patent Office was transferred to its jurisdiction. On April 1, 1925, it was, by executive order of President Coolidge, transferred to the Department of Commerce under Secretary Hoover.

Theory of the Law.—A patent is in substance a contract between the Government, representing the public, and the inventor, under which the inventor discloses to the public by an adequate specification an invention, which he might otherwise have kept secret, so that the public may benefit by the disclosure and freely use the invention after the patent has expired. In consideration of this disclosure the Government grants a 17-year monopoly to the inventor, whose invention would otherwise have become public property, under the common law, immediately on its disclosure.

Nature of the Monopoly.—The patent grant creates a right to exclude others from making, using or selling any embodiment of the patented invention during the life of the patent. "A patent secures to the patentee the right to debar others from making the thing patented, but it does not confer upon him the right to make it. That he could do (though not exclusively) without a patent." (*Pegram* v. *American Alkali Co.*, 122 Fed. 1,000–1,005.)

To Whom Granted.—Patents are granted to the first inventor, or to his executor or administrator in trust for his heirs or devisees, or, if he be insane, to his guardian, conservator or representative in trust for his estate. If one employs another to develop the details of his invention the patent still belongs to the employer.

Subjects of Patents.—Not every new thing is patentable. Patents are granted for new and useful inventions or discoveries, or new and useful improvements thereof, and for new, original and ornamental designs for an article of manufacture. An invention or discovery, to be patentable, must be within one of four classes enumerated by the statute, *i.e.*, an art, a machine, a manufacture or a composition of matter. An "art" is a process or method, and has been defined by the Supreme Court to be "a

mode of treatment of certain materials to produce a given result." (*Cochrane* v. *Deener,* 94 U.S. 780.) "Manufacture" means an article of manufacture. "New" means not patented or described in any printed publication in this or any foreign country before the invention or discovery thereof by the applicant for the patent, or more than two years prior to his application for a patent thereon. Public use or sale of the invention in the United States by the inventor or others any time more than two years prior to the inventor's application for a patent renders the invention public property and bars the grant of a valid patent thereon. "Useful" means capable of use, or operative, and the degree of usefulness is immaterial, except in close cases, in which commercial success is sometimes persuasive on the point of patentability.

Term of Letters Patent.—Patents for inventions run for 17 years from the date of issue (as distinguished from the date of application, which controls in most other countries). Patents for designs run for 3½, 7 or 14 years, according to the term asked and fee paid. Patents can be extended only by special act of Congress, except that a patentee who "served honorably in the military or naval forces of the United States at any time between April 6, 1917, and Nov. 11, 1918, and was subsequently honorably discharged" may have, between May 31, 1928, and Nov. 30, 1928, applied for an extension of his then existing patent for a term not exceeding three times the period of his enlistment (act of May 31st, 1928). Patents may be obtained for improvements on a prior patented invention, if additional invention was involved in making the improvement, but this does not extend the term of the original patent, and the improvement cannot be made, used or sold without consent of the owner of the earlier patent.

Procedure in Granting Patents.—Applications must be signed and sworn to by the inventor, or by his executor or administrator, if deceased, or by his guardian, if insane. A drawing must be filed if the invention is capable of illustration by a drawing. Models are rarely required. The best embodiment of the invention known to the applicant must be described fully in the specification ending in a claim or claims which "particularly point out and distinctly claim the part, improvement or combination which he claims as his invention or discovery." The claims constitute the most important part of the application and should be drawn by an expert attorney to define all the novel features or combinations of elements disclosed, and no more. An application may be amended from time to time before allowance, so long as the scope of the original disclosure is not exceeded. The Patent Office examiners make an extensive examination of the prior art to determine the margin of novelty in the matter claimed and reject all claims found to be anticipated or informal. Appeals are possible from such rejection to a board of appeals and from it to the courts. If two or more separate applications are filed for patents covering the same feature of invention, an interference is declared and testimony may be taken on which the Patent Office will grant the claim in controversy to the party found to be the first inventor, provided it does not appear that he has lost his rights by inexcusable inactivity. An interference proceeding may also be had between an application and an issued patent if the applicant filed his claim within two years after the grant of the interfering patent. If the applicant proves to have been the first inventor a second patent will be issued to him. When two issued patents interfere, the one erroneously granted can be cancelled by a U.S. court.

Assignments of Patent Rights.—The whole patent, or an undivided interest therein, or the exclusive right for a given territory, may be assigned in writing. Such assignment should be acknowledged before a notary public, U.S. commissioner, secretary of legation or consular officer authorized to administer oaths, to constitute *prima facie* evidence of execution, though the assignment is valid without this formality. If not recorded in the Patent Office within three months after execution an assignment is void as against any subsequent purchaser or mortgagee for a valuable consideration who is without notice of such earlier assignment. If an assignment of an interest in an invention is recorded before the final fee is paid on the application claiming it, the patent will issue to the assignee as their interests may appear.

Certain States have laws regulating assignments of patent rights executed within their boundaries, which have been held valid by the U.S. Supreme Court as within the police powers of the States in preventing fraud. In Kansas and Indiana a certified copy of the patent and an affidavit by the seller must be filed with the clerk of the county in which the sale is effected. In these States and in New York, Georgia, Arkansas, North and South Dakota, Pennsylvania, Ohio, Tennessee, Texas and Vermont, a note or other obligation given for a patent right must have the words, "Given for a patent right," appearing on its face. In Florida, Georgia, North Carolina, Virginia, West Virginia, Wisconsin and Rhode Island, a pedlar of patent rights or of patented articles must take out a licence. The penalties for violations of these laws are fines and imprisonment. In Tennessee they constitute felonies with imprisonment mandatory of from one to five years.

A U.S. trustee in bankruptcy takes title to all rights of the bankrupt in issued patents as of the date of the adjudication in bankruptcy, but not to unpatented inventions. The receiver of a corporation appointed by a State court, however, takes only the equitable title to the patents of the corporation, and an assignment executed by an officer of the corporation is necessary to complete the legal title, or one executed in the name of the corporation by some one designated in an order of the court having jurisdiction.

Reissues.—Any patent, which is inoperative or invalid by reason of a defective or insufficient specification, or because of too broad a claim, if the error has arisen by accident or mistake and without any fraudulent intention, may be reissued for the unexpired term. The application must be signed and sworn to by the inventor, if living. If a reissue application seeks to broaden the claim, it must be filed within two years of the grant of the original patent, unless there is a very good excuse for delay. Another remedy when a patent has too broad a claim is to limit it by disclaimer filed in the Patent Office. Any claim added by reissue takes effect as to recovery of damages for infringement only from the date of said reissue.

Patent Suits.—The U.S. courts alone have jurisdiction of suits for infringement of letters patent, but State courts may adjudicate questions of validity and infringement which arise collaterally in suits of which they otherwise have jurisdiction. The U.S. courts do not have jurisdiction of suits based on assignments of, or licences under, patents unless the parties are citizens of different States. The remedies for infringement include an injunction against continuance thereof, and a recovery of the damages the plaintiff has suffered, or of the profits the infringer has realized, from the making, using or selling of the patented thing or process. The Government may be sued for infringement in the U.S. Court of Claims and reasonable compensation therefor recovered. The Government may not be enjoined from continuing the infringing use or manufacture. Patents can be annulled for fraud perpetrated in obtaining them only by suit instituted by the U.S. attorney general.

Marking Patented Articles.—If a patented article, or the package in which it is sold is not marked "Patent" with the number of the patent, or "Patented" with the patent date if granted prior to April 1, 1927, no damages can be recovered for infringements committed prior to actual notice of infringement given by the patent owner to the infringer. False marking with the word "patent * * or any word of like import" renders the offender liable to a fine of $100 for each offence.

Bibliography.—*See* pamphlet of *Patent Laws* as amended to Oct. 1, 1927, and pamphlet of *Rules of Practice* in the Patent Office; Robinson, *Law of Patents* (1890); Walker on *Patents* (1917); Roberts, *Patentability of Inventions* (1927). (A. P.-S.)

INTERNATIONAL PATENTS

The International Convention for the protection of industrial property, covering patent rights, was signed at Paris on March 20, 1883; the necessary ratifications were exchanged on June 6, 1884, and the Convention came into force a month later. The Convention has since been revised at Brussels on Dec. 14, 1900, at Washington on June 2, 1911, and at The Hague on Nov. 6, 1925. The principal points of the Convention in respect of patents are the right of priority given to an applicant in one

country of the Union during the period of 12 months for making applications in other countries of the Union, and the provision giving a period of three years from application within which revocation for non-working is not to be made. Article 5, in its present form, provides that the importation by the patentee into the country where the patent has been granted of articles manufactured in any of the countries of the Union shall not entail revocation of the patent. Nevertheless each of the contracting countries shall have the right to take the necessary legislative measures to prevent the abuses which might result from the exercise of the exclusive rights conferred by the patent, for example, failure to work. These measures shall not provide for the revocation of the patent unless the grant of compulsory licences is insufficient to prevent such abuses. In no case shall the patent be liable to such measures before the expiration of at least three years from the date of the grant of the patent, and then only if the patentee is unable to justify himself by legitimate reasons. Provision was made by ss. 103 and 104 of the Patents Act 1883 for carrying out the Convention in Great Britain by Orders in Council, applying it from time to time to (a) British possessions whose legislatures had made satisfactory arrangements for the protection of inventions patented in Great Britain; (b) foreign States with which the sovereign had made arrangements for the mutual protection of inventions. The Act of 1907 contains similar provisions (s. 91, as amended by the Act of 1919). The Patents and Designs (Convention) Act, 1928, was passed to give effect to the revised Convention of 1925. In addition to Great Britain, Australia, Canada, Ceylon, New Zealand, Trinidad and Tobago, the following are now parties to the International Convention: Austria, Belgium, Brazil, Bulgaria, Cuba, Czechoslovakia, Danzig, Dominican Republic, Denmark, Esthonia, Finland, France, Germany, Greece, Hungary, Irish Free State, Italy, Japan, Yugoslavia, Latvia, Luxembourg, Mexico, Morocco (part under French protection), Netherlands and Dutch East Indies, Norway, Poland, Portugal (with Azores and Madeira), Spain, Sweden, Switzerland, Syria and Lebanon, Tunis, Turkey and the United States.

An international bureau in connection with the Convention is established at Berne, where an official monthly periodical, *La Propriété industrielle,* is published. (F. G. U.)

Other Countries.—For full information on this subject see *Patent Laws of the World* (1911–12). *See* also: Belgium, P. van der Haeghen, *Répertoire des droits intellectuels en Belgique* (1924); Brazil, G. A. Bailly, *Protection des Inventions au Brésil* (1915); France, H. Allart, *Traité théorique et pratique des brevets d'invention* (1911); E. Pouillet, *Traité théorique et pratique des brevets d'invention* (1915); Germany, H. Jeay, *Patentgesetz* (1911). *See* also *Oriental Patents and Trademarks: India and the East* (published by Remphy and Son, 1923, etc.).

PATER, WALTER HORATIO (1839–1894), English man of letters, was born at Shadwell on Aug. 4, 1839. He was the second son of Richard Glode Pater, a medical man, of Dutch extraction, born in New York. After Richard Pater's death the family moved to Enfield, where the children were brought up. Walter Pater was educated at King's School, Canterbury, and at Queen's College, Oxford. After taking his degree he settled in Oxford and read with private pupils. In 1864 he was elected to a fellowship at Brasenose. Pater now began to write for the reviews, his early papers including one on Coleridge in the *Westminster Review* (1866), and another (1867) on Winckelmann. In the following year his study of "Aesthetic Poetry" appeared in the *Fortnightly Review,* to be succeeded by essays on Leonardo da Vinci, Sandro Botticelli, Pico della Mirandola and Michelangelo. These, with other studies of the same kind, were in 1878 collected in his *Studies in the History of the Renaissance.*

Pater was now the centre of a small circle in Oxford. The little body of Pre-Raphaelites were among his friends, and by the time that *Marius the Epicurean* appeared he had quite a following of disciples to hail it as a gospel. This fine and polished work, the chief of all his contributions to literature, was published early in 1885. In it Pater displays, with perfected fullness and loving elaboration, his ideal of the aesthetic life, his cult of beauty as opposed to bare asceticism, and his theory of the stimulating effect of the pursuit of beauty as an ideal of its own. In 1887 he published *Imaginary Portraits,* a series of essays in philosophic fiction; in 1889, *Appreciations, with an Essay on Style;* in 1893, *Plato and Platonism;* and in 1894, *The Child in the House.* His *Greek Studies* and his *Miscellaneous Studies* were collected posthumously in 1895; his posthumous romance of *Gaston de Latour* in 1896; and his *Essays from the "Guardian"* were privately printed in 1897. A collected edition of Pater's works was issued in 1901.

Pater changed his residence from time to time, living sometimes at Kensington and in different parts of Oxford; but the centre of his work and influence was always his rooms at Brasenose. He wrote with difficulty, correcting and recorrecting with imperturbable assiduity. His mind, moreover, returned to the religious fervour of his youth, and those who knew him best believed that had he lived longer he would have resumed his boyish intention of taking holy orders. He was cut off, however, in the prime of his powers. He died on July 30, 1894.

Pater's nature was so contemplative, and in a way so centred upon reflection, that he never perhaps gave full utterance to his individuality. His peculiar literary style, too, burnished like the surface of hard metal, was too austerely magnificent to be always persuasive. At the time of his death Pater exercised a remarkable and a growing influence among that necessarily restricted class of persons who have themselves something of his own love for beauty and the beautiful phrase. But the cumulative richness and sonorous depth of his language harmonized intimately with his deep and earnest philosophy of life; and those who can sympathize with a nervous idealism will always find inspiration in his sincere and sustained desire to "burn with a hard, gem-like flame," and to live in harmony with the highest. (A. WA.)

Mr. Ferris Greenslet's *Walter Pater* (in the "Contemporary Men of Letters" series, 1904) is an interesting piece of criticism. Mr. Arthur Benson's study in the "English Men of Letters" series (1906), is admirable. *See* too a sketch in Edmund Gosse's *Critical Kit-Kats;* and an estimate from a Roman Catholic standpoint in Dr. William Barry's *Heralds of Revolt,* where Pater is compared with J. Addington Symonds. T. Wright's *Life of Walter Pater* (1907) is an elaborate but unsatisfactory piece of work. *See* E. Thomas, *Walter Pater: A critical study* (1913); also C. A. Stonehill, *Bibliography of Modern Authors.*

PATERNÒ, a town of Sicily, in the province of Catania, 11 m. W.N.W. of Catania by rail, at the foot of Mt. Etna. Pop. (1921) 33,334 (town), 33,914 (commune). There is a well-preserved 14th century castle.

PATERSON, WILLIAM (1658–1719), British writer on finance, founder of the Bank of England and projector of the Darien scheme, was born in April 1658, at Tinwald, Dumfriesshire. A desire to escape the religious persecution then raging in Scotland, led him southward, and after settling for some time in Bristol, he travelled to America where he lived chiefly in the Bahamas. It was here he formed the vast design known as the Darien scheme. On his return to England he was unable to induce the Government of James II. to engage in his plan. He went to the Continent and pressed it to no purpose in Hamburg, Amsterdam and Berlin, and on his return to London he engaged in trade and rapidly amassed a considerable fortune. About 1690 he was occupied in the formation of the Hampstead Water company, and in 1694 he founded the Bank of England. The Government required money, and the country, rapidly increasing in wealth, required a bank. The subscribers lent their money to the nation, and this debt became the bank stock. The credit of having formulated the scheme and persuaded its adoption is due to Paterson. He was one of the original directors, but in less than a year he fell out with his colleagues, and withdrew from the management. He had already propounded a new plan for an orphan bank (so called because the debt due to the city orphans by the corporation of London was to form the stock). But the subscribers to the Bank of England feared a rival to their own undertaking.

Paterson then went to Edinburgh, where he propounded the Darien (*q.v.*) scheme to his countrymen who were desirous of sharing in England's foreign trade. He is the supposed author of the Act of 1695 which formed the "Company of Scotland trading to Africa and the Indies." This company, he arranged, should

establish a settlement on the Isthmus of Darien, and "thus hold the key of the commerce of the world." There was to be free trade, the ships of all nations were to find shelter in this harbour not yet erected, differences of race or religion were neglected; but a small tribute was to be paid to the company, and this and other advantages would so act that Scotland would become one of the richest of nations.

On July 26, 1698, the first ships of the expedition set sail "amidst the tears and prayers and praises of relatives and friends and countrymen." Some financial transactions in which Paterson was concerned, and in which, though he had acted with perfect honesty, the company had lost, prevented his nomination to a post of importance. He accompanied the expedition as a private individual, and was obliged to look on whilst his "golden dream" faded away before his eyes. His wife and child died, and he was seized with a dangerous illness. It was noted that "he hath been so mightily concerned in this sad disaster, so that he looks now more like a skeleton than a man." Still weak and helpless, and yet protesting to the last against the abandonment of Darien, he was carried on board ship, and, after a stormy voyage, he and the remnant of the ill-fated band reached home in Dec. 1699.

In his native air Paterson quickly recovered his strength, and his fertile mind was soon at work on new schemes. He prepared an elaborate plan for developing Scottish resources by means of a council of trade, and tried to induce King William to enter on a new Darien expedition. In 1701 he removed to London, and here by conferences with statesmen, by writing, and by personal persuasion helped on the union. He was much employed in settling the financial relations of the two countries. One of the last acts of the Scots parliament was to recommend him to the consideration of Queen Anne. The United Parliament, to which be was returned as a member for the Dumfries burghs, though he never took his seat, decided that his claim should be settled, but it was not till 1715 that an indemnity of £18,241 was ordered to be paid him. His last years were spent in Queen square, Westminster, but he removed from there shortly before his death on Jan. 22, 1719.

As many as 22 works, all of them anonymous, are attributed to Paterson. These are classified by Bannister under six heads, as dealing with (1) finance, (2) legislative union, (3) colonial enterprise, (4) trade, (5) administration, (6) various social and political questions. Of these the following deserve special notice: (1) *Proposals and Reasons for constituting a Council of Trade* (1701). This was a plan to develop the resources of Scotland through the agency of a council, which, with the revenues derived from duties on sales, lawsuits, successions, etc., was to foster trade, revive the Darien scheme, relieve the poor, and regulate the currency. (2) *A Proposal to plant a Colony in Darien to protect the Indians against Spain, and to open the Trade of South America to all Nations* (1701). This details the advantages to be derived by Great Britain from the Darien scheme. (3) *Wednesday Club Dialogues upon the Union* (1706). These were imaginary conversations in a club in London about the union with Scotland. Paterson's opinions were put into the mouth of a speaker called May, who sets forward the terms which would make the union acceptable to Scotsmen. (4) Along with this another discussion of the same imaginary body, *An Inquiry into the State of the Union of Great Britain and the Trade thereof* (1717), may be taken. This was a consideration of the union and a discussion as to the best means of paying off the national debt—a subject which occupied a great deal of Paterson's attention during the later years of his life.

Paterson's plans were vast and magnificent, but he was no mere dreamer. Each design was worked out in minute detail, each was possible and practical. The Bank of England was a stupendous success. The Darien expedition failed from hostile attacks and bad arrangements. But the original design was that the English and Dutch should be partakers in it, and, if this had occurred, and the arrangements, against many of which Paterson in letter after letter in vain protested, had not been as they were, Darien might have been to Britain another India. Paterson was a zealous free-trader long before Adam Smith, and his remarks on finance and his argument against an inconvertible paper-currency, though then novel, now hold a place of economic orthodoxy. Paterson's works are excellent in form and matter; and few men who have written so much have said so little about themselves.

See S. Bannister, *Life of W. Paterson* (1858); Paterson's *Works*, by S. Bannister (3 vols., 1859); W. Pagan, *The Birthplace and Parentage of W. Paterson* (1865); *Eng. Hist. Review*, xi. 260. The brilliant account of the Darien scheme in the fifth volume of Macaulay's *History* is incorrect and misleading; that in Burton's *Hist. of Scotland* (vol. viii. ch. 84) is much truer. Consult also the memoir in Paul Coq, *La Monnaie de banque* (1863), and J. S. Barbour, *A History of William Paterson and the Darien Company* (1907). For a list of fugitive writings on Paterson *see* Poole's *Index of Periodicals*. (F. Wt.; X.)

PATERSON, a city of north-eastern New Jersey, U.S.A., the county seat of Passaic county; on the Passaic river, 13 m. N. of Newark and 17 m. N.W. of New York city. It is served by the Erie, the Lackawanna and the New York, Susquehanna and Western railways, interurban trolleys, motor-bus and truck lines. Pop. (1920) 135,875 (33% foreign-born white, including 11,566 from Italy and 10,503 from Poland, Russia and Lithuania); 1928 estimate, 144,900. It occupies a restricted area of 8·36 sq.m., surrounded by the city of Clifton on the south (pop. in 1920: 26,470); the boroughs of West Paterson (pop. 1,858), Totowa (1,864), Haledon (3,435), Prospect Park (4,292) and Hawthorne (5,135) on the west and north; and the township of Saddle River (2,845) and the borough of East Paterson (2,441) across the river on the north-east and the east. Within 10 m. of Paterson's city hall there is a population of about 600,000.

The river winds around and through the city in a series of curves. It has a descent here of about 70 ft., of which 50 ft. is in one perpendicular fall, and furnishes power for many of the manufacturing plants, formerly by a system of raceways and water-wheels, now through a hydro-electric plant. Three parks and two cemeteries border on the river. Since 1910 several old cemeteries in the heart of the city have been converted into parks or used for schools and business buildings. The city has a city-plan commission and a zoning commission. The assessed valuation for 1927 was $200,464,419.

Paterson has a unique form of government. The mayor, elected by the people every two years, appoints bi-partisan commissions (on finance, public works, fire and police, parks, education and health) which are responsible for the administration of their respective departments. The board of finance is the appropriating body, but it spends no funds, except for its own expenses. The water-supply from the Passaic river (furnished by a private company) will be replaced about 1930 by a share in the supply from the Wanaque watershed, under development by joint action of several municipalities. The city's sewage empties into the great Passaic valley drain (another joint undertaking, completed in 1927) which carries the sewage of 15 municipalities along the Passaic river from Paterson to Newark out to Robins reef in New York bay. Paterson has a low general death rate, and an exceptionally low infant mortality for an industrial community. The health department maintains six baby-welfare stations in different parts of the city. The public school plant has been greatly enlarged and modernized since the World War, and many improvements in methods and organization have been brought about on the initiative of the teachers. A normal school established by the city became a State institution in 1925. There is a museum in connection with the public library, and a collegiate centre is maintained with the co-operation of New York university.

Paterson is the principal silk-manufacturing centre of the country and has many other important industries. The aggregate output of the 1,087 establishments within the city limits in 1925 was valued at $200,976,520, of which $110,848,379 represented silk manufactures and $29,041,002 the dyeing and finishing of textiles, largely silk. Other important products are textile machinery and various other kinds, submarine cable, structural steel, boilers, aeroplane motors (including those used by Commander Byrd on his North Pole flight and by Lindbergh on his flight from New York to Paris), thread and men's shirts. The silk industry employs some 30,000 persons in Paterson and the

immediate suburbs. Every process is carried on except the reeling of the raw silk from the cocoon. Raw silk is received in skeins from Japan and China, Asia Minor, Italy and France and is made into every variety of broad and narrow silk, dyed, finished and ready for the market, before it leaves the city. About 20% of all the broad silk produced in the United States is made in Paterson (in plant units ranging from 10 to 750 looms) and 75% of all the silk that comes into the country is dyed here. It is estimated that there is constantly in transit through the streets, on any working day of the year, about $1,000,000 worth of silk, at all the various stages of manufacture.

Paterson had its origin in the incorporation on Nov. 22, 1791, of the Society for Establishing Useful Manufactures (the "S.U.M."), which was planned and organized by Alexander Hamilton, with a view to making the United States industrially independent. The Great falls of the Passaic river were selected by the society as a favourable situation for its enterprise, and here a town was established in 1792. It was named in honour of William Paterson, then governor of New Jersey, was incorporated as a township in 1831 and chartered as a city in 1851. The S.U.M. soon dropped its manufacturing operations, but continued to develop its real estate and water-power interests. It still exists (1929) and controls certain water rights. Cotton manufacturing was the first industry established. The first cotton yarn was spun in 1793 in a mill run by ox-power, and the next year, on completion of the dams and reservoir, a cotton factory began operations. Attempts to manufacture machinery were made as early as 1800. The first locomotive (the "Sandusky") was built in 1837, and by 1860 Paterson was supplying locomotives to all parts of the United States and to Mexico and South America. The first silk mill was established in 1839 by John Ryle and George Murray, who had been trained in the industry in England. From this time there was a steady development of silk-manufacturing, until in the '70s Paterson was using two-thirds of all the raw silk imported into the country. Paterson is closely linked with the development of transportation facilities by land, under water and in the air: a Rogers locomotive was the first to cross the great North-west; the submarine was invented here by John P. Holland, and the manufacture of aeroplane motors is now a leading industry. The population of the city was 19,586 in 1860, 51,031 in 1880 and 105,171 in 1900. Between 1900 and 1920 it increased 29%.

PATHĀN, the name applied in India to the Afghāns, though Rohilla (*q.v*, *Rohela,* "hillman") is a synonym. The early history of this highly composite race is obscure. Farishta imagined they were Copts. He may have meant Guptas, but his history is unconvincing. It is difficult to trace any clear mention of them before A.D. 1000 and then they seem to have been obscure mountaineers of the hills about Ghazni. The derivation of the name is obscure.

The name Afghān is in literature much older than Pathān (unknown to writers earlier than the 16th century), though it can hardly be a Pushtu word as that speech has no *f*, but it was not until the 18th century that the Afghāns established their independence and founded Afghānistān as a state.

The land of the Pathāns is bounded on the south by the country of the Baloch (*see* Baluchistān), extending northwards from the southern boundary of Dera Ismail Khān district up to and including Dīr, Swāt and Bajaur on the left bank of the Kābul. In these Khānates the name Pathān, however, no longer connotes Pathān by race, as it is applied only to a share-holder in tribal land, opposed to Fakīr (*q.v.*), a landless man, and loss of his land reduces a man to that status. Westwards the Pathān country projects into Afghānistān, and eastwards to and across the Indus, while Pathān colonies, often military as in Rohilkhand, old Afghān garrisons, fiefs, dynasties and settlements, are found all over northern India and even in the south. The true Afghānistān is indeed defined as extending from the Kashi-ghar or Shawal, the Afghān name for the Takht-i-Sulaimān, "Sulaimān's throne," the traditional cradle of the race, a lofty peak of the Koh-i-Syāh, "Dark Mt." to the border of Kandahār. On this throne is a place of pilgrimage. The Sulaimān range covering an area of fully 1,600m. from north to south and about 200m. from west to east may however be regarded as the earliest seat of the Afghāns. But the Pathāns do not admit that they originated in this area.

On their conversion to Islam, which belief must have been accepted by most of them at an early period, they discovered that they were of far more exalted ancestries, varied according to tribal caprice. Thus the Orakzai here claim Persian descent, but in the 16th century, a daring genealogist compiled an Afghān thesaurus for an Afghān patron and made all Afghāns descendants of Afghana, son of Jeremiah, son of Malik Saul, Solomon's commander-in-chief. The Pathāns comprise many tribes such as the Afrīdis, Orakzais, Mohmands (*qq.v.*), and in the Pathān area dwell such tribes as the Turis (*q.v.*), and the Dilazāks, not of Pathān origin. A termination—*zai* (Pers.—*zāda,* Pash, *zoe* "Son") —is a patronymic, which clan as well as tribe names have. The sept or family is styled *khel,* a word used widely in India and probably not borrowed from the Arabic *kheyl.*

PATHOLOGY, the branch of medical science which deals with the causes of disease, the anatomical, physiological and functional changes which these causes induce and the methods whereby the body combats both causes and changes. Used alone, the term refers to man and animals; for vegetable pathology or phytopathology, *see* PLANTS: *Pathology.*

The study of pathology began about 100 years ago and it was in the last 30 years of the 19th century that its importance began to be recognized by definite and separate academic provision for its prosecution. At first it consisted mainly in investigation of the changes found in the human body after death and their correlation with the signs of disease which had been observed during life. The large progress made along these lines soon led to its expansion in a variety of directions until pathology came to include almost anything which had to do with disease, and its field included aetiology, pathogenesis, morbid anatomy, microscopic histology, parasitology, functional changes, chemical alterations, and indeed any topic, except diagnosis and treatment, which was open to fairly accurate study. The contemporary progress of medicine and surgery showed also that laboratory methods for the investigation of sick persons afforded valuable aids in diagnosis; this large subject of "clinical pathology" is properly recognized as belonging to clinical medicine rather than to pathology. This very diverse assemblage of studies forms together a consistent whole, but the increase of knowledge in some directions has been so great that bacteriology, immunology, protozoology, pathological chemistry and other branches have been progressively separated as specialized topics. (*See* BACTERIA AND DISEASE; IMMUNITY; PARASITIC DISEASES, etc.) In the residuum, apart from a tendency to assimilate pathology to the other biological sciences and a considerable increase in the attention paid to functional as distinct from anatomical changes, no ideas or methods of primary importance have emerged in late years to cause any great change in general outlook, and workers have mostly been engaged on the elaboration and consolidation of the science. Pathology in this restricted sense may be taken to mean the study of the reactions of living organisms to injury.

Nature of Injuries.—The injury may be of very various kinds: mechanical trauma, injury by poisonous substances (many of the most important of which are produced by parasites), defective supply of food (*e.g.,* by living at high altitudes or by errors of diet), electricity, radiation energy and other factors which are still indefinite. The injury may immediately cause gross alterations in structure, and it is known that the physical injury of a cell often entails radical changes in the biological and chemical characters of its protoplasm which depend in some way on its architecture as a whole. Or the injury may be anatomically perceptible though unaccompanied by any large structural changes. Or it may, like electric shocks, cause no visible change and yet lead to a complete and permanent cessation of the activities which constitute what we know as life. Or, finally, it may cause no anatomical changes recognizable by present methods and be put in evidence only by greater or smaller alterations in function.

The obvious anatomical changes in injured tissues with which the early students of pathology mostly concerned themselves are

not as a rule the direct and immediate consequence of the injury. They result partly from alterations which take place in cells after death by the process known as *autolysis* and partly from the activity of the uninjured and healthy cells in the neighbourhood and elsewhere in the body which constitutes the response or *reaction.*

Autolysis.—This is the mechanism by which dead tissues tend to be automatically removed. The normal body consists of live cells and certain products of live cells (such as bone) which are not wholly dead in that they are in functional relation to living tissues. Any dead cells are therefore abnormal or foreign elements and must be removed if restoration of the normal structure is to be achieved. When cells die, ferments are set free which act on the substance of the cell much in the same way as the digestive juices act on food in the alimentary canal. The solids are liquefied and so readily absorbed into the circulating blood, carried away to other parts of the body and if necessary, excreted. Autolysis is naturally signalized by substantial structural changes recognizable by the naked eye or by the microscope. The translucency, colour and consistency of the part are altered, and it is on the recognition of these secondary changes that morbid anatomists depend. Under the microscope the nuclear membrane and chromatin, the protoplasm and the cell wall become more and more disorganized until nothing remains except amorphous débris.

The *reaction* by the uninjured parts of the body is the means by which the effect of the injurious agent is diminished and the normal constitution of the injured part restored as far as may be possible. It may be local or general. Many of the symptoms and signs of disease are due to it rather than to the injury which is the beginning of the disease.

Cellular Processes.—In the higher animals, cells which are mechanically injured or have suffered gross structural change seem as a rule to be incapable of recovery: nerve cells may have their long processes cut off and be able to repair the damage, but such facility is quite exceptional. It is more frequent in lower forms of life but here, too, in unicellular animals such as bacteria any substantial injury is usually irrecoverable and is made good not by the restoration of the individual but by a compensatory increase of the other members of the community of which the injured cell formed a part. Similarly in man, when a part is injured, the whole of the body is available and may be used in co-operation to bring the part, and with it the whole, back to normality. This reaction, whatever its real nature, has the appearance of being purposive in the sense that it is adapted to achieve a definite end.

Pathological changes indeed illustrate exquisitely two great biological truths. The first is that it is characteristic of all live organisms to resist any alterations in their structure and composition and, if these are varied by circumstances which are beyond control, to proceed actively to correct the deviation and so return to the normal state. The second is that all the parts of which the organism is composed work together and in relationship to one another for the common good. A growing realization of these principles has been one of the most productive changes in recent pathological thought. It carries the corollary that the anatomical changes, which are generally the first objects of study, must be regarded as representing phases of processes rather than definitive states. The mode of thought which has collected into museums specimens of morbid anatomy and classified them as if they were species of animals should be replaced by one which regards a hypertrophied heart, a cirrhotic liver, or a sclerosed kidney, not as a "typical" example of a state, but as an illustration of one stage in a process by which the body has responded to a stimulus of injury.

Mechanism of Reaction.—The general nature of the reaction being purposive and restorative, it is likely that the particulars of the mechanism by which it is brought about will vary widely, since the constants of live organisms are the ends which are achieved rather than the means by which they are reached. Such is the case as will be seen from some illustrative examples.

The human economy is adjusted to live in air at a pressure of about 760 mm. of mercury containing 21% of oxygen: a compromise of the conflict between having a blood of a tolerable viscosity for the heart to pump round the body and one which will carry an adequate amount of oxygen from the lungs to the tissues has been found at a concentration of about 5,000,000 red corpuscles per cubic millimeter; and the respiratory centre is adjusted to respond to a pressure of carbon dioxide which corresponds to about 40 mm. of mercury in the alveolar air. If man goes to an altitude of 15,000 ft. above sea-level, where the barometric pressure is only some 440 mm. of mercury and the oxygen pressure correspondingly reduced, he is at once in difficulties in respect to the supply of oxygen, especially if the need for it is increased by activity. No clear injury is inflicted on the tissues of the body which can be recognized by anatomical changes, but the shortage of oxygen causes plain symptoms and initiates a response the effect of which is to correct the deficiency wholly or in part. This is done by altering the sensitivity of the respiratory centre so that it responds to a lower pressure of carbon dioxide and so increasing the amount of air breathed, by changing the composition of the blood so that the haemoglobin will take up more than the normal amount of oxygen at a given oxygen pressure and by stimulating the bone marrow to grow and produce more red corpuscles so that the concentration of haemoglobin in the blood and hence its oxygen-carrying power are increased. The connecting links between the deficiency of oxygen and this complex reaction (*i.e.,* the immediate stimuli to which the reactions are responses) are not known. The result is that man can soon live comfortably under conditions so different from those to which he is accustomed that they would cause serious harm if not compensated.

Simple Wounds.—A simple incised *wound* of the skin and superficial tissues made by a knife which is chemically and bacteriologically clean inflicts an uncomplicated mechanical injury on a limited number of cells in the epidermis and dermis. This is followed after a few hours by a familiar reaction: the injured part feels full and uncomfortable and is swollen, red and painful. These are the outward signs of an inflammatory reaction, which consists intimately in a dilatation of the blood vessels, an increased flow of blood to the neighbourhood and an alteration in the walls of the capillary vessels which enables liquid plasma and leucocytes to pass through from the blood to the tissue spaces. The cells killed by the injury undergo autolysis and in the course of a few days they are replaced by fresh cells derived from the adjacent epithelial cells of the skin and from the connective tissue of the dermis, as is appropriate.

The result in the end is that the wound is healed and the part restored to normal. It is impossible to suppose that this reaction is started by the absence of the cells which were originally destroyed: the actual stimulus is no doubt provided by the soluble products of their autolysis, which can be shown outside the body to have a stimulating action on cell-growth and by suitable experiments to alter the permeability of capillary vessels. The process is self-regulated and the inflammatory reaction is accessory to the restorative growth. By increasing the local circulation it raises the temperature of the part and so promotes all cellular activities; it provides plasma, which helps to wash away the soluble remains of the dead cells, and leucocytes, which eat the more resistant remnants of the cells; the discomfort which attends the hyperaemia and swelling is of value in securing rest to the injured part and freedom from further mechanical disturbance, conditions which help cell-growth and healing. The process is also automatically regulated quantitatively for the amount of autolysate, *i.e.,* the amount of stimulus, depends on the extent of the original injury. Its effect varies with the responsivity of different tissues and, allowing for that, is determined by its concentration. If this is very high, which occurs in the ordinary way only with exceptionally massive destruction of tissue, it injures and kills cells and is responsible for the fatal condition known as secondary shock which may follow extensive injuries. Lower concentrations stimulate growth, as often happens with cellular poisons. And if the products of autolysis are present only in concentrations below the threshold value for stimulation, they have no action on the tissues. Hence in the example under consideration the response is limited to the immediate neighbourhood of the

injury and the growth of cells takes place where it is needed and not in all the parts of the body to which traces of autolysate are carried in the blood. The local reaction to a bullet or a piece of glass buried in the tissues illustrates the same regulative reaction. The response consists in a growth of the connective tissue next to the foreign body without any obvious destruction of cells, due to the irritants nowhere reaching an actually poisonous concentration owing to their small solubility in the tissue fluids.

Abscesses.—The history of an *abscess* illustrates a similar kind of injury stimulus and response, complicated by the fact that the infliction of the injury is itself a process rather than an event. Abscesses can be produced experimentally by unorganized irritants, but in the natural course they are caused by bacteria which are capable of multiplication and produce poisonous substances which are effective agents in killing and injuring cells, and as stimuli have, in a general way and apart from special actions, the same effect as the products of autolysis. At first the organisms are present only in small numbers and do relatively little damage, but as they increase in numbers the amount and concentration of their poisons increase in parallel until a substantial piece of tissue is destroyed. This undergoes autolysis and the stimulus of the autolysate is added to that of the bacterial toxins. (*See* Inflammation and Its Sequels.)

That specially sensitive cells may, however, be injured is shown by the fever and feeling of illness which an abscess may cause and by the functional impairment of the secretory cells of the kidney and stomach and other delicate tissues. We also find evidence of the reception of stimuli in distant parts of the body in the growth of leucocytes in the bone-marrow. Any good-sized abscess contains in its pus more leucocytes than are present at any one time in the circulating blood, from which it follows that the formation of an abscess leads to the production of fresh leucocytes and that the cells which develop into leucocytes must be exceptionally responsive to the small amounts of stimulating substances which reach them. This deduction is confirmed by direct examination of the bone-marrow where leucocytopoiesis is found going on actively, often with a vigour which results in there being an obvious excess of these cells in the circulating blood. The purposive and reparative nature of this reaction needs no further elaboration beyond indicating that the passage of plasma out of the inflamed vessels brings antibodies (*see* Immunity) to bear on the bacteria to which the leucocytes are also directly inimical and that the general, as contrasted with the local, rise of temperature promotes the multiplication of leucocytes at places distant from the abscess itself. The reaction does not always succeed: the bacteria may generate such a concentration of poisons throughout the body as is fatal to essential organs such as the brain and heart. On the other hand, an abscess may cure itself by destroying so much tissue that the pus finds an exit to the surface of the body and the absorption of poisons ceases because it becomes mechanically easier for them to pass outwards with the stream of plasma than inwards, a process of natural cure imitated and anticipated by surgical interference. The same result is gained if the bacteria die out or are killed off.

Hypertrophy (*q.v.*).—If one kidney is removed from a young animal, the other kidney will grow in the course of a few months to twice its normal size. Similarly, if an error of development leads to one kidney being absent from the beginning, the other will be as big as two normal kidneys. In this instance the injury inflicted on the kidney is the presentation of more work to do than it was designed to discharge, and an analogous increase of both kidneys can be brought about by increasing their work by giving excess of water or of nitrogenous food. Muscle and many of the other tissues of the body show the same intimate relation between quantity of substance and quantity of function and will increase their bulk in response to greater functional requirements.

The intermediary mechanism of this *hypertrophy* has not been identified, but the similarity between the products of activity and those of autolysis is suggestive and it may well be that the normal sizes of organs which accompany normal amounts of work are determined by the soluble substances set free in active katabolism. So, too, if functional activity is reduced, the bulk of corresponding tissue becomes smaller. An unused muscle soon wastes, and in consonance with the quietude of old age most of the important organs shrink. If the arm is cut off at the elbow, the muscles which normally move the lower arm wither, the bones to which they are attached grow smaller, and the nerve cells in the spinal cord which actuate them may disappear.

Two points need further mention: (1) The removal of one kidney has no detectable ill-effect on an animal or man; one kidney is evidently enough to do the ordinary excretory work which is required. But the kidneys and other organs are designed to discharge, and are capable of discharging, much more than the ordinary amount of function; a muscle can at any moment do more than its average work and indeed more than it has ever been called upon to do before. The possession of this *reserve force* is an obvious teleological necessity for survival, and so precise is the response to an increase of average work that it is maintained in hypertrophied as well as in normal organs. (2) If the increase of work is too large, hypertrophy does not occur, *i.e.*, the stimulus to hypertrophy is an amount of extra function within the range of the reserve force of the organ. This is a well recognized principle in the training of voluntary muscles for athletic or aesthetic purposes.

All these circumstances of the response to work seem best to be explained on the hypothesis that an organ is made up of a number of units, each of which requires a restorative period of rest after each of the periods of activity, which are necessary for its maintenance. To fulfil the ordinary amount of function only a proportion of units is active at any one time; as their activity proceeds they become, in accordance with the general law, progressively less excitable by the stimulus which rouses their activity and eventually cease to respond. Their function is then taken over by another set of units which, after a period of rest, are more responsive. In this way a larger number of units is kept in working order than is usually required. The maximum possible work is the amount which can be achieved by all the units working simultaneously: this is the limit of the reserve force, and if it is habitually reached no units have time for the necessary rest and restoration, the organ is worn out and cannot make hypertrophic growth.

These reparative responses are not the inevitable result of the application of the appropriate stimulus: the reaction may not occur if it is unnecessary or undesirable. If the portal vein bringing blood to the left half of the liver is tied, the left lobe progressively atrophies and the right lobe hypertrophies so that at any time the total quantity of liver substance remains about normal. But if the right lobe is injured by tying its bile duct, it does not hypertrophy and the left lobe does not atrophy, though it receives blood only through the hepatic artery. The atrophy is conditioned by the total functional requirements of the body for liver tissue and does not necessarily follow the reduction in blood supply. If rabbit's blood is injected into the circulation of a normal rabbit, the excess of liquid is got rid of in a few hours, and the excess of red corpuscles in ten days or so and the normal position is regained. If such a transfusion is repeated, the excess red cells are destroyed in two or three days and the animal can be brought by practice to a habit of disposing of them promptly. If such a trained animal is bled and then transfused with an equal quantity of blood from another rabbit, no destruction of the injected blood occurs. The difference is that the extra blood is not wanted by the normal animal while the bled animal has need of it to carry oxygen: in the former it is destroyed, in the latter it is kept and used.

Response.—Of the circumstances which facilitate response, age and experience are the most important: their influences will often be antagonistic. The inherent capacity of a tissue to grow and discharge any of its functions steadily diminishes as the organism of which it forms a part grows older. But its available ability to do anything is influenced by whether and how often it has done it before, individually and racially. Experience in such exercises as reproducing blood which has been lost by haemorrhage or making the substances which neutralize bacterial poisons gives the same advantage as it does in the more complicated reactions

of behaviour. In general, the most effective preparation for successful resistance to a large injury is the previous reception of small injuries of the same kind.

Reactions to stimuli may fail in whole or in part because the stimulus is too large and kills the whole organism or because the tissues are old or already diseased. In some instances it is the nature of the tissue which mostly determines the imperfection of the result. Blocking of one of the smaller blood vessels of the heart kills the muscle which the vessel normally supplies. The dead muscle autolyses and is removed, and its place is taken by fibrous tissue instead of by cardiac muscle, which is inherently incapable of the necessary multiplication of cells. The repair is for the time effective but it is unsatisfactory, for fibrous tissue is less elastic than muscle and is liable to tear. The nerve cells of the central nervous system never grow to repair an injury: if some of them are destroyed they cannot be replaced, and the best that can be achieved is a certain amount of functional restoration by the rearrangement and adaptation of the parts which remain. In other cases, the nature of the injury and the mode of its infliction determine the result. The common sclerosis of the kidney begins by the destruction of a proportion of the glomerulotubal units of which the organ is composed by some poison circulating in the blood. The dead tissue is cleared away and, since kidney cells cannot adequately regenerate, the gap is healed by the growth of the connective tissue. Later, which is characteristic of the disease, further destruction takes place and so on from time to time, each loss of secreting tissue being followed by fibrous tissue repair. The other units, as might be expected, hypertrophy, and up to a point function is adequately maintained, partly by the local reaction and partly by a general rise of arterial blood pressure backed by a hypertrophied heart which tends to compensate the diminution of vasomotor mobility and control resulting from the anatomical changes. But if successive injuries continue, the limits of the possible hypertrophy of the remaining healthy tissue are exceeded and its growth is impeded by the firm fibrous tissue which comes to constitute a large part of the organ. Hence, in the end, function fails, as it finally must if repeated injuries are inflicted on tissues which cannot be vicariously replaced and are capable only of compensatory hypertrophy (*i.e.*, most specialized tissues) and not of indefinite regeneration (*e.g.*, connective tissue, blood corpuscles).

These examples are sufficient to illustrate the kind of topics which form the subject-matter of pathological study and the way in which they can at the moment be fruitfully approached. The reaction to injury (using the word in a wide sense even including the new growths or tumours) is a process which is initiated by some definite stimulus arising within or outside the body and generally promoted and extended by secondary stimuli which are produced by the body in the early stages of the response. The injury and the response may be local or general; general injuries may provoke reactions, and local injuries may elicit responses in which many organs take part. The organism in this, as in other respects, has to be regarded as a coherent and essentially indivisible whole, and one must recognize the limitations of the point of view, fruitful enough in the past, from which a live animal appears as an assemblage of relatively independent cells or organs. The character of the response is such that it tends to correct in one way or another the anatomical defect or the functional derangement which is caused by the injury. Whatever the mechanism by which the result is attained, the reaction is purposive in appearance if not in intention, and its purpose is survival.

See Bacteria and Disease; Parasitic Diseases; Cancer Research; Tumours; and articles on special diseases or diseases of special organs.

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PATIALA, SIR BHUPINDAR SINGH, Maharaja of (1891–), head of the Sikh community in India, was born Oct. 12, 1891, the son of Maharaja Sir Rajendra Singh, who died in Nov. 1900. On receiving full ruling powers at the close of 1910 he maintained and greatly developed the progressive policy of the council of regency. He actively supported Great Britain during the World War. He promoted the inauguration of the chamber of princes in 1921, and represented the princes at the League of Nations Assembly at Geneva in 1925.

PATIALA or **PUTTIALA,** the premier native state of the Punjab, India, the chief of the three Sikh Phulkian states—Patiala, Nabha and Jind. It consists of three detached blocks of territory, mostly in the plains, though one portion extends into the hills near Simla. Area 5,942 sq.m.; pop. (1921) 1,499,739; estimated revenue, £860,000. Founded by a Sikh chieftain about 1763, it came under British protection, with the other cis-Sutlej states, in 1809. Patiala remained conspicuously loyal to the British during the Mutiny of 1857. The town of Patiala has a station on the N.W. railway. Pop. (1921), 47,531.

PATIENCE or "Solitaire," the name given to certain card-games played by a single person. Although known for centuries, they have seldom been mentioned by writers on playing-cards, and the rules have for the most part been handed down orally. There are two main varieties; in one luck alone prevails, since the player has no choice of play but must follow strict rules; in the other an opportunity is given for the display of skill and judgment, as the player has the choice of several plays at different stages of the game. The usual object is to bring the cards into regular ascending or descending sequences. The starting card is called the "foundation," and the "family" (sequence) is "built" upon it. In other varieties of Patience the object is to make pairs, which are then discarded, the game being brought to a successful conclusion when all the cards have been paired; or to pair cards which will together make certain numbers and then discard as before. There are hundreds of Patience games.

See *Patience Games* by "Cavendish" (1890); *Cyclopaedia of Card and Table Games*, by Professor Hoffmann (1891); *Patience Games*, by Professor Hoffmann (1892); *Games of Patience*, by A. Howard Cady (Spalding's Home Library, New York, 1896); *Dick's Games of Patience*, edited by W. B. and H. B. Dick (New York, 1898); *Games of Patience* (4 series), by Mary E. W. Jones (1898); *Le Livre illustré des patiences*, by "Comtesse de Blanccoeur" (1898); Tarbart's *Games of Patience* in De la Rue's series of handbooks (1905); R. F. Foster, *Hoyle's Games* (1928).

PATINIR, JOACHIM DE (*c.* 1475–1524) Flemish painter, was probably born at Bouvignes about the year 1475. In 1515 he entered the Antwerp painters' gild. He may be called one of the first landscape painters in the Netherlands, for, contrary to the custom of his time, the figures in his pictures are relatively small and are subsidiary to his views. He specialized on landscape. His views are seen from a high standpoint and range over a wide extent of hilly country. The plants of his foregrounds are carefully studied and masses of rich dark foliage and jutting fantastic rocks are placed in the middle distance. The scene is full of incidents, and a religious subject is introduced, because in Patinir's time landscape painting was not yet an art sufficient in itself. The figures are often painted by other artists.

Though few of Patinir's pictures have survived, a large number have been attributed to him. There are but three signed works: "The Flight into Egypt," at Antwerp, "the Baptism of Christ," at Vienna, and the "St. Jerome," at Carlsruhe. Four of his best pictures are at Madrid: "The Flight into Egypt," the "St. Jerome," "Heaven and Hell," and the "Temptation of St. Anthony." In the last named picture the figures are painted by Quentin Matsys. The so-called "Master of the Half-lengths" painted the figures in three of Patinir's landscapes—the "Virgin" at Copenhagen; the "St. John at Patmos," in the National Gallery, London, and the "Magi" at Munich.

Few facts are known about Patinir's life. He was visited by Dürer in 1520 in his house in the Rue Courte l'Hôpital at Antwerp. Patinir died at Antwerp in 1524.

See M. Friedlander, *Von Eyck bis Bruegel* (1921); Sir Martin Conway, *Van Eyck and his Followers* (1921).

PATIO, the Spanish name for an inner court or enclosed space open to the sky. The patio is a common feature in houses in Spain and Spanish America.

PATKUL, JOHANN REINHOLD (1660–1707), Livonian politician and agitator, was born on July 27, 1660, in prison at Stockholm, where his father lay under suspicion of treason. He was a captain in the Swedish army when, in 1689, at the head of a deputation of Livonian gentry, he went to Stockholm to protest against the rigour with which the land-recovery project of Charles XI. was being carried out in his native province. Another petition addressed to the king in the diet in 1692, on behalf of the rights of the Livonian gentry, involved him in a government prosecution. Patkul fled from Stockholm to Switzerland, and was condemned *in contumaciam* to lose his right hand and his estates. For the next four years he led a vagabond life, but in 1698, after vainly petitioning the new king, Charles XII., for pardon, he proceeded to the court of Augustus the Strong, elector of Saxony and king of Poland, at Dresden and bombarded him with proposals for the partition of Sweden. His first plan was a combination against her of Saxony, Denmark and Brandenburg; but, Brandenburg failing him, he was obliged very unwillingly to admit Russia into the partnership. The tsar was to be content with Ingria and Estonia, while Augustus was to take Livonia, nominally as a fief of Poland, but really as an hereditary possession of the Saxon house. Military operations against Sweden's Baltic provinces were to be begun simultaneously by the Saxons and Russians. After thus forging the first link of the partition treaty, Patkul proceeded to Moscow, and, at a secret conference held at Preobrazhenskoye, easily persuaded Peter the Great to accede to the league (Nov. 11, 1699). Throughout the earlier, unluckier days of the Great Northern War, Patkul was the mainstay of the confederates. At Vienna, in 1702, he picked up the Scottish general George Benedict Ogilvie, and enlisted him in Peter's service. In the same year he himself exchanged the Saxon for the Russian service. On Aug. 19, 1704, he succeeded, at last, in bringing about a treaty of alliance between Russia and the Polish republic to strengthen the hands of Augustus, but he failed to bring Prussia also into the anti-Swedish league because of Frederick I.'s fear of Charles and jealousy of Peter. From Berlin Patkul went on to Dresden to conclude an agreement with the imperial commissioners for the transfer of the Russian contingent from the Saxon to the Austrian service. The Saxon ministers, after protesting against the new arrangement, arrested Patkul and shut him up in the fortress of Sonnenstein (Dec. 19, 1705), disregarding the remonstrances of Peter against this violation of international law. After the peace of Altranstädt (Sept. 24, 1707) he was delivered up to Charles, and at Kazimierz in Poland (Oct. 10, 1707) was broken alive on the wheel, as a traitor to Sweden. Charles rejected an appeal for mercy from his sister, the princess Ulrica, on the ground that Patkul, as a traitor, could not be pardoned for example's sake.

See O. Sjögren, *Johan Reinhold Patkul*, (Swed.) (Stockholm, 1882); Anton Buchholtz, *Beiträge zur Lebensgeschichte J. R. Patkuls* (Leipzig, 1893). Patkul's fate provided the material for a tragedy by Gutzkow.

PATMORE, COVENTRY KERSEY DIGHTON (1823–1896), English poet and critic, the eldest son of Peter George Patmore, himself an author, was born at Woodford in Essex, on July 23, 1823. He was privately educated, being his father's intimate and constant companion. His first idea was to be an artist, but after a brief experiment he turned to literature. In 1844 he published *Poems*, a book which was ill-received by the critics. Patmore withdrew and destroyed the remainder of the edition. But the publication of this little volume introduced its author to various men of letters, among whom were Dante Gabriel Rossetti and Holman Hunt, and he was thus drawn into the eddies of the pre-Raphaelite movement, contributing his poem "The Seasons" to the *Germ*. At this time Patmore's father became involved in financial embarrassments; and in 1846 Monckton Milnes secured for the son an assistant-librarianship in the British Museum, a post which he occupied industriously for nineteen years, devoting his spare time to poetry. In 1847 he married Emily Andrews.

In 1853 he republished, in *Tamerton Church Tower*, the more successful pieces from the *Poems* of 1844, adding several new poems which showed distinct advance, both in conception and treatment; and in the following year (1854) appeared the first part of his best known poem, "The Angel in the House," which was continued in "The Espousals" (1856), "Faithful for Ever" (1860), and "The Victories of Love" (1862). In 1862 he lost his wife, after a long and lingering illness, and shortly afterwards joined the Roman Catholic Church. In 1865 he married again, his second wife being Marianne Byles; and a year later purchased an estate in East Grinstead, the history of which may be read in *How I managed my Estate*, published in 1886. In 1877 appeared *The Unknown Eros;* and in the following year *Amelia*, his own favourite among his poems, together with an interesting, though by no means undisputable, essay on *English Metrical Law*. This was followed by *Principle in Art* (1879) and *Religio poetae* (1893). After the death of his second wife in 1880 he married Harriet Robson. In later years he lived at Lymington, where he died on Nov. 26, 1896.

A collected edition of his poems appeared in two volumes in 1886, with a characteristic preface which might serve as the author's epitaph. "I have written little," it runs; "but it is all my best; I have never spoken when I had nothing to say, nor spared time or labour to make my words true. I have respected posterity; and should there be a posterity which cares for letters, I dare to hope that it will respect me." His best work is found in the volume of odes called *The Unknown Eros*, which is full not only of passages but of entire poems in which exalted thought is expressed in poetry of the richest and most dignified melody.

(A. Wa.)

The standard life of Patmore is the *Memoirs and Correspondence* (1901), edited by Basil Champneys. *See* also E. W. Gosse, *Coventry Patmore* (1905, "Literary Lives" series), and an essay by Mrs. Meynell prefixed to the selection (1905) in the "Muses' Library."

PATMOS, an island in the group of the Sporades in the Aegean Sea about 28 m. S.S.W. of Samos (37° 20′ N. lat. and 26° 35′ E. long.; length from north to south, about 10 m., greatest breadth 6 m.). The island is volcanic, bare and rocky throughout; rising to about 800 ft. with deeply indented coast. The harbour of Scala opening eastward divides the island into two nearly equal portions with a narrow isthmus where stood the ancient town. On the hill above are massive remains of the citadel. The modern town stands on a ridge in the southern half. A steep paved road leads in about twenty minutes from the port of Scala to the monastery of St. John, crowning the hill with towers and battlements, a fortress rather than a monastery. Of the 600 mss. once in its library only 240 are left. The houses of the town are better built than those of neighbouring islands, but the streets are narrow and winding. Pop. *c.* 4,200. The port of Scala contains about 140 houses, besides some old well-built magazines and some potteries. Scattered over the island are about 300 chapels.

Patmos is rarely mentioned in antiquity. Ionians settled there at an early date. As a remote islet it was the place of banishment of St. John the Evangelist, under Domitian in A.D. 95. He was released about eighteen months afterwards under Nerva. Here he is said to have written the Apocalypse. To the left of the road from Scala to the town, about half-way up the hill, a grotto is still shown (τὸ σπήλαιον τῆς Ἀποκαλύψεως) in which the apostle is said to have received the heavenly vision. It is reached through a small chapel dedicated to St. Anne. The *Acts of St. John*, attributed to Prochorus, narrates the miracles wrought by the apostle during his stay on the island, but, while describing how the Gospel was revealed to him in Patmos, it does not mention the Apocalypse. During the dark ages Patmos seems to have been entirely deserted, probably on account of the pirates. In 1088 the emperor Alexis Comnenus, by a golden bull, which is still preserved, granted the island to St. Christodulus for the purpose of founding a monastery. This was the origin of the Monastery of St. John, which now owns the greater part of the southern half of Patmos, as well as farms in Crete, Samos and other neighbouring islands. The embalmed body of the founder is in a side chapel of the church. The island was subject to Turkey till it was annexed by Italy in 1912. The population is Greek.

PATNA, one of the Orissa Feudatory States in Behar and Orissa. Pop. (1921) 494,456; area 2,399 sq.m. It lies in the

basin of the Mahanadi river, and is divided by a forest-clad hilly tract into a northern and a southern portion, both of which are undulating and well cultivated. The capital is Bolangir. The state was transferred to Bengal from the Central Provinces in 1905 and was incorporated in Behar and Orissa in 1912.

PATNA, a city, the capital of the province of Behar and Orissa, British India, situated on the right bank of the Ganges. Pop. (1921) 119,976. Patna was selected as the capital of Behar and Orissa on the creation of that province in 1912. A high court was established in 1916 and a university in 1917. The greater part of Patna consists of the city proper, which stretches along the river bank for 9 miles. Its main street is filled by a succession of small shops and houses, broken by public institutions and cultivated fields, with little to suggest the importance of a capital. Its trade is declining and now depends on local products. Its manufactures and industries are also on a small scale; at the census of 1921 there were only 15 concerns with ten or more employees, and their total labour force was only 1,000. West of it lies the civil station of Bankipur, and south-west of the latter the new capital. The new capital is well laid out and spacious: its main roads are 150 ft. wide and a central avenue has a length of nearly a mile and a width of 200 ft. The principal buildings are Government house, the Secretariat, the Council Chambers, the High Court and the Patna museum. The well-known Patna Oriental museum is in the city proper, as also other buildings and institutions mentioned later.

History.—Patna stands on the site of the ancient Pataliputra, the Palibothra of Megasthenes, who was sent there about 302 B.C. as an envoy to Chandragupta by Seleukos Nikator. According to his account, the city had a circuit of 25½ miles and the royal palace was more magnificent than those at Susa and Ecbatana. Under Asoka, Pataliputra was the capital of an empire extending from the Hindu Kush to the Bay of Bengal. The seat of government was moved to Ajodhya by Chandragupta II. towards the close of the 4th century A.D., and Pataliputra, which was a flourishing city in the next century, subsequently fell into ruin; the causes of its fall are obscure, but excavations show the effects of fire and flood. The Chinese pilgrim, Hiuen Tsiang, in the 7th century described it as an old city long deserted, with monasteries and temples in ruins. Patna rose to greatness after A.D. 1541, when Sher Shah made it the capital of Behar. By 1586, when Ralph Fitch visited it, Patna was "a very long and a great town." Under the Moguls it was the seat of the viceroy of Behar and a centre of commerce, which led to factories being established by both the English and Dutch. Its seizure by the English agent, Ellis, in 1763, precipitated war with the nawab of Bengal, Mir Kasim Ali Khan. The recapture of the city by his forces was followed by the ghastly tragedy known as "the massacre of Patna;" under the nawab's orders nearly 200 English prisoners were murdered in cold blood by one of his officers, an Alsatian named Reinhardt, who was known to Indians as Samru. Patna was finally taken by the British forces under Major Knox in 1763. The ancient Pataliputra lies buried deep under the silt of the Ganges, but most interesting remains have been unearthed in the south-west suburbs as the result of excavations in 1892–99 and 1912–16. Among them is the hall of a hundred columns built by the emperor Asoka, the ruins of which have been found to bear a similarity to those of the palace of Darius at Persepolis.

Buildings and University.—The oldest intact building in Patna is a mosque, with a courtyard of glazed tiles, built by Husain Shah, king of Bengal, in A.D. 1499; other noteworthy mosques are Sher Shah's mosque and the stone mosque of Prince Parwez, son of Jahangir (1626). A Sikh temple stands in the place where the great Guru Govind Singh was born in 1675; in it are preserved his cradle, shoes, swords and arrows, as well as a copy of the *Granth* or holy book of the Sikhs, said to have been presented by the guru himself. The old English factory, built early in the 18th century, in which Shah Alam was enthroned as emperor in 1761, is now occupied by the government press. The Gola in Bankipore, a curious brick building, 96 ft. high, of a bee-hive shape, was built in 1786 to serve as a granary for rice in case of famine; it was a typical "folly," for it was never filled.

The University of Patna, founded in 1917, consists of a number of colleges admitted to the degree standard, and of colleges and schools admitted to the intermediate standard. The majority are in Patna, viz., the Patna college, Behar National college, Patna Training college, Patna Law college, Behar National college of engineering, Prince of Wales Medical college and Patna New college. A Senate house was opened in 1926. A scheme of development has been adopted and new buildings, which will include a Science college, are under construction, or proposed.

The DISTRICT OF PATNA has an area of 2,062 sq.m.; pop. (1921) 1,574,287. Throughout the greater part of its extent the district is a level plain; but towards the south the Rajgir hills (*q.v.*) project into it and divide it from the district of Gaya for about 30 miles. The soil is for the most part alluvial, and the country along the bank of the Ganges is peculiarly fertile. The general line of drainage is from west to east; and high ground along the south of the Ganges forces back the rivers flowing from Gaya district. The result is that during the rains a belt of low-lying country four or five miles from its bank is flooded. The chief rivers are the Ganges and the Son. The only other river of any consequence is the Punpun, which is chiefly remarkable for the number of petty irrigation channels which it supplies. So much of the river is thus diverted that only a small portion of its water ever reaches the Ganges. The chief crops are rice, wheat, barley, maize and pulse. The Son canal irrigates 150,000 acres to the north-west; elsewhere irrigation is largely practised from private channels and also from wells.

Apart from Patna city, the district contains many places of historic interest. The Rajgir hills (*q.v.*) are not only associated with the life of Buddha, but contain remains of prehistoric and early historic date. Mahavira, the founder of Jainism, died at Pawapuri, which is consequently a place of Jain pilgrimage. Nalanda (the modern village of Bargaon) was a famous seat of Buddhist learning and culture: it has been called "the Oxford of Buddhist India." Sir A. Cunningham states that he met the finest sculptures of India here; and excavations begun in 1916 have disclosed a maze of *viharas* (monasteries) with seven levels of occupation and buildings of nine different periods. Between the 5th and 12th centuries A.D. the town of Behar was the site of another Buddhist *vihara*, whence its name; it was the capital of South Behar under the Pala kings and then under Mohammedan governors until the 16th century.

The DIVISION OF PATNA comprises the districts of Patna, Gaya and Shahabad, south of the Ganges. Area, 11,149 sq.m.; pop. (1921) 5,544,038. It formerly also included four districts north of the Ganges, viz., Saran, Champaran, Muzaffarpur and Darbhanga, which, in 1908, were formed into the division of Tirhut.

PATON, JOHN LEWIS ALEXANDER (1863–), British educationalist, was born in Sheffield on Aug. 13, 1863, son of the Rev. J. B. Paton, D.D. In Sept. 1903 he was appointed high master of Manchester grammar school and held the post till July 1924. On his retirement a fund was raised in his name to commemorate his services to the town and district, as well as to the school. Paton was a member of the consultative committee of the Board of Education from 1907 to 1915, was lecturer on education in Victoria university and president of the Teachers' Guild (1907) and of the Modern Languages Association (1911). He was a zealous advocate of the social and religious, as well as the literary sides of education.

He published in 1914 a *Life of J. B. Paton*, and his educational works include *Chapters on the Aims and Practice of Teaching* (1896); *The Public Schools from Within* (1906); *The Higher Education of Boys in England* (1906); *Cambridge Essays on Education* (1917); *Vocation* (1919); as well as a special report for the Board of Education on *The Teaching of Classics in Prussian Elementary Schools* (1907).

PATON, SIR JOSEPH NOEL (1821–1901), knighted in 1867, British painter, was born on Dec. 13, 1821, in Woolers Alley, Dunfermline. He began to exhibit at the Royal Academy, London, in 1856. His preference was for allegorical, fairy and religious subjects. He also produced a certain amount of sculpture, more notable for design than for searching execution. He was elected an associate of the Royal Scottish Academy in

1847, and a full member in 1850; and was appointed Queen's Limner for Scotland in 1866. In 1878 the University of Edinburgh conferred upon him the degree of LL.D. He was well known as an antiquary, his hobby being the collection of arms and armour. He died in Edinburgh on Dec. 26, 1901. Among his most famous pictures are "The Pursuit of Pleasure" (1855), "Mors Janua Vitae" (1866), "Oskold and the Ellé-maids" (1874) and "In Die Malo" (1882).

PATRAS (Gr. *Patrai*), the chief seaport on the west coast of Greece, and capital of the province of Achaea and Elis, on a gulf of the same name, 70 m. W.N.W. of Corinth. Pop. *c.* 39,500. It has been rebuilt since the War of Independence, is the seat of a Greek archbishop and an appeal court, and has railway communications with Athens via Corinth and with Kalamata via Pyrgos. It is the port from which the great bulk of currant crop is despatched. The port, formed by a mole and a breakwater, begun in 1880, offers a fair harbour for vessels drawing up to 22 ft. Other exports are sultanas, valonea, tobacco, olive oil, olives in brine, figs, citrons, wine, brandy, cocoons, and lamb, goat, and kid skins. The imports consist chiefly of colonial produce, manufactured goods and sulphate of copper for the vineyards. The castle is a mediaeval structure on the site of the ancient acropolis. The cathedral of St. Andrew is highly popular as the reputed burial-place of the saint.

In Greek legend, Eumelus, taught by Triptolemus how to grow grain, established three townships, Aroe (*i.e.*, ploughland), Antheia (the flowery), and Mesatis (the middle settlement), united by common worship of Artemis Triclaria at her shrine on the river Meilichus. The Achaeans, because the ruling families (*patrai*) lived there, enlarged Aroe, called it Patrae, and recognized it as one of the twelve Achaean cities. In 419 B.C. the town was, by the advice of Alcibiades, connected with its harbour by long walls in imitation of those at Athens. After the defeat of the Achaeans at Scarpheia its whole armed force was destroyed by Metellus, but after Actium, Augustus restored the ancient name Aroe, introduced a military colony of veterans from the 10th and 12th legions and bestowed the rights of coloni on Rhypae, Dyme, and the Locri Ozolae except those of Amphissa. Thus Colonia Augusta Aroe Patrensis became one of the most populous towns of Greece; its colonial coinage extends from Augustus to Gordian III. The scene of the martyrdom of St. Andrew is apocryphal, but, like Corinth, Patras was an early and effective centre of Christianity; its archbishop attended the Council of Sardica in 347. In 551 it was laid in ruins by an earthquake. In 807 it defeated the Avars. Captured in 1205 by William of Champlitte and Villehardouin, the city became the capital and its archbishop the primate of the principality of Achaea. In 1387 De Heredia, grand master of the order of the Hospital at Rhodes, endeavoured to master Achaea and tcok Patras by storm. Later the city was governed by the archbishop in the name of the pope; but in 1428 Constantine, son of John VI., held it for a while. Captured by the Turks, it was surrendered in 1687 to the Venetians, who made it the seat of one of the seven fiscal boards for the Morea. In 1714 it again fell into Turkish hands. It was at Patras that the Greek revolution began in 1821; but the Turks held out till 1828.

PATRICIANS, the members of the old citizen families of ancient Rome (Lat. *patricius*, an adjectival form from *pater*).

I. IN ROMAN HISTORY

Origin of Patricians and Plebeians.—From the earliest period known to us the free population of Rome contains two elements, patricians and plebeians, the former class enjoying all political privileges, the latter unprivileged. The patricians (*patricii*) are members of the clans (*gentes*) which originally formed the citizen body. The plebeians (*plebs*) include all the rest of the free population. The origin of the plebs has been much debated and was in all probability complex. One part was evolved from the "clients," freed men or aliens who attached themselves for reasons of defence and support to the great clans or to their individual members. Very probably also, as a result of an early conquest of Rome, much of the plebs differed in racial origin from its patrician rulers. A third source was the accumulation of aliens drawn to Rome as a centre of traffic between Etruria and Southern Italy. It is significant that many plebeians had acquired wealth, presumably from trade. Many of these aliens would place themselves under the protection of the state or the king rather than that of individual citizens. If the alien came from a town possessing the *ius commercii* with Rome, he would have no need to become the client of a private patron. The whole unprivileged class, whatever its origin, tended to become consolidated. The differences between its various sections were great and their interests often conflicting, *e.g.*, the desires of the trading alien, the favoured client of the patrician and the descendant of the conquered Ligurian must often have been widely separated; compromise was an essential to united action by the three. The constitution attributed to Servius Tullius, which placed military burdens on the shoulders of the plebeians and admitted them to a share, though an inadequate share, in political power, helped to unify the class and prepared the way for the struggle for power which was to occupy the next century and a half, and which resulted in the full attainment by the plebs of the privileges zealously guarded by the patricians.

Reforms of Servius Tullius.—The aim of the reforms associated with the name of Servius Tullius appears to have been the imposition of the duties of citizenship upon the plebeians. This involved an extension of plebeian privilege in two directions. First it was necessary to unify the plebeian order by putting the legal status of the clients on a level with that of the unattached plebeians; and again enrolment in the army involved registration in the tribes and centuries; and as the army soon developed into a legislative assembly meeting in centuries (*comitia centuriata*), the whole citizen body, including plebeians, acquired a small share of political power, which had hitherto belonged solely to the patricians. At the close of the monarchy the plebeian possessed the private rights of citizenship, except for his inability to contract a legal marriage with a patrician, and one of the public rights, that of giving his vote in the assembly. But in liability to the duties of citizenship, military service, and taxation, he was entirely on a level with the patrician. This position was tolerable during the monarchy, when the king served to hold the power of the patrician families in check. But when these families had expelled the Tarquins, the inconsistency between partial privilege and full burdens pressed on the plebeians.

The Struggle of the Orders.—The result was the long struggle for political equality of the two orders (*see* ROME: *History*, "The Republic"). The plebeians in 494 B.C. formed themselves into an exclusive order with annually elected officers (*tribuni plebis*) and an assembly, and by means of this machinery forced themselves by degrees into all the magistracies, and obtained the coveted right of intermarriage with the patricians. Admission to the senate followed, and the political privilege of the two orders was equalized, with the exception of certain disabilities which were attached to the patricians after the victory of the *plebs*. They were excluded from the tribunate and the council of the *plebs*, which had become important instruments of government, and were eligible for one place only in the consulship and censorship, while both were open to plebeians. Since the plebeian element in the state had an immense numerical preponderance over the patrician, these disabilities were not widely spread, and seem generally to have been cheerfully borne as the price of belonging to the families still recognized as the oldest and noblest in Rome. But the adoption of P. Clodius Pulcher into a plebeian family in 59 B.C. with a view to election to the tribunate shows that a rejection of patrician rights (*transitio ad plebem*) was not difficult to effect by any patrician who preferred actual power to the dignity of ancient descent. It was not so easy to recruit the ranks of the patricians. The first authenticated instance of the admission of new members to the patriciate is that of the *lex Cassia* which authorized Caesar as dictator to create fresh patricians. The same procedure was followed by Augustus. The right of creating patricians came to be regarded as inherent in the principate, and was exercised by Claudius and Vespasian without any legal enactment. Patrician rank was regarded as a necessary attribute of the *princeps*, a fact

illustrative of the tenacity with which the Romans clung to the name and form of an institution which had long lost its significance. After the political equalization of the two orders, noble birth no longer constituted a claim to political privilege. Instead of the old hereditary nobility there arose a nobility of office, consisting of all those families, whether patrician or plebeian, which had held curule office. It was the tenure of office that conferred distinction. In the early days of Rome, office was open only to the member of a patrician *gens.* In the principate, patrician rank was held to be a dignity suitable to be conferred on an individual holder of office. But the conferment of the rank upon an individual as distinct from a whole family (*gens*) is enough to show how widely the later conception of patrician rank differed from the ancient.

II. THE LATER PATRICIATE

Under Constantine a new meaning was given to the word patrician. It was used as a personal title of honour conferred for distinguished services. It was a title merely of rank, not of office; its holder ranked next after the emperor and the consul. It naturally happened, however, that the title was generally bestowed upon officials, especially on the chief provincial governors, and even upon barbarian chieftains whose friendship was valuable enough to call forth the imperial benediction. Among the former it appears to have become a sort of *ex officio* title of the Byzantine vice-gerents of Italy, the exarchs of Ravenna; among the barbarian chiefs who were thus dignified were Odoacer, Theodoric, Sigismund of Burgundy, Clovis, and even in later days princes of Bulgaria, the Saracens, and the West Saxons. The dignity was not hereditary and belonged only to individuals; thus a patrician family was merely one whose head enjoyed the rank of *patricius.* With the word were associated such further titles as *eminentia, magnitudo, magnificentia.* Those patricians who were purely honorary were called *honorarii* or *codicillarii;* those who were still in harness were *praesentales.* They were all distinguished by a special dress or uniform and in public drove in a carriage.

In Western Europe.—A further change in the meaning of the name is marked by its conferment on Pippin the Frank by Pope Stephen. The Italian *patricius* of the 6th and 7th centuries had come to be regarded as the *defensor, protector, patronus* of the Church, but the conferring of the title by a pope was entirely unprecedented. It is clear that the patriciate of Pippin was a new office, as the title is henceforward generally *patricius Romanorum,* not *patricius* alone. It was conferred on Charlemagne at his coronation, and borne indiscriminately by subsequent emperors and by a long line of Burgundian rulers and minor princes. On the fall of the Carolingian house the title passed to Alberic II. The emperor Frederick Barbarossa was the last to wear the insignia (in 1167).

BIBLIOGRAPHY.—(1) *The Ancient Patricians:* Th. Mommsen, *Staatsrecht III. passim* (1887); A. H. J. Greenidge, *Roman Public Life* (1901); J. E. Sandys, *Companion to Latin Studies* (1921), with useful bibliography; W. E. Heitland, *The Roman Republic* (1923). (2) *The Mediaeval Patricians:* J. B. Bury's *Later Roman Empire* (1889); Bryce, *Holy Roman Empire* (1904). *See* also histories of Charlemagne (*q.v.*) and his successors.

PATRICK, ST., the patron saint of Ireland,[1] was probably born about the year 389. He was the son of a deacon, Calpurnius, and the grandson of a presbyter named Potitus. His father was a middle-class landed proprietor and a decurion, who is represented as living at a place called Bannauenta. The only place of this name we know is Daventry, but it seems more probable that Patrick's home is to be sought near the Severn, and Rhys conjectures that one of the three places called Banwen in Glamorganshire may be intended. The British name of the future apostle was Sucat, to which Mod. Welsh *hygad,* "warlike," corresponds. His Roman name has also survived in a Hibernicized form, Cothrige, with the common substitution of Irish *c* for Brythonic *p.* (*Cf.* Irish *casc,* Lat. *pascha.*) Patrick was doubtless educated as a Christian and was imbued with reverence for the Roman Empire. When about sixteen years of age he was carried off by a band of Irish marauders. The latter were possibly taking part in the raid of the Irish king Niall Noigiallach, who met with his end in Britain in 405. Irish tradition represents the future apostle as tending the herds of a chieftain of the name of Miliucc (Milchu), near the mountain called Slemish in county Antrim, but Bury tries to show that the scene of his captivity was Connaught, perhaps in the neighbourhood of Croagh Patrick.

His bondage lasted for six years. During this time he became subject to religious emotion and beheld visions which encouraged him to effect his escape. He fled, in all probability to the coast of Wicklow, and encountered a vessel which was engaged in the export of Irish wolf-dogs. After three days at sea the traders landed, possibly on the west coast of Gaul, and journeyed for twenty-eight days through a desert. At the end of two months Patrick parted from his companions and betook himself to the monastery of Lérins, where he probably spent a few years. On leaving the Mediterranean he seems to have returned home. It was doubtless during this stay in Britain that the idea of missionary enterprise in Ireland came to him. In a dream he saw a man named Victorious bearing innumerable epistles, one of which he received and read; the beginning of it contained the words "The Voice of the Irish"; whilst repeating these words he says, "I imagined that I heard in my mind the voice of those who were near the wood of Foclut (Fochlad), which is near the western sea, and thus they cried: 'We pray thee, holy youth, to come and walk again amongst us as before.' " The forest of Fochlad was in the neighbourhood of Killala Bay, but it is possible that it extended considerably to the south. Despite his natural diffidence, and opposition on the part of his relatives, Patrick resolved to return to Gaul in order to prepare himself for his mission. He proceeded to Auxerre—a place which seems to have had a close connection with Britain and Ireland—and was ordained deacon by Bishop Amator, along with two others who were afterwards associated with him in spreading the faith in Ireland. The one was an Irishman called Fith, better known as Iserninus, the other Auxilius. Patrick must have spent at least fourteen years at Auxerre.

Mission to Ireland.—It seems not unlikely that Pelagianism had taken root among the Christian communities of Ireland, and it was found necessary to send a bishop to combat the heresy. Pope Celestine's choice fell on the deacon Palladius, who had taken a prominent part in stamping out the doctrine in Britain. Patrick probably felt great disappointment when Palladius was sent as the chosen envoy of Rome, but now Germanus seems to have decided that Patrick was the man for the task, and he was consecrated in 432. Patrick landed at Inverdea, at the mouth of the river Vartry in Wicklow, but we are not informed as to any of his doings in Leinster at this period. According to the story, he immediately proceeded northward to the kingdom of Ulidia (east Ulster), though a certain tradition represents him as going to Meath. Landing on the shores of Strangford Lough, he commenced his labours in the plain on the south-west side of that inlet. A convert chief named Dichu granted him a site for an establishment, and a wooden barn is stated to have been utilized for the purpose of worship, whence the modern Saul (Ir. *saball,* "barn"). Patrick's activity was bound to bring him sooner or later into conflict with the High-king Loigaire (reigned 428–467), son of Niall Noigiallach. Fedilmid, a brother of the monarch, is represented as having made over his estate at Trim to the saint to found a church, and thus the faith was established within Loigaire's territory.

The story makes Patrick challenge the royal authority by lighting the Paschal fire on the hill of Slane on the night of Easter Eve. It chanced to be the occasion of a pagan festival at Tara, during which no fire might be kindled until the royal fire had been lit. A number of trials of skill between the Christian missionary and Loigaire's Druids ensued, and the final result seems to have been that the monarch, though unwilling to embrace the foreign creed,

[1]His career is involved in considerable obscurity. Widely varying views have been held by modern scholars with regard to his activity, some going so far as to treat all the accounts of his labours as the fictitious creation of a later age. In the present article Bury's reconstruction of the saint's life has been chiefly followed. Apart from its importance in other respects, Bury's treatment of the subject has at any rate the merit of defending the traditional view of St. Patrick's career.

undertook to protect the Christian bishop. At a later date the saint was probably invited by Loigaire to take part in the codification of the *Senchus Mór* in order to represent the interests of the Christian communities. On another occasion Patrick is reported to have overthrown a famous idol known as *Cenn Cruaich* or *Cromm Cruaich* in the plain of Mag Slecht (county Cavan).

Patrick is stated to have visited Connaught on three different occasions and to have founded churches, one of the most important being that at Elphin. As regards Ulster our information is very scanty, though we find him establishing churches in the three kingdoms of the province (Ailech, Oriel and Ulidia). Patrick's work is more closely identified with the north of Ireland than with the south Traces of his mission, however, are to be found in Ossory and Muskerry. But his task in the south was doubtless rather that of an organizer, and a kind of circular letter has come down to us which was addressed by Patrick, Auxilius and Iserninus, to all the clergy of the island There is some evidence that he made a journey to Rome (441–443) and brought back with him valuable relics. On his return he founded the church and monastery of Armagh, the site of which was granted him by Daire, king of Oriel, and it is probable that the see was intended by him to be specially connected with the supreme ecclesiastical authority. Some years before his death, which took place in 461, Patrick resigned his position as bishop of Armagh to his disciple Benignus, and possibly retired to Saul in Dalaradia, where he spent the remainder of his life. The place of his burial was a matter of dispute in early Ireland, but it seems most likely that he was interred at Saul

Writings.—Two highly important documents purporting to have been written by Patrick have come down to us The one is the Confession, which is contained in an imperfect state in the Book of Armagh (*c* 807), but complete copies are found in later mss. The Confession, written towards the end of his life, gives a general account of his career Various charges had been brought against him by his enemies, among them that of illiteracy, the truth of which is borne out by the crudeness of his style, and is admitted by Patrick himself The other document is the so-called Letter to Coroticus, a British king of Strathclyde, whose soldiers had in the course of a raid in Ireland killed a number of Christian neophytes on the very day of their baptism while still clad in white garments. Others had been carried off into slavery, and a deputation of clergy which Patrick had sent to ask for their release had been subjected to ridicule. In his Letter the saint in very strong language urges the Christian subjects of the British king not to have any dealings with their ruler and his bloodthirsty followers until full satisfaction should have been made. The text of this letter occurs in a number of mss but is not contained in the Book of Armagh It is however certain that it was known in the 7th century A strange barbaric chant commonly known as the Lorica or Hymn of St Patrick is preserved in the *Liber hymnorum*. This piece, called in Irish the *Faed Fiada* or "Cry of the Deer," contains a number of remarkable grammatical forms, and late editors believe that it may very well be genuine.

From such slender material it is not easy to form a clear conception of the saint's personality His was evidently an intensely spiritual nature, and in addition to the qualities which go to form a strong man of action he must have possessed an enthusiasm which enabled him to surmount all difficulties His importance in the history of Ireland and the Irish Church consists in the fact that he brought Ireland into touch with western Europe and more particularly with Rome, and that he introduced Latin into Ireland as the language of the Church His work consisted largely in organizing the Christian societies which he found in existence on his arrival, and in planting the faith in regions which had not yet come under the sway of the gospel

AUTHORITIES —Apart from the Letter and Epistle mentioned above our chief sources of information with regard to the life of St. Patrick are contained in the Book of Armagh. The one is the memoir by Tírechán, a bishop who had been the disciple of Bishop Ultan of Ardbraccan in Meath (d 657) The first part of this memoir, which was probably compiled about 670, deals with the saint's work in Meath, the second with his activity in Connaught. Various additions are appended to this compilation, and there are still further additional notes. The other biography was written towards the end of the 7th century by Muirchu Maccu Machtheni, who dedicated his work to Bishop Aed of Slébte (d. 700). (*See* edition by N. J. D. White, 1920). The first portion deals with Patrick's career down to his arrival in Ireland and contains an unvarnished statement of fact. But when the story passes to Ireland Muirchu's narrative becomes full of the mythical element. Muirchu influenced later biographies. Bury has shown that both Tírechán and Muirchu drew from written material which existed in part at any rate in Irish. Among later lives we may mention the hymn *Genair Patraicc*, commonly attributed to Fíacc, which is considered by the latest editors to have been originally composed about 800. Three anonymous Latin lives were published by Colgan in his *Trias Thaumaturga* (Louvain, 1645), and there exists an 11th-century Irish life in three parts published by Whitley Stokes for the Rolls series (1887) A Latin translation of a different copy of this work, now lost, was published by Colgan. Lastly a life by an otherwise unknown Irish writer named Probus occurs in the Basel edition of Bede's works (1563) and was reprinted by Colgan.

See J. B Bury, *The Life of St. Patrick and his Place in History* (London, 1905), J. H. Todd, *St. Patrick the Apostle of Ireland* (Dublin, 1861); H Zimmer, article "Keltische Kirche" in *Realencyklopadie fur protestantische Theologie und Kirche* (1901; trans by Miss Meyer, "The Celtic Church in Britain and Ireland," London, 1902); J Gwynn, *Liber Ardmachanus;* Whitley Stokes, *The Tripartite Life of St Patrick* (London, 1887), N J. D White, "The Writings of St Patrick" (critical edition) in *Proceedings of the Royal Irish Academy* (1904); *Liber Ardmachanus* (docs. relating to St Patrick) edited by J Gwynn (1913), F R. M Hitchcock, *St. Patrick and his Gallic friends* (1916); Muirchu, *The Writings and Life of St Patrick*, ed. N. J. D White (1920). (E. C. Q.; X)

PATRIOTIC SOCIETIES, organizations formed in many countries, for the purpose of commemorating historical events of the past, preserving the records and sites of such events, and, in general, fostering a spirit of patriotism and love of country Such societies are especially numerous and influential in the United States The oldest, the Society of the Cincinnati (*q v*), dates back to the Revolutionary War, but others of importance were not founded until the last quarter of the 19th century The chief societies in the United States, with the dates of their organization, are the Society of Mayflower Descendants (1897), Colonial Dames of America (1890), Society of Colonial Wars (1893), Sons of the Revolution (1876), Daughters of the Revolution (1891), Sons of the American Revolution (1889), Daughters of the American Revolution (1890) and the Sons of Veterans (1879). The Daughters of the Confederacy (1894) and the Sons of Confederate Veterans (1896) commemorate the spirit and sacrifices of the Confederate cause in the Civil War Eligibility for membership in all the above is based upon the historical services of an ancestor. The Grand Army of the Republic, formed by the Union soldiers after the American Civil War, long possessed a political as well as social importance A similar organization of the World War veterans of the United States is the American Legion (*q v*) There are also many local societies formed usually for the preservation of historical sites and one national body of importance known as the American Scenic and Historic Preservation Society

See S A. Phillips, *The Patriotic Societies of the United States* (1914).

PATRIZZI, FRANCESCO (FRANCISCUS PATRITIUS) (1529–1597), Italian philosopher and scientist, was born at Clissa, Dalmatia, and died in Rome He gained the patronage of the bishop of Cyprus, who brought him to Venice He was appointed to the chair of philosophy at Ferrara, and was, later, invited to Rome by Clement VIII In spite of his almost incessant controversies with the Aristotelians, he published in 15 books a treatise on the *New Geometry* (1587), and works on history, rhetoric and the art of war.

PATROCLES (*c.* 312–261 B C.), a Macedonian general and writer on geographical subjects, who lived during the reigns of Seleucus I and Antiochus I When in command of the fleet of Seleucus (285) he undertook a voyage of exploration on the Caspian Sea to discover possible trade routes, and decided that the Caspian was a gulf or inlet connecting with the Indian Ocean

See Strabo ii 68, 74, xi 508, xv 689; Diod Sic xix 100; Plutarch, *Demetrius*, 47, Pliny, *Nat Hist* vi 21; Photius, *cod.* 224 (on Memnon), W W Tarn, "Patrocles and the Oxo-Caspian Trade Route" in *Journal of Hellenic Studies*, vol xxi. (1901).

PATRON, a word of which the various meanings in European

languages are derived from that of the Lat. *patronus*. (*See* below PATRON AND CLIENT.) The earliest use of the word in English appears to have been in the special sense of the holder of an advowson, the right of presentation to a benefice. From this meaning is deduced that of the person in whom lies the right of presenting to public offices, privileges, etc. From the earliest Christian times the saints took the place of the pagan tutelary deities (*Di tutelares*) and were in this capacity called *tutelares* or *patroni*, patron-saints.

A full list of saints, with the objects of the peculiar patronage of each is given in M. E. C. Walcott's *Sacred Archaeology* (1868).

PATRON AND CLIENT. This relationship, which existed at Rome as elsewhere in Latium from time immemorial, had ceased long before the end of the republic to be of any great practical importance, and its origin is thus obscure. In any case in early Rome the hereditary bond between patron and client seems to have been not altogether unlike that which existed between a feudal lord and his man. The client was bound to follow his patron to war and to contribute to such expenses as his ransom if he were captured and the dowries of his daughters. He was also perhaps bound to work on his patron's land, and it is probable that the institution of *precarium* (tenancy at will) originated in grants of land to clients, which, though legally revocable at any time, were in fact hereditary. The ethical element was always strong; thus the patron was bound to protect his client and, in particular, to represent him or give him aid if he were involved in litigation, though whether this means that the client was originally incapable of appearing in a court of law himself is not clear. Litigation between the two was forbidden, and they might not give evidence against each other.

With the obsolescence of legal clientship in the later republic the word came to be used of those dependants whom a rich or influential man gathered round him and who attended him, for instance, at his morning levee. This relationship, often one of arrogance on the one side and servility on the other, is graphically described by Martial.

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PÄTS, KONSTANTIN (1874–), Estonian statesman, was born in the Pärner district. He studied law at Dorpat and he became in 1901 editor of the *Teatajä* (Newsheet), the first daily paper in the Estonian language. This journal maintained radical principles and gave much prominence to economic questions. Päts secured municipal administration for Estonia from the Russians, being himself appointed assistant to the mayor of Reval. During the revolution of 1905, when the Russian authorities gave way to panic, Päts was the real ruler of the town and succeeded in protecting Reval from plunder and excess. When the Russian punitive expeditions arrived he was sentenced to death by the military court, but the sentence was later commuted by the courts to imprisonment for one year. After the revolution of 1917 Päts became head of the national administration, and on the declaration of independence of Estonia on Feb. 24, 1918, he formed the first temporary Government. For his resistance to the plans for the formation of a Baltic duchy he was imprisoned by the German Occupation authorities, but on the collapse of German rule he returned to the head of the temporary Government. He fostered the steady growth of the Agrarian party. Päts became president of the Riijikogu and prime minister in 1920–22 and again in 1923.

PATTERSON, JOSEPH MEDILL (1879–), American publisher and editor, was born in Chicago (Ill.), Jan. 6, 1879. He graduated from Yale university in 1001 and joined the staff of the Chicago *Tribune*. In the year 1914 he became associated with his cousin, Robert Rutherford McCormick (*q.v.*), as co-editor and publisher of the Chicago *Tribune*, which, under their direction, rose to be one of the most influential and successful papers in the United States. He acted as war correspondent in China, 1900, and in Belgium and France, 1914–15.

His works include *A Little Brother of the Rich* (1908); *Rebellion* (1911) and *Note Book of a Neutral* (1915).

PATTI, ADELINA JUANA MARIA (BARONESS CEDERSTRÖM) (1843–1919), a famous singer, was born at Madrid on Feb. 19, 1843. Her parents, both of whom were operatic vocalists, settled in America, where their daughter was taught singing by Maurice Strakosch, who married Amelia Patti, an elder sister. Gifted with a brilliant soprano voice, Adelina Patti began her public career at the age of seven in the concert halls of New York, where, in 1859, she also made her first appearance as Lucia in *Lucia di Lammermoor*. On May 14, 1861, she sang as Amina in *La Sonnambula* at Covent Garden, and from this time her appearances in London, Paris and all the other principal musical centres of the world, constituted one long unbroken succession of triumphs. In 1868 she married Henri, marquis de Caux, a member of Napoleon III.'s household, from whom she was divorced in 1885; she then married Nicolini, the tenor, who died in 1898, and in 1899 Baron Cederström, a Swede, who was naturalized as an Englishman. Madame Patti ceased to appear on the operatic stage in public after the '80s, but at Craig-y-Nos, her castle in Wales, she built a theatre in which she loved to give private performances. Her actual last public appearance was made on behalf of the Red Cross on Oct. 20, 1914, when she was in her 72nd year. Madame Patti died on Sept. 27, 1919.

PATTISON, MARK (1813–1884), English author and rector of Lincoln College, Oxford, was born on Oct. 10, 1813. He was educated privately, and at Oriel college, Oxford; in 1839 he obtained a fellowship at Lincoln College. Pattison was at this time a Puseyite, and greatly under the influence of J. H. Newman, for whom he worked, helping in the translation of Thomas Aquinas's *Catena Aurea*, and writing in the *British Critic* and *Christian Remembrancer*. He was ordained priest in 1843, and was tutor of Lincoln College from 1843 to 1855. Pattison then travelled in Germany to investigate Continental systems of education, and began the researches into the lives of Casaubon and Scaliger, which occupied the remainder of his life. In 1861 he was elected rector of Lincoln, but he never liked the routine of university business. He died at Harrogate on July 30, 1884. His biography of *Isaac Casaubon* appeared in 1875. His *Sermons and Collected Essays*, edited by Henry Nettleship, were published posthumously (1889), as well as the *Memoirs* (1885), an autobiography deeply tinged with melancholy.

PAU, a city of south-western France, chief town of the department of Basses-Pyrénées, 66m. E.S.E. of Bayonne on the southern railway to Toulouse. Pop. (1926), 33,820. It stands on the edge of a plateau 130ft. above the right bank of the Gave de Pau (a left-hand affluent of the Adour), about 620ft. above the sea. A small stream, the Hédas, flowing in a deep ravine and crossed by several bridges, divides the city into two parts. Pau is famous as a winter health-resort.

Pau derives its name from the word *pal*, in allusion to the stakes which were set up on the site chosen for the town. It was founded probably in the early 11th century by the viscounts of Béarn, and was the residence, from 1512 onwards, of the kings of Navarre. The 14th century castle is connected with the town by a bridge, built under Louis XV. On the left of the entrance is the donjon built by Gaston Phoebus. On the north-east is the 14th century Tour de Montauzet. There is a fine collection of Gobelin and Flemish tapestries in the castle. A portion of the buildings of a Jesuit college founded in 1622 remains. Pau is the seat of a court of appeal and a court of assizes and has a tribunal of first instance, a tribunal of commerce and a chamber of arts and manufactures. In 1928 a new railway between France and Spain placed Pau in contact with Jaca in the Spanish province of Huesca.

PAUL, "the Apostle of the Gentiles," the first great Christian missionary and theologian. He holds a place in Christianity second only to that of the Founder Himself. Born and bred a strict Jew, he came to distinguish clearly between Judaism and the Gospel of Christ, and to present Christianity as the universal religion for man as man, not merely a sect of Judaism

with proselytes of its own. This, and nothing less, was the issue involved in the problem of Christianity and the Jewish Law; and it was Paul who settled it once and for all.

The primitive apostles in the main continued their Master's own practical attitude to the Law, as though the Cross here made no difference, and without seeing far into principles. But with Paul it was otherwise. For him the issue was defined by the Cross. It was "Pharisaism *or* Jesus"; and that, as he saw it, meant virtually Law *or* Love as the ultimate revelation of God. As Saul the Pharisee, he had taken the Mosaic Law in the strict sense, one demanding perfect inner and outer obedience; and he had relied on it utterly for the righteousness it was held able to confer. Hence when it gave way beneath him as means of salvation—nay, plunged him ever deeper in the Slough of Despond by bringing home his inability to be righteous by doing righteousness—he was driven to a *revolutionary* attitude to the Law *as method of justification.* "Through (the) Law" he "died unto (the) Law," that he "might live unto God" (Gal. ii. 19). By this experience not only Pharisaic Judaism, but the legal principle in religion altogether, was turned upside down within his own soul; and of this fact his teaching and career as an apostle were the outcome.

But Paul had in him other elements besides the Jewish, though these lay latent till after his conversion. As a native of Tarsus, he had points of contact with Greek culture and sentiment. As a Roman citizen likewise, conscious of membership in a world-wide systèm of law and order, he could realize the idea of a universal religious franchise, with a law and order of its own. Both these factors in his training contributed to the moulding of Paul the missionary statesman. In his mind the conception of the Church as something as catholic as the Roman empire first took shape; and through his wonderful labours the foundations of its actual realization were firmly laid.

PAUL'S LIFE

Early Life.—"Saul, who is also Paul," was "a Hebrew, of Hebrews" born, *i.e.*, of strict Jewish origin (Phil. iii. 5). Yet, as his double name suggests, he was reared amid the Dispersion, at Tarsus in Cilicia, the son of a Roman citizen (Acts xxii. 28). *Paulus* was not an uncommon name in Syria and eastern Asia Minor and was a natural one for a Roman citizen. Ramsay develops this point suggestively (*Pauline and Other Studies,* p. 65). "If we could think of him sometimes as Gaius Julius Paulus—to give him a possible and even not improbable name—how completely would our view of him be transformed. Much of what has been written about him (as a narrow, one-sided Jew) would never have been written if Luke had mentioned his full name." Nor would it have been written, if the influences due to his Tarsian citizenship (xxi. 39) had been kept in mind. Tarsus was peculiarly successful "in producing an amalgamated society in which the Oriental and Occidental spirit in unison attained in some degree to a higher plane of thought and action" (id., *The Cities of St. Paul,* 89). Accordingly Paul's letters bear traces of Hellenic culture up to the level of a man of liberal education. Whether he went beyond this to a first-hand study of philosophy, particularly of the Stoic type for which Tarsus as a university was famous, is open to question. The main difficulty in deciding on this, as on other points of contact between Paul and Hellenism, is the fact that he certainly got many of his Greek ideas through the medium of Judaeo-Greek or Hellenistic literature.

By a careful study of his letters, we can form some idea of the element in Paul's early life due to Jewish birth (Phil. iii. 4–7). Upon the "advantage" of the Jew, as "entrusted with the oracles of God" (Rom. iii. 1 *seq.*), he dwells in Rom. ii. 17 (*seq.*) in a way suggesting his own youthful attitude to "the name of a Jew." Something depends on the age at which the young Saul passed from Tarsus to Jerusalem and the school of Gamaliel; the transition would not much affect the legal element in his religious life and outlook. Nor was personal acceptance with God the sole prize that floated before his soul. The end of ends was a righteous nation, deserving the fulfilment of the divine promises. But this too could come only by obedience to the Law. Thus all that the young Pharisee cared for most hung upon the Law of his fathers.

Outwardly he attained the goal of legal blamelessness as few attained it; and for a time he may have felt a measure of self-satisfaction. But if so, a day came when the inner meaning of the Law, as extending to the sphere of desire and motive, came home to him in stern power, and his peace fled (Rom. vii. 9). For sin in his inner, real life was unsubdued; nay, it seemed to grow ever stronger, standing out more clearly and defiantly as insight into the moral life grew. To the Law he had been taught to look for righteousness. In his experience it proved but the means to "knowledge of sin," without a corresponding impulse towards obedience. Not only did it make him realize the latent possibilities of evil desire ("the evil heart," *Yetzer hara*): it also made him aware of a subtler evil, the reaction of self-will against the demands of the Law. While one impulse was in harmony with the will of God, the other was in sympathy with "the law of sin." Could the Law achieve the separation, making the whole person "die" to "the flesh" and so escape its sway? No, answered Saul's experience: the Law rather adds power to sin as egoism (1 Cor. xv. 56; Rom. vii. 11, 13). Whence then is deliverance to come? It can only come with the Messianic age and through Messiah. Then the Law would reign inwardly as outwardly, being "written on the heart," as promised in prophecy.

So may we conceive Saul's position, though not with full consciousness, before contact with Christianity. How then would the message, "Jesus is the Messiah," strike such a man? It would seem a blasphemous caricature of things most sacred. If the simple message of the first witnesses, that One whose life and preaching were largely out of harmony with the Law, as Saul understood it, had in fact been raised from the dead by Israel's God and so vindicated—to the condemnation of that generation of God's people—if this seemed to Saul mere madness, what was he to say to Stephen's views as to the Law and the people of Law, both past and present (*see* STEPHEN)? Stephen could not be right. Perish the thought! Perish, too, all those who upheld the crucified Nazarene, the accursed of the Law! For His death could mean but one of two things. Either He was, as "hung on a tree," accursed of God, or—awful alternative, yet inevitable to Saul's logical mind—the Law *relative to which He was accursed* was itself set aside. Saul turned from the suggestion as too shocking to his pride, alike in his people and in its divine Law, for him seriously to consider its alleged credentials—the Resurrection, and the supernatural power and goodness of Him whose claims it was held to confirm. Why stay to weigh the evidence of Galilean common folk (*Am-ha-aretz*), when over against it stood immemorial prescription, and the deliberate judgment of the custodians of the Law as to this man as "a deceiver"? The logic of the movement had declared itself through the mouth of Stephen; and now weak toleration must be abandoned.

Saul the Persecutor.—So Saul was driven to persecute. Yet the goading of unsatisfied intuition did not cease. We may even suspect that Stephen's philosophy of Israel's history had made an impression on his confidence in his nation's religious authorities If mistaken before, why not again? This granted possible, all turned on the evidence as to the Resurrection of the crucified Prophet of Nazareth. The joyous mien of His followers, even when confronted with death, seemed to betoken a good conscience before God. Yet Saul felt the status of the Law to be too grave an issue to depend on the probabilities of human testimony. So he plunged on, in devotion to what still seemed the cause of God against impugners of His *Torah,* but not without his own doubts. He was, in fact, finding it "hard to kick against the goad" (Acts xxvi. 14) plied in his deeper consciousness, as he followed his inherited beliefs. Still he was in the main honest (1 Tim. i. 13), and his hindrances were exceptional. Direct personal experience on the point on which all hinged, the alleged divine vindication of Jesus as Messiah-elect, following on the legal condemnation by the national authorities, was needful to open up a clear exit from his religious *impasse.*

The Vision at Damascus.—It was at this critical point that, as he neared Damascus on a mission of persecution, there was granted him—as he believed ever after in the face of all

challenge—a vision of Jesus, in risen and glorified humanity, as objective as those to the original witnesses with which in 1 Cor. xv. he classes it.

As to the sense in which this vision, so momentous in its issues, may be regarded as "objective," the following points deserve notice. On the one hand it is generally agreed (1) that Paul distinguished this appearance of the risen Jesus from his other "visions and revelations of the Lord," such as he refers to in 2 Cor. xii. 1 *sqq.*, and classed it with those to the Twelve and others which first created the belief that Jesus had been "raised from the dead"; (2) that this belief included for Paul a transformed or spiritualized body, his vision of which seems to colour his conception of the resurrection body generally (Phil. iii. 21), though he had certain traditional notions to start with; *cf.* 2 Cor. v. 1 *sqq.* On the other hand, analogies furnished by religious psychology (*e.g.*, the case of the Sadhu Sundar Singh), including a sudden vision amid light and the hearing of a voice as accompaniments of a religious crisis, affect our ability to take Saul's consciousness in the matter as a simple transcript of objective facts. But beyond this physical concomitant of his vision we cannot go historically. After all, the main point for Paul's development—as well as the basis of all theories of the vision—is the degree of discontinuity between his thought before and after the event. On this Paul is clear and emphatic, though the bearing of the modern discovery of the "unconscious" mental processes upon the fact must be left open.

Whatever was the nature of the vision, its spiritual content determined the course of his life. Jesus was, in spite of all, God's Messiah, His Righteous One, the type of true righteousness in man, through spiritual union with Whom like righteousness was to be attained, if at all. In a flash Saul's personal problem as to acceptance with God and victory over sin was changed. It became simply a question how spiritual union with this Messiah was to come about. He had vanquished and "condemned sin in the flesh" by His perfect obedience (Rom. viii. 3, v. 19), of which the Cross was now seen to be the crowning act. As for the Law as means of justification, it was superseded by the very fact that Messiah had realized His righteousness on another principle altogether than that of "works of the Law," and had in fact been crucified by its action. Thus He had died to it as a *dispensational principle*. This meant that those united to Him by faith were themselves sharers in His death to the Law as master and judge, and so were quit of its claims in that new moral world into which they were raised as sharers also in His Resurrection (Rom. vi. i.–vii. 6). Henceforth they "lived unto God" in and through Messiah, by the self-same Spirit by which He had lived the sinless life (viii. 9). Here we have at once Paul's mysticism and his distinctive gospel in germ.

The New Theory of the Law.—The old régime had dissolved. His first act was to make explicit, through confession and baptism, his submission and adhesion to Jesus as Messiah, implicit in his cry from the ground, "What shall I do, Lord?" Thereby he formally "washed away his sins" (Acts xxii. 16). Then he began boldly to proclaim in the synagogues of Damascus that Jesus, whose followers he had come to root out, was verily the Messianic Son of God (ix. 20; *cf.* Matt. xvi. 16). Yet ere long he felt the need for quiet in which to think out his new position. He withdrew to some spot in the region south of Damascus, then vaguely called Arabia (Gal. i. 17). Chief among the problems pressing for reinterpretation in the light of his recent experience was the place of the Law in God's counsels. While the Law could warn and even restrain the sinner from overt sins, it could not redeem or save him from the love of sin. In a word, it could not "give life" (Gal. iii. 21). Hence its direct remedial action was quite secondary. Its primary effect, and therefore divine purpose, was to drive men humbly to seek something more, God's grace. It "shut up all unto (realized) disobedience, that God might have mercy upon all" (Rom. xi. 32; Gal. iii. 22). Thus the place of the Law in God's counsels was episodic. The radical egoism of the natural man could be transcended, and self-glorying excluded, not by the Law, with its "law (principle) of works," but by the "law of faith" (Rom. iii. 27). In fine, the function of the Law was secondary, preparatory, temporary. Its reign closed when its work in shutting up men to faith in and through Christ—the perfect form of faith—was accomplished. Its day was over when Jesus accepted crucifixion at its hands, and so passed on to inaugurate a new "Covenant" marked by a final relation between man and God, the filial, the Spirit of which was already in the hearts of Christian believers (Gal. iii. 23–iv. 7). Thus the Cross of Jesus satisfied the claims of Law *as a dispensation* or divinely sanctioned method, which had to be honoured even in the act of being transcended, "that God might be just (*i.e.*, dispensationally consistent), while justifying the believer in Jesus" on a fresh basis (Rom. iii. 26). Such a view did but "establish the Law" (v. 31) within its own sphere, while pointing beyond it to one in which its aim, real obedience, found fulfilment.

Here lay the revolutionary element in Paul's thought in relation to Judaism. Historically, it saved Christianity from being a mere Jewish sect. But as it was conditioned by recoil from an overdriven use of the Law in the circles in which Saul was trained, so it was at times one-sided in its emphasis on the pathological workings of the Law upon human nature, in virtue of sinful egoism. Still Saul secured mankind for ever against bondage to religious legalism. In him, as F. W. Myers put it,

> Desperate tides of the whole world's anguish
> Poured through the channels of a single heart.

He first detected the specific virus generated by Law in the "natural man," and discovered the antidote in Christ. Nor had he the Jewish *Torah* exclusively in view. He deals with it rather as the classic type of law in religion. "Nitimur in vetitum cupimusque negata." This is too often overlooked by Jewish critics. Paul felt reverence for the *Torah* in what he took to be its proper place, as secondary to faith and subordinate to Christ. In short, Paul set forth the principle of *inspiration to God-likeness* by a personal ideal, in place of obedience to an impersonal Law, as condition of salvation.

Christology.—Saul's conversion left Jesus the Christ as central to his new world as the Law had been to his old. An inspiring personality superseded a static code of precepts. All was summed up in Christ, and Him crucified. This was to him the essence of Christianity as distinct from Judaism. As, to the Jew, life was lived under the law or in it as native element, so to the Christian life was "in Christ" as element and law of being. Christ simply replaced the Law as form and medium of relations between God and man. In this Paul went far beyond the older apostles, whose simpler attitude to the Law had never suggested the problem of its dispensational relation to Messiah, though in fact they relied on Messiah alone for acceptance with God. The logic of this, as Paul later urged it on Peter at Antioch (Gal. ii. 15 *sqq.*), they did not yet perceive. But the contrast goes farther. The very form in which Jesus was known to Saul by personal experience, namely, as a spiritual being—in a body already glorified in virtue of a regnant "spirit of holiness" (Rom. i. 4)—determined all his thought about Him. To this even Jesus's earthly life, real as it was, was subordinate. The extent of Paul's knowledge of the historical Jesus has been much debated. Besides his express appeals to Davidic birth, the institution of the Supper, the Death and Resurrection, and to precepts of "the Lord" (1 Cor. vii. 10, ix. 14; *cf.* Rom. xii. 14), he shows a marked insight into the character of Jesus as it is described in the Gospels (*see* 2 Cor. x. 1; *cf.* Phil. ii. 5–8). Still his attitude to Jesus was fixed by his own experience. The varied theoretic expressions in his writings of Christ's relations to God, to mankind, and even to the universe, were to him but corollaries of this.

The most persistent element in his conception of Christ's person started from his own experience, though it included the speculative postulate of pre-existence in terms of some current Messianic form of thought. That is, Paul's new Christology expressed his peculiar sense of the all-inclusive significance of Christ in his own experience. So, too, most of his distinctive thoughts on religion, sometimes called "Paulinism" (*see* p. 393), were both experimental in origin and capable of statement in terms of his Christ. To him the Death and Resurrection of Christ were not

isolated facts, nor yet abstractions, but had being within his own experience: so that here, and not in any second-hand facts touching Christ's earthly career, lay the real spiritually verified basis of the whole Christian life.

His Early Apostolate.—It is unlikely that Saul began straightway to preach all the ideas prominent in his epistles, which belong only to about 10 years at the end of a ministry of some 30. Even his special mission to the Gentiles dawned on him only gradually. No doubt, as he looked back, he felt that the final purpose of God in "revealing His Son in him" had been that he "might preach Him among the Gentiles." But this does not prove that he saw it all at once as involved in "the heavenly vision." He was intensely Jewish in feeling; "to the Jew first" was his maxim all along. Only bitter experience convinced him (Rom. ix. 1 *sqq.*, x. 1 *sqq.*) that the Jews as a people would continue to spurn their birthright in God's Messiah—until the Gentiles had come in.

Saul began his preaching in the synagogues of Damascus, especially, we may suppose, after his return from Arabia (Acts. ix. 22; Gal. i. 17). Then came his first visit to Jerusalem since conversion, in the third year from that event, for the purpose of making the personal acquaintance of Peter (Gal. i. 18), presumably to hear first-hand about Jesus's earthly ministry and teaching, as well as to make the leading apostle directly acquainted with his conversion and its fruits. Barnabas helped to dispel the suspicion with which the arch-persecutor was at first regarded. Such preaching as Saul did in Jerusalem was to the Hellenists, *e.g.*, his Cilician compatriots (ix. 29; *cf.* vi. 9). But he had to leave suddenly, apparently after a vision in the Temple which brought him fresh light as to the scope of his future ministry. During the 10 or 11 years at least "in the regions of Syria and Cilicia" which ensued, it was still primarily to the Jews that he preached; for the news of him which reached "the churches of Judaea," from time to time, was such that they "kept glorifying God" in him (Gal. i. 21–23)—as they would not have done had he addressed himself largely to Gentiles. His preaching, that is, was mostly to the Synagogue and its adherents of non-Jewish origin, whether circumcised or not. Of Saul's history, however, during these obscure years we gain only rare glimpses (*cf.* 2 Cor. xi. 24), the first and most important being in connection with the foundation at Antioch of a mixed Church of Jews and Gentiles. Whatever may have been the first beginnings of this new departure, the situation soon caused Barnabas, who had been sent from Jerusalem to supervise the work begun by Hellenist preachers, to seek Saul's co-operation; and "for a whole year" the two worked in Antioch and instructed the numerous converts—including not a few uncircumcised Gentiles. It is not clear for how long Antioch remained Saul's headquarters. But we may imagine him evangelizing also in the region between Antioch and Tarsus (Gal. i. 21; *cf.* Acts xv. 23, 41). About this time he seems to have attained quite a fresh sense of the degree to which Gentiles were destined to form part of that "Israel of God" which was being gathered through faith in Jesus as the Christ. Writing later, about A.D. 56, he speaks of having had an overpowering revelation some 13 years previously (*i.e.*, about 42–43), the very period now in question. He says nothing as to its theme; but it can hardly have been unconnected with his central preoccupation, the scope of the Church, as set forth later in Eph. ii. 11, iii. 13.

Second Visit to Jerusalem.—Fresh revelation would lead to more definite efforts to win Gentiles as such, and this again to his second visit to Jerusalem, some 11 (or 13, Gal. ii. 1) years after the former one. He would now feel the need of a clear understanding with Jerusalem touching his gospel, "lest perchance he should run in vain or have already so run" (ii. 2). Saul was not the man to wait for a foreseen evil to develop. "So, in accordance with a revelation," as he says, he with Barnabas sought private conference with the leaders in Jerusalem, to lay before them his gospel (ii. 2). The date would be *c.* 43–45. His aim was to confer solely with leaders (contrast Acts xv. 4, 12), like James and Cephas and John, the "pillars" of the Jerusalem community. But certain persons, who showed such a spirit as to make him describe them as "pseudo-brethren," managed to be present and demanded the circumcision of Titus, a Greek whom Saul had taken with him. In this demand he saw a blow at the heart of his gospel for Gentiles, and would not give way. The "pillars" themselves, too, recognized Saul and Barnabas as entrusted with a specific Gentile mission, parallel with their own to Jews. Only, as pledge that the two should not diverge but remain sister branches of Messiah's Ecclesia, until He should return and remove all anomalies, they asked that the Gentile missionaries should "remember the poor"—whether generally or those of the Mother Church. Here was a proviso which Saul was as eager as they could be to get carried out; and this he was able to prove ere long in the special form of relief to the poor in Judaea, which he and Barnabas fitly administered in person (Acts xi. 30, xii. 25). This relief visit took place about 45–46.

First Journey.—Having now reached an understanding with the "pillars" in Jerusalem, Saul felt anxious to break fresh ground, and probably broached the subject to the leaders at Antioch. As they waited on God for guidance, the Spirit directed that Barnabas and Saul be set apart for such an enterprise; and this was done in solemn form (xiii. 1–3). Naturally Barnabas thought of his native Cyprus; and thither they sailed, about spring A.D. 46 or 47, with Mark (*q.v.*) as their assistant. Their work lay at first in synagogues. But at Paphos an event occurred to which special notice is given as marking the beginning of a new prominence of Paul in the conduct of the mission (*cf.* "Paul and his company"). Further, on leaving Cyprus the mission entered the region where Paul, not Barnabas, was most at home. At Perga in Pamphylia a fresh decision was reached as to the route now to be taken; and this led to Mark's withdrawing (*see* MARK).

Perhaps in the late summer or autumn of A.D. 46 or 47 Paul arrived in Pisidian Antioch. Its population included the native Anatolian, the Greek, and the Jewish elements, so frequently found together in Asia Minor since the days of the Seleucid kings of the Hellenistic period. The Anatolian ground-stock had marked affinity with the Semitic peoples, though it was Hellenized in speech and education. Hence the enthusiasm with which Paul's gospel was received (xiii. 44 *sqq*; Gal. iv. 14 *seq.*). Here and now he uttered the memorable protest against Jewish unbelief: "It was necessary that the word of God should first be spoken to you: seeing ye thrust it from you, and judge yourselves unworthy of eternal life, lo, we turn to the Gentiles" (xiii. 46). This had at first for Paul only a local meaning, as he continued to begin in each city with the synagogue. But the emphasis laid on the incident in Acts shows that to one looking back it meant much, since henceforth Paul's work was to lie mainly among Gentiles.

Paul's experiences were much the same at Iconium. Then at Lystra, in the Lycaonian *regio* of the province, occurred the healing of a lame man at the word of Paul (*cf.* Rom. xv. 9). The story, told in a few graphic touches, sets before us Paul as the tactful missionary, meeting the needs of a simple folk with an elementary natural theology. At Derbe, the frontier city of Galatia to the south-east, Paul was within easy reach of Tarsus, his old home. But the needs of his young converts drew him back to face fresh dangers in Lystra, Iconium and Antioch, in order to encourage "the disciples." To give them the support of responsible oversight, the apostles "appointed for them elders" in each church, probably on the model of the synagogue: for Paul had a due sense of the corporate life of each local brotherhood and of the value of recognized leaders and pastors. Then they returned to Antioch, and reported to a church meeting "all that God had done with them, and how he had opened a door of faith unto the Gentiles." So ended Paul's first missionary journey known to us in detail, the very first wherein his vocation as apostle of the Gentiles took marked effect.

It was at this point, perhaps, that Paul's courage in defence of vital principle was called into action, owing to a visit of Peter to Antioch. Peter had fallen in with the custom at Antioch whereby Jewish and Gentile Christians ate together. But this was more than was understood even by James to be involved in the alliance of the two missions. It was one thing not to force Judaism on Gentile Christians; it was another to sanction table-fellowship between Gentile and Jewish Christians as full brethren. Let Peter, said James through his friends, remember Judaean feelings

as well. Was it not wrong to break with the sentiment of the Mother Church in Judaea for the comfort of Gentile brethren on the spot, whom they had but recently regarded as "unclean"? The plea swept not only Peter and the local Jewish Christians off their feet, but even Barnabas also.

But Paul saw that by their very reliance on Christ rather than the Law for justification, Jewish Christians had in principle set aside the Law as the means of righteousness: that they had virtually come down from their prerogative standing on the Law and classed themselves with "sinners of the Gentiles"; and finally that they had been led into this by Jesus the Messiah Himself. If that attitude were sinful, "then was Christ the minister of sin." If righteousness depend after all on the Law, then why did Christ die? This penetrating analysis (Gal. ii. 14–21) of the implications of Christian faith was unanswerable, as regards any legal observance as condition of justification. Thus Evangelic principle told against the expediency alleged on the Jewish side; while as for expediency in relation to the Gentiles, it was a matter not only of Antioch, and the Jews and Gentiles there involved, but also of the whole Roman world, and the relative numbers of potential converts from either class in it.

The New Issue Raised.—So far Gentile believers had been a mere minority, not essentially affecting the Jewish character and atmosphere of the Messianic "Church" (*Ecclesia*), any more than proselytes were thought to affect Judaism. But in Antioch and in Galatia uncircumcised Gentiles formed a large part, if not the majority, of the heirs to Messianic salvation. Now that the logic of facts was unfolding so as to jeopardize the Law *in toto*, it could not but appear to many Jewish Christians time boldly to deny the reality of any Gentile's portion in Messianic salvation apart from circumcision (as binding to observance of the Law). So argued those with Pharisaic antecedents, who invaded the headquarters of the liberal mission at Antioch. Paul and Barnabas took up the gage; and as the Judaizers no doubt claimed that they had the Judaean Church at their back, the local church felt that the issue would have to be decided in Jerusalem itself. So they sent up Paul and Barnabas, "and certain others of their number" (Acts xv. 2; contrast Gal. ii. 1 *seq.*), to confer with "the apostles and elders" there. The fact that Paul consented to go at all, to the seeming prejudice of his own divine commission, is best explained by his prior understanding with "the pillars" of the Judaean Church itself (Gal. ii. 1–10). His object was twofold: to secure in the centre of Judaeo-Christianity that public vindication of Gentile freedom from "the yoke of the Law" on which he felt he could count, and to save the Church from outward schism.

On the main issue there could be no compromise. It was conceded, largely through the influence of Peter and James, that the good pleasure of the Holy Spirit (xv. 28a), in possessing Gentile hearts, settled the question. But as to the need of considering age-long Jewish sentiment on points where divergent practice would tend to prevent Jewish Christians from recognizing Gentile believers as brethren, as well as place a needless stumbling-block between Jews and a Messianic society in which unlimited "uncleanness" was tolerated—on this compromise was possible. The compromise was proposed by James (xv. 20 *seq.*) and accepted by Paul. Indeed he had less to sacrifice than the other side in the concordat. For in the case of Gentile proselytes to Messianic Judaism the ritual Law was to be waived, and a *minimum* of proselyte rules, indispensable (xv. 28) to a type of piety essentially common to all "in Christ," taken as sufficient. Of the "abstinences" in question only that touching blood (in its two forms) was really a ritual matter. The other two were deductions from fundamental Christian ideas.

The above is the simplest reading of the case, especially if the question of table-fellowship (in Gal. ii. 11 *seq.*) had preceded. Some scholars dispute that Paul could have been a party to such a concordat at all. Others maintain that the reference to "things strangled" is an interpolation, not shared by the early Western text, and that "blood" meant originally homicide. Hence the rules had no reference to food apart from constructive idolatry. This theory does not remove the contradiction with Gal. ii. 10, and seems textually improbable.

At no point in his career does Paul's greatness appear more than now in his relations with Judaeo-Christianity. Equally above the *doctrinaire* temper and that of mere opportunism, he acted as a true missionary statesman, with his eye both on the larger future and the limiting present. As he himself obeyed the principle of concern for others' good by conforming his own practice to certain Jewish forms of piety (1 Cor. ix. 19 *seq.*, 22); so he was ready to enjoin on Gentiles abstinence from blood, simply as a thing abhorrent to Jewish sentiment. His was the spirit of a strong man, who can afford and loves to be generous, for the greater good of all. This is the key to his conduct all along, to keep in touch with Jerusalem, including repeated visits, in order to remove prejudice against him due to rumours.

Paul's Second Great Mission Tour.—Not long after this concordat Paul proposed to Barnabas a visitation of the churches they had jointly founded. But Barnabas made the reinstatement of John Mark as their helper a condition of so doing. To this Paul demurred on the ground that he could not be relied upon in all emergencies. Each went to his own sphere of work, Barnabas to Cyprus and Paul towards Asia Minor; and we never again read of them as together, though Paul later refers to his old colleague in kindly terms (1 Cor. ix. 6 and Col. iv. 10). He found a colleague in Silas (Silvanus), a "leading" man in the Jerusalem Church, but like himself a Roman citizen (Acts xvi. 37, 39); and started with the goodwill of the Antiochene Church, probably in summer A.D. 50. His way lay through churches of his own foundation, in one of which he found a helper to replace Mark, Timothy of Lystra, who was to be as a son to him up to the very end. Confident in the conciliatory spirit of both sides in the concordat, and anxious to show how ready he was to consider Jewish feeling where Gentile freedom was not involved, he circumcised this young semi-Jew before taking him as his associate into regions where work would still lie largely among Jews.

But the secondary issues of this visit were among the bitterest in Paul's life, owing to the unscrupulous action of Judaizers who, in his absence, began a subtle propaganda amongst his converts in this region. Had not Paul himself confessed the value of circumcision (v. 11) in the case of Timothy, the son of a Gentile father? As for his earlier policy, it must have been due simply to a wish to humour his converts' prejudices (i. 10), to begin with. At any rate the gospel they now brought was the authentic Apostolic Gospel; and if Paul's did differ from it, so much the worse for his gospel, since it could in no case claim to be other than derived from theirs (i. 1–9, 11 *seq.*). How plausible must such a plea have seemed to inexperienced Gentile converts, "bewitching" their minds away from the central facts: Christ crucified and the free gift of the Spirit through faith in Him. But how disingenuous as regards Paul's real position! Can we wonder at the indignation of his reply, and that he was goaded on to pass a counter-judgment upon their motives too sweepingly severe (vi. 12 *seq.*)? In any case the gross abuse by the Judaizers of Paul's promulgation of the "abstinences" in Galatia fully explains his contrary practice elsewhere.

European Mission.—Paul left his Galatian converts about autumn A.D. 50, for the adjacent province, "Asia." But not even yet was he to preach there, being diverted by something in which he saw the divine hand; and when later he tried to enter Bithynia, he was again turned aside by "the spirit of Jesus." His course seemed open only westwards to the coast, which was reached at Troas, a chief port of transit from Asia to Macedonia. It was a new departure to which Paul there found himself summoned, when in a night-vision "a certain Macedonian" stood as if entreating him: "Come over into Macedonia and help us." Here was the positive guidance to which two negative divine interventions had been leading up. Paul hesitated not a moment, though the idea was bolder than that of his own frustrated plan. "Straightway," in the words of Luke, "we sought to go forth into Macedonia, concluding that God had called us to preach the Gospel unto them." The mission began at Philippi, a Roman *colonia* Here the Jewish settlement, in which as usual Paul sought first to gain a footing, was a small one, consisting in the main of women—who enjoyed much freedom in Macedonian society. But

the normal extension of his work was cut short by an incident characteristic both of the age and of the way in which the fortunes of the Gospel were affected by the vested interests around it. The story of Paul's imprisonment again illustrates his quiet mastery of any situation. Next came Thessalonica, the real capital of the province (*see* THESSALONIANS).

But Jewish jealousy was soon aroused, particularly by the loss of their converts; and in alliance with the rabble of the market place, it was able once more to cut short the preachers' work. The charge made had a serious ring, since it involved not only danger to public order but treason against the emperor and the imperial cult (*laesa majestas*). On the other hand, Paul himself, in alluding (2 Thess. ii. 3–12) to both emperor and empire (6 *seq.*) as the force at present restraining "the mystery of lawlessness" (ἀνομία), seems to see the beginnings of "the apostasy" of God's own people, the Jewish nation—as once before under Antiochus Epiphanes, the prototype of "the man of lawlessness" seated in "the temple of God"—in so unhallowed an alliance as that which existed at Thessalonica between Judaism and paganism. For the former was using the very Messianic idea itself to stir up the latter against the followers of Jesus (Acts xvii. 7). Paul withdrew to Beroea, in Thessaly, and then by sea to Athens.

At Athens he soon drifted, after the manner of the place, into informal debate with casual listeners in the Market-place (*Agora*). The scope of his doctrine, the secret of right living, was such as to attract the notice of the Epicureans and Stoics. But its actual content seemed to them a strange farrago of Greek phrases and outlandish talk about a certain "Jesus" and some power associated with him styled "the Resurrection"; and Paul's attempt to lead up to his gospel by the natural theology of monotheism missed its mark. The real effect of the episode was upon Paul himself and his future methods among typical Greeks.

Paul soon moved on to Corinth, where he was to win success and find material for such experiences, both when present and absent, as developed the whole range of his powers of heart and mind (*see* CORINTHIANS, EPISTLES TO THE). Corinth was more typical of the Graeco-Roman world than any other city visited by Paul. No wonder that Paul's first feeling was one of utter impotence. It was "in weakness, and in fear, and in much trembling," that he began a most fruitful ministry of a year and a half. His guiding principle was to trust solely to the moral majesty of the gospel of the Cross, declared in all simplicity as to its form (1 Cor. ii. 1 *sqq.*), not heeding its first impression upon the Jew of intolerable humiliation, and on the Greek of utter folly (i. 18 *sqq.*). Before his great work began, Paul gained two fresh fellow-workers, whose share in parts at least of his later ministry was very great, Aquila, a Jew of Pontus, and his talented wife Priscilla. Probably they were already Christians; and as they, too, were tent-makers Paul shared their home and their work. Ere long there came the usual breach with the synagogue. The definite turning to the Gentiles met with much success, and Paul was encouraged by a night vision to continue in Corinth for more than a year longer. It was during his first winter at Corinth, A.D. 51–52, that Paul wrote his earliest extant missionary letters—to the Thessalonians (and perhaps Galatians). He wrote not as a theologian but as the prince of missionaries. His gospel was always in essence the same; but the form and perspective of its presentation varied with the training, mental and moral, of his hearers or converts. It was no abstract, rigid system. This warns us against hasty inferences from silence, and so limits our attempt to trace progress in his theology. It bears also on our estimate of him as a man and an apostle, asking from men only such faith as could be real to them at the time. The special perspective of his first two epistles is affected by the brevity of his stay at Thessalonica and the severity of persecution there. Owing to the latter fact the early return (Parousia) of Christ, as a vindication of their cause so near as reasonably to influence conduct (1 Thess. iv. 11), had naturally been prominent in his teaching among them. Further, the moral fruits of the new life in the Spirit are here enjoined in a very direct manner (iv. 1–8).

Paul as Ethical Teacher.—What was distinctive of Paul's ethical teaching was the intimate way in which he, like his Master, infused precepts with the spirit in which and by which they were to be realized, as varied aspects of the ideal of love to God and man. He was supremely concerned with the dynamic of conduct, as to which his own experience made him the most inspiring of teachers and the greatest interpreter of the mind of Christ. The master motive on which he relied for all, was the imitation of Christ in a peculiarly inward sense. To the believer Christ was no mere external example, but was already within him as the principle of his own new moral being, in virtue of indwelling "holy Spirit," the Spirit of Christ. Christian righteousness was *inspired* virtue. Here lay the new "power" so characteristic of the Gospel (Rom. i. 16), a motive adequate to the enhanced moral ideal in Christ. The wonder of it was that this power annulled the moral past, giving the once vicious an equal freedom with the "virtuous." To this sovereign, emancipating influence of God's holy Spirit, antagonizing "the flesh" and all its works, Paul confidently entrusted his converts for "sanctification" or progressive transformation (Gal. iii. 3, v. 16 *sqq.*) into "the image of Christ," the full actuality of the type already latent in Christian faith. Such teaching is implicit in the Thessalonian letters; but it is explicit in the Epistle to the Galatians. But how would it be taken by raw Gentiles, say in Corinth, untutored to self-denial, in things whether of sense or spirit? That their egoism often perverted Paul's libertarianism into an apology for libertinism, in keeping with current habits, as well as for selfish individualism in the use of intellect or even "gifts of the Spirit," may be gathered from his letters to Corinth. What here concerns us, however, is the splendidly positive way in which Paul met such abuses, not by falling back upon legalism as a "safeguard" against licence, but by reapplying the laws of spirituality.

In Corinth.—Side by side with the religion of the city and of the family, polytheistic and utilitarian in the main, stood the "mysteries" or esoteric cults, which were sought out and participated in by the individual for the satisfaction of essentially personal religious needs. Clearly those trained by such mysteries would be more drawn than ordinary polytheists to his gospel, with its doctrine of mystical yet real union with the Divine in Christ, and with its message of life through death. This being so, we shall not be surprised to find, especially at Corinth, traces of the reaction of conceptions proper to the mysteries upon the ideas and practices of Paul's converts (*cf.* 1 Cor. xv. 29), and even upon the language in which he set forth his meaning to them (*see* ii. 6 *sqq.*). Whether Paul himself was influenced by such ideas, *e.g.*, in relation to the sacraments, is another question.

Third Great Journey.—After some 18 months in Corinth, Paul decided to break fresh ground—now at last, perhaps, at Ephesus, the key to the province of Asia. He took with him his fellow-workers Priscilla and Aquila, and left them at Ephesus while he himself visited Syria. After some stay there, he started, before autumn A.D. 53, for his third great campaign. Passing through south Galatia, where he further fortified his converts (xviii. 23), he would reach Ephesus before winter closed in. Already his circle of helpers had gained a fresh member of great gifts, the Alexandrine Jew Apollos (*q.v.*). He had been brought into fuller sympathy with the Pauline gospel by Priscilla and Aquila; and, learning from them the situation in Corinth, had gone to try to overcome Jewish criticism there (xviii. 24–28). At first Paul taught in the synagogue, until hostility drove him to "separate the disciples" and transfer his headquarters to "the school of Tyrannus." This was a lecture-room such as "sophists" or *rhetors* were wont to use for their "displays," and many doubtless would at first regard Paul as a new lecturer on morals and religion. His influence radiated throughout the whole province of Asia, partly through visitors to Ephesus, and partly through lieutenants, such as Timothy and Epaphras (Col. i. 7; iv. 13). The latter part of his stay at Ephesus was full of trials due to his success affecting trades dependent on the cult of the Ephesian Artemis. His words, "humanly speaking, I fought the beasts at Ephesus" (1 Cor. xv. 32), may mean that he was almost torn in pieces by mob fury. Indeed he lived much of his time in Ephesus as one under daily sentence of death, so constant was his danger.

At this point of the narrative we are brought to the most pain-

ful episode in Paul's career, a psychological crucifixion of which we have the vivid record in his correspondence with the Corinthian church (*see* CORINTHIANS). There were misunderstandings on the part of large sections of it, which strained relations with Paul and impaired his apostolic authority in their eyes. In this connection the presence of interloping Jewish "apostles," with their claims for themselves and their insinuations as to Paul's motives (2 Cor. xii. 14–16), greatly complicated and embittered the situation on both sides. In the end, as 2 Cor. shows, the bulk of the Church saw its mistake and proved its loyalty.

The Second Epistle to the Corinthians was written from Philippi or Thessalonica (ix. 2); and Timothy joins in its opening salutation. He had, it seems, been summoned from Ephesus by a hurried note of Paul's from Macedonia, on the way to Corinth. In it he is informed that Erastus had remained in Corinth, while Paul had been deprived also of the help of Trophimus, so that Timothy was unexpectedly needed at his side.

For us the great event of this visit to Corinth is the writing of that epistle which shows that his mind was now bent on the extension of his mission westwards to the metropolis of the empire itself. To Rome his thoughts had been turned for many a year, but he had time and again checked the impulse to visit it (Rom. xv. 22 *seq.*). The city had long been occupied by the Gospel in one form or another; and it was a point of honour with him to preach "where Christ was not named," not to build on others' foundations (xv. 20). But his eye was now fixed on Spain, if not also on south Gaul. It was, then, largely as basis for his mission to the western Mediterranean that Paul viewed Rome. Yet after all Rome was the focus of the world. Paul could not simply pass by it (i. 11 *seq.*). Paul looked westwards at this time. Yet his heart turned also to Judaea, where he felt his line of march still threatened by the danger of disunion in the very Body of Christ. At all cost this must be averted. The best hope lay in a practical exhibition of Gentile sympathy with the Mother Church in Jerusalem. The means for such a thank-offering for benefits received, ultimately from Jerusalem (Rom. xv. 27), had been collected with patient labour; and the delegates to accompany Paul with it had already assembled at Corinth (xx. 4). Paul had intended to cross the Aegean from Corinth with his party, by the direct route to Syria. But a Jewish plot, to take effect on the voyage, caused him to start earlier by the longer land-route, as far as Philippi; whence, after waiting to observe the Days of the Unleavened Bread, he sailed to join his fellow-almoners at Troas. There is no need to follow all the stages of what follows (*see* Ramsay, *St. Paul the Traveller*). But every personal touch is meant to tell, even Paul's walk from Troas to Assos, perhaps for solitary meditation, away from the crowded ship; and all serves to heighten the feeling that it was the path to death that Paul was already treading (xx. 23). This lies at the heart of his impressive farewell to the Ephesian elders, a discourse which gives a vivid picture of his past ministry in Ephesus. Its burden, as *Luke is at pains to emphasize* by his comment upon the actual parting, is that "they should behold his face no more." But Paul, though moved in his feelings, was not to be moved from his purpose.

Last Visit to Jerusalem.—He went forward, having arranged with a trusty host at Jerusalem in the person of Mnason, a Hellenist of Cyprus; and entered the holy city in good time to show his loyalty to the Jewish Feast of Pentecost. He was well received by James and the elders of the Church. So far scholars are agreed, since the "we" form of narrative, which began again at Philippi (xx. 5), reaches to this point. But as to the historical value of what follows, before "we" reappears with the start for Rome, there is diversity of opinion. The present writer, holding that "we" is no exclusive mark of the eye-witness (*see* ACTS), sees no reason to distrust the narrative in Acts xxi. 19–xxvi. We are not told how the Gentile offering of loyal love was met by the Jerusalem Church as a whole. That its general effect upon the comity of the two branches of the Messianic Ecclesia was good, seems implied by the serene tone of Paul's later references to the unity of the Body (Eph. ii. 19–22; iii. 5 *seq.*). What does stand out clearly in Acts is all that bears on Paul's position as between the Jewish and the Roman authorities. Here we observe a gradual shifting of the charge against him, corresponding in part to the changes of venue. The more local elements recede, and those of interest to a Roman court emerge. And here the transference of the case from the provincial court to Nero's own appeal court at Rome was of ill omen. The last words of Agrippa, "This man could have been set at liberty had he not appealed to Caesar," are probably recorded with a touch of tragic irony.

Rome.—The journey to Rome calls for no detailed notice (*see* Ramsay, *St. Paul the Traveller*). Its main interest for us is the impression of nobility, courage and power, which Paul conveyed to the centurion Julius and his fellow-passengers generally; while the enthusiasm of the eyewitness himself visibly rises as dangers thicken and Paul rises above them all. At last Italy is reached, and Paul is met by "brethren" from Rome, who came 30 or 40 miles to welcome him; "whom when Paul saw, he thanked God and took courage." From Paul's letters, however, we gather that if he looked for sympathy from the Roman Church he looked largely in vain. Whilst some welcomed, and most regarded him as indeed a champion of the Gospel, whose fearless testimony even in bonds emboldened many—including the Judaizing section who wished him no good—to preach Jesus more openly than before; few, if any, really showed him brotherly love or cared for the interests of Christ outside Rome that were on his heart (Phil. i. 12–17, ii. 21). Such absorption in their own affairs struck Paul as strangely un-Christian, and added disappointment to irksome confinement, chained as he was by one wrist to a praetorian soldier night and day. Yet he rose above it all. Only let "Christ be magnified" in his body, whether by life or death.

Epistles from Rome.—The letter which makes us aware how things lay is Philippians, the most devotional of all his writings. It flows from his heart as joyful thanks for tokens of continued mindfulness of him recently received from his old Philippian friends through Epaphroditus, one of their number. Touched and filled with spiritual joy, he turns to comfort his friends in their sorrow for him, out of the stores of Divine consolation received through his own fresh sense of need (*cf.* 2 Cor. i. 3 *sqq.*). "Rejoice in the Lord" is its recurring note. Here we get the word of the hour, both for Paul and for his converts.

Of the remaining epistles written during his imprisonment in Rome, the little note to Philemon touching his slave Onesimus casts fresh light on Paul "the Christian gentleman," by its humour and considerateness. The two larger ones do not seem at first sight to reflect his personality so much as his life as the father of churches, and the way in which he extended the lines of his gospel, to bear on problems raised by ever fresh reactions upon it of the old traditions amid which his Asian converts still lived (*see* COLOSSIANS). Both aspects really blend; for the epistles are addressed to churches which were feeling certain effects of the seeming calamity that had overtaken him whom they in some sense regarded as their founder, and aim at raising them to the writer's own higher standpoint (Eph. iii. 13, vi. 19–22; Col. ii. 1 *seq.*, iv. 8 *seq.*).

The Pastoral Epistles.—In the so-called Pastoral Epistles the same subjects in the main are handled similarly, yet more summarily, as befits one writing instructions to friends familiar with the spirit behind his concrete precepts. Allowing for this, and for the special circumstances presupposed, there is no more "moralism" about the "wholesome instruction" in the Christian walk given in these epistles (1 Tim. i. 10; *cf.* vi. 3; 2 Tim. iv. 3) than in the other group. "Moralism" is ethical precept divorced from the Christian motive of grateful love, or connected with the notion of salvation as "of works" rather than prevenient grace. But of this there is no real trace in the Pastorals, which are a type of letter by themselves as regards their recipients and certain of the aspects of church life with which they deal. As dealing with methods of instruction and organization, which must have increasingly occupied the attention of those responsible for the daily course of church life, they contain nothing inappropriate to the last two years of Paul's life, when he was considering how his churches might best be safeguarded from errors.

self set forth the Gospel in the same perspective as a devoted disciple of His? Must not the personal embodiment of the life of the Messianic kingdom by Jesus himself, and so His personality, become the prime medium through which this life in its essential features, and especially in its spirit of devoted love, attains and maintains its hold upon the souls of men? Surely the new life must appear most fully and movingly *sub specie Christi;* and the *imitatio Christi,* in an inner sense which finds in Him the very principle of the new Christian consciousness as to God and man, must be the most direct and morally potent means to the realization of the Christ-type. Thus to say that Paulinism is practically and proximately "Christocentric," is not to deny that it is ultimately and theoretically "Theocentric," if only Christ's *personality* be regarded as the revelation of God the Father—even if in virtue of unique community of nature with Him, as Son. It may be questioned whether Paul attained, or indeed had within his reach in that age, the best intellectual equivalent of his religious intuition of Christ as "mediator between God and man." But it is another matter to question whether his intuition, that the personality of the Christ Himself was the secret of the spiritual power latent in his Gospel, be a true interpretation of the Gospel, as it appears even in the Synoptics. Thus the truth seems to lie rather with those who see in Paul "Jesus's most genuine disciple" (H. Weinel), the one who best understood and reproduced His thought. True, Jesus saw the Gospel through the sinless consciousness of a Saviour, while Paul saw it ever through the eyes of a conscious sinner. But that is the perspective in which mankind generally has to view the Gospel; and apart from the special quality of Paul's personal experience of sin, the Gospel as it "found" him may surely be in principle the needful experimental complement to the Gospel as set forth by Jesus Himself. By restoring Jesus's own stress upon "eternal life" as present rather than future, Paul saved Christianity from a Judaizing of the universal and spiritual religion of "grace" rather than legal merit, with which Jesus had in fact inspired His personal disciples.

No doubt there is another side to all this, the side of Paul's idiosyncrasy, both religiously and as a thinker. Paul's special religious experience has proved a limitation to his direct and full influence. While "numberless men have discovered themselves in reading Paul," more have not been "found" by him; and of those who have felt the religious appeal of his writings, not a few have misunderstood the theoretic setting of his message. Indeed misunderstanding, one way or another, was Paul's usual lot in the ancient Church (especially for Greeks and Romans) as regards his most distinctive ideas, due partly to the difficult form in which some of those ideas were couched. But to say this is little more than saying that Paulinism is a less universal form of the Gospel than that given it by his Master, Jesus Christ. To do full justice to Paulinism in this respect, we must compare it with other interpretations of Jesus and His Gospel in the age immediately ensuing. At the one extreme stands Judaeo-Christianity, with its ultra-conservatism and undeveloped spirituality; at the other Gnosticism, with its ultra-spiritualism, born of rigid dualism and a defective sense for historical continuity in revelation. Between these stands Paul, blending the positive ideas of both in a religious unity of immense ethical power and initiative; while the other and intermediate types represented in the New Testament all testify to his pervasive influence.

BIBLIOGRAPHY.—For this, in its immense range, *see* the articles "Paul" in Hastings's *Dict. of the Bible,* the *Ency. Bib.*, and C. Clemen, *Paulus* (1904). The following works may be taken as fairly typical:—

1. For Paul's *Life:* Lives by E. Renan, T. Lewin, Conybeare and Howson, F. W. Farrar, A. Sabatier (*see* 2); C. Weizsäcker, *Das Zeitalter* (Eng. trans., 1894), W. M. Ramsay, *St. Paul the Traveller and Roman Citizen* (1896), C. Clemen, B. W. Bacon (1905), A. Deissmann, *St Paul* (1912); T. R. Glover, *Paul of Tarsus* (1925). Some of these deal largely with Paul's teaching.

2. For *Paulinism:* Baur's *Paulus* (1845, 1866); E. Reuss, *Hist. de la théol. chrét. au siècle apostolique,* tome ii. (Eng. trans., 1872); B. Jowett, essays in his *Epistles of St. Paul to the Thess., etc.;* J. B. Lightfoot, dissertations in his *Commentaries;* Matthew Arnold, *St. Paul and Protestantism;* O. Pfleiderer, *Hibbert Lecture* (1885); A. Sabatier, *L'Apôtre Paul* (1881); J. F. Clarke, *The Ideas of the Apostle Paul* (1884); G. B. Stevens, *The Pauline Theology* (1892); A. B. Bruce, *St. Paul's Conception of Christianity* (1894); G. Matheson, *The Spiritual Development of St. Paul;* brief sketches by W. Bousset, H. Weinel, W. Wrede, P. Wernle, and A. Jülicher (in *Die Kultur der Gegenwart,* 1905, I. iv. i. 69–97) *cf.* W. Sanday, article "Paul" in *Dict. of Christ and the Gospels* (1908), where the literature bearing on "Jesus and Paul" will be found; F. Prat, *La Théol. de S. Paul* (1908); A. E. Garvie, *Studies in Paul and his Gospel* (1911); W. Morgan, *The Rel. and Theol. of Paul* (1917); C. H. Dodd, *The Meaning of Paul for to-day* (1920); A. Deissmann, *The Rel. of Jesus and the Faith of Paul* (1923); C. A. Scott, *Christianity acc. to St. Paul* (1927); S. Cave, *The Gospel of St. Paul* (1928). (J. V. B.)

PAUL I., pope from 757 to 767, succeeded his brother Stephen III. on May 29, 757. He died on June 28, 767. His successor was Stephen IV.

PAUL II. (Pietro Barbo), pope from Aug. 30, 1464, to July 26, 1471, was born at Venice in 1417. He was made cardinal-priest of Sta. Cecilia, then of St. Marco by Nicholas V., was a favourite of Calixtus III. and was unanimously and unexpectedly elected the successor of Pius II. He immediately declared that election "capitulations," which cardinals had long been in the habit of affirming as rules of conduct for future popes, could affect a new pope only as counsels, not as binding obligations. He opposed the domineering policy of the Venetian government in Italian affairs. His repeated condemnations of the Pragmatic Sanction of Bourges resulted in strained relations with Louis XI. of France. He pronounced excommunication and deposition against King George Podiebrad on Dec. 23, 1466, for refusal to enforce the Basel agreement against the Utraquists, and prevailed on Matthias Corvinus, king of Hungary, to declare war against him on March 31, 1468. Matthias was not particularly successful but George Podiebrad died on March 22, 1471. The pope carried on fruitless negotiations (1469) with the emperor Frederick III. for a crusade against the Turks.

Paul endeavoured to make drastic reforms in the curia, and abolished the college of abbreviators (1466). He suppressed the Roman academy, but on religious grounds. On the other hand he was friendly to Christian scholars; he restored many ancient monuments; made a magnificent collection of antiquities and works of art; built the Palazzo di St. Marco, now the Palazzo di Venezia; and probably first introduced printing into Rome. He began in 1469 a revision of the Roman statutes of 1363—a work which was not completed until 1490. Paul established the special tax called the *quindennium* in 1470, and by bull of the same year (April 19) announced the jubilee for every twenty-five years. He began negotiations with Ivan III. for the union of the Russian Church with the Roman see. He died on July 26, 1471, and was succeeded by Sixtus IV.

The principal contemporary lives of Paul II., including that by Platina, are in L. Muratori, *Rerum ital. scriptores,* iii. pt. 2, and in Raynaldus, *Annales ecclesiastici* (1464–1471). There is an excellent article by C. Benrath in Hauck's *Realencyklopädie.*

PAUL III. (Alessandro Farnese), pope from 1534 to 1549, was born on Feb. 28, 1468. As a pupil of the famous Pomponius Laetus and, subsequently, as a member of the circle of Cosmo de' Medici he received a finished education. His advancement was rapid. To the liaison between his sister Giulia Farnese Orsini and Alexander VI. he owed his cardinal's hat; but the steady favour which he enjoyed under successive popes was due to his own cleverness and capacity for affairs. His election to the papacy, on Oct. 13, 1534, to succeed Clement VII., was virtually without opposition.

Paul's instincts and ambitions were those of a secular prince of the Renaissance; but circumstances forced him to become the patron of reform. By the promotion to the cardinalate of such men as Contarini, Caraffa, Pole and Morone, and the appointment of a commission to report upon existing evils and their remedy, the way was opened for reform; while by the introduction of the Inquisition into Italy (1542), the establishment of the censorship and the Index (1543) and the approval of the Society of Jesus (1540), agencies were set on foot for combating heresy.

But in the matter of a general council, so urgently desired by the emperor, Paul showed himself irresolute and procrastinating. Finally on Dec. 13, 1545, the Council assembled in Trent; but when the victories of Charles V. seemed to threaten its inde-

pendence it was transferred to Bologna (March 1547) and not long afterwards suspended (Sept. 1549). He concluded the truce of Nice (1538) between Charles and Francis, and contracted an alliance with each. But the peace of Crespy and the emperor's negotiations with the Protestants (1544) turned him against Charles, and he was suspected of desiring his defeat in the Schmalkaldic War. The most deplorable weakness of Paul was his nepotism. *See* FARNESE: *Family*.

Paul was gifted and cultured, a lover and patron of art. He began the famous Farnese Palace; constructed the Sala Regia in the Vatican; commissioned Michelangelo to paint the "Last Judgment," and to resume work upon St. Peter's; and otherwise adorned the city. Easy-going, luxurious, worldly-minded, Paul was not in full sympathy with the prevailing influences about him.

See Panvinio, continuator of Platina, *De vitis pontiff. rom.*; Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–02, both contemporaries of Paul III.); and also the extensive bibliography in Herzog-Hauck, *Realencyklopädie, s.v.* "Paul III."

PAUL IV. (Giovanni Pietro Caraffa), pope from 1555 to 1559, was born on June 28, 1476, of a noble Neapolitan family. His ecclesiastical preferment he owed to the influence of an uncle, Cardinal Oliviero Caraffa. Having filled the post of nuncio in England and Spain, he served successive popes as adviser in matters pertaining to heresy and reform. But he resigned his benefices, and, in conjunction with Cajetan, founded the order of the Theatines (1524) with the object of promoting personal piety and of combating heresy by preaching. In 1536 Paul III. made him cardinal-archbishop of Naples and a member of the reform commission. After the failure of Contarini's attempt at reconciliation with the Protestants (1541) the papacy committed itself to the reaction advocated by Caraffa; the Inquisition and censorship were set up (1542, 1543), and the extermination of heresy in Italy undertaken with vigour.

Elected pope, on May 23, 1555, in the face of the veto of the emperor, Paul regarded his elevation as the work of God. With his defects of temper, his violent antipathies, his extravagant motion of papal prerogative, his pontificate was filled with strife. He joined with France (1555) in order to drive the "accursed Spaniards" from Italy. But the victory of Philip II. at St. Quentin (1557) and the threatening advance of Alva upon Rome forced him to come to terms and to abandon his French alliance. He denounced the peace of Augsburg as a pact with heresy; nor would he recognize the abdication of Charles V. and the election of Ferdinand. By insisting upon the restitution of the confiscated church-lands, assuming to regard England as a papal fief, and requiring Elizabeth, whose legitimacy he aspersed, to submit her claims to him, he raised insuperable obstacles to the return of England to the Church of Rome.

Paul's attitude towards nepotism was at variance with his character as a reformer. An unworthy nephew, Carlo Caraffa, was made cardinal, and other relatives were invested with the duchies of Paliano and Montebello. It was Paul's hope in this way to acquire a support in his war with the Spaniards. But the defeat of his plans disillusioned him, and he turned to reform. A stricter life was introduced into the papal court; the regular observance of the services of the Church was enjoined; many of the grosser abuses were prohibited. These measures only increased Paul's unpopularity, so that when he died on Aug. 18, 1559, the Romans vented their hatred by demolishing his statue, liberating the prisoners of the Inquisition, and scattering its papers. Paul's want of political wisdom, and his ignorance of human nature aroused antagonisms fatal to the success of his cause.

See references under Paul III.; also Castaldo, *Vita del pontifice Paolo Quarto* (Modena, 1618); Ranke, *Popes* (Eng. trans. by Austin), i. 286 *seq.* (an excellent sketch); Ancel, *Disgrace et procès dès Caraffa* (1909); Riess, *Politik Pauls IV.* (1909).

PAUL V. (Camillo Borghese), successor of Leo XI., was born in Rome on Sept. 17, 1552, of a noble family. He studied in Perugia and Padua, became a canon lawyer and was vice-legate in Bologna. As a reward of a successful mission to Spain Clement VIII. made him cardinal (1596) and later vicar in Rome and inquisitor. Elevated to the papacy on May 16, 1605, his extreme conception of papal prerogative, his arrogance and obstinacy, his perverse insistence upon the theoretical and disregard of the actual, made strife inevitable. He provoked disputes with the Italian states over ecclesiastical rights. Savoy, Genoa, Tuscany and Naples, wishing to avoid a rupture, yielded; but Venice resisted. (*See* SARPI, PAOLO.) The pope talked of coercion by arms; but Spain, to whom he looked for support, refused to be drawn into war, and the quarrel was finally settled by the mediation of France (March 22, 1607). Paul became involved in a quarrel with England over the new oath of allegiance required after the discovery of the Gunpowder Plot; and by his condemnation of Gallicanism (1613) he provoked the defiant declaration of the states general of 1614 that the king held his crown from God alone.

Paul encouraged missions, confirmed many new congregations and brotherhoods, authorized a new version of the Ritual and canonized Carlo Borromeo. His devotion to the interests of his family exceeded all bounds, and they became enormously wealthy. Paul began the famous Villa Borghese; enlarged the Quirinal and Vatican; completed the nave, façade and portico of St. Peter's; erected the Borghese Chapel in Sta. Maria Maggiore; and restored the aqueduct of Augustus and Trajan ("Acqua Paolina"). He also added to the Vatican library, and began a collection of antiquities. Paul died on Jan. 28, 1621, and was succeeded by Gregory XV.

See Bzovius (Bzowski), *De vita Pauli V.* (Rome, 1625; contained in Platina, *De vitis pontiff. rom.*, ed. 1626), who depicts Paul as a paragon of all public and private virtues; Vitorelli, continuator of Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (a contemporary of the pope); Goujet, *Hist. du pontificat de Paul V.*, (1765); and the biography in Herzog-Hauck, *Realencyklopädie.*

PAUL I. (1754–1801), emperor of Russia, was born in the Summer Palace in St. Petersburg on Oct. 1 (N.S.), 1754. He was the son of the grand duchess, afterwards empress, Catherine. Scandal said that his father was not her husband the grand duke Peter, afterwards emperor, but one Colonel Soltykov. There is probably no foundation for this story except gossip, and the cynical malice of Catherine. During his infancy he was taken from the care of his mother by the empress Elizabeth, whose ill-judged fondness is believed to have injured his health. Catherine's dissolute court was a bad home for a boy, but Catherine took great trouble to arrange his first marriage with Wilhelmina of Darmstadt, who was renamed in Russia Nathalie Alexéevna, in 1773. She allowed him to attend the council to gain experience.

After his first marriage he began to engage in intrigues. He suspected his mother of intending to kill him, and once openly accused her of causing broken glass to be mingled with his food. Yet, though his mother removed him from the council and began to keep him at a distance, her actions were not unkind. The use made of his name by the rebel Pugachev in 1775 tended no doubt to render his position more difficult. When his wife died in childbirth in that year his mother arranged another marriage with the beautiful Sophia Dorothea of Württemberg, renamed in Russia Maria Feodorovna. Paul and his wife were allowed to travel through western Europe in 1781–1782. In 1783 the empress gave him an estate at Gatchina, where he maintained a brigade of soldiers whom he drilled on the Prussian model. As Paul grew his character became steadily degraded. He fell under the influence of two of his wife's maids of honour in succession, Nelidov and Lapuknin, and of his barber, a Turkish slave named Koroïssov. For some years before Catherine died it was obvious that he was hovering on the border of insanity.

Catherine contemplated setting him aside in favour of his son Alexander, to whom she was attached. No definite step was taken to set him aside, probably because nothing would be effective short of putting him to death, and Catherine shrank from the extreme course. The four and a half years (1796–1801) of Paul's rule in Russia were unquestionably the reign of a madman. (*See* RUSSIA: *History.*) His conduct of the foreign affairs of Russia plunged the country first into the second coalition against France in 1778, and then into the armed neutrality against Great Britain in 1801. His political follies might have been condoned had he not treated the people about him like a shah, or one

of the craziest of the Roman emperors. He began by repealing Catherine's law which exempted the free classes of the population of Russia from corporal punishment and mutilation. Nobody could feel himself safe from exile or brutal ill-treatment at any moment.

In Russia as in mediaeval Europe there was no safe prison for a deposed ruler. A conspiracy was organized by Counts Pahlen and Panin, and a half-Spanish, half-Neapolitan adventurer, Admiral Ribas; the death of Ribas delayed its execution. On the night of March 11, 1801, Paul was murdered in his bedroom in the St. Michael Palace. He was succeeded by his son, the emperor Alexander I., who was actually in the palace, and to whom Nicholas Zubov, one of the assassins, announced his accession.

See, for Paul's early life, K. Waliszewski, *Autour d'un trône* (Paris, 1894), or the English translation, *The Story of a Throne* (London, 1895), and P. Morane, *Paul I. de Russie avant l'avènement* (Paris, 1907). For his reign, T. Schiemann, *Geschichte Russlands unter Nikolaus I.* (Berlin, 1904), vol. i. and *Die Ermordung Pauls*, by the same author (Berlin, 1902).

PAUL-BONCOUR, JOSEPH (1873–), French politician, was born at St. Aignan on Aug. 4, 1873. After a brilliant university career, he joined the Paris bar. His book *Le fédéralisme économique*, published in 1900, showed him an ardent advocate of the trade union movement, and in 1906 he was elected to the Chamber as an independent Socialist, a follower of Painlevé, by his native district of Loire-et-Cher. In 1911 Paul-Boncour was appointed labour minister in the Radical Monis-Bertaux cabinet. In 1914 he held a command in Lorraine. Meanwhile, he had definitely joined the socialist party, thus fulfilling a promise made to Jaurès a few months before the latter's tragic end. He was returned to the Chamber at the November 1919 election and at once joined forces with Léon Blum in the struggle against the national Bloc. He was again returned in 1924, this time as deputy for Jaurès' former constituency of the Tarn. He was repeatedly a member of the French delegation to the Assembly of the League of Nations, and took an important part in the work of the League. He presided over the committee (Dec. 1925) appointed to report to the Council on the agenda for the disarmament conference. The role which he played in the League made him the object of attacks from many of the socialists, who reproached him with having been at Geneva the official delegate of a bourgeois government, and who tried to force on him the choice between this role and membership of the socialist party. Following the withdrawal of the support of the Radical-Socialist party from the government in 1928, Paul-Boncour resigned his appointment as French delegate to the League of Nations, but still remains a member of the Chamber.

PAULDING, JAMES KIRKE (1778–1860), American writer and politician, of Dutch descent, was born in what was formerly Dutchess (now Putnam) county (N. Y.), on Aug. 22, 1778. His father was ruined by pledging his fortune to secure supplies for the continental army. When about 18 Paulding moved to New York, secured a clerical position, and began writing anonymously for Peter Irving's paper, the *Morning Chronicle*. On Jan. 24, 1807, with William Irving, his brother-in-law, and with Washington Irving, he began the humorous series *Salmagundi*. The literary war with the English reviewers was continued in two clever satires, *The Diverting History of John Bull and Brother Jonathan* (1812) and *John Bull in America; or, The New Munchausen* (1825). One of his more serious books *The United States and England* (1815) attracted the notice of President Madison, who in 1815 appointed him secretary to the board of navy commissioners, a position he held until 1823. From 1824 to 1838 Paulding was navy agent in New York city and from 1838 to 1841 was secretary of the Navy in the cabinet of President Van Buren. In 1846 he purchased an estate near Hyde Park (N. Y.), where he lived till his death, April 6, 1860.

As early as 1824 Columbia college conferred on him the degree of Master of Arts for his literary work. Although the novel *Koningsmarke* (1823) and two narrative poems date from this early period—*The Lay of the Scottish Fiddle* (1813), a parody of Scott, and *The Backwoodsman* (1818)—most of his fiction was written later. His best-known novels include: *The Dutchman's Fireside* (1831); *Westward Ho!* (1832), a vivid tale of migration to the Mississippi valley; and *The Old Continental: or, The Price of Liberty* (1846). His *Life of Washington* (1835) was favourably reviewed by Poe and went through nine American editions before it was overshadowed by Irving's. The best of his plays, *The Lion of the West*, in 1830 won a prize offered by James Hackett for the best original comedy with an American as the leading character. His style, at its best, in ease and quiet irony, compares favourably with that of his friend Washington Irving.

See the *Literary Life of James K. Paulding* (1867), by his son, W. I. Paulding, which accompanied the edition of the father's work (1867–68); also the biography by A. L. Herold (1926), which contains a good bibliography.

PAULET, POULETT or POWLETT, an English family of an ancient Somersetshire stock, taking a surname from the parish of Pawlett near Bridgwater.

SIR AMIAS POULETT or Paulet (d. 1537), knighted in 1487 after the battle of Stoke, was treasurer of the Middle Temple in 1521, when Wolsey, in revenge for an indignity suffered at the knight's hands when the future chancellor was a young parson at Limington, forbade his leaving London without leave. To propitiate the cardinal, Sir Amias, rebuilding the Middle Temple gate, decorated it with the cardinal's arms and badge.

SIR AMIAS POULETT (1536–1588), is famous as the puritan guardian at Tutbury and Chartley of Mary, queen of Scots. After his prisoner's sentence at Fotheringhay, he beset Elizabeth's ministers with messages advising her execution, but he firmly withstood "with great grief and bitterness," the suggestion that she should be put to death secretly, saying that God and the law forbade.

SIR WILLIAM PAULET, marquess of Winchester, a member of a younger branch of the family, received many honours from Henry VIII. in return for his services against the Pilgrimage of Grace. The king's death found him lord president of the council and one of the executors of the famous will of the sovereign. The fall of the protector Somerset gave him the lord treasurership and a patent of the earldom of Wiltshire. He shared the advancement of Northumberland and was created in 1551 marquess of Winchester, but, although he delivered the crown jewels to the Lady Jane in 1553, he was with the lords at Baynard Castle who proclaimed Queen Mary. Only his death in 1572 drove from office this tenacious treasurer.

His princely house at Basing was held for King Charles by JOHN, the FIFTH MARQUESS OF WINCHESTER, whose diamond had scratched "Aimez Loyauté" upon every pane of its windows. The cavalier marquess died in 1675, unrecompensed, and his son CHARLES, a morose extravagant, had the dukedom of Bolton in 1689 for his desertion of the Stuart cause.

CHARLES, SECOND DUKE OF BOLTON (1661–1722), was made lord-lieutenant of Ireland in 1717. A third CHARLES, the 3rd duke, is remembered as an opponent of Sir Robert Walpole and as the husband of Lavinia Fenton, the Polly Peachum of Gay's opera. The dukedom became extinct in 1794

PAULICIANS, an evangelical Christian Church spread over Asia Minor and Armenia from the 5th century onwards. The Armenian patriarch John IV. (*c.* 728) states that Nerses, his predecessor, had chastised the sect, but ineffectually; and that after his death (*c.* 554) they had continued to lurk in Armenia. An anonymous account was written perhaps as early as 840, and incorporated in the Greek *Chronicon* of Georgius Monachus. It was also used by Photius (*c.* 867), bk. i., chs. 1–10 of his *Historia Manicheorum*, who, having held an inquisition of Paulicians in Constantinople was able to supplement it with a few additional details; and by Petrus Siculus (*c.* 868), who visited the Paulician fortress Tephrike to treat for the release of Byzantine prisoners. His *History of the Manicheans* is dedicated to the archbishop of Bulgaria, whither the Paulicians were sending missionaries.

The Paulicians were, according to the *Chronicon*, Manicheans, and were called after Paul of Samosata (*q.v.*). One Constantine, however, of Mananali, a canton on the western Euphrates, was regarded by the Paulicians as their real founder. He based his teaching on the Gospels and the Epistles of Paul, repudiating

other scriptures; and taking the Pauline name of Silvanus, began to organize churches, whose numbers soon increased. From the few facts and dates supplied by Photius and Petrus Siculus it may be inferred that with the exception of a period early in the ninth century (when Sergius, the greatest of their leaders, carried on a powerful missionary propaganda) they were in conflict, frequently armed conflict, with the Byzantine Empire until the 10th century. Nevertheless the movement spread in Bulgaria and then revived and became stronger than ever in Armenia. The crusaders found them everywhere in Syria and Palestine, and corrupted their name to Publicani, under which name, often absurdly conjoined with Sadducaei, we find them during the ages following the crusades scattered all over Europe. After 1200 we can find no trace of them in Armenian writers until the 18th century, when they reappear in their old haunts. In 1828 a colony of them settled in Russian Armenia, bringing with them a book called the *Key of Truth,* which contains their rites of name-giving, baptism and election, compiled from old mss., we know not when.

Doctrine.—On Paulician beliefs we have mainly hostile evidence, which needs sifting. The *Chronicon* source gives these particulars:—

1. They anathematized Mani, yet were dualists and affirmed two principles—one the heavenly Father, who rules not this world but the world to come; the other an evil demiurge, lord and god of this world, who made all flesh. The good god created angels only. The Byzantines erred in confusing these principles.

2. They denied the virgin birth of Jesus, and allegorized the Virgin as the upper Jerusalem in which the Lord came in and went out and denying that he was really made flesh of her.

3. They allegorized the Eucharist and explained away the bread and wine of which Jesus said to His apostles, "Take, eat and drink," as mere words of Christ, and denied that we ought to offer bread and wine as a sacrifice. Such allegorization meets us already in Origen, Eusebius and other early fathers, and is quite compatible with that use of a material Eucharist which Nerses II. attests among the Paulicians of the early 6th century, and for which the *Key of Truth* provides a form.

4. They assailed the cross, saying that Christ is a cross, and that we ought not to worship the tree, because it is a cursed instrument. John IV. and other Armenian writers report the same, and add that they smashed up crosses when they could.

5. They repudiated Peter, calling him a denier of Christ, and would not accept his repentance and tears. The *Key of Truth,* however, merely warns us that *all* the apostles constitute the Church universal and not Peter alone.

6. The monkish garb was revealed by Satan to Peter at the baptism, when it was the devil, the ruler of this world, who, so costumed, leaned forward and said, "This is my beloved son."

7. They called their meetings the Catholic Church, and the places they met in places of prayer, προσευχαί. The Armenian Paulicians equally denied the name of church to buildings of wood or stone, and called themselves the Catholic Church.

8. They explained away baptism as "words of the Holy Gospel," citing the text "I am the living water." So the Armenians taught that the baptismal water of the Church was "mere bath-water," *i.e.,* they denied it the character of a reserved sacrament. But there is no evidence that they eschewed water-baptism.

9. They permitted external conformity with the dominant Church, and held that Christ would forgive it.

10. They rejected the orders of the Church, had only two grades of clergy, namely, associate itinerants (συνέκδημοι, Acts xix. 29) and copyists (νοτάριοι), and scorned priestly vestments.

11. Their canon included only the "Gospel and Apostle."

13. Their Christology was as follows: "God out of love for mankind called up an angel and communicated to him his desire and counsel; then he bade him go down to earth and be born of woman. . . . And he bestowed on the angel so commissioned the title of Son, and foretold for him insults, blasphemies, sufferings and crucifixion. Then the angel undertook to do what was enjoined, but God added to the sufferings also death." However, the angel, on hearing of the resurrection, cast away fear and accepted death as well; and came down and was born of Mary, and named himself son of God according to the grace given him from God; and he fulfilled all the command, and was crucified and buried, rose again and was taken up into heaven. Christ was only a creature (κτίσμα), and obtained the title of Christ the Son of God by way of grace and remuneration for obedience.

The scheme of salvation here set forth recurs among the Latin Cathars. It resembles that of the *Key of Truth,* in so far as Jesus is Christ and Son of God by way of grace and reward for faithful fulfilment of God's command. But the *Key* lays more stress on the baptism. In this scheme the Baptism occupies the same place which the Birth does in the other, but both are adoptionist. The Armenian fathers held that Jesus, unlike other men, possessed incorruptible flesh, made of ethereal fire, and so far they shared the main heresy of the Paulicians. In many of their homilies Christ's baptism is also regarded as his regeneration by water and spirit, and this view goes beyond the modest adoptionism set forth in the *Key of Truth.* Certain features of Paulicianism noted by Photius and Petrus Siculus are omitted in the *Chronicon* source. One of these is the Christhood of the fully initiated, who as such ceased to be mere "hearers" (*audientes*) and themselves became vehicles of the Holy Spirit. As Jesus anointed by the Spirit became the Christ, so they became christs. Hence their opponents spoke of their "self-conferred priesthood" and "anthropolatrous apostacy," "calling themselves christs."

Because they regarded their Perfect or Elect ones as Christs and anointed with the Spirit, the mediaeval Cathars regularly adored them. So it was with Celtic saints, and Adamnan, in his life of St. Columba, i. 37, tells how the brethren after listening to St. Baithene, "still kneeling, with joy unspeakable, and with hands spread out to heaven, venerated Christ in the holy and blessed man." So in ch. 44 of the same book we read how a humble stranger "worshipped Christ in the holy man" (*i.e.,* St. Columba); but such veneration was due to every presbyter. The Christ is an elect one, who, as the Cathars put it, having been consoled or become a Paraclete in the flesh, stands in prayer with his hands outspread in the form of a cross, while the congregation of hearers or *audientes* adore the Christ in him. It was because they believed themselves to have living christs among them that the Paulicians rejected the fetish worship of a material cross, in which orthodox Armenian priests imagined they had by prayers and anointings confined the Spirit of Christ.

The later Cathars of Europe repudiated marriage on the ground that the only true marriage is of Christ with his bride the Virgin church, and perhaps this is why Paulicians and Thonraki would not make of marriage a religious rite or sacrament. The Cathars adhere to adult baptism, which in ancient wise they confer at thirty years of age or later, and have retained in its primitive significance the rite of giving a Christian name to a child on the eighth day.

BIBLIOGRAPHY.—Beside the works mentioned in the text *see* J. C. L. Gieseler, *Ecclesiastical History,* ii. 208 (Edinburgh, 1848) and "Untersuchungen uber die Geschichte der Paulicianer" in *Theol. Studien u. Kritiken,* Heft I. s. 79 (Jahrg., 1829); Mosheim's *Ecclesiastical History,* Century IX. ii. 5; G. Finlay, *History of Greece,* vols. ii and iii.; Gibbon, *History of the Decline and Fall of the Roman Empire,* ch. liv.; Ign. von Dollinger, *Sektengeschichte des Mittelalters,* chs. i.–iii.; Karapet Ter-MKrttschian, *Die Paulikianer* (Leipzig, 1843); Aršak Ter Mikelian, *Die armenische Kirche* (Leipzig, 1892); Basil Sarkisean, *A Study of the Manicheo-Paulician Heresy of the Thonraki* (Venice, San Lazaro, 1893, in Armenian); F. C. Conybeare, *The Key of Truth* (Oxford, 1898); C. A. Scott, art. "Paulicians" in Hastings, *Encyclopaedia of Religion and Ethics,* vol. ix.

PAULINUS, SAINT, of NOLA (353–431). Pontius Meropius Anicius Paulinus, who was successively a consul, a monk and a bishop, was born at Bordeaux in A.D. 353. His father, *praefectus praetorio* in Gaul, was a man of great wealth, who entrusted his son's education, with the best of results, to Ausonius. In 378 Paulinus was raised to the rank of *consul suffectus,* and in the following year he appears to have been sent as *consularis* into Campania. It was at this period, while present at a festival of St. Felix of Nola, that he entered upon his lifelong devotion to the cult of that saint. He had married a wealthy Spanish lady named Therasia; this happy union was clouded by the death in infancy of their only child. From Campania Paulinus returned to his native place and came into correspondence or personal

intimacy with Martin of Tours and Ambrose of Milan, and ultimately (about 389) he was formally received into the church by bishop Delphinus of Bordeaux, whence shortly afterwards he withdrew with his wife beyond the Pyrenees. The asceticism of Paulinus and his liberality towards the poor soon brought him into great repute; and while he was spending Christmas at Barcelona the people insisted on his being forthwith ordained to the priesthood. In the following year he went into Italy, and after visiting Ambrose at Milan and Siricius at Rome, he settled at Nola among the rude structures which he had caused to be built around the tomb and relics of his patron saint. With Therasia (now a sister, not a wife), while leading a life of rigid asceticism, he devoted the whole of his vast wealth to charity and to public works of utility or ornament; besides building basilicas at Fondi and Nola, he provided the latter place with a much-needed aqueduct. Not later than 409, he became bishop of Nola, an office he held until his death in 431. His feast-day is June 22.

The extant writings of Paulinus consist of some fifty *Epistolae*, addressed to Sulpicius Severus, Delphinus, Augustine, Jerome and others; thirty-two *Carmina* in a great variety of metre, including a series of hexameter "natales," begun about 393 and continued annually in honour of the festival of St. Felix, metrical epistles to Ausonius and Gestidius, and paraphrases of three psalms; and a *Passio S. Genesii*.

His works were edited by Rosweyde and Fronton le Duc in 1622 (Antwerp, 8vo), and their text was reprinted in the *Bibl. max. patr.* (1677). The next editor was Le Brun des Marettes (2 vols. 4to, Paris, 1685), whose text was reproduced in substance by Muratori (Verona, 1736), and reprinted by Migne. The poems and letters are edited in the Vienna *Corpus script. eccl. lat.* vol. xxviii. *See* also P. Reinelt, *Studien über die Briefe d. h. Paulin von Nola* Breslau, 1904.

PAULINUS (d. 644), first bishop of the Northumbrians and archbishop of York, was sent to England by Pope Gregory I. in 601 to assist Augustine in his mission. He was consecrated by Justus of Canterbury in 625 and escorted Æthelberg, daughter of Æthelberht, to the Northumbrian king Edwin (*q.v.*). In 627 Edwin was baptized and assigned York to Paulinus as his see. It was at Lincoln that he consecrated Honorius as archbishop of Canterbury. In 633 Edwin was slain at Hatfield Chase and Paulinus retired to Kent, where he became bishop of Rochester. He received the pallium in 634 and died in 644.

See Bede, *Historia ecclesiastica* (ed. C. Plummer, Oxford, 1896).

PAUL OF SAMOSATA, patriarch of Antioch (260–272), was, if we may credit the encyclical letter of his ecclesiastical opponents preserved in Eusebius's *History*, bk. vii. ch. 30, of humble origin. The letter just mentioned is the only indisputably contemporary document concerning him and was addressed to Dionysius and Maximus, respectively bishops of Rome and Alexandria, by seventy bishops, priests and deacons, who attended a synod at Antioch in 269 and deposed Paul. Their sentence, however, did not take effect until late in 272, when the emperor Aurelian, having defeated Zenobia and anxious to impose upon Syria the dogmatic system fashionable in Rome, deposed Paul and allowed the rival candidate Domnus to take his place.

Paul held that it was a man and not the divine Logos which was born of Mary. Jesus was a man who came to be God, rather than God become man. Paul's Christology therefore was of the Adoptionist type, which we find among the primitive Ebionite Christians of Judaea, in Hermas, Theodotus and Artemon of Rome, and in Archelaus the opponent of Mani, and in the other great doctors of the Syrian Church of the 4th and 5th centuries. Lucian the great exegete of Antioch and his school derived their inspiration from Paul, and he was through Lucian a forefather of Arianism. Probably the Paulicians of Armenia continued his tradition, and hence their name. (*See* PAULICIANS.)

Paul of Samosata represented the high-water mark of Christian speculation; and it is deplorable that the fanaticism of his own and of succeeding generations has left us nothing but a few scattered fragments of his writings. Already at the Council of Nicaea in 325 the Pauliani were put outside the Church and condemned to be rebaptized. It is interesting to note that at the synod of Antioch the use of the word *consubstantial* to denote the relation of God the Father to the divine Son or Logos was condemned, although it afterwards became at the Council of Nicaea the watchword of the orthodox faction.

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PAULSBORO, a borough of Gloucester county, New Jersey, U.S.A., on the Delaware river and the Pennsylvania railroad, 12 m. S.W. of Camden and Philadelphia. Pop. (1920) 4,352; 1928 local estimate 7,500. It has a large oil refinery and various other manufacturing industries. The borough was incorporated in 1904.

PAULSEN, FRIEDRICH (1846–1908), German philosopher and educationalist, was born at Langenhorn (Schleswig) and educated at Erlangen, Bonn and Berlin, where he became extraordinary professor of philosophy and pedagogy in 1878. In 1896 he succeeded Eduard Zeller as professor of moral philosophy at Berlin. He died on Aug. 14, 1908. He was the greatest of the pupils of G. T. Fechner, to whose doctrine of panpsychism he gave great prominence by his *Einleitung in die Philosophie* (1892; Eng. trans., 1895). He attempted to give an epistemological account of our knowledge of the psycho-physical. Admitting Kant's hypothesis that by inner sense we are conscious of mental states only, he holds that this consciousness constitutes a knowledge of the "thing-in-itself"—which Kant denies. Soul is, therefore, a practical reality which Paulsen, with Schopenhauer, regards as known by the act of "will." But this "will" is neither rational desire, unconscious irrational will, nor conscious intelligent will, but an instinct, a "will to live" (*Zielstrebigkeit*), often subconscious, pursuing ends, indeed, but without reasoning as to means. This conception of will, though consistent and convenient to the main thesis, must be rigidly distinguished from the ordinary significance of will, *i.e.*, rational desire. Paulsen is almost better known for his educational writings than as a pure philosopher. His *German Education, Past and Present* (Eng. trans., by I. Lorenz, 1907) is a work of great value.

PAULUS, surnamed SILENTIARIUS ("The silentiary," one of the imperial ushers), Greek poet, contemporary and friend of Agathias, during the reign of Justinian. In addition to some 80 epigrams, preserved in the Greek Anthology, there is extant by him a description of the church of St. Sophia. The poem was recited at the second dedication of the church (A.D. 562), in the episcopal hall of the patriarchate. The poems are of importance for the history of Byzantine art in the 6th century.

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PAULUS (older form PAULLUS), **LUCIUS AEMILIUS,** surnamed MACEDONICUS (*c.* 229–160 B.C.), Roman general, a member of a patrician family of the Aemilian gens, son of the consul of the same name who fell at Cannae. Consul for the second time in 168, he finished off the Macedonian War at Pydna (June 22), and with the help of 10 commissioners organized the country as a Roman province. The captive king Perseus was shown at his triumph. Paulus was censor in 164, and died in 160 after a long illness. At the funeral games exhibited in his honour the *Hecyra* of Terence was acted for the second and the *Adelphi* for the first time. An aristocrat to the backbone, he was yet beloved by the people. Of the vast sums brought by him into the Roman treasury from Spain and Macedonia he kept nothing to himself, and at his death his property scarcely sufficed to pay his wife's dowry. As a general he was a strict disciplinarian.

See Plutarch, *Aemilius Paulus;* Livy xliv. 17–xlvi. 41; Polybius xxix.–xxxii.

PAULUS DIACONUS, or **WARNEFRIDI,** or **CASINENSIS** (*c.* 720–*c.* 800), the historian of the Lombards, belonged to a noble Lombard family and flourished in the 8th century. An ancestor named Leupichis entered Italy in the train of Alboin and received lands at or near Forum Iulii (Friuli). During an invasion

the Avars swept off the five sons of this warrior into Illyria, but one, his namesake, returned to Italy and restored the ruined fortunes of his house. The grandson of the younger Leupichis was Warnefrid, who by his wife Theodelinda became the father of Paulus. Born between 720 and 725, Paulus received an exceptionally good education, probably at the court of the Lombard king Ratchis in Pavia, learning from a teacher named Flavian the rudiments of Greek. It is probable that he was secretary to the Lombard king Desiderius, the successor of Ratchis; it is certain that this king's daughter Adelperga was his pupil. After Adelperga had married Arichis, duke of Benevento, Paulus at her request wrote his continuation of Eutropius. It is possible that he took refuge at Benevento when Pavia was taken by Charlemagne in 774, but it is much more likely that his residence there was anterior to this event by several years. Soon he entered a monastery on the lake of Como, and before 782 he had become an inmate of the great Benedictine house of Monte Cassino, where he made the acquaintance of Charlemagne. About 776 his brother Arichis had been carried as a prisoner to France, and when five years later the Frankish king visited Rome, Paulus successfully wrote to him on behalf of the captive. His literary attainments attracted the notice of Charlemagne, and Paulus became a potent factor in the Carolingian renaissance. In 787 he returned to Italy, where he died between 794 and 800.

The chief work of Paulus is his *Historia gentis Langobardorum*. This incomplete history in six books was written after 787 and deals with the story of the Lombards from 568 to the death of King Liutprand in 747. The story is told from the point of view of a Lombard patriot and is especially valuable for the relations between the Franks and the Lombards. Paulus used the document called the *Origo gentis Langobardorum*, the *Liber pontificalis*, the lost history of Secundus of Trent, and the lost annals of Benevento; he made a free use of Bede, Gregory of Tours and Isidore of Seville. His *Historia romana* continues the *Breviarium* of Eutropius from 364 to 553.

Paulus wrote at the request of Angilram, bishop of Metz (d. 791), a history of the bishops of Metz to 766, the first work of its kind north of the Alps. This *Gesta episcoporum mettensium* is published in Bd. ii. of the *Monumenta Germaniae historica Scriptores*, and has been translated into German (Leipzig, 1880). He also wrote many letters, verses and epitaphs: *see* Karl Neff, *Die Gedichte des Paulus Diaconus* (Munich, 1908).

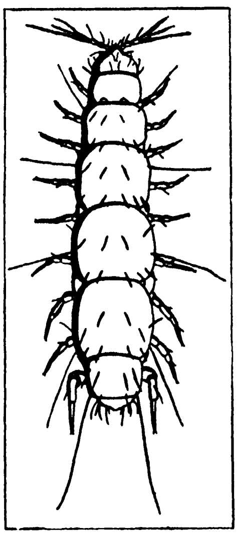
Of the *Historia* there are about a hundred manuscripts extant. It was largely used by subsequent writers, was often continued, and was first printed in Paris in 1514. It has been translated into English, German, French and Italian, the English translation being by W. D. Foulke (Philadelphia, 1807), and the German by O. Abel and R. Jacobi (Leipzig, 1878). Among the editions of the Latin the best is that edited by L. Bethmann and G. Waitz, in the *Monumenta Germaniae historica. Scriptores rerum langobardicarum* (Hanover, 1878). The *Historia romana* was edited by H. Droysen and published in the *Monumenta Germaniae historica. Auctores antiquissimi*, Bd. ii. (1879).

See C. Cipolla, *Note bibliografiche circa l'odierna condizione degli studi critici sul testo delle opere di Paolo Diacono* (Venice, 1901).

PAUMOTU (TUAMOTU or LOW ARCHIPELAGO): *see* PACIFIC ISLANDS.

PAUNCEFOTE, JULIAN PAUNCEFOTE, 1ST BARON (1828–1902), English diplomatist, third son of Robert Pauncefote of Preston Court, Gloucestershire, was born on Sept. 13, 1828. He was educated at Marlborough, Paris and Geneva, and called to the bar at the Inner Temple in 1852. He was for a short time secretary to Sir William Molesworth, secretary for the colonies, and then held colonial appointments at Hongkong and in the East Indies until 1874. He was then legal adviser to the colonial office, and afterwards to the foreign office, of which he became permanent under-secretary in 1882. In 1885 he was one of the delegates to the Suez Canal international commission, and received the G.C.M.G. and the K.C.B. Salisbury sent him as British minister at Washington in 1889. He did much during his term of office to maintain friendly relations between the two countries, especially during the Venezuelan crisis. The Bering Sea fishery dispute (1890–1892) was successfully negotiated by him; he arranged a draft treaty for Anglo-American arbitration, and the revision of the Clayton-Bulwer Treaty on the subject of the Panama Canal. He died at Washington, May 26, 1902.

PAUPER. In the particular and technical sense in which it is commonly used in Britain, pauper means a person in receipt of poor law relief, either for himself or for his dependants. In order to get this relief it is necessary to be not merely poor, but destitute, *i.e.*, without material resources directly available and appropriate for satisfying physical needs, whether actually existing or likely to arise in the immediate future. The relief given may be either "indoor," *e.g.*, maintenance in a workhouse, hospital, infirmary, asylum, or poor law school, or "outdoor" in the form of allowances in money or kind, or of medical attendance in the home. Pauperism formerly involved disfranchisement. This was slightly modified in 1885 by the Medical Relief Disqualification Removal Act, which provided that a man who received medical relief only should not lose his vote, save for the election of boards of guardians. In 1918 the Representation of the People Act swept away the "pauper disqualification" generally. It left two restrictions, however. Regular inmates of poor law institutions cannot be voters, because residence in such institutions does not qualify them for inclusion in the electoral register. And the recipient of any form of poor law relief is ineligible for election as a member of a board of guardians or of a district council.



FROM LUBBOCK IN "TRANSACTIONS"

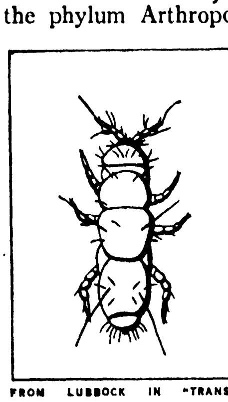
PAUROPUS HUXLEYI, SHOWING ADULT SPECIMEN FROM ABOVE (GREATLY MAGNIFIED)

The following table shows the total number of paupers in England and Wales on Jan. 1, and in Scotland on Jan. 15, in certain years:

Year	Paupers (England and Wales)	Paupers (Scotland)
1870	1,084,821	138,683 (May 14)
1880	837,940	105,411
1890	793,246	95,040
1900	807,471	99,932
1913	794,227	108,292
1923	1,537,990	271,858
1928	1,236,000	240,580

It should be noted that these figures represent the numbers in receipt of relief on a single day. The number of individuals who become paupers during the course of the year would be much larger. Thus the total on Jan. 1, 1907, in England and Wales was slightly under 800,000; but the year's count showed a total of 1,700,000. (*See* POOR LAW.) (C. M. L.)

PAUROPODA, a class of minute soil-dwelling animals of the phylum Arthropoda, it forms with Diplopoda (Millipedes, *q.v.*) and Symphyla (*q.v.*) the superclass Progoneata in which the openings of the reproductive system are near the front of the body, in contrast with those of the Opisthogoneata (Centipedes and Insects) in which the reproductive system opens at the hinder end of the body.



FROM LUBBOCK IN "TRANSACTIONS"

YOUNG PAUROPUS WITH ONLY 3 PAIRS OF LEGS (GREATLY MAGNIFIED)

The white body has a distinct head with one pair of highly characteristic antennae and an elongated trunk bearing nine pairs of simple, jointed legs and many tactile hairs. Each antennae consists of a basal part of four segments from the last of which spring two slenderer branches. True eyes are absent. Respiratory and blood systems are unknown, otherwise the internal anatomy is typically arthropodan in spite of the complexity of the male reproductive system.

When Lubbock discovered *Pauropus huxleyi,* which is only a millimetre and a half long, he gave a very true description of it

as "a bustling, active, neat and cleanly little creature" but the "look of cheerful intelligence" which he ascribed to it must be taken with a grain of salt. *Eurypauropus* is much more slothful.

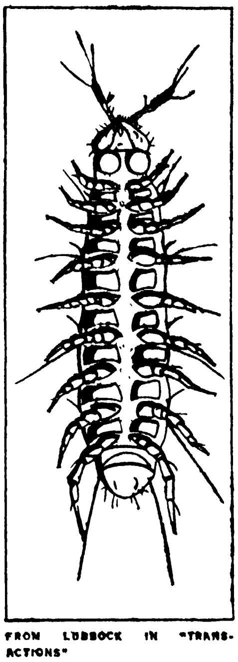
The class comprises two families: PAUROPIDAE and EURYPAUROPIDAE.

The female lays eggs and the young are hatched with three pairs of legs.

Pauropoda are widely distributed. Fossil forms are unknown, but detailed study of the body structures reveals considerable racial specialization. The poorly chitinized mouth-parts are indicative of a diet of soft tissues.

See C. Attems *Pauropoda in Handbuch der Zoologie*, Vol. 4, (1926).

(S. G. B.-B.)



FROM LUBBOCK IN "TRANSACTIONS"

PAUROPUS HUXLEYI, SEEN FROM BELOW (GREATLY MAGNIFIED)

PAUSANIAS (5th century B.C.), Spartan regent and commander, of the Agiad family, son of Cleombrotus. He succeeded his father as regent for Pleistarchus, the son of Leonidas, in 479 B.C. He first distinguished himself as commander of the combined Greek forces in the victory of the Plataea (*q.v.*). In 478 he was appointed admiral of the Greek fleet, and succeeded in reducing the greater part of Cyprus, the strategic key of the Levant, and in capturing Byzantium from the Persians, thus securing the command of the Bosporus. But he entered into treacherous negotiations with the Persian king, and alienated the Greek forces by adopting oriental clothes, and the haughtiness and inaccessibility of a Persian commander. Pausanias was recalled by the ephors and, though acquitted on the charge of Medism, was not again sent out officially. He returned, however, and seized Hermione and Sestos, but was dislodged by the Athenians. For some time he lived at Cleonae in the Troad, carrying on negotiations with Xerxes, but was again recalled to Sparta, where he incited the helots to revolt. When his schemes were almost matured, the evidence of a confidential slave led to the discovery of his plot by the ephors. He fled to the sanctuary of Athena Chalcioecus on the Spartan Acropolis; there he was starved to death. The date is probably 471–470 B.C.

See Herodotus v. 32, ix. 10–88; Thucydides i. 94–96, 128–134, ii. 71, 72, iii. 58; Diodorus Siculus xi. 30–47, 54; Cornelius Nepos, *Pausanias;* Justin ii. 15, ix. 1, 3; Pausanias iii. 4, 14, 17; Polyaenus viii. 51; Aristodemus ii., iv., vi.–viii.; Athenaeus xii. 535E, 536A; Plutarch, *Cimon* 6, *Themistocles* 23, *Aristides* 11–20, 23. (M. N. T.)

PAUSANIAS, Greek traveller and geographer of the 2nd century A.D., was probably a native of Lydia, and was possibly born at Magnesia ad Sipylum; he was certainly interested in Pergamum and familiar with the western coast of Asia Minor; but his travels extended far beyond the limits of Ionia. Before visiting Greece he had been to Antioch, Joppa and Jerusalem, and to the banks of the river Jordan. In Egypt he had seen the pyramids and had heard the music of the vocal Memnon, while at the temple of Ammon he had been shown the hymn once sent to that shrine by Pindar. He had taken note of the fortifications of Rhodes and Byzantium, had visited Thessaly, and had gazed on the rivulet of "blue water" beside the pass of Thermopylae. In Macedonia he had almost certainly viewed the traditional tomb of Orpheus, while in Epirus he was familiar with the oracular oak of Dodona, and with the streams of Acheron and Cocytus. Crossing over to Italy, he had seen something of the cities of Campania, and of the wonders of Rome.

His *Description of Greece* (περιήγησις τῆς Ἑλλάδος), takes the form of a tour in the Peloponnesus and in part of northern Greece. It is divided into ten books: (i.) Attica and Megara; (ii.) Argolis, including Mycenae, Tiryns and Epidaurus; (iii.) Laconia; (iv.) Messenia; (v.) and (vi.) Elis, including Olympia; (vii.) Achaea; (viii.) Arcadia; (ix.) Boeotia, and (x.) Phocis, including Delphi. Book i. was written after Herodes Atticus had built the Athenian Stadium (A.D. *c.* 143), but before he had built the Odeum (*c.* 160–161). This book was probably published some years before the rest. The statement in book v. (1, 2), that 217 years had elapsed since the restoration of Corinth (44 B.C.), shows that Pausanias was engaged on his account of Elis in A.D. 174, during the reign of Marcus Aurelius. He repeatedly refers to buildings erected by Hadrian, who died in A.D. 138. He had lived in that emperor's time. He mentions the wars of Antoninus Pius against the Moors, and of Marcus Aurelius (in and after A.D. 166) against the Germans (viii. 43). The latest event recorded is the incursion of the robber-horde of the Costobocs (A.D. *c.* 176; x. 34, 5).

The work has no formal preface or conclusion. It suddenly begins with the promontory of Sunium, and it ends abruptly with an anecdote of a blind man of Naupactus. The author's general aim may be inferred from his saying at the close of his account of Athens and Attica: "Such (in my opinion) are the *most famous* of the Athenian *traditions* and *sights;* from the mass of materials I have aimed from the outset at selecting the really *notable*" (i. 39, 3). It is possibly in the hope of giving variety and interest to the topographical details of Athens that the author intersperses them with lengthy historical disquisitions; but the result is that the modern reader is tempted to omit the "history" and to hasten on to the "topography," on which the author is now a primary authority. In the subsequent books he introduces two improvements. His account of each important city begins with a sketch of its history; and, in his subsequent descriptions, he adopts a strictly topographical order. He takes the nearest road from the frontier to the capital; he there makes for the central point, *e.g.*, the market-place, and describes in succession the several streets radiating from that centre. Similarly, in the surrounding district, he follows the principal roads in succession, returning to the capital in each case, until, at the end of the last road, he crosses the frontier for the next district.

In the later books he gives a few glimpses into the daily life of the inhabitants, ceremonial rites and superstitious customs. He frequently introduces narratives from history and of legend and folk-lore; and it is only rarely that he allows us to see something of the scenery. But, happily, he notices the pine-trees on the sandy coast of Elis, the deer and the wild boars in the oak-woods of Phelloë, and the crows amid the giant oak-trees of Alalcomenae. He tells us that "there is no fairer river than the Ladon," "no reeds grow so tall as those in the Boeotian Asopus," and the rain that deluges the fallow plain of Mantineia vanishes into a chasm to rise again elsewhere. It is mainly in the last three books that he touches on the products of nature.

He is inspired by a patriotic interest in the ancient glories of Greece. He is most at home in describing the religious art and architecture of Olympia and of Delphi; but, even in the most secluded regions of Greece, he is fascinated by all kinds of quaint and primitive images of the gods, by holy relics and many other sacred and mysterious things. He is interested in visiting the battlefields of Marathon and Plataea, and in viewing the Athenian trophy on the island of Salamis, the grave of Demosthenes at Calauria, of Leonidas at Sparta, of Epameinondas at Mantineia, and the colossal lion guarding the tomb of the Thebans on the Boeotian plain. At Thebes itself he views the shields of those who died at Leuctra, and the ruins of the house of Pindar; the statues of Hesiod and Arion, of Thamyris and Orpheus, in the grove of the Muses on Helicon; the portrait of Corinna at Tanagra, and of Polybius in the cities of Arcadia.

At Olympia he takes note of the ancient quoit of Iphitus inscribed with the terms of the Olympic truce, the tablets recording treaties between Athens and other Grecian states, the memorials of the victories of the Greeks at Plataea, of the Spartans at Tanagra, of the Messenians at Naupactus, and even those of Philip at Chaeroneia and of Mummius at Corinth. At Delphi, as he climbs the sacred way to the shrine of Apollo, he marks the trophies of the victories of the Athenians at Marathon and on the Eurymedon, of the united Greeks at Artemisium, Salamis and Plataea, of the Spartans at Aegospotami, of the Thebans at Leuctra, and the shields dedicated in memory of the repulse and

defeat of the Gauls at Delphi itself. At Athens, he sees pictures of historic battles, portraits of famous poets, orators, statesmen and philosophers, and inscriptions recording the laws of Solon; on the Acropolis, the trophy of the Persian wars, the great bronze statue of Athena, at the entrance to the harbour of the Peiraeus, the grave of Themistocles; and, outside the city, the monuments of Harmodius and Aristogeiton, of Cleisthenes and Pericles, of Conon and Timotheus, and of all the Athenians who fell in battle, except the heroes of Marathon, "for these, as a meed of valour, were buried on the field."

In the topographical part of his work, he is fond of digressions on the wonders of nature, the signs that herald the approach of an earthquake, the tides, the ice-bound seas of the north, and the noonday sun which at the summer solstice casts no shadow at Syene. He criticizes the myths and legends relating to the gods and heroes. He prefers the works of the 5th and 4th centuries B.C. to those of later times At Delphi he admires the pictures of Polygnotus, closing the seven chapters of his minute description with the appreciative phrase. "so varied and beautiful is the painting of the Thasian artist" (x. 31, 2). In sculpture his taste is no less severe. Even in the "uncouth" work of Daedalus, he recognizes "a touch of the divine" (ii. 4, 5). In architecture, he admires the prehistoric walls of Tiryns, and the "Treasury of Minyas," the Athenian Propylaea, the theatre of Epidaurus, the temples of Bassae and Tegea, the walls of Messene, the Odeum at Patrae, as well as the building of the same name lately built at Athens by Herodes Atticus (vii. 20, 6), and finally the Stadium which that munificent Athenian had faced with white marble from Pentelicus.

He has been well described by J. G Frazer as "a man made of common stuff and cast in a common mould, his intelligence and abilities seem to have been little above the average, his opinions not very different from those of his contemporaries." His literary style is "plain and unadorned yet heavy and laboured" (*Introduction*, pp. xlix., lxix).

In all parts of Greece the accuracy of his descriptions has been proved by the remains of the buildings which he describes; and a few unimportant mistakes, and some slight carelessness in copying inscriptions, do not lend any colour to an imputation of bad faith. His accurate notice of Mycenae led to its discovery by Schliemann. It has been stated with perfect justice by Frazer (p. xcv. *seq.*) that "without him the ruins of Greece would for the most part be a labyrinth without a clue, a riddle without an answer." For the possible extent of Pausanias's obligations to Polemon and other writers *see* the references below, especially those to the work of Frazer, Kalkmann and Gurlitt.

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The present writer is much indebted to Gurlitt's comprehensive monograph, and to the admirable Introduction prefixed to J. G. Frazer's excellent Translation and Commentary. *See* also C Robert, *Pausanias als Schriftsteller* (Berlin, 1909). (J. E SA.; X)

PAVIA (anc. *Ticinum*, *q.v.*), a town of Lombardy, Italy, capital of the province of Pavia, on the Ticino about 2 m. above its junction with the Po, 22½ m. S. of Milan by rail, 253 ft. above sea-level. Pop. (1921), 36,422 (town); 42,043 (commune). On the right bank of the river lies the suburb of Borgo Ticino connected with the town by a covered bridge (1351–54). The bastions have been transformed into boulevards and gardens.

Monuments.—The church of San Michele Maggiore, originally constructed under the Lombard kings, was burnt in 1004, and the present building dates from the latter part of the 11th and the first half of the 12th centuries, and was completed in 1155. The lower part of the façade is adorned with three fine portals and with reliefs in sandstone, and has arcading under the gable. The dome is octagonal. The interior is vaulted and has eight pillars and a mosaic pavement of the 12th or 13th centuries.

The cathedral of San Martino, begun in 1488 by Cristoforo Rocchi, is a vast "central" structure, unfinished until the dome and façade were completed in 1898 according to Rocchi's still extant model. The church of S. Pietro in Ciel d'Oro, which as it stands was consecrated in 1132, is very similar to S. Michele. The Lombard king Liutprand (711–744), whose bones were found in 1896, was buried here In 1923 the remains of Boethius were also placed here. The Arca di S. Agostino (after 1362) is a sumptuous tomb containing the relics of S. Augustine of Hippo.

The church of S. Maria del Carmine is externally one of the most beautiful brick Gothic churches in northern Italy. S. Francesco has a façade after that of Chiaravalle near Milan. The church of S. Maria di Canepanova with its small dome was designed by Bramante. Near it are three tall, slender brick towers of the Gothic period S Teodoro, with a 12th century exterior, has frescoes by Bartolommeo Suardi (Bramantino) after 1507. Outside the town lie the churches of S. Salvatore and of S. Lanfranco Beccari (d. 1189) (12th century) with the saint's tomb by Giovanni Antonio Amedeo (1447–1522), a native of Pavia.

The university was refounded by Galeazzo II. in 1361 on the site of a law school probably founded by Lanfranc, afterwards archbishop of Canterbury (d 1089), though we find Pavia a centre of study as early as A.D. 825, and it duly celebrated its 1100th anniversary in 1925. The present imposing building was begun by Lodovico il Moro in 1490. In the library are preserved some of the ashes of Columbus, who was a student here. Volta made here his first electrical experiments. For poor students there are two colleges, the Borromeo and the Ghislieri founded by S. Carlo Borromeo (1563) and Pope Pius V. (1569).

Pavia has iron-foundries and artificial silk and other factories. It is also an important agricultural centre It lies on the main line from Milan to Genoa (which crosses the Po by a bridge half a mile long), with several branch lines Barges pass down the Po to the Adriatic or to Milan by canal Five miles N. of Pavia is the Carthusian monastery of Certosa di Pavia, one of the most magnificent in the world Its founder Gian Galeazzo Visconti laid the first stone in August 1396, and the nave was then begun in the Gothic style, but was not completed until 1465 The rest of the church with its external arcaded galleries and lofty pinnacles (including the fine dome) and the cloisters were executed in the Renaissance style under Guiniforte Solari (1453–81) with details in terra-cotta of great beauty and richness. Giovanni Antonio Amedeo was chief architect in 1481–99, and the lower part of the façade was finished in 1507. It is perhaps the finest piece of elaborate and richly adorned Renaissance architecture in existence. In the south transept of the church is the tomb of the founder In the north transept is the tomb of Lodovico Sforza, il Moro and his wife by Cristoforo Solari. An elegant portal leads into the small cloister; the terra-cotta ornaments surmounting the slender marble pillars are the work of Rinaldo de Stauris (1463–78), who executed similar decorations in the great cloister. This cloister is 412 ft. long by 334 ft. wide and contains 24 cells of the monks, little three-roomed houses each with its own garden Within the confines of the monastery is the Palazzo Ducale which since 1901 has been occupied by the Certosa museum.

History.—For earlier period *see* TICINUM. By the conquest of Pavia and the capture of Desiderius in 774 Charlemagne completely destroyed the Lombard supremacy. It was then the centre of the Carolingian power in Italy, and a royal residence was built in the neighbourhood (Corteolona on the Olona) It was in San Michele Maggiore that Berengar of Friuli, and his successors down to Berengar II. and Adalbert II, were crowned "kings

of Italy." Under the reign of the first the city was sacked and burned by the Hungarians. At Pavia was celebrated in 951 the marriage of Otto I. and Adelheid (Adelaide). Laid in ruins by Henry II., who was attacked by the citizens on the night after his coronation in 1004, it none the less closed its gates on Conrad the Salic in 1026.

The jealousy between Pavia and Milan having in 1056 broken out into open war, Pavia had recourse to the emperors, and for the most part she remained attached to the Ghibelline party till the latter part of the 14th century. From 1360, when Galeazzo was appointed imperial vicar by Charles IV., Pavia became practically a possession of the Visconti family and in due course formed part of the duchy of Milan. For its insurrection against the French garrison in 1499 it paid the penalty in 1500. Having been strongly fortified by Charles V., the city was in 1525 able to bid defiance to Francis I., but two years later the French under Lautrec sacked it. In 1655 Prince Thomas of Savoy vainly besieged Pavia with an army of 20,000 Frenchmen.

The Austrians under Prince Eugène occupied it in 1706, the French in 1733 and the French and Spaniards in 1743; and the Austrians were again in possession from 1746 till 1796, when it was seized by Napoleon. The revolutionary movement of February 1848 was crushed by the Austrians who held it until 1859.

See C. Dell' Acqua, *Guida illustrata di Pavia* (Pavia, 1900), and refs. there given; L. Beltrami, *La Chartreuse de Pavie* (Milan, 1899); *Storia documentata della Certosa di Pavia* (Milan, 1896). (T. A.)

Battle of Pavia (1525).—In 1524 Francis I. of France, at the head of some 30,000 men, moved into Italy, took Milan and lay siege to Pavia. This city was hard-pressed when Lannoy, Charles V.'s viceroy of Naples, marched to its relief at the head of a numerically slightly inferior force. On Feb. 25, 1525, an attempt was made to join hands with the garrison, but Francis so skilfully deployed his artillery that he took the Spanish attacking column in flank, and drove it back in confusion. Imagining the victory to be his, he set out in pursuit, only to be met by an epoch-making tactical surprise which ended in the destruction of his army, and the capture of himself.

One of Lannoy's generals was the Marquis de Pescaire, a man of genius. He had under his command 1,500 Spanish arquebusiers, and having grasped the true value of the fire-arm had instructed them "without word of command . . . to wheel round, to face about from this side to that, now here, now there, with the utmost rapidity" (Brantôme). When the French cavalry charged they were met by this novel system of defence which threw them into complete confusion. Meanwhile the advance of the French cavalry and infantry had masked their guns, and whilst Francis was held in front by the arquebusiers, Antonio de Leyva, at the head of his garrison, made a sortie from Pavia and fell on his rear. As the battle of Ravenna (1512) marks the advent of artillery as the weapon of demoralization, so does that of Pavia mark the superiority of hand firearms over lance and pike. In spite of the lessons of Alfonso d'Este at the first and of Pescaire at the second, it took many years of bloodshed before European armies grasped their meaning.

See Brantôme, *Hommes Illustres; J.* F. C. Fuller, *British Light Infantry in the Eighteenth Century; The Cambridge Modern History,* vol. ii., 1903. (J. F. C. F.)

PAVIA Y ALBUQUERQUE, MANUEL (1828–1895), Spanish general, born at Cadiz, Aug. 2, 1828. Lieutenant in 1846, captain in 1855, and major in 1862, he joined the staff of Marshal Prim in 1865, shared in the unsuccessful revolutionary movements of 1866, and after two years of exile, in the successful revolution of 1868. After the abdication of Amadeus, Pavia put down the Carlists and the chief cantonal insurrections of the south. He hoped to realize with Castelar a dictatorial, military, and political republic which would rally round its standard all the most conservative groups. The plan was interrupted by the military *pronunciamiento* for the purpose of dissolving the Cortes of 1873. On Jan. 3, 1874, Pavia made his *coup d'état;* master of the situation after the *pronunciamiento* but free from personal ambition, he sent for Serrano to form a Government with Conservatives and Radicals of the revolution. He died on Jan. 4, 1895.

PAVLOV, IVAN PETROVICH (1849–), Russian physiologist, was born on Sept. 14 (old style), 1849, in the district of Ryazan in Russia, son of the village priest. He studied science at the university and then medicine at the military medical academy of St. Petersburg (Leningrad). He graduated as a doctor in 1883, and in 1884 was appointed *privat-dozent* in physiology, but he went for two years to Germany to work under Ludwig and Heidenhain. In 1890 Pavlov was appointed director of the physiological department of the institute of experimental medicine at St. Petersburg and in 1897 professor at the medical academy. In 1907 he was elected member of the Russian academy of sciences. He is famous for his research on the problems of digestion, and on cerebral activity and the theory of reflexes. His first achievements were on the physiology of blood circulation. He devised special methods of treating animals, which enabled him to make observations under normal conditions of the organism. His first papers appeared in 1878–79. From 1892–97 a series of papers on the physiology of digestion was published in the *Archives des Sciences Biologiques.* In 1897 a collected account was published in German and French, *Die Arbeit der Verdauungsdrüsen.* (Eng. trans., *The Work of the Digestive Glands,* 1902.) For this important work he was awarded the Nobel prize in 1904. Most of his and his pupils' researches are published in Russian. In 1907 Pavlov was elected a foreign member of the Royal Society and in 1915 he was awarded the Copley medal. Since the war, as director of the physiological laboratories in the Russian Academy of Medicine and the Institute of Experimental Medicine, he has added to his fame. In 1928, on the occasion of the Harvey tercentenary, he was made an honorary fellow of the Royal College of Physicians in London. Many of his lectures and treatises have been translated into English by Professor Anrep, of Cambridge. *See* M. Dontchef-Dezeuze, *L'Image et les Réflexes Conditionnels dans les travaux de Pavlov* (1914) and *Conditioned Reflexes, an investigation of the physiological activities of the Cerebral Cortex* (Oxford, 1927).

PAVLOVA, ANNA (1885–), Russian dancer, was born in St. Petersburg (Leningrad) on Jan. 31, 1885. At the age of 10 she entered the Imperial Ballet School, attached to the Mariinski Theatre, St. Petersburg, and subsequently became prima ballerina of this theatre. She later appeared at the Imperial Opera House in St. Petersburg, and in 1910 made her first visit to England. Assisted by Michael Mordkin she appeared at the Palace theatre, London, in "Le Cygne," "Les Papillons" and "Valse Caprice." In the same year she appeared in Paris with Diaghilev's Russian ballet in "Les Sylphides," "Pavillon d'Armide" and "La Nuit Egyptienne"; and also in New York in the ballet "Coppelia." Later, after making regular appearances in London for some years at the Palace theatre, she toured in the United States, winning much admiration for her original dance creations, especially those in the classical style.

PAVLOVO, a town of Russia in the Nizhegorod province, on the Oka river, in 55° 58′ N., 43° 5′ E. Pop. (1926) 16,258. Since the 17th century it has been famous for its cutlery, hardware and locksmith trade, carried on in Pavlovo itself and the neighbouring villages, in cottages and small workshops. A factory has recently been established in the town, which has a museum of cutlery models.

PAWHUSKA, a city of north-eastern Oklahoma, U.S.A., at the foot of the Osage hills; the county-seat of Osage county. It has a municipal airport and is served by the Midland Valley and the Santa Fe railways. The population was 6,414 in 1920 (88% native white) and was estimated locally at over 10,000 in 1928. It is the seat of the Osage Indian Agency and a government boarding-school for Indian girls, and a trading centre for the Osage Nation (numbering 2,229 headrights) who have received $157,367,400 (1920–28) from lease-sales of their oil-lands, besides royalties amounting to about $16,000,000 a year, and are the richest people (*per caput*) in the world. The city is also the metropolis for cotton and stock-raisers and for oil-prospectors. The Osage Agency was established here in 1872. The name (meaning "white-hair") was that of a famous and respected Osage chief. In 1906 the site was selected and surveyed for one of the five towns to be

established in the Osage Nation, as provided by the federal Allotment Act; a lot-sale was held which realized $25,000 for the Indians; and the city was incorporated. By 1928 it was a well built city, with substantial business buildings, a beautiful residence district "on the hill," established schools and churches and public utilities, a municipal hospital, a library, an assessed valuation of $7,280,312, several manufacturing industries, banks with deposits aggregating $5,676,258 on Aug. 1928, and a council-manager form of government (adopted 1921).

PAWNBROKING is the business of lending money on the security of goods taken in pledge. If we desire to trace with minuteness the history of pawnbroking we must go back to the earliest ages of the world, since the business of lending money on portable security (*see* MONEY-LENDING, and USURY) is one of the most ancient of human occupations.

In China the pawnshop was probably as familiar two or three thousand years ago as it is to-day, and at all events down to the outbreak of the long period of successive civil wars which began in the first quarter of the present century its conduct was still regulated quite as strictly as in England. The Chinese conditions, too, were decidedly favourable to the borrower. He might, as a rule, take three years to redeem his property, and he could not be charged a higher rate than 3% per annum—a regulation which would close every pawnshop in England in a month. Both Rome and Greece were as familiar with the operation of pawning as the modern poor all the world over; indeed, from the Roman jurisprudence most of the contemporary law on the subject is derived.

The Pledge System.—It was, indeed, in Italy, and in more modern times, that the pledge system which is now almost universal on the continent of Europe arose. In its origin that system was purely benevolent, the early *monts de piété* established by the authority of the popes lending money to the poor only, without interest, on the sole condition of the advances being covered by the value of the pledges. Thus as early as 1198 something of this nature was started at Freising in Bavaria; while in 1350 a similar endeavour was made at Salins in Franche Comté, where interest at the rate of 7½% was charged. Nor was England backward, for in 1361 Michael Northbury, or de Northborough, bishop of London, bequeathed 1,000 silver marks for the establishment of a free pawnshop. These primitive efforts, like the later Italian ones, all failed. The Vatican was therefore constrained to allow the Sacri monti di pietà to charge sufficient interest to their customers to enable them to defray expenses. Thereupon a learned and tedious controversy arose upon the lawfulness of charging interest, which was only finally set at rest by Pope Leo X., who, in the tenth sitting of the Council of the Lateran, declared that the pawnshop was a lawful and valuable institution, and threatened with excommunication those who should presume to express doubts on the subject. The Council of Trent inferentially confirmed this decision.

Italian Monti di Pietà.—Long before this, however, monti di pietà charging interest for their loans had become common in Italy. The date of their establishment was not later than 1464, when the earliest of which there appears to be any record in that country—it was at Orvieto—was confirmed by Pius II. Three years later another was opened at Perugia by the efforts of two Franciscans, Barnabus Interamnensis and Fortunatus de Copolis. They collected the necessary capital by preaching, and the Perugian pawnshop was opened with such success that there was a substantial balance of profit at the end of the first year. The Dominicans endeavoured to preach down the "lending-house," but without avail. Viterbo obtained one in 1469, and Sixtus IV. confirmed another to his native town of Savona in 1479. After the death of Brother Barnabus in 1474 a strong impulse was given to the creation of these establishments by the preaching of another Franciscan, Father Bernandino di Feltre, who was in due course canonized. By his efforts monti di pietà were opened at Assisi, Mantua, Parma, Padua, Pavia and elsewhere. From Italy the pawnshop spread gradually all over Europe. Augsburg adopted the system in 1591, Nuremberg copied the Augsburg regulations in 1618, and by 1622 it was established at Amsterdam, Brussels, Antwerp and Ghent. Madrid followed suit in 1705, when a priest opened a charitable pawnshop with a capital of fivepence.

Introduction in France.—The institution was, however, very slow in obtaining a footing in France. It was adopted at Avignon in 1577, and at Arras in 1624. The doctors of the once powerful Sorbonne could not reconcile themselves to the lawfulness of interest, and when a pawnshop was opened in Paris in 1626, it had to be closed within a year. Then it was that Jean Boucher published his *Défense des monts de piété*. Marseilles obtained one in 1695; but it was not until 1777 that the first mont de piété was founded in Paris by royal patent. The statistics which have been preserved relative to the business done in the first few years of its existence show that in the twelve years between 1777 and the Revolution, the average value of the pledges was 42 fr. 50, which is well above the present average. The interest charged was 10% per annum, and large profits were made upon the sixteen million livres that were lent every year. The National Assembly, in an evil moment, destroyed the monopoly of the mont de piété, but it struggled on until 1795, when the competition of the money-lenders compelled it to close its doors. So great, however, were the extortions of the usurers that the people began to clamour for its reopening, and in July 1797 it recommenced business with a fund of £20,000 founded by five private capitalists. At first it charged interest at the rate of 36% per annum, which was gradually reduced, the gradations being 30, 24, 18, 15, and finally 12% in 1804. In 1806 it fell to 9%, and in 1887 to 7%. In 1806 Napoleon I. re-established its monopoly, while Napoleon III., as prince-president, regulated it by new laws that are still in force. In Paris the pledge-shop is, in effect, a department of the administration; in the French provinces it is a municipal monopoly; and this is generally true throughout the continent of Europe.

In Great Britain.—In England the pawnbroker, like so many other distinguished personages, "came in with the Conqueror." From that time, indeed, to the famous legislation of Edward I., the Jew moneylender was the only pawnbroker. Yet, despite the valuable services which the class rendered, not infrequently to the Crown itself, the usurer was treated with studied cruelty—Sir Walter Scott's Isaac of York was no mere creation of fiction. These barbarities, by diminishing the number of Jews in the country, had, long before Edward's decree of banishment, begun to make it worth the while of the Lombard merchants to settle in England. It is now as well established as anything of the kind can be that the three golden balls, which have for so long been the trade sign of the pawnbroker, were the symbol which these Lombard merchants hung up in front of their houses, and not, as has often been suggested, the arms of the Medici family. In 1338 Edward III. pawned his jewels to the Lombards to raise money for his war with France. Henry V. did much the same in 1415.

The Lombards were not popular, and Henry VII. harried them a good deal. In the very first year of James I. "An Act against Brokers" was passed and remained on the statute-book until 1872. It was aimed at "counterfeit brokers," of whom there were then many in London. This type of broker was evidently regarded as a mere receiver of stolen goods, for the act provided that "no sale or pawn of any stolen jewels, plate or other goods to any pawnbroker in London, Westminster or Southwark shall alter the property therein," and that "pawnbrokers refusing to produce goods to their owner from whom stolen shall forfeit double the value."

Throughout both the 17th and 18th centuries the general suspicion of the pawnbroker appears to have been only too well founded. It would appear from the references Fielding makes to the subject in *Amelia*, which was written when George II. was on the throne, that, taken in the mass, he was not a very scrupulous tradesman. Down to about that time it had been customary for publicans to lend money on pledges that their customers might have the means of drinking, but the practice was at last stopped by act of parliament. Nor was respect for the honesty of the business increased by the attempt of "The Charitable Corporation" to conduct pawnbroking on a large scale. Established by charter in 1707, "this nefarious corporation," as Smollett called it, was a swindle on a large scale. The directors gambled wildly with the shareholders' money, and in the end the common council of the city of London petitioned parliament for the dissolution of

this dishonest concern. When it collapsed in 1731 its cashier, George Robinson, M.P. for Marlow, and another principal official disappeared, less than £30,000 being left of a capital which had once been twenty times as much.

Modern English Regulations.—The pawnbroker's licence dates from 1785, the duty being fixed at £10 in London and £5 in the country; and at the same time the interest chargeable was settled at ½% per month, the duration of loans being confined to one year. Five years later the interest on advances over £2 and under £10 was raised to 15%. The modern history of legislation affecting pawnbroking begins, however, when the act of 1800 was passed, in great measure by the influence of Lord Eldon, who never made any secret of the fact that, when he was a young barrister without briefs, he had often been indebted to the timely aid of the pawnshop. The pawnbrokers were grateful, and for many years after Lord Eldon's death they continued to drink his health at their trade dinners. The measure increased the rate of interest to a halfpenny per half-crown per month, or fourpence in the pound per mensem—that is to say, 20% per annum. Loans were to be granted for a year, although pledges might be redeemed up to fifteen months, and the first week of the second month was not to count for interest. The act worked well, on the whole, for three-quarters of a century, but it was thrice found necessary to amend it. Thus in 1815 the licence duties were raised to £15 and £7, 10s. for London and the country respectively; another act of 1840 abolished the reward to the "common informer" for reporting illegal rates of interest; while in 1860 the pawnbroker was empowered to charge a halfpenny for the pawn-ticket when the loan was under five shillings. As time went on, however, the main provisions of the act of 1800 were found to be very irksome, and the Pawnbrokers' National Association and the Pawnbrokers' Defence Association worked hard to obtain a liberal revision of the law. It was argued that the usury laws had been abolished for the whole of the community with the single exception of the pawnbroker who advanced less than £10. The limitations of the act of 1800 interfered so considerably with the pawnbrokers' profits that, it was argued, they could not afford to lend money on bulky articles requiring extensive storage room. In 1870 the House of Commons appointed a Select Committee on Pawnbrokers, and it was stated in evidence that in the previous year 207,780,000 pledges were lodged, of which between thirty and forty millions were lodged in London. The average value of pledges appeared to be about 4s., and the proportion of articles pawned dishonestly was found to be only 1 in 14,000.

The result of the Select Committee was the Pawnbrokers Act of 1872, which repealed, altered and consolidated all previous legislation on the subject, and is still the measure which regulates the relations between the public and the "brokers of pawn." Based mainly upon the Irish law passed by the Union Parliament it put an end to the old irritating restrictions, and reduced the annual tax in London from £15 to the £7, 10s. paid in the provinces. By the provisions of the act (which does not affect loans above £10), a pledge is redeemable within one year, and seven days of grace added to the year. Pledges pawned for 10s. or under and not redeemed in time become the property of the pawnbroker, but pledges above 10s. are redeemable until sale, which must be by public auction. In addition to one halfpenny for the pawn-ticket, or one penny if the loan is over 10s., the pawnbroker is entitled to charge as interest one halfpenny per month on every 2s. or part of 2s. lent where the loan is under 40s., and on every 2s. 6d. where the loan is above 40s.; and since 1922 he has been allowed to charge in addition an extra halfpenny for each 5s. or part of 5s. lent. "Special contracts" may be made where the loan is above 40s. at a rate of interest agreed upon between lender and borrower. Unlawful pawning of goods not the property of the pawner, and taking in pawn any article from a person under the age of twelve, or intoxicated, or any linen, or apparel or unfinished goods or materials entrusted to wash, make up, etc., are, *inter alia*, made offences punishable by summary conviction.

Elaborate provisions are made to safeguard the interests of borrowers whose unredeemed pledges are sold under the act. Thus the sales by auction may take place only on the first Monday of January, April, July and October, and on the following days should one not be sufficient. This legislation was, no doubt, favourable to the pawnbroker rather than to the borrower. The annual interest on loans of 2s. had been increased by successive acts of parliament from the 6% at which it stood in 1784 to 25% in 1800, and to 27 in 1860—a rate which was continued by the measure of 1872. The annual interest upon a loan of half-a-crown is now 260%, as compared with 173 in 1860 and 86 in 1784; while the extreme point is reached in the case of a loan of 1s. for three days, in which case the interest is 1014% per annum.

Scotland and Ireland.—The growth of pawnbroking in Scotland, where the law as to pledge agrees generally with that of England, is remarkable. Early in the 19th century there was only one pawnbroker in that country, and in 1833 the number reached only 52. Even in 1865 there were no more than 312. In 1928 there were 238 in Edinburgh and Glasgow alone. In Ireland, as in the Free State and in Northern Ireland, the rates for loans are practically identical with those charged in England, but a penny is paid for any ticket. Articles pledged for less than £1 must be redeemed within six months, but nine months are allowed when the amount is between 30s. and £2. For sums over £2 the period is a year, as in England. In Ireland, too, a fraction of a month is calculated as a full month for purposes of interest, whereas in England, after the first month, fortnights are recognized. In 1838 there was an endeavour to establish monts de piété in Ireland, but the scheme was so unsuccessful that in 1841 the eight charitable pawnshops that had been opened had a total adverse balance of £5340. In 1847 three were left; eventually they also collapsed.

United States.—The pawnbroker in the United States is, generally speaking, subject to considerable legal restriction, but violations of the laws and ordinances are frequent. Each state has its own regulations, but those of New York and Massachusetts may be taken as fairly representative. "Brokers of pawn" are usually licensed by the mayors, or by the mayors and aldermen, but in Boston the police commissioners are the licensing authority. In the State of New York permits are renewable annually on payment of $500, and the pawnbroker must file a bond with the mayor, executed by himself and two responsible sureties, in the sum of $10,000. The business is conducted on much the same lines as in England, and the rate of interest is 3% per month for the first six months, and 2% monthly afterwards. Where, however, the loan exceeds $100 the rates are 2 and 1% respectively. To exact higher rates is a misdemeanour. Unredeemed pledges may be sold at the end of a year. Pawnbrokers are not allowed to engage in any kind of second-hand business. In the state of Massachusetts unredeemed pledges may be sold four months after the date of deposit. The licensing authority may fix the rate of interest, which may vary for different amounts, and in Boston every pawnbroker is bound to furnish to the police daily a list of the pledges taken in during the preceding 24 hours, specifying the hour of each transaction and the amount lent.

Municipal Pawnshops.—The fact that on the continent of Europe monts de piété are almost invariably either a state or a municipal monopoly necessarily places them upon an entirely different footing from the British pawnshop, but, compared with the English system, the foreign is often very elaborate and rather cumbersome. Moreover, in addition to being slow in its operation, it is, generally speaking, based upon the supposition that the borrower carries in his pockets "papers" testifying to his identity. On the other hand, it is argued that the English borrower of more than £2 is at the mercy of the pawnbroker in the matter of interest, that sum being the highest for which a legal limit of interest is fixed. The rate of interest upon a "special contract" may be, and often is, high. For the matter of that, indeed, this system of obtaining loans is always expensive, either in actual interest or in collateral disadvantages, whether the lender be a pawnbroker intent upon profit, or the official of a mont de piété. In France pawnshops are a municipal monopoly held in Paris by the Crédit Municipal and the head institution claims to be the greatest pawnshop in the world. Officially styled "Mont de Piété" it is popularly known as "ma tante," just as the pawnbroker in England is often called "my uncle." It is, however, something

more than a pawnshop and, in certain respects, fulfils some of the functions of a bank. The Crédit Municipal was founded by Louis XVI. and was opened in 1777, since which time it has been maintained by every successive government; Napoleon recognized it in 1804. By degrees the business increased so considerably that branches had to be opened in many quarters of Paris, and there are now twenty of them. Broadly speaking the Crédit Municipal lends on all marketable articles, and its customers are by no means limited to the poorer classes. The well-to-do, for example, when leaving Paris for the summer, often pawn their silver, the operation costing less than the hire of the necessary space in a safe deposit. The minimum loan is three francs. The habit of pawning clothes and wearing apparel is steadily decreasing, while the deposit of jewellery and other valuables is growing. The one tendency is due to the increased prosperity of the working classes; the other to the high cost of living. Advances are made for six months, and if they are not then repaid the loan may be renewed for a similar period. If at the end of a year the loan is neither repaid nor renewed, the pledge is sold, the borrower receiving the difference between the amount of the debt and the price obtained for the pawned article. The borrower may, however, repay by instalments. Rates of interest vary, but bank and Stock Exchange rates are followed as closely as possible and the average is about 7%. On pledges valued at more than 500 francs the interest is slightly higher than on those of smaller worth; on shares the rate is usually a little lower. Since 1919 traffic in pawn tickets has been forbidden. The law of July 25th, 1891, authorized the Crédit Municipal to lend money on stocks and bonds accepted or guaranteed by the Banque de France, such as Government and municipal issues. Loans on these paper securities are limited to 3,000 francs, but it is considered probable that the limit will presently be raised to 10,000 francs.

The profits of the Crédit Municipal are paid over to the "Assistance Publique," the comprehensive term used to indicate the body of charitable foundations. Originally this was the rule throughout France, but now many of the monts de piété are entirely independent of the charitable institutions. Provincial monts de piété can only be created by decree of the President of the Republic, with the consent of the local Conseil Communal; the mayor is the president. The administrative council is drawn one third each from the Conseil Communal, the governors of charitable societies and the townspeople. A large proportion of the capital required for conducting the institutions has to be raised by loan, while some part of the property they possess is the product of gifts and legacies. The amount to be advanced by a municipal pawnshop is fixed by an official called the *commissaire-priseur*, who is compelled to load the scales against the borrower, since, should the pledge remain unredeemed and be sold for less than was lent upon it, he has to make good the difference. This official is paid at the rate of ½% upon loans and renewals, and 3% on the amount obtained by the sales of forfeited pledges. The maximum and minimum that may be advanced are fixed. Somewhere between forty and fifty French towns possess municipal pawnshops, a few of which, like those of Grenoble and Montpellier, having been endowed, charge no interest.

Germany and Austria.—Pawnbroking in Germany is conducted at once by the state, by the municipalities, and by private enterprise; but of all these institutions the state loan office in Berlin is the most interesting. It dates from 1834, and the working capital was found, and still continues to be provided, by the Prussian State Bank. The profits are invested, and the interest devoted to charitable purposes. The maximum and minimum rates of interest are fixed, but the rate varies with the situation of the money market; the private pawnshops usually charge a higher rate than the state office. Two-thirds of the estimated value is the usual extent of a loan; four-fifths is advanced on silver, and five-sixths on fine gold. Before the inflation which followed the World War state and municipal bonds might be pledged up to a maximum of £150, the advance being 80% of the value, and a fixed interest of 6% was charged upon these securities. During and after the inflation securities could not be pledged; now, however, money is again being advanced upon state bonds.

The pawnbroking laws of Austria and Hungary are somewhat similar to those which prevail in England. Free trade exists, and the private trader has to obtain a government concession and deposit caution-money varying in amount from £80 to £800, according to the size of the town. He has, however, to compete with the monts de piété or Versatzaemer, which are sometimes municipal and sometimes state institutions. The chief of these is the imperial pawn office of Vienna, which was founded with charitable objects by the emperor Joseph I., in 1707, and one-half of the annual surplus has still to be paid over to the Vienna poor fund, though these payments are at present suspended. Here, as in Berlin, the profits are relatively small. Interest which, after the War, was very high, is calculated in fortnightly periods, however speedily redemption may follow upon pawning. Six months, with an additional period of six months, is the maximum period. The Hungarian state and municipal institutions appear, on the whole, to compete somewhat more successfully with the private firms than is the case in Vienna. The practice in Bohemia, Moravia and Silesia is still governed by the old Austrian law. In Czecho-Slovakia it conforms to the former Hungarian laws.

Italy.—In Italy, the "country of origin" of the mont de piété, the institution still flourishes. Four-fifths of the value is lent upon gold, one-half upon precious stones, and two-thirds upon other articles. The interest is 7% on all sums. The loans are of two types, one for a period of three months, the other for one year. A little less is lent if the owner of the pledge asks for a loan for a year. At every renewal the pledge is again estimated and if its value has diminished the debtor can choose between paying off the loan, having the object sold, or paying the difference between the first and the second estimate if he insists on a renewal. A fortnight must elapse after the day on which the payment is due before the pledge can be sold. The difference between the selling price and the sum lent goes to the owner. In addition to the interest the mont de piété retains 1% for the ticket, whatever the amount lent. The mont de piété's agencies retain an extra 2% on the loans. Private agencies have been suppressed.

Spain and Portugal.—The monts de piété in Spain have for a generation past been inseparably connected with the savings banks. We have already seen that the institution owes its origin in that country to the charitable exertions of a priest who charged no interest, and the system grew until in 1840, a century after his death, the mont de piété began to receive the sums deposited in the savings bank, which had just been established, for which it paid 5% interest. In 1869 the two institutions were united. This official pawnshop charges 6% upon advances which run for periods varying from six to twelve months, according to the nature of the article pledged, and a further month's grace is allowed before the pledges are sold by auction; 7% is usually lent upon jewellery. Private pawnbrokers are also very numerous, especially in Madrid; but their usual charges amount to about 60% per annum.

In Portugal the monte pio is an amalgamation of bank, benefit society and pawnshop. Its business consists chiefly in lending money upon marketable securities, but it also makes advances upon plate, jewellery and precious stones, and it employs officially licensed valuers. The rate of interest varies with the bank rate, which it slightly exceeds, and the amount advanced upon each article is about three-fourths of its certified value. There is in Portugal a second class of loan establishment answering exactly to the English pawnshop. The pawnbroker is compelled to deposit a sum, in acceptable securities, equal to the capital he proposes to embark, and the register of his transactions must be submitted quarterly to the chief of the police for examination.

Russia.—In the Union of Socialist Soviet Republics pawnshops are exclusively a state institution regulated by law and managed by the urban Soviets. The ordinary objects are accepted in pledge, but paper securities are barred. Articles may be pledged for a total period of fourteen months, but in the first place for four months only. There can then be a two months' renewal, followed by another of four months, with the right to a further prolongation of two months, with a final two months to complete the total permissible period. As much as 90% of their value may be lent

upon the precious metals, but not more than 75% upon other goods. The rate of interest is fixed by the urban Soviets, and ratified by the People's Commissar for Finance, and varies from town to town. In Moscow it is 1½% per month on pledges ranging in value from 1 to 15 roubles, 1¾% on those ranging from 15 to 25 roubles, and 2% for those of higher value.

Scandinavia.—Pawnbroking in Denmark has existed since 1688, but in 1753 the Royal Naval Hospital was granted the exclusive right to establish a "Royal Lombard" for advancing money on pledges, and was allowed to charge higher interest than the law permitted. The "Royal Lombard" still exists and does a very extensive business. The rate of interest is 1½% per month. The duration of a loan is three months, renewals being allowed. The old law was extended in 1867, when pawnbrokers were required to be licensed by the municipalities and to pay a small annual licensing fee. The rate of interest was such as might be agreed upon. The business is now regulated by a law of 1921 which applies both to the "Royal Lombard" and to private pawnbrokers, and limits the rate of interest. Up to Jan. 1st, 1926, the maximum rate of interest was 5% a month; from Jan. 1st, 1926, to Jan. 1st, 1936, it is fixed at a maximum of 4% a month, and from Jan. 1st, 1936, the maximum will be 1½% a month. During any of these periods a lower maximum rate of interest may, however, be fixed by the police in the various jurisdictions. All unredeemed pledges may eventually be sold by auction, though the loan may be renewed at any time before the sale. The Act of 1921, which also limits the granting of pawnbrokers' licences, will presumably result in the gradual disappearance of professional pawnbrokers, the greatly reduced rate of interest leaving but a small margin of profit.

In Sweden there are no special statutes affecting pawnbroking, with the exception of a proclamation by the Governor of Stockholm prohibiting the lending of money upon articles which may be suspected of having been stolen. Individuals still carry on the business on a small scale, but the bulk of it is now conducted by companies, which give general satisfaction. For many years there was in Stockholm a municipal establishment charging 10% for loans paid out of the city funds. The cost of administration was, however, so great that there was an annual loss upon its working, and the opportunity was taken to abolish it when, in 1880, a private company was formed called the "Pant Aktie Bank," to lend money on furniture and wearing apparel at the rate of 3 öre per krone a month, and 2 öre per krone a month on gold, silver and other valuables; a krone (nominal value, 1s. 1½d.) contains 100 öre. Some years later an opposition was started which charged only half these rates, with the result that the original enterprise reduced its interest to the same level, charging, however, 2 öre per krone per month for bulky articles—a figure which is now usual for pledges of that description. The money is lent for three months, and at the end of five months the pledge, if unredeemed, is sold by auction under prescribed conditions.

In Norway a police licence is required for lending money on pawn where the amount advanced does not exceed £4, 10s. Beyond that sum no licence is necessary, but the interest charged must not exceed such a rate as the king may decide.

Switzerland.—The fate of pawnbroking in Switzerland appears to be not very dissimilar from that of the Jew who is fabled to have once started in business at Aberdeen. Nevertheless the cantons of Bern and Zürich have elaborate laws for the regulation of the business. In both the broker must be licensed by the cantonal government, and the permit can be refused only when the applicant is "known to be a person undeserving of confidence." Regular books have to be kept, which must be at all times open to the inspection of the police, and not more than 2% interest per month may be charged upon loans up to 50 francs, 1½% between 50 and 300 francs, and 1% over 300 francs. A loan runs for six months, and unredeemed pledges may be sold by auction a month after the expiration of the fixed period, and then the sale must take place in the parish in which the article was pledged. The business is unprofitable owing to the low rate of interest, and in the cantons of Bern, Fribourg and Neuchâtel there are only two pawnbrokers. The Zürich cantonal bank, however, conducts a pawnbroking department, which lends nothing under 4s. or over £40 without the special sanction of the bank commission. Loans must not exceed two-thirds of the trade value of the pledge, but 80% may be lent upon the intrinsic value of gold and silver articles. The establishment makes practically no profit.

See C. L. Attenborough, *The Law of Pawnbroking* (1913; new edn., 1925); S. W. Levine, *The Business of Pawnbroking* (N.Y., 1913); F. Astier, *Des Monts-de-Piété en France* (Paris, 1913); L. Degani, *I Monti di Pietà* (Turin, 1916); Hetyer, *Das gegenwärtige öffentliche Leihaus in Deutschland* (Leipzig, 1907). (J. P. B.)

PAWNEE, an important Caddoan tribe, or group of four tribes—the Chaui, Kitkehahki, Pitahauerat and Skidi—formerly on Platte river, Nebraska. They were bison hunters, but also farmed, practised agricultural rites and lived in earth lodges. Their highest deity was Tirawa. Symbolism was developed in their religion, which included a star cult and a summer solstice sacrifice of a captive girl to the morning star. Their organization was primarily into villages; there are indications of matrilineal descent. They fought the Dakota, Cheyenne and other tribes, were friendly to the whites, but suffered at their hands through encroachment, disease and alcohol. In 1823 their chief village was burned by hostile Delawares. By treaty in 1833 they had ceded their territory south of the Platte, and in 1838 they surrendered all their remaining land except a strip on the Loup river. Here they lived until 1874, when they moved to the Oakland reservation in Indian Territory, now Oklahoma. They were formerly one of the most powerful of the plains tribes. Until nearly 1840, the population was 10,000; in 1849 it was 4,500; 1861, 3,400; 1879, 1,400; 1906, 600. *See* A. C. Fletcher, *Bur. Am. Ethn. Rep.* xxii. (1904).

PAWTUCKET, a city of Providence county, Rhode Island, U.S.A., on the Blackstone river (known here as the Pawtucket or the Seekonk), 4 m. N. of Providence and adjoining Central Falls. It is served by the New York, New Haven and Hartford railroad, motor-bus and truck lines and a steamboat line (for freight) to New York. Pop. (1920) 64,248 (33% foreign-born white, largely English, French-Canadians, Irish and Scots); 1928 local estimate 72,100. The city has an area of 8·6 sq.m., lying on both sides of the river, which in the heart of the business district makes a picturesque plunge of 50 ft. over a mass of rocks, providing good water-power. It is the second city of the State in size and in the value of its manufactures, which in 1925 amounted to $108,281,019. Textiles are the leading products. Almost every branch of cotton-manufacturing is represented, and there are many silk and rayon mills. Tennis racquets, machine tools and textile machinery are also distinctive products. The river has been improved by the Federal Government since 1867, until there is now a 16 ft. channel all the way to Narragansett bay; and the State has built a pier. The city's parks cover 242 ac., and its most conspicuous building is a fine new high school on the river-bank, built in 1926 at a cost of $1,700,000. The assessed valuation of property for 1927 was $135,231,540. The first settlement within the present city limits was made on the west side of the river about 1670 by Joseph Jenks, an iron worker, and the village became a centre of skilful and inventive ironmongers. In 1790 Samuel Slater found here the mechanical skill necessary to reproduce the Arkwright machinery for the manufacture of cotton goods. His mill (still standing) was the first successful factory of the kind in the United States. The part of Pawtucket which lies east of the river was originally in Massachusetts, and was transferred to Rhode Island in 1862; the part west of the river was annexed to Pawtucket from North Providence in 1874; and in 1885 the town was chartered as a city. The name is an Indian word meaning "fall of the waters."

PAX, the name given in ecclesiastical usage to a small panel or tablet decorated usually with a representation of the Crucifixion, which in the Roman ritual was kissed at the eucharistic service by the celebrating priest, then by the other clergy and the congregation. The use of the "pax" dates from the 13th century, and is said to have been first introduced in England in 1250 by Archbishop Walter of York. It took the place of the actual "kiss of peace" which was in the Roman Mass given by the bishop to the priests, and by them to the deacons and so to the laity, between

the consecration and communion, and which survives in symbolical form at High Mass. In the Greek Church the kiss (*εἰρήνη, ἀσπασμός*) takes place before the consecration, and now consists in the celebrant kissing the oblation and the deacon kissing his stole (*see* F. E. Brightman, *Liturgies Eastern and Western*, 1896). *See* the *Catholic Encyclopaedia, s.v.* "Pax."

PAXO [Paxos], one of the Ionian Islands (*q.v.*), about 8 m. S. of the south end of Corfu, is a hilly mass of limestone 5 m. long by 2 broad, and not more than 600 ft. high. Pop. *c.* 5,400. It produces excellent olive oil. Gaion (or, less correctly, Gaia), the principal village, lies on the E. coast, and has a small harbour. Towards the centre, on an eminence, stands Papandi, the residence of the bishop, and there are many churches with picturesque belfries. On the W. and S.W. coasts are remarkable caverns (Davy, *Ionian Islands*, i. 66–71). Ancient writers apply the plural form Paxi to Paxos and the smaller island now known as Antipaxo (Propaxos of the *Antonine Itinerary*). Paxos is the scene of the legend, in Plutarch's *De defectu oraculorum*, of the cry "Pan is dead." (*See* Pan.)

PAXTON, SIR JOSEPH (1801–1865), an English architect and ornamental gardener, who was born of humble parents at Milton Bryant, near Woburn, Bedfordshire, on Aug. 3, 1801. He was in 1823 employed in the arboretum at Chiswick, the seat of the duke of Devonshire, and eventually became superintendent of the duke's gardens and grounds at Chatsworth, and manager of his Derbyshire estates. In 1836 he began to erect a grand conservatory 300 ft. in length, which was finished in 1840, and formed the model for the Great Exhibition building of 1851. Perhaps Paxton's most interesting design was that for the mansion of Baron James de Rothschild at Ferrières in France, but he designed many other important buildings. He was M.P. for Coventry from 1854 until his death at Sydenham on June 8, 1865.

His works include: a *Practical Treatise on the Culture of the Dahlia* (1838), and a *Pocket Botanical Dictionary* (1st ed., 1840).

PAYA, a tribe of Indians living in north-eastern Honduras on the upper part of the Patuca river. Formerly they probably occupied the north coast from Trujillo to Cape Gracias. The linguistic relationship of the Paya tongue is uncertain; there is a tendency to regard the Payas, with their neighbours, the Jicaque, as the northern frontier of South American penetration in Central America.

See Karl Sapper, "Die Payas in Honduras," in *Globus,* bd. lxxv., Heft 2.

PAYMENT, the performance of an obligation, the discharge of a sum due in money or the equivalent of money. In law, in order that payment may extinguish the obligation it is necessary that it should be made at a proper time and place, in a proper manner, and by and to a proper person.

Payment may be made at any time of the day upon which it falls due, except in the case of mercantile contracts, where the creditor is not bound to wait for payment beyond the usual hours of mercantile business. If no place be fixed for payment, the debtor is bound to find, or to use reasonable means to find, the creditor, unless the latter be abroad. Payment must be made in money which is a legal tender, unless the creditor prefers to waive his right to payment in money by accepting some other mode of payment, as a negotiable instrument or a transfer of credit. If the payment be by negotiable instrument, the instrument may operate either as an absolute or as a conditional discharge. In the ordinary case of payment by cheque the creditor accepts the cheque conditionally upon its being honoured; if it be dishonoured, he is remitted to his original rights. If payment be made through the post, in a letter properly directed, and it be lost, the debt is discharged if there was a direction so to transmit the money. Payment must be made to the creditor or his agent. A *bona fide* payment to an apparent agent may be good, though he has in fact no authority to receive it. Such payment will usually be good where the authority of the agent has been countermanded without notice to the debtor. The fact of payment may be presumed, as from lapse of time. Thus payment of a testator's debts is generally presumed after 20 years. A written receipt (*q.v.*) is only presumptive and not conclusive evidence of payment. If payment be made under a mistake of fact, it may be recovered, but it is otherwise if it be made under a mistake of law, for it is a maxim of law that *ignorantia legis neminem excusat.* Money paid under compulsion of law, even though not due, cannot generally be recovered where there has been no fraud or extortion. For appropriation of payments *see* Appropriation.

Money may be paid into court to abide the result of pending litigation, as where litigation has already begun, as security for costs or as a defence or partial defence to a claim. Payment into court does not necessarily (except in actions for libel and slander) operate as an admission of liability. Money may sometimes be paid into court where no litigation is pending, as in the case of trustees. The payment of wages to labourers and workmen otherwise than in coin is prohibited. *See* under Labour Law: *Truck Acts.* Domestic or agricultural servants are excepted. *See* also Limitation, Statutes of.

Scotland.—The law of Scotland as to tender of payment agrees with that of England, except that Bank of England notes are not legal tender, and that part payment if accepted in full satisfaction extinguishes the whole debt. Scots laws, however, recognizes two presumptions in regard to payment. *Debitor non praesumitur donare,* an unascribed payment if accepted by the creditor must be imputed to account of the debt, but where there are several debts the creditor may choose which debt he will impute the payment to. *Donatio non praesumitur* is applied as meaning that where a stranger pays the debt he is presumed to have paid it with the debtor's money. Payment or satisfaction is also presumed from lapse of time, *i.e.*, (1) three years from the last entry in merchant's accounts, (2) five years from the tenant's removal in the case of rent, (3) six years in the case of bills, and (4) 20 years in the case of obligations contained in holograph writings. Where a debt is constituted by writ or is the result of a credit transaction, payment cannot be proved by witnesses.

United States.—In the United States the law as a rule does not materially differ from English law. In some States, however, money may be recovered, even when it has been paid under a mistake of law. The question of legal tender has been an important one. In 1862 and 1863 Congress passed acts making treasury notes legal tender (*see* Greenbacks). After much litigation, the Supreme Court of the United States decided in 1871 (*Knox* v. *Lee*) in favour of the constitutionality of these acts, both as to contracts made before and after they were passed. These notes are legal tender for all purposes except duties on imports and interest on the public debt. All gold coins and standard silver dollars are legal tender to any amount. Silver coins below the denomination of a dollar are legal tender up to $10, and cent and 5-cent pieces legal tender to an amount not exceeding 25 cents. It falls exclusively within the jurisdiction of Congress to declare paper or copper money a legal tender. By the constitution of the United States, "no State shall . . . make anything but gold and silver coin a tender in payment of debts" (art. i. s. 10).

A number of American States have by statute or decision departed from the general rule that a receipt in full is insufficient to make an agreed part payment discharge the entire debt. And it should be noted further that a certified check, though commonly accepted, is not legal tender. The most important present class of legal tender is the Federal Reserve note.

See I. Williston, *Contracts* § 120; R. Pound, 18 *Yale L. J.* 454.

PAYMENT BY RESULTS. A term used to describe various methods of wage remuneration in which some inducement is held out to the wage-earner to increase his pay by increased production. The simplest method is to pay a straight rate per piece, so that the worker draws remuneration in strict proportion to the number of units of output produced by him. Such payment per piece may be accompanied by an agreement to pay a minimum wage whatever the output.

The premium-bonus system is an interesting form of payment by results. The essence of this system is to fix by agreement between employer and employed a basis time for the completion of a definite unit of work. At the same time, the workman is guaranteed a time-rate of wage. If the worker accomplishes the unit of work in less than the basis time, he receives, over and

PAYN, JAMES (1830–1898), English novelist, was born at Cheltenham, on Feb. 28, 1830. He edited *Chambers's Journal* with much success for 15 years. He removed to London in 1861. In the pages of the *Journal* he published in 1864 his most popular story, *Lost Sir Massingberd*. Payn wrote some hundred novels, among the best known being *Carlyon's Year* (1868), *By Proxy* (1878), and *The Talk of the Town* (1885). In 1883 he succeeded Leslie Stephen as editor of the *Cornhill Magazine* and continued in the post until the breakdown of his health in 1896. He died in London, on March 25, 1898.

A biographical introduction to his *The Backwater of Life* was furnished by Sir Leslie Stephen.

PAYNE, JOHN HOWARD (1791–1852), American actor and playwright, was born in New York city, on June 9, 1791. When but 14 years of age, Payne established and edited *The Thespian Mirror*, of which 14 numbers were published. In 1806 he published *Julia*, his first play, which was performed at the Park theatre, New York city, the same year. On Feb. 24, 1809, also at the Park theatre, Payne made his début as an actor, playing the part of Norval in the tragedy of *Douglas*. His instant success in this rôle was followed by successes as Zaphno in *Mahomet*, Octavian in *The Mountaineers*, Salem in *Barbarossa*, Tancred in *Sigismonda* and Romeo in *Romeo and Juliet*. In 1813 he was engaged at the Drury Lane theatre in London. He remained in England or France for nearly 20 years as an actor and playwright. During his stay in Europe he wrote, translated, or adapted for the English stage more than 60 plays. For a time he was employed by the Drury Lane theatre to live in Paris and make translations and adaptations of French drama. In 1818 he wrote *Brutus*, which, produced at Drury Lane with Edmund Kean in the title rôle, ran for 50 nights. It speedily became a favourite in America and formed part of the regular repertoire of McCullough, Edwin Forrest and Edwin Booth In May 1823 his opera, *Clari; or the Maid of Milan*, was performed at the Covent Garden theatre, London. This is the opera in which his famous song *Home Sweet Home* appears, and it was first sung on that occasion by Ann Maria Tree. Washington Irving was Payne's constant friend and adviser while in England and aided him materially in writing the popular *Charles the Second*. Payne was the first American who as an actor or playwright attracted a great deal of attention in England He corresponded with Charles Lamb, and cherished an ardent but unrequited love for Mary Shelley. In 1832 Payne returned to America. He became interested in the Cherokee Indians with whom he lived for a time in the hut of John Ross, their famous chief. He espoused their cause against the Government in memorials and magazine articles, and collected their myths and traditions In 1842 President Tyler appointed him American consul at Tunis, Africa, but he was recalled in 1845. In 1851 he was reappointed to his old post. He died at Tunis on April 9, 1852.

Bibliographies of Payne's writings are found in *The Literary Collector* (Mar. 1905), and in the *Cambridge History of American Literature*, vol. i. (1917). *See* G. Harrison, *Life and Writings of John Howard Payne* (1875); C. H Brainard, *John Howard Payne* (1885); Bibliophile Society, *Romance of Mary W. Shelley, John Howard Payne and Washington Irving* (1907); W. T. Hanson, *Early Life of John Howard Payne* (1913).

PAYNE, PETER (*c.* 1380–1455), English Lollard and Taborite, the son of a Frenchman by an English wife, was born at Hough-on-the-Hill near Grantham, about 1380. He was educated at Oxford, where he adopted Lollard opinions, and had graduated as a master of arts before Oct. 6, 1406, when he was concerned in the irregular proceedings through which a letter declaring the sympathy of the university was addressed to the Bohemian reformers From 1410 to 1414 Payne was principal of St. Edmund Hall, and during these years was engaged in controversy with Thomas Netter of Walden, the Carmelite defender of Catholic doctrine. In 1414 he was compelled to leave Oxford and taught for a time in London.

Ultimately Payne took refuge in Bohemia, where he became a leader of the reformers at Prague. He joined the sect of the "Orphans," and had a prominent part in the discussions and conferences of the ten years from 1420 to 1430. Payne was one of the Bohemian delegates to the council of Prague. He arrived at Basel on Jan. 4, 1433, and his unyielding temper and bitter words probably did much to prevent a settlement. The Bohemians left Basel in April. The party of the nobles, who had been ready to make terms, were attacked in the Diet at Prague, by the Orphans and Taborites. Next year the dispute led to open war. The nobles were victorious at Lipau on May 29, 1434, and it was reported in England that Payne was killed. When soon afterwards the majority of the Orphans joined the moderate party, Payne allied himself with the more extreme Taborites. In Feb. 1437 the pope desired the emperor Sigismund to send Payne to be tried for heresy at Basel. Payne took refuge with Peter Chelcicky, the Bohemian author. Two years later he was captured and imprisoned at Gutenstein, but was ransomed by his Taborite friends. Payne took part in the conferences of the Bohemian parties in 1443–1444, and again in 1452. He died at Prague in 1455. Payne was also known as Clerk at Oxford, as Peter English in Bohemia, and as Freyng, after his French father, and Hough from his birth place.

Bibliography.—The chief facts of Payne's English career are given in the *Loci e libro veritatum* of T. Gascoigne (ed. Thorold Rogers, Oxford, 1881). For his later life the principal sources are contained in the *Monumenta conciliorum generalium saeculi v*, *Saeculi xv*, or *saeculi quintodecimi*, vols. i.–iii. (Vienna, 1857–1894). For modern authorities consult Palacky, *Geschichte von Bohmen*, vii.–ix., and Creighton's *History of the Papacy*. The biography by James Baker, *A Forgotten Great Englishman* (1894), is too partial.

PAYNTER (or Painter), **WILLIAM** (*c.* 1540–1594), English author, was a native of Kent He matriculated at St. John's college, Cambridge, in 1554. In 1561 he became clerk of the ordnance in the Tower of London, a position in which he appears to have amassed a fortune out of the public funds. In 1586 he confessed that he owed the government a thousand pounds, and in the next year further charges of peculation were brought against him. In 1591 his son Anthony owned that he and his father had abused their trust, but Paynter retained his office until his death. The first volume of his *Palace of Pleasure* appeared in 1566. It included 60 tales, and was followed in the next year by a second volume containing 34 new ones. A second improved edition in 1575 contained seven new stories Paynter borrows from Herodotus, Plutarch, Aulus Gellius, Aelian, Livy, Tacitus, Quintus Curtius; from Giraldi Cinthio, Matteo Bandello, Ser Giovanni Fiorentino, Straparola, Queen Margaret of Navarre and others. To the vogue of this and similar collections we owe the Italian setting of so large a proportion of the Elizabethan drama. The early tragedies of *Appius and Virginia*, and *Tancred and Gismund* were taken from *The Palace of Pleasure*; and among better-known plays derived from the book are the Shakespearian *Timon of Athens*, *All's Well that Ends Well* (from Giletta of Narbonne), Beaumont and Fletcher's *Triumph of Death* and Shirley's *Love's Cruelty*.

The Palace of Pleasure was edited by Joseph Haslewood in 1813. This edition was collated (1890) with the British Museum copy of 1575 by Mr. Joseph Jacobs, who added further prefatory matter, including an introduction dealing with the importance of Italian *novelle* in Elizabethan drama.

PAYSANDÚ, the second city of Uruguay in importance, capital of a department of the same name, is situated upon the east bank of the Uruguay river, about 214 m. N W. of Montevideo. Pop. (1928 estimate) 24,000. Growth is constant because of immigration and a favourable climate. The Uruguay river is navigable for steamers of 14 ft. draft and Paysandú has become an important port. Regular steamer communication is maintained with Buenos Aires and Montevideo. A railway connects with Montevideo toward the south-east, and another penetrates the northern country to the Brazilian frontier Paysandú is the centre of the meat packing and frozen meat industry of the republic, and also possesses breweries, sawmills, creameries, canning establishments, tanneries, flour mills, etc. It has a street car system, electric lights, a public library, theatre, two public markets, hospital, meteorological observatory. There are some good government buildings, and several bank and hotel buildings in modern style. The town was named in honour of Pay Sandú, a priest.

The department of Paysandú—area, 5,117 sq m.; pop. (1928 estimate) 90,523—is one of the richest stock-raising regions.

PAZ SOLDAN, MARIANO FELIPE (1821–1886), Peruvian historian and geographer, was born at Arequipa, on Aug 22, 1821. He studied law, and after holding some minor judicial offices, was minister to New Granada in 1853 In 1860 Castilla made him director of public works In 1861 he published his great atlas of the republic of Peru, and in 1868 the first volume of his history of Peru after the acquisition of her independence A second volume followed, and a third, bringing the history down to 1839, was published after his death by his son In 1870 he was minister of justice and worship under President Balta, but shortly afterwards retired from public life to devote himself to his great geographical dictionary of Peru, which was published in 1877 During the disastrous war with Chile he sought refuge at Buenos Aires, where he was made professor in the National college, and where he wrote and published a history of the war, *Historia de la Guerra del Pacifico* (1884) He died at Lima on Dec 31, 1886

PEA (*Pisum*), a genus of the family Leguminosae, consisting of herbs with compound pinnate leaves ending in tendrils, by means of which the weak stems are enabled to support themselves, and with large leafy stipules at the base The flowers are typically "papilionaceous" (*see* LEGUMINOSAE) with a "standard" or large petal above, two side petals or wings, and two front petals below forming the keel The stamens are ten—nine united, the tenth usually free or only slightly joined to the others This separation allows approach to the honey which is secreted at the base of the staminal tube The ovary is prolonged into a long, thick, bent style, compressed from side to side at the tip and fringed with hairs The fruit is a characteristic "legume" or pod, bursting when ripe into halves, which bear the large globular seeds (peas) on their edges These seeds are on short stalks, the upper extremity of which is dilated into a shallow cup (*aril*), the two seed-leaves (*cotyledons*) are thick and fleshy, with a radicle bent along their edges on one side

The genus is exceedingly close to *Lathyrus*, being only distinguished technically by the style, which in the latter genus is compressed from above downwards and not thick It is not surprising therefore, that under the general name "pea" species both of *Pisum* and of *Lathyrus* are included The common field pea with purple flowers, tan-coloured or compressed mottled seeds and two to four leaflets is *Pisum arvense*, which is cultivated in all temperate parts of the globe, but which according to the Italian botanists, is truly a native of central and southern Italy The garden pea, *P sativum*, which has white flowers, is more tender than the preceding, and its origin is not known, it has not been found in a wild state, and it is considered that it may be a form of *P arvense*, having, however, from four to six leaflets to each leaf and globular seeds of uniform colour

P sativum was known to Theophrastus and De Candolle (*Origin of Cultivated Plants*, p 329) points out that the word "pison" or its equivalent occurs in the Albanian tongue as well as in Latin, whence he concludes that the pea was known to the Aryans, and was perhaps brought by them into Greece and Italy Peas have been found in the Swiss lake-dwellings of the bronze period The garden peas differ considerably in size, shape of pod, degree of productiveness, form and colour of seed, etc The sugar peas are those in which the inner lining of the pod is very thin instead of being somewhat horny, so that the whole pod can be eaten Unlike most papilionaceous plants, peaflowers are self-pollinated The numerous varieties of peas in cultivation have been obtained by cross-fertilization, and also by selection Peas constitute a highly nutritious article of diet from the large quantity of nitrogenous materials they contain in addition to substantial amounts of starchy and saccharine matters

The sweet pea, cultivated for the beauty and fragrance of its flowers, is a species of the allied genus *Lathyrus* (*L odoratus*), a native of southern Europe The chick pea (*q v*) (*Cicer arietinum*), cultivated in many countries, is still farther removed from the true peas The everlasting pea of gardens is a species of *Lathyrus* (*L latifolius*) with very deep fleshy roots, bold foliage, and beautiful but scentless flowers

The field pea (*Pisum arvense*) is better adapted than the bean to light soils, and is best cultivated in rows of such a width as to admit of horse-hoeing The early stage at which the plants fall over, and forbid further culture, renders it even more needful than in the case of beans to sow them only on land already clean If annual weeds can be kept in check until the peas once get a close cover, they then occupy the ground so completely that nothing else can live under them, and the ground after their removal, is found in the choicest condition A thin crop of peas should never be allowed to stand, as the land is sure to become wholly overrun with weeds, these will completely choke the growth of the peas The difficulty of getting this crop well harvested renders it peculiarly advisable to sow only the early varieties

The pea prefers a friable calcareous loam deeply worked, and well enriched with good hotbed or farm-yard manure The early crops require a warm sheltered situation but the later are better grown 6 or 8 ft apart, or more, in the open quarters, dwarf crops being introduced between the rows The dwarf or early sorts may be sown 3 or 4 ft apart The deep working of the soil is of importance, lest the plants should suffer in hot dry weather from mildew or arrest of growth The first sowing may be made about the beginning or middle of November, in front of a south wall, the plants being defended by spruce fir branches or other spray throughout the winter In February sowings are sometimes made in private gardens, in flowerpots or boxes, and the young plants afterwards planted out The main crop should be sown towards the end of February, and moderate sowings should be made twice a month afterwards, up to the beginning of July for the north, and about the third week in July for warmer districts During dry hot weather late peas derive great benefit from mulching and watering The latest sowings at the middle or end of August, should consist of the best early sorts, as they are not so long in producing pods as the larger and finer sorts, and by this means the supply may be prolonged till October or November As they grow the earth is drawn up to the stems, which are also supported by stakes a practice which in a well-kept garden is always advisable, although it is said that the early varieties arrive sooner at maturity when recumbent

Peas grown late in autumn are subject to mildew, to obviate which it has been proposed to dig over the ground in the usual way and to soak the spaces to be occupied by the rows of peas thoroughly with water—the earth on each side to be then collected so as to form ridges 7 or 8 in high, these ridges being well watered, and the seed sown on them in single rows If dry weather at any time set in, water should be supplied profusely once a week

To produce very early crops the French market-gardeners used to sow early in November in frames, on a border having a good aspect, the seeds being covered very slightly The young plants are transplanted into other frames in December the ground inside being dug out so as to be 18 or 20 in below the sashes, and the earth thus removed placed against the outside of the frames The young plants, when 3 or 4 in high, are planted in patches of three or four 8 in asunder, in four longitudinal rows The sashes are covered at night with straw mats, and opened whenever the weather is sufficiently mild When 8 or 10 in high the stems are inclined towards the back of the frame, a little earth being drawn to their base, and when the plants come into blossom the tops are pinched out above the third or fourth flower to force them into bearing As soon as they begin to pod the soil may have a gentle watering, whenever sufficiently warmed by the sun but a too vigorous growth at an earlier period would be detrimental Thus treated the plants bear pods fit for gathering in the first fortnight in April

(V H B)

PEABODY, ELIZABETH PALMER (1804–1894), American educationist, was born at Billerica (Mass), on May 16, 1804 Educated at a small private school by her gifted mother, as were her sisters Sophia (Mrs Nathaniel Hawthorne) and Mary (Mrs Horace Mann), she began her own teaching at 16 Later she was assistant in A Bronson Alcott's famous Temple school, of which she published a *Record* (1835) Although overshadowed by Margaret Fuller, she was one of the leading feminine figures in the Transcendental movement, her West street book-

shop becoming a sort of club. She opened in Boston in 1860 the first kindergarten in America. In 1867 she went to Europe to study Froebel's methods at first hand, and thereafter through training classes, lectures, magazine contributions and her editing of the *Kindergarten Messenger* (1873–77) she spread the new theories. Her writing reflects her dominant interests. She died at Jamaica Plain, on Jan. 3, 1894.

See *Elizabeth Peabody,* a master's thesis from the University of Chicago, by Doris L. McCart (1918).

PEABODY, GEORGE (1795–1869), American philanthropist, was descended from an old yeoman family of Hertfordshire, England, named Pabody or Pebody. He was born in the part of Danvers which is now Peabody, Mass., on Feb. 18, 1795. After being apprenticed at a grocery store, he became assistant to his brother, and afterwards to his uncle, who had a business in Georgetown, District of Columbia. He served as a volunteer in the War of 1812, and afterwards became partner with Elisha Riggs in a dry goods store at Georgetown. Through his energy and skill the business increased with astounding rapidity, and, on the retirement of his partner about 1830, Peabody found himself at the head of one of the largest mercantile concerns in the world. About 1837 he established himself in London as merchant and money-broker at Wanford court, in the City, and in 1843 he withdrew from the American business.

Peabody gave £50,000 for educational purposes at Danvers; £200,000 to found and endow a scientific institute in Baltimore; various sums to Harvard university; £700,000 to the trustees of the Peabody Educational Fund to promote education in the southern States; and £500,000 for the erection of dwelling-houses for the working-classes in London. He received from Queen Victoria the offer of a baronetcy, but declined it. In 1867 the U.S. Congress awarded him a special vote of thanks. He died in London on Nov. 4, 1869; his body was carried to America in a British warship, and was buried in his native town.

See the *Life* (Boston, 1870) by Phebe A. Hanaford.

PEABODY, JOSEPHINE PRESTON (1874–1922), American poet, was born in Brooklyn, N.Y., in 1874, and educated at Radcliffe college. In 1898 she published *The Wayfarers: A Book of Verse.* Her later publications include *Fortune and Men's Eyes: New Poems with a Play* (1900); *Marlowe,* a drama (1901); *Pan: A Choric Idyl* (1904); *The Piper,* a play (1909); *The Singing Man* (1911); *The Wolf of Gubbio,* a play (1913); *Harvest Moon* (1916); *The Chameleon* (1917), and *Portrait of Mrs. W.,* a play (1922). *The Piper* won the Stratford-on-Avon prize and was produced at the Memorial theatre at Stratford in 1910. It was subsequently played in New York. Her plays are all poetic in form. She died at Cambridge, Mass., on Dec. 4, 1922.

See *Diary and Letters of Josephine Preston Peabody* (1925); *Collected Poems of Josephine Preston Peabody* (1927); and *Collected Plays of Josephine Preston Peabody* (1927).

PEABODY, a city of Essex county, Massachusetts, U.S.A., 13 m. N.E. of Boston; served by the Boston and Maine railroad. Pop. (1920) 19,552 (36% foreign-born white, largely from Greece, Ireland, Russia and Poland); 1928 local estimate 21,000. The city has an area of 17 sq. miles. Its factory output (principally leather, shoes, leather machinery and cotton goods) was valued in 1925 at $27,222,241. The area originally formed part of the town of Salem; then (1752) of the district and (1757) the town of Danvers. In 1855 it was separately incorporated as the town of South Danvers, and in 1868 the name was changed to honour George Peabody, the philanthropist, a native of the town. It was incorporated as a city in 1916.

PEACE, CHARLES (1832–1879), English criminal, was born at Darnley. He started his career as a Manchester portico robber, but in 1876 shot P. C. Cook, who attempted to capture him when burgling a house at Whalley Range. Though a man named Habron was sentenced for this (afterwards pardoned on Peace's confession) the police correctly ascribed to Peace the shooting of Arthur Dyson at Banner Cross in a quarrel over a woman. Peace then disappeared from police ken for years; he was in fact living in Evelina road, Peckham, as "Mr. Thompson, a gentleman of independent means," and at nights carried out the series of widespread burglaries which entirely baffled the police. He was arrested almost by accident on Blackheath, the police at first not knowing who he was, and hanged for the murder of Dyson in Feb. 1879. His plea that the killing was accidental in both cases was rejected, popular feeling being bitter against him. After his death he became a legendary figure, the wildest exploits being ascribed to him.

See *The Master Criminal, The Life Story of Charles Peace* (1910); R. W. Postgate, *Murder, Piracy and Treason* (1926).

PEACE, a river of western Canada. It rises in the Rocky mountains near 55° N., and breaking through the mountains, flows north-east into Slave river, near Lake Athabasca. The district between 56° 40′ and 60° N., and between 112° W. and the Rocky mountains is usually known as the Peace River district.

Here about Grande Prairie and Dunvegan some grove-like openings in the forests and a slightly longer growing season than obtains in the districts immediately surrounding, have attracted farming settlement. The Peace River district is now connected by railway with Edmonton and may soon seek an outlet across the Rockies to join the C.N. railway to Prince Rupert. Oats, vegetables and dairy farming do well. There are probably 12 million acres suitable for mixed farming in the Peace basin between Hudson Hope and Vermilion Chutes.

PEACE, freedom from war or hostilities; a state or relation of concord and amity. In international law, that condition of a nation not at war with another. Gudelinus in his *De jure pacis commentarius* (1620) defines peace as "tranquil freedom, contrary to war of which it constitutes the end and the destruction."

Although ever since the dawn of history war has been a recognised institution and custom, it has been increasingly realised, with the advance of civilisation, that the use of violence and force was an abnormal condition which ought to be entirely eliminated from human affairs. More particularly in the world as it now exists with a dense and rapidly rising population dependent for its maintenance and welfare on highly developed international communications, war means the paralysis, if not the actual destruction, of culture, economic progress and human civilisation. Modern weapons of warfare are now so efficient and destructive that hostilities can no longer be confined to the combatant forces of the belligerents, but bring disaster and the horrors of war to peaceful inhabitants without distinction of age or sex. The problem, therefore, of how best to prevent war assumes at present a more vital importance than it has ever had before.

Much reliance was placed in the past on the "balance of power" and on treaties of military alliance between the great Powers, but such schemes utterly failed to maintain peace in the world. In proportion as they guaranteed immunity from attack to the Powers within the particular group, they tended to stimulate war with outside States and were in fact a cause rather than a prevention of war.

More progressive minds have based their plans for the preservation of peace on a federation or union of all the "civilised" Powers. The creation of an International Tribunal and of an International Legislature form a prominent feature of these schemes. On the other hand, more recent jurists believing that the society of nations is in a perpetual condition of anarchy because it possesses no code of law have advocated the codification of international law so as to render it universal and binding on all nations. Again, disarmament or at least the general limitation of armaments to the lowest possible point, has also been put forward as an essential element of peace.

As to the federation of States for the maintenance of peace, there are three plans which for their outstanding merit and because of the influence they have exercised on the present day organisation of the society of nations, deserve special attention. They are, in the chronological order of their publication, St. Pierre's *Projet pour rendre la paix perpétuelle en Europe;* Jeremy Bentham's *Plan for an Universal and Perpetual Peace* and Kant's *Zum ewigen Frieden.*

Abbe de St. Pierre.—St. Pierre's project, published in 1713, was the outcome of the difficulties attending the settlement of the

peace at the Conference of Utrecht which so much impressed the author that he set out at once to work a scheme for the abolition of war. The first article of the project provides that the twenty-four Christian States of Europe should form themselves into a perpetual alliance for their mutual security against both foreign and civil war and for the mutual guarantee of their respective possessions and of the treaties of peace. The third article enacts that the Allies were to renounce the right of making war against each other and first seek reconciliation through the mediation of the rest of the members of the alliance and, in the event of the failure of mediation, to refer the disagreement for arbitration to the "Senate of Peace" which thus became a permanent and compulsory arbitral court. The sanction for these provisions is contained in article 4 of the project which stipulates that if any of the Allies should refuse to comply with the award of the Senate, for which three-fourths of the votes were sufficient, or should ignore any of the regulations passed by the Alliance or should prepare to wage war, then the Alliance was to arm and act offensively against the contravening State until it was reduced to obedience.

Jeremy Bentham.—Bentham's plan was published in 1789 and is based upon two fundamental principles, both of which the author considered essential for the success of the peace movement:—(1) the reduction and fixation of the forces of the several States which composed the European Concert; (2) the emancipation of the colonial dependencies of each State as such colonies were a constant source of war. As a natural corollary to the preservation of peace, Bentham urged the establishment of an International Court of Judicature for the settlement of disputes between the States and also of a Common Legislature for recording the resolutions agreed to by the States and for placing under the ban of Europe any State which should refuse to conform itself to these resolutions. The most powerful instrument, however, for the sanction of these resolutions was public opinion, aided by the liberty of the Press and the suppression of secret diplomacy.

Immanuel Kant.—Kant's project for a perpetual peace (published in 1795) is based upon the same idea of a general federation of States, but is further developed on more general and universal lines The author lays down as a first condition of a perpetual peace that the civic constitution of every State adhering to the proposed league should be republican, viz., a form of government where every citizen participates by his representatives in the exercise of the legislative power and especially in that of deciding on the question of peace as against war. The second condition is that the public law of Europe should rest on a federation of *free* States. Nations cannot escape from the lawless condition which connotes wars unless they renounce, as private individuals have renounced, their uncivilised ways and submit themselves to obligatory public laws and form thus a *civitas gentium* which should gradually extend so as to comprise ultimately all the peoples of the world Here then is the first idea of an organisation which includes all nations, and not only the Christian or European States as in all the schemes that have preceded Kant's.

THE HAGUE PEACE CONFERENCES

The first time that a gathering of nations ever assembled for discovering means to maintain peace occurred in 1899 at The Hague Conference at which twenty-six States participated. The chief outcome of their deliberations was the Convention for the Pacific Settlement of International Disputes. The Second Peace Conference of 1907, which also met at The Hague and included the representatives of forty-four States—practically the whole of the world's then independent nations—re-affirmed the Convention and further developed it.

Mediation.—The first method advocated by The Hague Convention for the prevention of wars is Mediation (articles 2 to 8) Mediation itself was not a new instrument in international relations. Both the Peace Treaty of Paris, 1856, and the Berlin Act, 1885, provide for an appeal to mediation for the purpose of avoiding further conflicts in the Near East between the signatory Powers. But what is special in The Hague Convention is its generalisation which makes it applicable to all conflicts and the recognition that even States which are stranger to a dispute have a right to offer their good offices or mediation and that the exercise of this right must never be regarded as an unfriendly act.

Arbitration.—The second method put forward by The Hague Convention for the pacific settlement of disputes is Arbitration, which has in fact proved the best instrument for avoiding war in the past Since the period following the Napoleonic wars, arbitration has steadily increased and the impetus given to it by The Hague Conferences has further developed this "most equitable and efficacious" means for the preservation of peace. A "Permanent Court of Arbitration" was set on foot at The Hague in 1900 in accordance with the organisation provided in The Hague Convention. The fundamental principle is contained in Article 15 of the Convention:—"International arbitration has for its object the settlement of differences between States by judges of their own choice and on the basis of respect for law." In 1903 an important step was taken by Great Britain and France which agreed to submit to arbitration all disputes of a legal nature not involving their "vital interests, independence, honour or the interests of third States." Many other Powers followed the lead given by this treaty, but there is a serious drawback in the restrictive clause of vital interests and also in the fact that the question whether a dispute is of a legal nature or not is left to the discretion of the parties. The subject of compulsory arbitration was lengthily discussed at the Second Peace Conference, 1907, but no agreement to a Convention by absolute majority could be obtained although thirty-one States voted in its favour. The final Act of the Conference contains the following declaration:—"The Conference is unanimous in (1) admitting the principle of compulsory arbitration; (2) in declaring that certain disputes, in particular those relating to the interpretation and application of the provisions of international agreements, may be submitted to compulsory arbitration without any restriction." Meanwhile, arbitration treaties are multiplying. In the recent treaty concluded between the United States and France on February 6, 1928, and which is intended to serve as a model for similar treaties with the other Powers, the restrictive clause of vital interests, independence and honour has been suppressed and all legal disputes are declared to be subject to arbitration with the only exception of disputes which are within the "domestic" jurisdiction of either of the parties (including the Monroe doctrine for the United States) or involve the interests of third parties (France further reserved her obligations under the Covenant of the League of Nations.) In this respect, the new treaty is much more satisfactory as it expressly specifies the questions excluded from arbitration and avoids the use of phrases which can be construed as including almost all international disputes.

International Commissions of Inquiry.—For the investigation of facts likely to lead to a war and with which the parties are insufficiently acquainted, The Hague Peace Conferences recommend the setting up of International Commissions of Inquiry entrusted with the duty of examining these facts and reporting thereon. Disputes involving the honour or the vital interests of the parties are, however, expressly excluded This new institution was used for the first time in the Dogger Bank incident of 1904 and most probably averted war between Great Britain and Russia. In 1914 the so-called Bryan Peace Treaties were signed providing for the establishment of Permanent International Commissions of Inquiry in all cases, even those involving the honour and vital interests of the contracting Powers with the obligation imposed upon them to refrain from hostilities until the inquiry was over. Thirty-one States have so far adhered to these treaties

THE LEAGUE OF NATIONS

The League established as an integral part of the treaties of peace which terminated the war of 1914–18 represents a serious effort to organise the community of States through a written Charter—the Covenant of the League of Nations. Before this war, no organised body was in existence to detect the first menace of conflicts and by opportune action to prevent recourse to arms.

By article 11 of the Covenant every war or threat of war—whether immediately affecting any of the member States of the League or not—is declared to be a matter of concern to the whole League which is empowered to take any action that may be deemed wise and effectual to safeguard the peace of the world. The League's organs—the Assembly and the Council—are intended to bring within full public discussion any international dispute likely to lead to war and by maintaining personal contacts and co-operation between the leading statesmen of the world to allow time, by a procedure of delay, for passions to cool. The methods adopted in the Covenant for the prevention of war (when diplomacy and mediation have failed) are set out in article 12 which is as follows:—"The members agree that if there should arise between them any dispute likely to lead to a rupture, they will submit the matter either to arbitration or judicial settlement or to an inquiry by the Council and they agree in no case to resort to war until three months after the award by the arbitrators or the judicial decision or the report of the Council." The reference in the article to "judicial settlement" is meant to imply submission of the dispute to the *Permanent Court of International Justice* set up at The Hague by a unanimous vote of the Assembly of the League of Nations on December 13, 1920. The creation of this tribunal has for the first time in the world's history provided States with a real Court of Justice organised on strictly judicial lines. Its jurisdiction is, on principle, optional. Article 36 of the Statute of the Court offers, however, to States the possibility of making this jurisdiction obligatory by providing that they may by a declaration recognise as "compulsory *ipso facto* and without special agreement the jurisdiction of the Court in all or any of the classes of legal disputes concerning (*a*) the interpretation of a treaty; (*b*) any question of international law; (*c*) the existence of any fact which, if established, would constitute a breach of an international obligation; and (*d*) the nature and extent of the reparation to be made for the breach of an international obligation." So far only 15 States have effectively bound themselves to this compulsory jurisdiction and the only Great Power amongst them is Germany. The establishment of the Permanent Court does not displace the Court of Arbitration organised by The Hague Peace Conferences but leaves to States the choice between two kinds of jurisdiction, the one judicial and the other arbitral. On the other hand, the Permanent Court of Justice has a further function which was never possessed by the Court of Arbitration, the function to deliver advisory opinions upon any dispute or question referred to it by the Council or the Assembly of the League of Nations and thus help these bodies in their task of effecting a conciliation by supplying them with an authoritative legal opinion on the question in controversy. For disputes other than those of a legal nature and which cannot therefore be satisfactorily settled by either a judicial settlement or by arbitration, the Covenant provides for submission to an inquiry by the Council and, as a further resort, to the Assembly of the League. The Council's functions in such a case are threefold:—(1) to investigate the dispute; (2) to endeavour to effect a conciliation; (3) either unanimously or by a majority vote to publish a report setting forth the facts of the dispute and proposing a recommendation for its settlement (articles 15 and 17 of the Covenant). And a general tendency has recently grown up to adopt *Conciliation Commissions* in the first instance with subsequent reference to the Council if the Commission's proposals are not accepted by the parties to the dispute. The third Assembly of the League, by a unanimous resolution adopted on September 22, 1922, recommended the conclusion by States of treaties for the setting up of such Conciliation Commissions.

The methods adopted by the League for the prevention of war have proved up to now so effective as to encourage further hope in the future. It has so far been responsible for the peaceful settlements of disputes, such as that between Sweden and Finland over the Aaland Islands, between Germany and Poland upon the Upper Silesian frontier, between Serbia and Greece and Albania in respect of the latter's boundaries, between Poland and Czechoslovakia upon a similar boundary dispute, between Great Britain and Turkey in regard to the frontiers of 'Iraq, in the Memel incident in January 1923 and in the very grave dispute between Greece and Bulgaria in October 1925. Any one of these incidents might have led to war but for the timely intervention of the League.

The Locarno Pact strove to complete the League of Nation's organisation by definitely securing the adhesion of Germany and eliminating thus that most critical dispute between France and Germany which had proved such a source of wars in Europe. By the Treaty of Mutual Guarantee concluded on October 16, 1925, Germany and France and also Germany and Belgium undertook "that they will in no case attack or invade each other or resort to war against each other." They undertook, further, to settle by peaceful means "all questions of every kind" which might arise between them and which could not be settled by diplomacy. This involves submission to the Permanent Court of International Justice or to a Court of Arbitration of all "questions as to their respective rights," viz., judicial disputes, and reference to a Permanent Conciliation Commission of "all other questions." Failing settlement by conciliation, the dispute is to be dealt with by the Council of the League of Nations. This compulsory submission to judicial settlement or arbitration accepted by France, Germany and Belgium applies also as between Germany and Poland and Germany and Czechoslovakia and constitutes a great step in advance of article 13 of the Covenant of the League which makes such submission voluntary and not compulsory.

The Paris Peace Pact, 1928.—Whilst the League of Nations is the most effective instrument of peace ever devised, it does not completely abolish war, as under articles 15 and 16 of the Covenant both a collective war and an individual war still remain possible either as an ultimate sanction of the League's resolutions or in case all peaceful means have failed. To fill up this gap, a multilateral treaty, known as the Paris Peace Pact, was signed on August 27, 1928, for the "renunciation of war." By December 5, 1928, fifty-nine nations out of the sixty-four independent States of the world, had adhered to the Pact and there was every reason to believe that the remaining five, which are all South American republics, would also at an early date agree to it. The initiative for the conclusion of this treaty rests with Monsieur Briand, the French Foreign Secretary, and the United States Secretary of State, Mr. Kellogg, and followed closely on the Resolution passed unanimously in September 1927 by the Eighth Assembly of the League of Nations that "all wars of aggression are and shall always be prohibited" and that "every pacific means must be employed to settle disputes of every description which may arise between States." The Paris Pact extends this prohibition to all wars generally and not only to wars of "aggression" which are in fact incapable of any exact definition.

The Pact is a very brief document consisting of three articles only, the last of which is merely a formal one dealing with ratification. The important principle is contained in article I that "the High Contracting Parties solemnly declare, in the name of their respective peoples, that they condemn recourse to war for the solution of international controversies and renounce it as an instrument of national policy in their relations with one another." The article has been purposely drafted in such general terms so as to include all international differences which may arise between the parties and covers therefore not only justiciable disputes, but also political and economical controversies and, generally, all disputes other than domestic ones. On the other hand, the renunciation of war is expressly limited to wars undertaken as "an instrument of national policy"—a term which, according to the official interpretation placed upon it by Mr. Kellogg, excludes wars resorted to under the "inalienable right of self-defence" (United States Note of June 23, 1928, *The Times*, June 25, 1928). The expression itself of an "instrument of national policy" is not defined in the Pact, but the official note of the French Foreign Office of April 19, 1928, explains the words as meaning "an instrument of personal, spontaneous and independent political action in which States take the initiative and not as an action in which they find themselves involved by the application of a treaty such as the Covenant of the League or any other treaty registered at the League of Nations." It must

therefore be presumed that the Pact does not prohibit wars undertaken collectively as a measure of international sanction or coercion, but only wars undertaken by an individual State or group of States in their own interest and not on behalf of the community of nations. Even with this limitation, the Pact assumes the character of the most important international event since the establishment of the League of Nations since it deprives of its legitimacy the right to go to war which has hitherto been regarded as an attribute of sovereignty of every independent State. Up to and including the World War, it has always been a common habit of diplomacy to attach to every proposal for the settlement of a dispute the threat that failure to comply therewith would be followed by war. In the words of Clausewitz war is "an instrument of national policy whereby one nation imposes its will upon another." The Pact takes away this custom of associating warfare with national prestige or interest and commits the contracting parties to the fundamental principle that war ought to be "delegalised" in the international sphere as it has already been delegalised inside every civilised State. It also creates a basis upon which the United States and Russia—not at present members of the League of Nations—can co-operate with the rest of the world in maintaining peace by the solemn declaration agreed to by all the signatory Powers that the "settlement or solution of all disputes or conflicts, of whatever nature or of whatever origin they may be, which may arise between them, shall never be sought except by pacific means" (article 2 of the Pact).

Pan-American Union.—In 1881 Mr. Blaine, the then Secretary of State of the United States, put out the suggestion in his instructions to the United States ministers in Central and South America that delegates of all the American republics should participate in a Congress for the purpose of preventing wars on the American continent Out of this policy has eventually resulted the Pan-American Union whose headquarters are at Washington where also was held in 1889 the first of the Pan-American Conferences which ended in the declaration that "arbitration constituted the public law of the American nations." The other outstanding Pan-American Conferences are those held.—(*a*) at Santiago in 1923 when a Convention for the settlement of disputes was adopted and (*b*) at Havana in February 1928 when two anti-war resolutions were unanimously agreed to by the twenty-one American republics, the first of which contains the declaration that the parties "adopt compulsory arbitration as the means they will employ for the peaceful settlement of their international disputes of a legal character," and the second of which that "every war of aggression is considered illicit and as such declared prohibited" and that "all the American nations must employ peaceful means for the settlement of all conflicts which may arise between them." In pursuance of these resolutions, another Pan-American Conference was held at Washington in December 1928 to draft and adopt appropriate treaties of compulsory arbitration and conciliation.

Codification of International Law.—It was Jeremy Bentham who first advocated the codification of international law as a basis for an everlasting peace between civilised nations. Since then, many attempts have been made to secure peace by the enactment of universal rules binding on all the States of the world. The two Hague Peace Conferences have endowed nations with several Conventions each of which is a model of its kind. The Pan-American Conferences, previously referred to, have adopted many Conventions, the principal object of several of which is the preservation of peace amongst the American republics. The subject has also attracted the serious attention of the League of Nations which, through its "Committee of Experts for the progressive codification of International Law," is now working at the gradual development of an international code. Such a code constitutes an absolute necessity now that a Permanent Court of International Justice is in existence.

Disarmament.—It is being increasingly realised that the existing rivalry in armaments and military preparations is a real threat to the preservation of peace There is considerable force in the argument advanced by pacifists that the renunciation of war as an instrument of national policy and the simultaneous building of more instruments of war are in reality incompatible. The plea that such armaments are necessary for a nation's security leads to a vicious circle since no nation can make itself secure without at the same time making neighbouring States insecure. Reliance on military weapons by one nation inevitably creates the necessity for similar preparation in other nations. This process of emulation in armaments is a policy from which no State can free itself without the co-operation of the other States. Article 8 of the Covenant of the League of Nations, recognising that the maintenance of peace requires the reduction of national armaments, invites the Council of the League to formulate plans for such a reduction and also to advise as to the best means for preventing the effects attendant on the private manufacture of munitions and implements of war which is open to serious objection The work is being now carried on by the "Preparatory Disarmament Commission" of the League which was convened to meet at Geneva on April 15, 1929, for the purpose of discussing a general plan of disarmament. The "necessity of accomplishing the reduction and limitation of armaments with as little delay as possible" formed the subject of an important resolution adopted by the Assembly of the League in September 1928. Another step in the same direction was taken by the Treaty for the limitation of Naval Armaments signed at Washington on February 6, 1922, by Great Britain, France, Italy, Japan and the United States binding themselves to scrap a certain number of warships and to limit their construction and acquisition of battleships and the calibre of the guns to be carried. No agreement, however, has as yet been found possible on the limitation of the smaller craft such as cruisers, destroyers and submarines. Nor has any treaty been concluded up to now for the reduction of the military or air forces.

Modern Factors of Peace.—The progress registered remains small nor is it possible to anticipate that nations will ever consent to a general disarmament before a feeling of security is established in the international sphere. And the essential condition for such a feeling of security can only be created when the same principle which maintains peace inside the State is extended also to the mutual relations of the States, viz, what Hobbes calls the "social contract," that in no case recourse to violence or force will be made for the settlement of disputes. The Paris Peace Pact is a great step in the right direction But, of course, what is required is, in the first place, a renunciation of war for all purposes without any qualification or restriction. In the second place, States must surrender the right which they claim at present to decide, at their own discretion, whether an international controversy should be submitted or not to peaceful means for its settlement. Submission to a judicial settlement or arbitration for all disputes of a legal character and to conciliation for all other disputes ought to be made compulsory Meanwhile, there are many hopeful signs that the world is tending more and more towards the attainment of peace. One of them is the growth of modern democracy. Resort to wars for the purpose of gratifying the ambition of heads of the State or of increasing their territories or wealth appears difficult, if not impossible, under a democratic system of government where the choice of life and death for thousands of people can no longer depend on the arbitrary wishes of one man or a group of men. Another important factor of great influence is the spread all over the world of Societies bound by their articles to promote peace and understanding amongst the various nations. Prominent examples of such societies are the League to Enforce Peace in the United States and the innumerable League of Nations Unions in the British Empire A further factor of peace is the modern development of the Press and also of the means of transport which tend to bring the peoples of the world more and more together and to increase their mutual knowledge of each other. The whole of mankind is now more linked together than it has ever been before and reciprocal influences for peace, order and justice are bound to react strongly in the community of nations Although war still remains possible and much more remains to be accomplished, the possibility of its breaking out has been reduced to the lowest

limit. The progress that the world has made in the cause of peace in the last ten years surpasses every previous effort. For the first time in the world's history, there is a "common conscience of mankind" intent upon avoiding war and realising that peace is necessary for the development of human progress and civilisation. (C. J. C.)

See J. S. Bassett, *The Lost Fruits of Waterloo* (1919) and *The League of Nations* (1928); F. S. Marvin (editor), *The Evolution of World Peace* (1921); B. Price, *The World Talks It Over* (1927); C. C. Morrison, *The Outlawry of War* (1927); J. T. Shotwell, *The Pact of Paris* (1928) and publications of the American Peace Society, World Peace Foundation and Carnegie Endowment for International Peace. F. B. Boeckel, *Between War and Peace* (1928) contains a comprehensive bibliography.

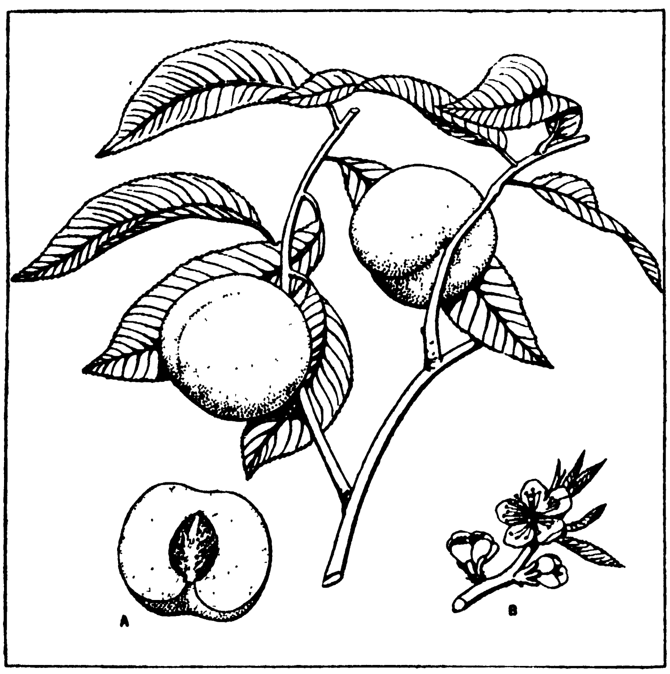
PEACE, BREACH OF THE: *see* BREACH OF THE PEACE.

PEACE CONFERENCES. For conferences for the promotion of peace held before 1914 *see* HAGUE CONFERENCES. For peace conferences subsequent to the World War *see* relevant headings., *e.g.:* INTERNATIONAL CONFERENCES; LOCARNO, PACT OF; PARIS, CONFERENCE OF; VERSAILLES, TREATY OF, etc.

PEACE PIPE. *see* CALUMET.

PEACH, the name of a fruit tree which is included under the genus *Prunus* (*Prunus persica*); its resemblance to the plum is obvious. Others have classed it with the almond as a distinct genus, *Amygdalus;* while others again have considered it sufficiently distinct to constitute a separate genus, *Persica.*

In general terms the peach may be said to be a medium-sized tree, with lanceolate, stipulate leaves, borne on long, slender, relatively unbranched shoots, and with the flowers arranged singly, or in groups of two or more, at intervals along the shoots of the previous year's growth. The flowers have a hollow tube at the base bearing at its free edge five sepals, an equal number of petals, usually concave or spoon-shaped, pink or white, and a great number of stamens. The pistil consists of a single carpel with its ovary, style, stigma and solitary ovule or twin ovules. The fruit is a drupe having a thin outer skin (epicarp) enclosing



BY COURTESY OF THE ROYAL HORTICULTURAL SOCIETY

A BRANCH OF THE PEACH TREE: (A) SECTION OF FRUIT, (B) FLOWERS

the flesh of the peach (mesocarp), the inner layers of the carpel becoming woody to form the stone, while the ovule ripens into the kernel or seed. This is exactly the structure of the plum or apricot, and differs from that of the almond, which is identical in the first instance, only in the circumstance that the fleshy part of the latter eventually becomes dry and leathery and cracks open along a line called the suture.

The nectarine is a variation from the peach, mainly characterized by the circumstance that, while the skin of the ripe fruit is downy in the peach, it is shining and destitute of hairs in the nectarine. That there is no essential difference between the two is, however, shown by the facts that the seeds of the peach will produce nectarines, and vice versa, and that it is not very uncommon, though still exceptional, to see peaches and nectarines on the same branch, and fruits which combine in themselves the characteristics of both nectarines and peaches. The blossoms of the peach are formed the autumn previous to their expansion, and this fact, together with the peculiarities of their form and position, requires to be borne in mind by the gardener in his pruning and training operations. The only point of practical interest requiring mention here is the very singular fact attested by all peach-growers, that, while certain peaches are liable to the attacks of mildew, others are not. In the case of the peach this peculiarity is in some way connected with the presence of small glandular outgrowths on the stalk, or at the base of the leaf. Some peaches have globular, others reniform glands, others none at all, and these latter trees are more subject to mildew than are those provided with glands.

As to the origin of the peach two views are held, that of A. de Candolle, who attributes all cultivated varieties to a distinct species, probably of Chinese origin, and that adopted by many naturalists, but more especially by Darwin, who looks upon the peach as a modification of the almond. The botanical evidence seems to indicate that the wild almond is the source of cultivated almonds, peaches and nectarines, and consequently that the peach was introduced from Asia Minor or Persia, whence the name *Persica* given to the peach. On the other hand, de Candolle, from philological and other considerations, considers the peach to be of Chinese origin, though it is not found wild there.

For further details, *see* C. Darwin, *The Variation of Animals and Plants under Domestication* (1868); A. de Candolle, *The Origin of Cultivated Plants* (1884). (X.)

Cultivation in the United States.—The first Spanish explorers brought the peach to the New World and as early as 1600 peaches were common in Mexico. Before the lapse of another century the peach had been carried by explorers, settlers and Indians to every part of the two continents where this fruit is now grown. Nowhere else in the world does the peach thrive so well as in temperate parts of the Western Hemisphere. Soil and climate exactly suit the peach in the Americas so that soon after its introduction in the New World it became a wide-spread escape from cultivation and early botanists considered it a native. In no other part of the world is the peach so largely grown as a commercial product as in the peach regions of the United States. Using the census report of 1920 as a basis of calculation, it can be stated that the commercial value of the peach crop of the United States is about $35,000,000 per annum. Formerly a luxury, the peach is now a necessity in American homes and is used fresh, dried or canned the year around. The value of canned peaches in the United States is about one-seventh that of the total value above given. The peach ranks second to the apple in the fruit industry of the United States.

Hedrick, in a monograph on the peach in New York published in 1917, described 2,181 varieties, nearly all of which are or have been grown in some part of the United States. Probably 500 sorts are to be found in American orchards and nurseries at the present time. All of the many kinds grown on the American side of the Atlantic, with less than a half-dozen exceptions, have originated in the regions where grown to meet the needs of a very distinctive American peach industry.

The cultivation of this fruit in the New World differs markedly from the methods of growing in the Old World. Orchards are more extensive, culture less intensive; trees are always grown as standards, never trained on walls or in arbitrary shapes; nearly all of the kinds are yellow-fleshed and free of stone, seldom with white flesh which often clings to the stone as in Europe. The suppression of diseases by spraying and orchard hygiene is much more necessary in America than in Europe.

Two unusual diseases unknown in Europe take tremendous toll from American peach orchards. One of these diseases, peach yellows, the more virulent, spread like a wave of fire through the peach orchards of America a half-century ago before methods of control were discovered. The disease is much less virulent now

than when it first made its appearance and is controlled fairly well by removing all diseased trees. The cause of the disease is generally supposed to be some lowly organism, as it is violently contagious. "Little peach," which appeared a few decades later than peach yellows, is likewise contagious through some unknown organism, and just as "yellows" is named from yellow foliage, so "little peach" receives its name from small peaches which are inedible. Like the yellows it is controlled by cutting out diseased trees.

The following are the leading commercial varieties named in order of ripening·

Mikado (June Elberta),—the earliest yellow-fleshed peach; handsome, good; Greensboro,—productive, hardy, white-fleshed, good, semi-clingstone; Rochester,—yellow, freestone, excellent quality, a desirable early variety; Carman,—white, freestone, good in quality, Champion,—excellent quality, white, semi-clingstone, home use; Belle of Georgia,—white, handsome, semi-freestone, good; Early Crawford,—splendid yellow peach, freestone, uncertain bearer; South Haven,—yellow, freestone, hardy, promising new sort; J H Hale,—very large, handsome, yellow, freestone, requires cross pollination; Early Elberta,—Elberta type but earlier, freestone; Elberta,—the leading commercial peach in New York, handsome, large, yellow, freestone; Wilma,—Elberta type, ripening a week later, freestone; Crosby,—yellow, freestone, good quality, hardy; Chili,—yellow, freestone, late, excellent for home canning. (U P H.)

PEACHAM, HENRY (*c.* 1576–*c.* 1643), English writer, was the son of Henry Peacham, curate of North Mimms, Hertfordshire, and author of a book on rhetoric called the *Garden of Rhetoric* (1577). The elder Peacham became in 1597 rector of Leverton, Lincolnshire The son was educated at Trinity college, Cambridge, where he graduated B A in 1594–95 and M A in 1598. He was for some time a schoolmaster at Wymondham, Norfolk, but settled in London in 1612, earning his living as tutor to young men preparing for the universities His first book was *Graphice* (1606), a treatise on pen and water-colour drawing, which, as *The Gentleman's Exercise,* passed through three editions. The years 1613–14 he spent abroad, part of the time as tutor to the three young sons of Thomas Howard (1585–1646), earl of Arundel, and partly on his own account He travelled in Italy, France, Westphalia and the Netherlands The table of Sir John Ogle, English governor of Utrecht, was, he says, a "little academy," where he met soldiers and scholars of all nationalities When he returned to London he was accused of libel on the king. The charge was, however, easily rebutted

Peacham had many friends in London, among them Thomas Dowland the musician, Inigo Jones, and Edward Wright the mathematician In 1622 appeared Peacham's magnum opus, the *Compleat Gentleman* Enlarged editions appeared in 1626 and 1627 The 1627 edition was reprinted in 1634, and a third, with additional notes on blazonry by Thomas Blount (1617–79), appeared in 1661. Peacham was a Cavalier, even an ardent polemist in the royal cause, but the central point of his book is a more or less Puritan sentiment of duty In his later years Peacham was reduced to extreme poverty, and is said to have written children's books at a penny each His last book was published in 1642, and it may be concluded that he died soon afterwards

His other works include· *Minerva Britanna* (1612), dedicated to Henry, prince of Wales, *The Period of Mourning* (1613), in honour of the same prince; *Thalia's Banquet* (1620), a book of epigrams; *The Art of Living in London* (1642), and *The Worth of a Peny* (1641), etc. There is a nearly complete collection of Peacham's works in the Bodleian, Oxford Harleian MS 6855 contains a translation by Peacham of James I's *Basilicon doron* into Latin verse, written in his own hand and ornamented with pen and ink drawings. His *Compleat Gentleman* was edited by G. S. Gordon in 1906 for the Clarendon Press; the *Art of Living* is reprinted in the *Harleian Misc.* ix.; *The Worth of a Peny* in E Arber's *English Garner* (vol vi. 1883)

PEACH TREE BORER, a North American sesiid moth (*Aegeria exitiosa*), one of the most important and serious enemies of the peach in the United States It is supposed to cause damage to the amount of $6,000,000 annually. The principal injury occurs east of the Rocky mountains, from Canada south to Florida. It attacks trees of all ages. Its original food plants were probably wild cherry and wild plum. It also attacks nectarines, apricots, prunes, almonds and plums, but is pre-eminently injurious to the peach. The adult moth is a clear-winged creature resembling a wasp at first glance. It has a wing-spread of about 1¼ in. The eggs are laid about the base of the tree, and the larvae bore rapidly under the bark and downwards toward the collar. The larva feeds and grows rapidly, and remains in the larval state from May or June through the following winter, transforming to pupa in the spring, enclosed in a silken cocoon in which are incorporated bits of bark and excrement. Many larvae may be found in the same peach trunk, the number varying from 2 or 3 to 40 or 50 Ninety such larvae have been found in one peach tree six or seven years old.

Although the insect has several hymenopterous parasites, artificial control work is very necessary In the old days much laborious hand work was done The earth was removed from around the crown, the trunk brushed or scraped, and the borers removed with a knife Of late, however, paradichlorobenzene has come into use. This is a white crystalline substance which vaporizes readily The bases of the trees should be cleaned, and the material should then be applied evenly in a circular band 1 in. or 2 in wide at a distance of about 2 in from the tree trunk Then it is covered with earth arranged so as to make a cone-shaped mound around the tree. The fumes of the chemical will kill the larval borers

For an illustrated practical account of this insect, see *Farmers' Bulletin* No. 1246, U S Department of Agriculture. (L. O. H.)

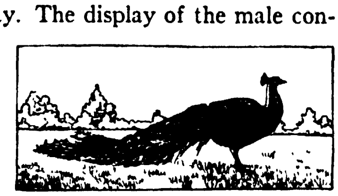
PEACOCK, THOMAS LOVE (1785–1866), English novelist and poet, was born at Weymouth on Oct 18, 1785, the only son of a London glass merchant, who died soon after the child's birth He was educated at a private school at Englefield Green, and after a brief experience of business determined to devote himself to literature His first books were poetical, *The Monks of St. Mark* (1804), *Palmyra* (1806), *The Genius of the Thames* (1810), *The Philosophy of Melancholy* (1812)—works of no great merit. He also made several dramatic attempts, which were never acted. He served for a short time as secretary to Sir Home Popham at Flushing, and paid several visits to Wales In 1812 he became acquainted with Shelley. In 1815 he showed his real bent by writing his novel *Headlong Hall.* It was published in 1816, and *Melincourt* followed in the ensuing year. During 1817 he lived at Great Marlow, enjoying the almost daily society of Shelley, and writing *Nightmare Abbey* and *Rhododaphne,* by far the best of his long poems. In 1819 he was appointed assistant examiner at the India House. About this time also he proposed marriage, by letter, to Jane Griffith, whom he had not seen for eight years. They had four children, only one of whom, a son, survived his father; one daughter was the first wife of George Meredith. His novel *Maid Marian* appeared in 1822, *The Misfortunes of Elphin* in 1829, and *Crotchet Castle* in 1831; and he would probably have written more but for the death in 1833 of his mother. He also contributed to the *Westminster Review* and the *Examiner.* His services to the East India Company, outside the usual official routine, were considerable He was especially concerned with steam navigation to India, and after representing the company before parliamentary committees on the subject, superintended the construction of iron steamers which proved successful He also drew up the instructions for the Euphrates expedition of 1835. In 1836 he succeeded James Mill as chief examiner, and in 1856 he retired upon a pension. During his later years he contributed several papers to *Fraser's Magazine,* including reminiscences of Shelley, whose executor he was. He also wrote in the same magazine his last novel, *Gryll Grange* (1860) He died on Jan. 23, 1866, at Lower Halliford, near Chertsey, where so far as his London occupations would allow him, he had resided for more than forty years.

Novels.—Peacock's position in English literature is unique There was nothing like his type of novel before his time; though there might have been if it had occurred to Swift to invent a story as a vehicle for the dialogue of his *Polite Conversation* Peacock speaks as well in his own person as through his puppets; and his pithy wit and sense, combined with remarkable grace and accuracy of natural description, atone for the primitive simplicity of plot and character. Of his seven fictions, *Nightmare Abbey* and *Crotchet Castle* are perhaps on the whole the best, the former displaying the most *vis comica* of situation, the latter the fullest

maturity of intellectual power, and the most skilful grouping of the motley crowd of "perfectibilians, deteriorationists, statu-quo-ites, phrenologists, transcendentalists, political economists, theorists in all sciences, projectors in all arts, morbid visionaries, romantic enthusiasts, lovers of music, lovers of the picturesque and lovers of good dinners," who constitute the dramatis personae of the Peacockian novel. *Maid Marian* and *The Misfortunes of Elphin* are hardly less entertaining. Both contain descriptive passages of extraordinary beauty. *Melincourt* is a comparative failure, the excellent idea of an orang-outang mimicking humanity being insufficient as the sole groundwork of a novel. *Headlong Hall* and *Gryll Grange* complete the list of his novels. The latter contains the most beautiful of his poems, "Years Ago," the reminiscence of an early attachment. The ballads and songs interspersed through his tales have much charm; his longer poems have less interest.

Peacock's works were collected, though not completely, and published in three volumes in 1875, with an excellent memoir by his granddaughter Mrs. Clarke, and a critical essay by Lord Houghton. His prose works were collected by Richard Garnett in ten volumes (1891). The Halliford edition (H. F. B. Brett-Smith and C. E. Jones, 1924–) will contain the whole of Peacock's works when completed. *See* A. B. Joung, *The Life and Novels of Thomas Love Peacock* (1904). For an interesting personal notice, see *A Poet's Sketch Book*, by R. W. Buchanan (1884). (R. G.; X.)

PEACOCK (*Pavo cristatus*), a beautiful and well known bird, proverbial personification of pride. It inhabits India and Ceylon, whence it has been introduced into aviaries and private parks in many parts of the world. Its most famous ornament is the long tail-coverts; the feathers of the train bear the "peacock eyes" at their distal ends. The crest on the head and the colour of the neck and breast are also of great beauty. The display of the male consists in the spreading of the train, accompanied at intervals by a shivering or rattling of the quills. The bird was formerly much esteemed for the table. A white variety is known and also a blue one, termed the Japanese peacock; both of these are the result of domestication. A second species (*P. muticus*) inhabits Burma and Java, and somewhat resembles the Japanese variety, but possesses a golden-green neck and breast.



BY COURTESY OF THE NEW YORK ZOOLOGICAL SOCIETY

THE INDIAN PEACOCK

PEAK, THE, a high table-land in the north of Derbyshire, England, included in the Pennine range of hills. The name, however, is extended to cover the whole of the hilly district north of Buxton. The table-land reaches an elevation of 2,088 ft. in Kinder Scout. The geological formation is millstone-grit, and the underlying beds are not domed, but cup-shaped, dipping inward from the flanks of the mass. The summit is a peaty moorland, through which masses of rock project. (*See* DERBYSHIRE.)

PEALE, CHARLES WILLSON (1741–1826), American portrait painter, celebrated especially for his portraits of Washington, was born in Queen Anne county (Md.), on April 16, 1741. During his infancy the family removed to Chestertown, Kent county (Md.), and after the death of his father (a country schoolmaster) in 1750 they removed to Annapolis. Here, at the age of 13, he was apprenticed to a saddler. About 1764 he began seriously to study art. He got some assistance from Gustavus Hesselius, a Swedish portrait painter then living near Annapolis, and from John Singleton Copley in Boston; and from 1767 to 1770 he studied under Benjamin West in London. In 1770 he opened a studio in Philadelphia, and met with immediate success. In 1772, at Mount Vernon, Peale painted a three-quarters-length study of Washington (the earliest known portrait of him), in the uniform of a colonel of Virginia militia. This canvas is now in the Lee memorial chapel of Washington and Lee university. He painted various other portraits of Washington; probably the best known is a full-length, which was made in 1778, and of which Peale made many copies. This portrait had been ordered by the Continental Congress, which, however, made no appropriation for it, and eventually it was bought for a private collection in Philadelphia. Peale painted two miniatures of Mrs. Washington (1772 and 1777) and portraits of many of the famous men of the time, a number of which are in Independence hall, Philadelphia.

Peale removed to Philadelphia in 1777, and served as a member of the committee of public safety; he aided in raising a militia company, became a lieutenant and afterwards a captain, and took part in the battles of Trenton, Princeton and Germantown. In 1779 and 1780 he was a member of the Pennsylvania assembly, where he voted for the abolition of slavery. He freed his own slaves whom he had brought from Maryland. In 1801 he undertook, largely at his own expense, the excavation of the skeletons of two mastodons in Ulster and Orange counties, N.Y., and in 1802 he established at Philadelphia Peale's museum. He was one of the founders, in 1805, of the Pennsylvania Academy of the Fine Arts at Philadelphia. At the age of 81 Peale painted a large canvas, "Christ Healing the Sick at Bethesda," and at 83 a full-length portrait of himself, now in the Academy of the Fine Arts. He died at his country home, near Germantown (Pa.), on Feb. 22, 1826.

His brother, JAMES PEALE (1749–1831), also an artist, painted two portraits of Washington (one now the property of the New York Historical Society, and the other in Independence hall, Philadelphia), besides landscapes and historical compositions.

PEALE, REMBRANDT (1778–1860), American artist, was born in Bucks county (Pa.), on Feb. 22, 1778, the son of Charles Willson Peale (*q.v.*). He studied under his father, under Benjamin West in London (1802–03), and in Paris in 1807 and 1809. As early as 1795 he had begun from life a portrait of Washington. Of this he made many replicas, the latest in 1823, purchased by the U.S. Government in 1832, and now in the Capitol at Washington.

His portraits include those of President Jefferson, Mrs. Madison, Commodores Perry, Decatur, and Bainbridge, Houdon, the sculptor, General Armstrong, and an equestrian portrait of General Washington, now in Independence hall, Philadelphia. His "Court of Death" (1820) is in the Detroit art gallery. In 1825 Peale succeeded John Trumbull as president of the American Academy of Fine Arts (founded in 1802 as the New York Academy of Fine Arts), and he was one of the original members of the National Academy of Design. He wrote several books, among them *Notes on Italy* (1831), *Reminiscences of Art and Artists* (1845). He died in Philadelphia on Oct. 3, 1860.

A brother, RAPHAELLE PEALE (1774–1825), was one of the earliest of American still-life painters; and another brother, TITIAN RAMSEY PEALE (1800–1885), made numerous drawings, some of them in water-colour, in illustration of animal life.

See "Rembrandt Peale," partly autobiographical, in C. E. Lester's *The Artists of America* (1846).

PEANUT (Ground-nut, Earth-nut, Pistache de Terre, Monkey nut, Goober, Manilla nut), the fruit or pod of *Arachis hypogaea* (family Leguminosae). The plant is an annual of diffuse habit, 1 to 2 ft. high, with hairy stem, and two-paired, abruptly pinnate leaflets. The pods or legumes are stalked, oblong, cylindrical, about 1 in. in length, the thin reticulated shell containing from one to three irregularly ovoid seeds. After the flower withers, the flower stalk has the peculiarity of elongating and bending down, forcing the young pod underground, and thus the seeds become matured at some distance below the surface. Hence the specific and various vernacular names of the plant. Originally a native of South America, it is extensively cultivated in all tropical and sub-tropical countries. The plant thrives in a light sandy soil, and is very prolific. The pods when ripe are dug up and dried. The seeds are largely eaten fresh in tropical countries; when roasted they are used in various ways for food. The seeds yield a large quantity of oil, which is used by natives for lamps, as a fish or curry oil and for medicinal purposes. The leaves form an excellent food for cattle, being very like clover.

Large quantities of seeds are imported to Europe, chiefly for the oil. The seeds yield from 42 to 50% of oil by cold expression, but a larger quantity is obtained by heat, although of inferior quality. The seeds being soft facilitate mechanical expression, and where a solvent is used, a very pure oil is obtained. The expressed oil is limpid, of a light yellowish or straw colour, having a faint

smell and bland taste; it forms an excellent substitute for olive oil and is used in various food preparations.

In 1925 the principal countries importing peanuts were: France, 1,503,887,000 lb.; Germany, 713,245,000 lb.; United Kingdom, 335,004,000 lb.; Netherlands, 229,540,000 lb.; and the United States, 120,158,000 pounds. The chief exporting countries were: British India, 1,036,670,000 lb; Senegal, 985,409,000 lb.; and China, 530,227,000 pounds. The principal countries exporting peanut oil were: China, 78,408,000 lb; France, 53,744,000 lb; Netherlands, 26,336,000 lb.; and the United Kingdom, 25,431,000 pounds. The chief importing countries were: Netherlands, 40,209,000 lb.; United Kingdom, 25,148,000 lb., Algeria, 23,542,000 lb.; Germany, 23,016,000 lb.; and Canada, 16,134,000 pounds.

Since 1900, when the annual production was about 100,000,000 lb, peanut culture in the United States has very greatly increased In 1927 the total crop, grown on 1,128,000 ac, amounted to 806,990,000 lb, valued at $32,501,000; 80% of this yield was produced in four States—Georgia, North Carolina, Alabama and Virginia, ranking in the order named The value, in 1925, of the products of the peanut roasting, shelling and cleaning establishments was $20,623,810 Throughout the country roasted peanuts, which are eaten out of hand, are everywhere sold in confectioners' shops and by street venders; peanuts are also extensively used in making various confections Since 1900 the food preparation known as peanut butter has become increasingly popular and is now regularly sold by grocers; the value at the factory of the peanut butter produced in 1925 was $6,200,547 The consumption of peanut oil for food and other purposes exceeds the supply available from domestic crops, resulting in extensive importations of peanuts for oil-extraction.

PEAR, a fruit-bearing tree (*Pyrus communis*) belonging to the rose family and very closely allied to the apple (*q v*), cultivated since ancient time for its juicy pome fruit. The pear differs from the apple in its more erect manner of growth, smooth, shining, very finely-toothed leaves, pure white (rarely pink) flowers, the granular flesh of the ripe fruit, and also in the shape of the fruit, which tapers toward the inner end and has no depression around the stem. In both the pear and the apple the edible part of the fruit is formed from the greatly enlarged end of the flowering stem This encloses within its flesh the five somewhat horny seed-containing vessels (carpels) constituting the "core," which is really the true fruit

The main distinction is the presence in the tissue of the fruit, or beneath the rind, of clusters of cells filled with hard woody deposit in the case of the pear, constituting the "grit," while in the apple no such formation of woody cells takes place The appearance of the tree—the bark, the foliage, the flowers—is, however, usually quite characteristic in the two species Cultivated pears, whose number is enormous, are without doubt derived from one or two wild species widely distributed throughout Europe and western Asia.

The cultivation of the pear extends to the remotest antiquity. Traces of it have been found in the Swiss lake-dwellings; it is mentioned in the oldest Greek writings, and was cultivated by the Romans. The word "pear" or its equivalent occurs in all the Celtic languages, while in Slavonic and other dialects different appellations, but still referring to the same thing, are found—a diversity and multiplicity of nomenclature which led Alphonse de Candolle to infer a very ancient cultivation of the tree from the shores of the Caspian to those of the Atlantic.

Cultivation.—The pear may be readily raised by sowing the pips of ordinary cultivated or of wilding kinds, these forming what are known as free or pear stocks, on which the choicer varieties are grafted for increase For new varieties the flowers should be fertilized with a view to combine, in the seedlings which result from the union, the desirable qualities of the parents The dwarf and pyramid trees, more usually planted in gardens, are obtained by grafting on the quince stock, the Portugal quince being the best.

In selecting young pear trees for walls or espaliers, some prefer plants one year old from the graft, but trees two or three years trained are equally good. The trees should be planted immediately before or after the fall of the leaf. The wall trees require to be planted from 25 to 30 ft. apart when on free stocks, and from 15 to 20 ft. when dwarfed. Where the trees are trained as pyramids or columns they may stand 8 or 10 ft. apart, but standards in orchards should be allowed at least 30 ft., and dwarf bush trees half that distance

In the formation of the trees the same plan may be adopted as in the apple. For the pear orchard a warm situation is very desirable, with a soil deep, substantial, and thoroughly drained. It is useless attempting to grow pears in low-lying districts subject to spring frosts: although the trees will thrive and flower, frosts often cause such havoc in these districts that a crop of fruit is rarely produced. Any good free loam is suitable, but a calcareous loam is the best. Pear trees worked on the quince should have the stock covered up to its junction with the graft. This is effected by raising up a small mound of rich compost around it, a contrivance which induces the graft to emit roots into the surface soil, and also keeps the stock from becoming hard or bark-bound The fruit of the pear is produced on spurs, which appear on shoots more than one year old The mode most commonly adopted of training wall pear trees is the horizontal For the slender twiggy sorts the fan form is to be preferred, while for strong growers the half-fan or the horizontal is more suitable.

The summer pruning of established wall or espalier-rail trees consists chiefly in the timely displacing, shortening back, or rubbing off of the superfluous shoots, so that the winter pruning, in horizontal training, is little more than adjusting the leading shoots and thinning out the spurs, which should be kept close to the wall and allowed to retain but two or at most three buds. In fan-training the subordinate branches must be regulated, the spurs thinned out, and the young laterals finally established in their places

Summer and autumn pears should be gathered before they are fully ripe, otherwise they will not in general keep more than a few days The Jargonelle should be allowed to remain on the tree and be pulled daily as wanted, the fruit from standard trees thus succeeding the produce of the wall trees

Select list of pears and their period of ripening:—

Jargonelle	Aug.	Beurre Hardy	Oct.
Clapp's Favourite	Aug.–Sept	Marie Louise	Oct.–Nov.
Williams' Bon Chrêtien	Aug.–Sept	Durondeau	Nov.
Beurre d'Amanlis	Sept.–Oct	Pitmaston Duchess	Oct.–Nov.
Beurre Superfin	Sept.–Oct	Doyenne du Comice	Nov.
Louis Bonne de Jersey	Oct.–Nov	Beurre Diel	Oct.–Nov.
Fondante d'Automne	Oct	Thompson's	Nov.
Jersey Gratioli	Sept.–Oct	Glow Merceau	Dec.–Jan.
Conference	Oct.–Nov.	Beurre d'Anjou	Dec.–Jan.
Emile d'Heyst	Oct.–Nov	Josephine de Malines	Jan.–May

Select list of culinary pears:—

Bellisime d'Hiver	Nov.–April	Uvedales' St Germain	Jan.–April
Catillac	Dec.–April	Vicar of Wakefield	Nov.–Jan.
Fertility	Oct	Verulam	Jan.–March

Pears suitable for exhibition:—

Beurre Alex Lucas	Doyenne du Comice
Beurre d'Amanlis	Durondeau
Beurre Diel	Louis Bonne de Jersey
Clapp's Favourite	Triomphe de Vienne
Conference	Pitmaston Duchess
Doyenne Boussach	Williams' Bon Chrêtien

Diseases.—The pear is subject to several diseases caused by fungi. *Gymnosporangium sabinae*, one of the rusts (Uredineae) passes one stage of its life-history on living pear leaves, forming large raised spots or patches which are at first yellow but soon become red and are visible on both faces; on the lower face of each patch is a group of cluster-cups or aecidia containing spores which escape when ripe This stage in the life-history was formerly regarded as a distinct fungus; it is now known, however, that the spores germinate on young juniper leaves, in which they give rise to this other stage in the plant's history known as *Gymnosporangium*.

Pear scab is caused by a parasitic fungus, *Venturia pyrina*,

very closely allied to the apple scab fungus. As in the case of the apple disease, it forms large irregular blackish blotches on the fruit and leaves, the injury being often very severe especially in a cool, damp season. The fungus mycelium grows between the cuticle and the epidermis, the former being ultimately ruptured by numerous short branches bearing spores (conidia) by means of which the disease is spread As a preventive spraying with Bordeaux mixture or lime-sulphur wash just before flowering and as soon as the petals have fallen, is recommended.

Pear trees may also be attacked by a great variety of insect pests. Thus the younger branches are often injured by the pearl oyster scale (*Aspidiotus ostreaeformis*), which may be removed by washing in winter with lime-sulphur at winter strength. A number of larvae of Lepidoptera feed on the leaves; the remedy is to capture the mature insects when possible. Winter moths (*Cheimatobia brumata*) and others must be kept in check by putting greasy bands round the trunks from October till December or January, to catch the wingless females that crawl up and deposit their eggs in the cracks and crevices in the bark. In the early stages if the entrance of the caterpillars has been detected, a wire should be pushed into the hole. One of the worst pests of pear trees is the pear midge, *Diplosis pyrivora*, the females of which lay their eggs in the flower-buds before they open. The yellow maggots devour the seeds and thus ruin the crop. When deformed fruits are noticed they should be picked off and burned immediately. Species of aphides may be removed by a nicotine and soap wash. The pear leaf blister mite (*Eriophyes pyri*) sometimes severely injures the leaves, on which it forms blisters: the best remedy is to cut off and burn the diseased leaves. This remedy can only be applied when the disease is recognized at an early stage. When the disease has obtained a hold, spray during the dormant season with an oil emulsion or a lime-sulphur caustic soda wash. (X.)

Cultivation in the United States.—Names and descriptions of varieties of pears in European publications number about 5,000, while in the horticultural literature of the United States not more than 1,000 are to be found This is an indication that the pear is not as popular in the United States as in France, England, Belgium and Germany, the great pear-growing countries of Europe. The reason is that the pear, as compared with other hardy fruits, reaches perfection in comparatively few places in the New World. The climate in most parts of America is uncongenial to the pear, a fruit which thrives only in equable climates and does not endure well the sudden and extreme variations in climate to which most parts of North and South America are subject. In the United States, commercial pear culture is confined to favourable localities on the Atlantic seaboard, about the Great Lakes and on the Pacific slope, and even in these favoured regions the product sent to market comes largely from the plantations of specialists.

Liability to loss by pest is also a great detriment to the popularity of the pear in America. Insect pests of pears are numerous and difficult to combat. Foliage and fruit are attacked by several parasitic fungi, requiring treatment wherever the pear is grown, which, even under very favourable conditions, often fails to give the fruits a fair check A bacterial blight is so serious in effects and virulency as to give it the popular name, "fire blight." The disease is caused by a bacterium which cannot be checked by sprays and is combated only by the drastic remedy of cutting out branches and trees Still another reason why the pear is not a popular dessert fruit in America is that, of all fruits, the varieties of this one are the most variable in the quality of the product. Sorts that should produce pears of the highest quality often bear fruits poor or indifferent in texture or flavour in unfavourable seasons or unsuitable soils And, still again, the pear falls short as a commercial product because it is not easily handled so as to stand transportation or keeping in cold storage, conditions demanded in America.

The care given to growing pears in America is not more exacting than that given any other hardy fruit. The trees respond readily to cultivation, pruning and fertilization. These items of culture are much the same as for the apple, plum, cherry and peach. Once well started, pear orchards perhaps endure more neglect than do orchards of any other tree fruit, if the climate and soil be suitable. Varieties of pears, possibly, have the charm of individuality more marked than varieties of their orchard associates. The fruits are more varied in size, shape, texture and flavour than others of the hardy tree fruits and in length of season exceed all others excepting the apple. For this reason, the pear is the fruit of fruits for connoisseurs, and a splendid collection can, with a little care, be grown in a comparatively small space from the hundred or more varieties to be had from nurseries. Cross pollination is an important factor in the successful culture of pears. Mixed plantings of at least two compatible varieties set in blocks of three to four rows wide are desirable.

The following are leading commercial varieties named in order of ripening.—

Tyson,—hardy, vigorous, blight resistant, a midsummer variety for home use; Clapp's Favorite,—best early pear, large, productive, attractive, blights very badly; Bartlett,—the leading commercial variety; Seckel,—bears late, blight resistant, vigorous, choicely good but small; Beurre Bosc,—attractive, high in quality, blights badly; Sheldon,—excellent quality for home use, unattractive in shape and colour; Winter Nelis,—late keeper, high quality, small and unattractive.

Most of these varieties, as well as nearly all other sorts listed by nurseries, originated in Europe. American pear growing will undoubtedly be greatly benefited when the country has a pear flora of its own. (U. P. H.)

PEARCE, CHARLES SPRAGUE (1851–1914), American artist, was born at Boston (Mass), on Oct. 13, 1851. In 1873 he became a pupil of Léon Bonnat in Paris, and after 1885 he lived in Paris and at Auvers-sur-Oise. He painted Egyptian and Algerian scenes, French peasants, and portraits, and also decorative work, notably for the Congressional library at Washington. He received medals at the Paris Salon and elsewhere, and many decorations. Among his best known paintings are "The Decapitation of St. John the Baptist" (1881), in the Art Institute of Chicago; "Prayer" (1884), owned by the Massachusetts charitable mechanic association; "The Return of the Flock," in the Bohemian club, San Francisco; and "Meditation," in the New York Metropolitan Museum He died in Paris on May 18, 1914.

PEARL, RAYMOND (1879–), American biologist, was born at Farmington (N.H) June 3, 1879 He studied at the University of Michigan, Leipzig, the Naples zoological station and London After holding a number of important appointments he became, in 1925, director of the Institute of Biological Research, a new division of Johns Hopkins university. He became known through his biological researches on variation in organisms, and his studies in heredity. He was a member of the executive committee, chairman of the agricultural committee and member of the executive board of the National Research Council, 1916–19, being also chief of the statistical division of the U.S. Food Administration, 1917–19. (*See* DEATH.)

Pearl wrote, among other works, *Variation and Differentiation in Ceratophyllum; Variation and Correlation in the Crayfish* (with A. B. Clawson, 1907); *Diseases of Poultry: Their Etiology, Diagnosis, Treatment and Prevention* (with F M. Surface and M. R Curtis, 1915); *Modes of Research in Genetics* (1915), *The Nation's Food* (1920); *The Biology of Death* (1922); *Introduction to Medical Biometry and Statistics* (1923); *Studies in Human Biology* (1924); *The Biology of Population Growth* (1925); *Alcohol and Longevity* (1926); *To Begin With* (1927); and *The Rate of Living* (1928).

PEARL. Pearls are calcareous concretions of peculiar lustre, produced by certain molluscs, and valued as objects of personal ornament. The experience of pearl-fishers shows that those shells which are irregular in shape and stunted in growth, or which bear excrescences, or are honeycombed by boring parasites, are those most likely to yield pearls.

The substance of a pearl is essentially the same as that which lines the interior of many shells and is known as "mother-of-pearl." Sir D. Brewster first showed that the iridescence of this substance was an optical phenomenon due to the interference of rays of light reflected from microscopic corrugations of the surface—an effect which may be imitated by artificial striations on a suitable medium When the inner laminated portion of a nacreous shell is digested in acid the calcareous layers are dissolved away,

leaving a very delicate membranous pellicle, which, as shown by Dr. Carpenter, may retain the iridescence as long as it is undisturbed, but which loses it when pressed or stretched.

It is obvious that if a pearl presents a perfectly spherical form it must have remained loose in the substance of the muscles or other soft tissues of the mollusc. Frequently, however, the pearl becomes cemented to the interior of the shell, the point of attachment thus interfering with its symmetry. In this position it may receive successive nacreous deposits, which ultimately form a pearl of hemispherical shape, so that when cut from the shell it may be flat on one side and convex on the other, forming what jewellers know as a *perle bouton*. In the course of growth the pearl may become involved in the general deposit of mother-of-pearl, and be ultimately buried in the substance of the shell It has thus happened that fine pearls have occasionally been unexpectedly brought to light in cutting up mother-of-pearl in the workshop.

When a pearl oyster is attacked by a boring parasite the mollusc protects itself by depositing nacreous matter at the point of invasion, thus forming a hollow body of irregular shape known as a "blister pearl." Hollow warty pearl is sometimes termed in trade *coq de perle*. Solid pearls of irregular form are often produced by deposition on rough objects, such as small fragments of wood, and these, and in fact all irregular-shaped pearls, are termed *perles baroques*, or "barrok pearls."

A pearl of the first water should possess, in jewellers' language, a perfect "skin" and a fine "orient"; that is to say, it must be of delicate texture, free from speck or flaw, and of clear almost translucent white colour, with a subdued iridescent sheen It should also be perfectly spherical, or, if not, of a symmetrical pear-shape.

Pearl Fisheries.—The ancients obtained their pearls chiefly from India and the Persian gulf, but at the present time they are also procured from the Sulu seas, the coast of Australia, the shores of Central America and some of the South Pacific islands The ancient fisheries of Ceylon (Taprobane) are situated in the Gulf of Manaar, the fishing-banks lying from 6 to 8m. off the western shore, a little to the south of the isle of Manaar. The Tinnevelly fishery is on the Madras side of the strait, near Tuticorin These Indian fishing-grounds are under the control of Government inspectors, who regulate the fisheries. The oysters yield the best pearls at about four years of age Fishing generally commences in the second week in March, and lasts for from four to six weeks, according to the season The boats are grouped in fleets of from 60 to 70, and start usually at midnight so as to reach the oyster-banks at sunrise. Each boat generally carries 10 divers. On reaching the bank a signal-gun is fired, and diving commences. A stone weighing about 40 lb is attached to the cord by which the diver is let down The divers work in pairs, one man diving while the other watches the signal-cord, drawing up the sink-stone first, then hauling up the baskets of oysters, and finally raising the diver himself On an average the divers remain under water from 50 to 80 seconds, though exceptional instances are cited of men remaining below for as long as six minutes. In his work the diver makes skilful use of his toes. To arm himself against the attacks of sharks and other fishes which infest the Indian waters he carries spikes of ironwood; and the genuine Indian diver never descends without the incantations of shark-charmers, one of whom accompanies the boat while others remain on shore As a rule the diver is a short-lived man

Since the days of the Macedonians pearl-fishing has been carried on in the Persian gulf It is said that the oyster-beds extend along the entire Arabian coast of the gulf, but the most important are on sandbanks off the islands of Bahrein. The chief centre of the trade is the port of Lingah. Most of the products of this fishery are known as "Bombay pearls," from the fact that many of the best are sold there. Very fine pearls are obtained from the Sulu archipelago, on the north-east of Borneo. The mother-of-pearl shells from the Sulu seas are characterized by a yellow colour on the border and back, which unfits them for many ornamental purposes. Pearl oysters are also abundant in the seas around the Aru islands to the south-west of New Guinea From Labuan a good many pearl-shells are occasionally sent to Singapore. They are also obtained from the neighbourhood of Timor, and from New Caledonia. The pearl oyster occurs throughout the Pacific, mostly in the clear water of the lagoons within the atolls, though fine shells are also found in deep water outside the coral reefs.

Pearl-fishing is actively prosecuted along the western coast of Central America, especially in the Gulf of California, and to a less extent around the Pearl islands in the Bay of Panama. The fishing-grounds are in water about 40ft. deep, and the season lasts for four months An ordinary fishing-party expects to obtain about three tons of shells per day, and it is estimated that one shell in a thousand contains a pearl. The pearls are shipped in barrels from San Francisco and Panama Some pearls of rare beauty have been obtained from the Bay of Mulege, near Los Coyetes, in the Gulf of California; and in 1882 a pearl of 75 carats, the largest on record from this district, was found near La Paz in California. The coast of Guayaquil also yields pearls. Columbus found that pearl-fishing was carried on in his time in the Gulf of Mexico, and pearls are still obtained from the Caribbean sea In the West Indies the best pearls are obtained from St Thomas and from the island of Margarita, off the coast of Venezuela From Margarita Philip II. of Spain is said to have obtained in 1579 a pearl of 250 carats

River Pearls.—River pearls are produced by the species of *Unio* and *Anodonta*, especially by *Unio margaritiferus* These species belong to the family Unionidae, order Eulamellibranchia. They inhabit the mountain-streams of temperate climates in the northern hemisphere The pearls of Britain are mentioned by Tacitus and by Pliny, and a breastplate studded with British pearls was dedicated by Julius Caesar to Venus Genetrix As early as 1355 Scotch pearls are referred to in a statute of the goldsmiths of Paris; and in the reign of Charles II. the Scotch pearl trade was sufficiently important to attract the attention of parliament.

The principal rivers in Scotland which have yielded pearls are the Spey, the Tay and the South Esk; and to a less extent the Doon, the Dee, the Don, the Ythan, the Teith, the Forth and many other streams. In North Wales the Conway was at one time celebrated for its pearls, and it is related that Sir Richard Wynn, chamberlain to the queen of Charles II, presented her with a Conway pearl which is believed to occupy a place in the British crown. In Ireland the rivers of Donegal, Tyrone and Wexford have yielded pearls

River pearls are found in many parts of the United States, and have been systematically worked in the Little Miami river, Warren county, O, and also on the Mississippi, especially about Muscatine, Iowa. The season extends from June to October. Japan produces fresh-water pearls, found especially in the *Anodonta japonica*.

Chinese Pearl Culture.—But it is in China that the culture of the pearl-mussel is carried to the greatest perfection. The Chinese also obtain marine pearls, and use a large quantity of mother-of-pearl for decorative purposes. More than 22 centuries before our era pearls are enumerated as a tribute or tax in China; and they are mentioned as products of the western part of the empire in the *Rh'ya*, a dictionary compiled earlier than 1000 B.C. A process for promoting the artificial formation of pearls in the Chinese river-mussels was discovered by Ye-jin-yang, a native of Hoochow, in the 13th century; and this process is still extensively carried on near the city of Teh-tsing, where it forms the staple industry of several villages Large numbers of the mussels are collected in May and June, and the valves of each are gently opened with a spatula to allow of the introduction of various foreign bodies, which are inserted by means of a forked bamboo stick. These "matrices" are generally pellets of prepared mud, but may be small bosses of bone, brass or wood After a number of these objects have been placed in convenient positions on one valve, the unfortunate mollusc is turned over and the operation is repeated on the other valve. The mussels are then placed in shallow ponds connected with the canals, and are nourished by tubs of night-soil being thrown in from time to time After several months, in some cases two or three years, the mussels are

removed, and the pearls which have formed over the matrices are cut from the shells, while the molluscs themselves serve as food. Millions of such pearls are annually sold at Soo-chow. The most curious of these Chinese pearls are those which present the form of small seated images of Buddha. The figures are cast in very thin lead, or stamped in tin, and are inserted as previously described. Specimens of these Buddha pearls in the British Museum are referred to the species *Dipsas plicata.* It should be mentioned that Linnaeus, probably ignorant of what had long been practised in China, demonstrated the possibility of producing artificial pearls in the fresh-water mussels of Sweden.

Pink pearls are occasionally found in the great conch or fountain shell of the West Indies, *Strombus gigas,* L.; but these, though much prized, are not nacreous, and their tint is apt to fade. They are also produced by the chank shell, *Turbinella scolymus,* L. and other gastropods. Yellowish-brown pearls, of little or no value, are yielded by the *Pinna squamosa,* and bad-coloured concretions are formed by the *Placuna placenta.* Black pearls, which are very highly valued, are obtained chiefly from the pearl oyster of the Gulf of Mexico. The common marine mussel *Mytilus edulis* also produces pearls, which are, however, of little value.

The Pearl Oyster.—Genuine precious pearls and the most valuable mother-of-pearl are produced by various species and varieties of the genus *Margaritifera.* The genus is represented in tropical regions in all parts of the world. It belongs to the family Aviculidae, which is allied to the Pectens or scallop shells. In this family the hinge border is straight and prolonged into two auriculae; the foot has a very stout byssus. *Margaritifera* is distinguished by the small size or complete absence of the posterior auricula. The species are as follows. The type species is *M. margaritifera,* which has no teeth on the hinge. Geographical races are distinguished by different names in the trade. Specimens from the Malay Archipelago have a dark band along the margin of the nacre and are known as black-edged Banda shell; those from Australia and New Guinea and the neighbouring islands of the western Pacific are called Australian and New Guinea black-lip. Another variety occurs in Tahiti, Gambier islands and Eastern Polynesia generally, yielding both pearls and shell. It occurs also in China, Ceylon, the Andaman islands and the Maldives. Another form is taken at Zanzibar, Madagascar and the neighbouring islands, and is called Zanzibar and Madagascar shell. Bombay shell is another local form fished in the Persian gulf and shipped via Bombay. The Red sea variety is known as Egyptian shell. Another variety occurs along the west coast of America and from Panama to Vancouver, and supplies Panama shell and some pearls. A larger form, attaining a foot in diameter and a weight of 10 lb. per pair of shells, is considered a distinct species, *M. maxima.* It is the most valuable species of mother-of-pearl oyster.

Dr. Jameson distinguishes in addition to the above 32 species of *Margaritifera;* all these have rudimentary teeth on the hinge. The most important species is *M. vulgaris,* to which belong the pearl oyster of Ceylon and southern India, the lingah shell of the Persian gulf and the pearl oyster of the Red sea. Since the opening of the Suez canal the latter form has invaded the Mediterranean, specimens having been taken at Alexandria and at Malta, and attempts have been made to cultivate it on the French coast. The species occurs also on the coasts of the Malay peninsula, Australia and New Guinea, where it is fished both for its shells (Australian lingah) and for pearls. Two species occur on the coasts of South Africa but have no market value. *M. carchariarum* is the Shark's bay shell of the London market. It is taken in large quantities at Shark's bay, Western Australia, and is of rather small value; it also yields pearls of inferior quality. The pearl oyster of Japan, known as Japan lingah, is probably a variety of *M. vulgaris. M. radiata* is the West Indian pearl oyster.

The largest and steadiest consumption of mother-of-pearl is in the button trade, and much is also consumed by cutlers for handles of fruit and dessert knives and forks and pocket-knives. It is also used in the inlaying of Japanese and Chinese lacquers, European lacquered papier-mâché work, and trays, &c., and as an ornamental inlay generally. Among the South Sea islands the shell is largely fashioned into fishing-hooks. Among shells other than those of *M. margaritifera* used as mother-of-pearl may be mentioned the green ear or ormer shell (*Haliotis tuberculata*) and several other species of *Haliotis,* besides various species of *Turbo.*

Origin of Pearls.—While there is no doubt that pearls, whether found in oysters or mussels, are the results of pathological processes due to irritants, considerable variation of opinion exists as to the nature of the exciting bodies. As we have seen, the Chinese long ago discovered that river-mussels could be induced to yield pearls by inserting into them foreign bodies to form matrices for the deposition of pearl matter, and pearl culture of this kind has become an industry of importance (*see* PEARL, CULTIVATED).

In the case of the fresh water mussel Filippi of Turin showed in 1852 that the species of Trematode (fluke) *Distomum duplicatum* was the cause of a pearl formation in the fresh-water mussel *Anodonta.* Kuchenmeister subsequently investigated the question at Elster in Saxony and came to a different conclusion, namely that the central body of the pearl was a small specimen of a species of water mite which is a very common parasite of *Anodonta.* Filippi however states that the mite is only rarely found within a pearl, the Trematode occurring in the great majority of cases. R. Dubois and Dr. H. Lyster Jameson have made special investigations of the process in the common mussel *Mytilus edulis.* The sac or cyst is formed by the larva of a species of Trematode belonging to the genus *Lecithodendrium,* a species closely resembling and probably identical with *L. somateriae,* which lives in the adult state in the eider duck. At Billiers, Morbihan, in France, the host of the adult Trematode is another species of duck, namely the common scoter, *Oidemia nigra,* which is notorious in the locality for its avidity for mussels. Trematodes of the family Distomidae, to which the parasite under consideration belongs, usually have three hosts in each of which they pass different stages of the life history. In this case the first host at Billiers is a species of bivalve called *Tapes decussatus,* but at Piel in Lancashire there are no *Tapes* and the first stages of the parasite are found in the common cockle. The Trematode enters the first host as a minute newly hatched embryo and leaves it in the form called cercaria (*see* TREMATODA). The cercaria makes its way into the tissues of a mussel and there becomes enclosed in the cyst previously described. If the mussel is then swallowed by the duck the cercariae develop into adult Trematodes or flukes in the liver or intestines of the bird. In the mussels which escape being devoured the parasites cannot develop further, and they die and become embedded in the nacreous deposit which forms a pearl. Dr. Jameson points out that, as in other cases, pearls in *Mytilus* are common in certain special localities and rare elsewhere, and that the said localities are those where the parasite and its hosts are plentiful.

In the case of the Ceylon pearl oysters, Prof. Herdman concluded that the exciting cause of pearl formation was the larva of a cestode or tapeworm (*q.v.*). The cestode theory has, however, been somewhat discredited in recent years; it is by no means certain that the pearl nucleus is always a parasite; many different exciting causes may lead to pearl formation.

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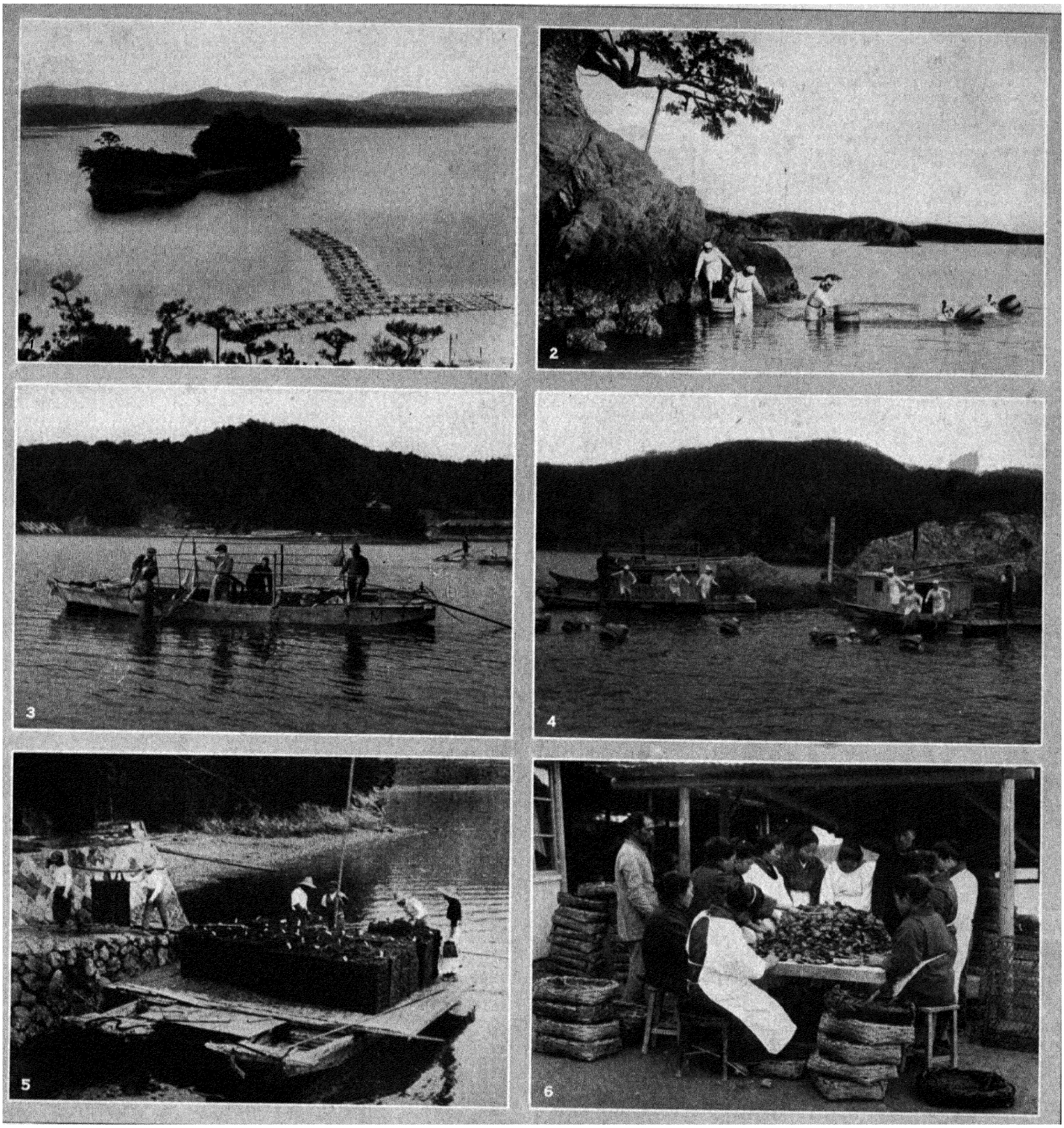
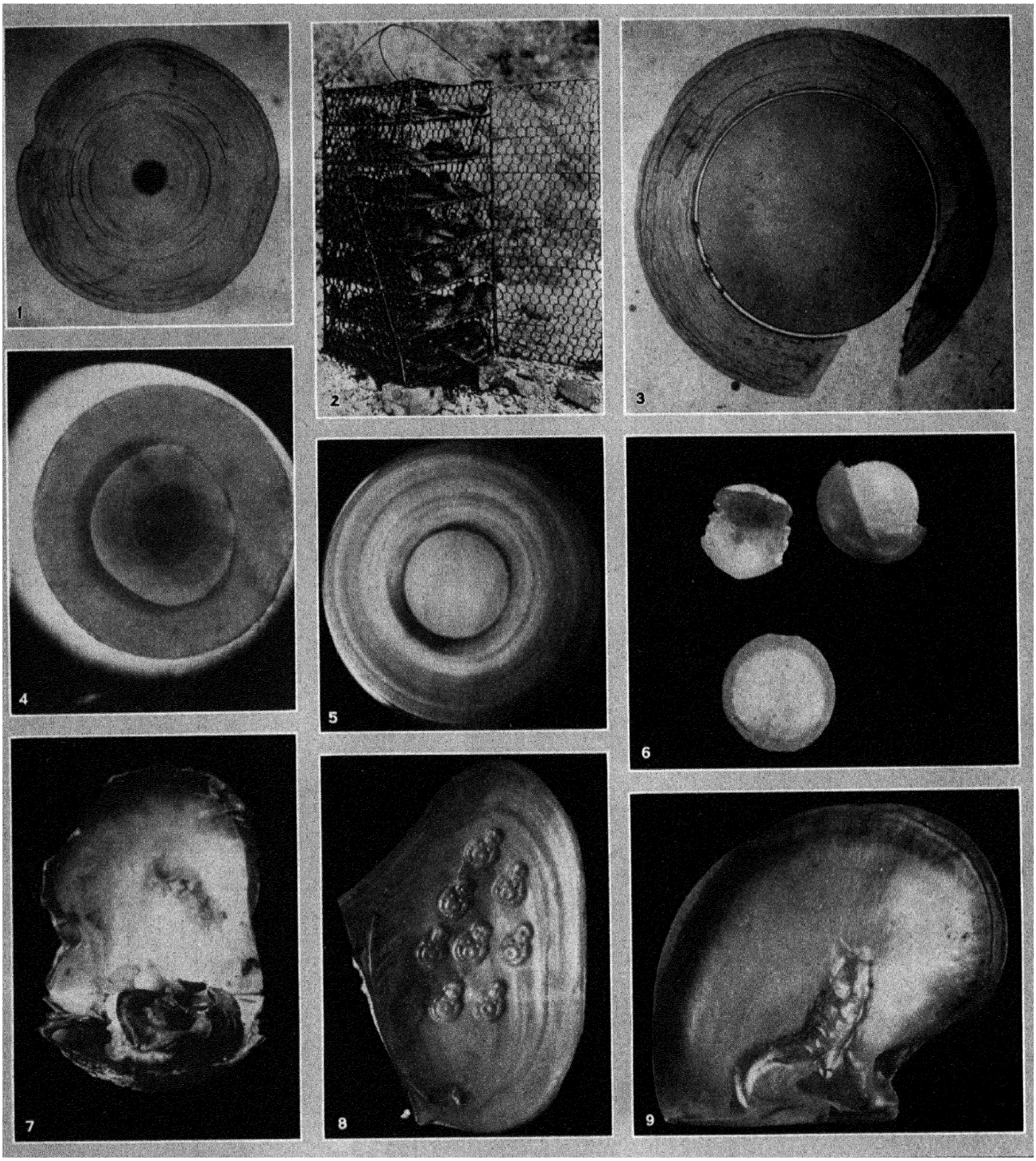
PEARL, ARTIFICIAL. Fine artificial pearls were first made in western Europe in 1680 by Jacquin, a rosary-maker in Paris. Spheres of thin glass are filled with a preparation known as "essence d'orient," made from the silvery scales of a small fish called the bleak (*q.v.*), which is caused to adhere to the inner wall of the globe, and the cavity is then filled with white wax.



BY COURTESY OF K. MIKIMOTO

STAGES IN JAPANESE PEARL CULTURE

1. Rafts at the Mikimoto pearl culture station, Gokasho Bay, Japan. By means of these rafts great numbers of wire cages filled with young oysters are suspended near the bottom of the sea
2. Japanese diving girls preparing to dive for young oysters which will be used in the culture process. They go to the bottom of the bay and bring up handfuls of oysters which they place in the floating tubs
3. Boat and diver in uniform showing the type of apparatus used for general diving purposes at pearl culture stations
4. Diving girls plunging in the bay from boats. During the pearl season from May to November many girls are employed in the pearl culture stations of Japan. They dive for young oysters and keep the cages free from seaweed and other marine growths
5. Landing the cages. Oysters remain in these cages six or seven years while in cultivation. During this time they are removed, examined and cleaned twice a year. On the top of each cage is placed a tag on which its historical record is kept
6. Preparing oysters for incubation. The young oysters are sorted carefully and only large strong ones are kept.



BY COURTESY OF (1, 3, 6) DR. KERR AND THE "JEWELERS' CIRCULAR," (2, 4, 5, 7) K. MIKIMOTO, (8, 9) THE AMERICAN MUSEUM OF NATURAL HISTORY

SPECIMENS OF NATURAL AND CULTIVATED PEARLS

1. Cross section of a natural pearl magnified about 16 times. The concentric structure has developed around the small parasite in the centre, which was the irritant that caused the oyster to form a pearl
2. Cage of the type used in Japan for pearl cultivation; it has a capacity of about 150 pearl oysters
3. Cross section of a culture pearl, magnified about 16 times; it is without concentric structure in the core (a mother-of-pearl bead), and shows the line of cleavage which commonly separates the core from the outer layer of nacre
4. Cross section (magnified) of an Oriental or natural pearl
5. Cross section (magnified) of a culture pearl
6. Drilled culture pearl sawed in half, part of the nacre shell having been broken away during cutting
7. Fine specimen of a culture pearl in the natural state
8. The shell of an Oriental mollusc with imbedded Buddha images, a curious product of pearl cultivation. Cultivated pearls have been produced in China since the 13th century. The Buddha figures are of lead or tin
9. Fish imbedded and covered with mother of pearl in a pearl shell

They are now manufactured in enormous quantities by different processes. An excellent substitute for black pearl is found in the so-called "ironstone jewellery," and consists of close-grained haematite, not too highly polished. Pink pearls are imitated by turning small spheres out of the rosy part of the conch shell, or even out of pink coral.

PEARL, CULTIVATED. "Cultured" pearls are "natural" pearls beautified by the scientific control of their formation and growth. Examination of a section of an "accidental or "natural" pearl shows, in the majority of cases, a nucleus surrounded by a series of concentric layers of pearly nacreous matter. The concentric layers consist alternatively of Calcium Carbonate (Aragonite), and the protein Conchiolin ($C_{30}H_{48}N_9O_{11}$). The nucleus varies, and may consist of sea-weed, sand, a parasite worm, or in general, anything which acts as a foreign irritant to the oyster, and which conforms to specific conditions to be described later. Experimental work on the introduction of nuclei into the oyster so as to obtain pearls, has been carried out principally in China and Japan, but the successful production of the "spherical" cultured pearl was only obtained after assiduous research by the Japanese. K. Mikimoto commenced researches on pearl cultivation in 1891, working on a theory advanced by Dr Mitsukuri (professor of Zoology, Imperial University of Japan) He inserted a small spherical mother-of-pearl bead between the body of the oyster, and the shell, and after several years found that the bead was covered with pearl secretion. Unfortunately these beads were firmly attached to the oyster shell, and therefore resembled "Blister" pearls. A wide range of materials can be used as nuclei, but mother-of-pearl was chosen by the Japanese in order that the pearl should consist entirely of oyster products. The secretion is periodic, and occurs during the warm season. The most vital portion of the oyster for pearl development is the outside of the epithelium which surrounds the mantle. This epithelium secretes from the outside normally, mother-of-pearl, and abnormally, the pearl The determining factor in the formation of a pearl is not the presence of a foreign body in the interior of the oyster, but the epithelial cells in the subepidermal tissues of the mantle. These living epithelial cells are capable of secreting the nacreous matter. Nuclei which enter the body of the oyster without carrying a particle of the living epithelium will not cause the development of a pearl In cases where the irritant or nucleus is directly attached to the epithelium of the mantle, the oyster envelopes it with a covering of epithelial cells, forming a sac, which is then coated with successive layers of nacre to produce the pearl. "Natural" pearls are found which contain no central nucleus, and Dr. Alverdes and K. Mikimoto independently, by transplanting small sections of the living epithelium cells of one oyster into another, demonstrated the development of pearl matter, but such pearls were very irregular in shape, and entirely free from nucleus.

The Oysters Employed.—The finest pearls are developed by the strongest oysters, obtained by the Japanese by careful breeding and repeated examination for disease during growth The oyster spawn is collected, and when old enough the young oysters or "spats" are placed in fine meshed cages in order to protect them from the attacks of star fish, octopuses or other enemies, and are lowered into the sea. Cleansing of the cages is necessary, and the oysters themselves are frequently examined for disease; at the age of two they are transferred into a wider meshed cage and returned to the sea. When they are three years old, the age of maturity, the oysters are operated upon for pearl development. The shell of one oyster is removed, and a small spherical bead of mother of pearl is placed on the outside of the secreting epithelium of the mantle. This epithelium is then dissected from the oyster, and drawn over the mother of pearl nucleus so as to form a sac, which is ligatured at one end. The sac is next taken from the oyster, and grafted into the sub-epidermal tissues of a second oyster; the ligature is removed, and after treatment of the wound with astringents, the second oyster is placed in a cage, and finally returned to the sea. During the next seven years the oyster continues the secretion of the nacreous layers upon the mother-of-pearl nucleus, and development proceeds exactly as in the formation of a "natural" pearl. Supervision is maintained during this period, and finally the oysters are opened for the extraction of the "cultured" pearls. Approximately sixty per cent of the oysters operated upon yield pearls, but owing to the irregularity in shape, due to uncontrollable factors in their development, those of marketable value are only about 5%.

Distinction Between Cultured and Natural Pearls.—Pearls of culture generally possess a finer structure than those of accidental growth. This is due to the smaller amount of organic matter which is consumed and secreted by the oysters, which live in well-cleaned cages. "Natural" pearls contain on an average two per cent of water, but those of "culture" contain less than this, an important factor after the pearl has dried out. Several attempts have been made to distinguish between pearls of "culture" and "natural" pearls X-rays and X-ray photography failed. Professor Cox and Dr. Lyster Jameson studied the effect of polarized light without success. Ultra-violet rays at first appeared more successful, as pearls of "culture" gave a different coloured transparency from "natural" pearls fished from the waters either of India or of Australia. Finally it was found that the method would only indicate the locality in which the pearls were developed. The only method of ascertaining which variety is "cultured" and which "natural" is to cut the pearl and examine the cross section. In the case of the former the mother-of-pearl bead can be observed

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(J. R. D)

PEARL, THE. The Middle-English poem known as "Pearl" or "The Pearl" is preserved in the unique ms Cotton Nero Ax at the British Museum; in this volume are contained also the poems "Cleanness," "Patience," and "Sir Gawayne and the Green Knight." All the pieces are in the same handwriting, and from internal evidences of dialect, style and parallel references, it is now generally accepted that the poems are all by the same author One other alliterative poem, "Sir Erkenwald," may be assignable to him. The ms, which is quaintly illustrated, belongs to the end of the 14th or the beginning of the 15th century.

"Pearl" is a poet's lament for the loss of a girl-child, "who lived not upon earth two years"; the poet is evidently the child's father In grief he visits the little grave, and there in a vision beholds his Pearl, now transfigured as a queen of heaven—he sees her beneath "a crystal rock," beyond a stream; the dreamer would fain cross over, but cannot. From the opposite bank Pearl, grown in wisdom as in stature, instructs him in lessons of faith and resignation, expounds to him the mystery of her transfiguration, and leads him to a glimpse of the New Jerusalem. Suddenly the city is filled with glorious maidens, who in long procession glide towards the throne, all of them clad in white, their robes pearl-bedecked like Pearl herself. There he sees, too, "his little queen." A great love-longing possesses him to be by her. He must needs plunge into the stream that sunders him from her In the very effort the dreamer awakes, to find himself resting upon the mound where his Pearl had "strayed below"

"While the main part of the poem," according to Gollancz, "is a paraphrase of the closing chapters of the Apocalypse and the parable of the Vineyard, the poet's debt to the *Romaunt of the Rose* is noteworthy, more particularly in the description of the wonderful land through which the dreamer wanders; and it can be traced throughout the poem, in the personification of Pearl as Reason, in the form of the colloquy, in the details of dress and ornament, in many a characteristic word, phrase and reference. 'The river from the throne,' in the Apocalypse, here meets 'the waters of the wells' devised by Sir Mirth for the Garden of the Rose. From these two sources, the Book of Revelation, with its

almost Celtic glamour, and *The Romaunt of the Rose,* with its almost Oriental allegory, are derived much of the wealth and brilliancy of the poem. The poet's fancy revels in the richness of the heavenly and the earthly paradise, but his fancy is subordinated to his earnestness and intensity."

Leading *motifs* of "Pearl" are to be found in the Gospel—in the allegory of the merchant who sold his all to purchase one pearl of great price, and in the words, so fraught with solace for the child-bereft, "for of such is the Kingdom of Heaven." Naturally arising from the theme, and from these *motifs,* certain theological problems of the time are treated perhaps too elaborately.

The poem consists of 101 stanzas, each of 12 lines, with four accents, rhymed *ab, ab, ab, ab, bc, bc;* the versification combines rhyme with alliteration; trisyllabic effects add to the easy movement and lyrical charm of the lines. Five stanzas (in one case six), with the same refrain, constitute a section, of which accordingly there are 20 in all, the whole sequence being linked together by the device of making the first line of each stanza catch up the refrain of the previous verse, the last line of the poem re-echoing the first line. The author was not the creator of this form, nor was he the last to use it.

By piecing together personal and other indications to be found in the poems an imaginary biography of the unknown poet may be constructed. It may be inferred that he was born about 1330–40, somewhere in Lancashire, or a little to the north; that he delighted in open-air life, in woodcraft and sport; that his early life was passed amid the gay scenes that brightened existence in mediaeval hall and bower; that he availed himself of opportunities of study, theology and romance alike claiming him; that he wedded, and had a child perhaps named Margery or Marguerite —the Daisy or the Pearl—at whose death his happiness drooped and life's joy ended.

It is noteworthy that soon after 1358 Boccaccio wrote the Latin eclogue "Olympia" in memory of his young daughter Violante. A comparative study of the two poems is full of interest; the direct influence of the Latin on the English poem is doubtful, although "Pearl" may be later than "Olympia."

See *Pearl, an English Poem of the Fourteenth Century, edited, with a modern Rendering,* by I. Gollancz (1891; with *Olympia,* 1921); *Sir Erkenwald,* ed. I. Gollancz, *Select Early English Poems* (1922); Facsimile of ms. Cotton Nero Ax (E.E.T.S., 1923); *Cambridge History of English Literature,* vol. i. ch. xv. (bibl.). (I. G.)

PEARSALL, ROBERT LUCAS DE (1795–1856), English composer, was born on March 14, 1795, at Clifton. He produced many works of lasting beauty, nearly all of them for voices in combination: from his part songs, such as "Oh, who will o'er the downs?" to his elaborate and scholarly madrigals, such as the admirable eight-part compositions, "Great God of Love" and "Lay a Garland." He died on Aug. 5, 1856.

PEARSE, PATRICK HENRY (1879–1916), Irish leader and poet, was born in Dublin on Nov. 10, 1879. Educated at the Christian Brothers schools and the Royal University of Ireland, he became editor of the *Claidheamh Soluis,* the weekly organ of the Gaelic League. He was secretary to the publication committee of the League and an energetic member of its executive. After touring Belgium to study bilingual methods, he published several *Fiana,* tales from Irish manuscripts. Pearse's chief interest was education and he approved Birrell's Irish Education Bill, as it gave the Irish control over their own education. He founded St. Enda's school at Cullenswood, Dublin, moving it in 1910 to the Hermitage, Rathfarnham. After a tour in America, Pearse joined the Irish Volunteer Movement and was commander-in-chief of the Irish forces in the rebellion of 1916. On April 30, 1916, he sent out an order to his troops to surrender. He himself was arrested and executed on May 3, 1916.

See his *Life* by Desmond Ryan (1919).

PEARSON, SIR CYRIL ARTHUR (1866–1921), British newspaper proprietor, was born at Wookey, near Wells, Feb. 24, 1866, and was educated at Winchester. He early founded the business of C. Arthur Pearson, Ltd., newspaper proprietors and publishers; and after making large profits with *Pearson's Weekly* and other periodicals he founded in 1900 *The Daily Express,* a halfpenny rival to *The Daily Mail.* In 1904 he purchased *The Standard* with *The Evening Standard.* He was a strong supporter of Mr. Chamberlain's tariff reform movement, and was vice-president of the Tariff Reform League and vice-chairman of the Tariff Commission of 1903. In 1905 he amalgamated *The Evening Standard* with *The St. James's Gazette* which he had bought a few months previously. In 1910 increasing—later complete—failure of sight obliged him to retire from the active direction of newspapers. Henceforth he devoted himself and his fortune with whole-hearted industry to efforts to ameliorate the condition of the blind. During the World War he established at his house, St. Dunstan's, in Regent's Park, London, a hospital for blinded soldiers, and became chairman of the Blinded Soldiers' and Sailors' Care Committee (1914). He also became president of the National Institution for the Blind. He was created a baronet in 1916 and G.B.E. in 1917. Sir Arthur died in London on Dec. 9, 1921.

PEARSON, JOHN (1612–1686), English divine and scholar, born at Great Snoring, Norfolk, on Feb. 28, 1612, studied at Queen's College, Cambridge, and became a fellow of King's and a weekly preacher at St. Clement's, Eastcheap, in London. In 1659 he published in London his famous *Exposition of the Creed* (*see* the ed. by Burton, 1883), *Chevalier* (1849) and *Sinker* (1882) and his *Golden Remains of the ever-memorable Mr. John Hales of Eton,* with an interesting memoir. In 1662 he was made master of Trinity college, Cambridge. In 1667 he was admitted F.R.S. His defence of the authenticity of the letters of Ignatius in his *Vindiciae epist. S. Ignatii* (1672) was confirmed by J. B. Lightfoot and other recent scholars. In 1672 Pearson was appointed to the bishopric of Chester. In 1682 his *Annales cyprianici* were published at Oxford, with John Fell's edition of the works of Cyprian. He died at Chester on July 16, 1686. His last work, the *Two Dissertations on the Succession and Times of the First Bishops of Rome,* formed with the *Annales Paulini* the principal part of his *Opera posthuma,* ed. H. Dodwell (1688).

See memoir by E. Churton, prefixed to the edition of Pearson's *Minor Theological Works* (2 vols., 1844). Churton also edited most of the theological writings.

PEARSON, JOHN LOUGHBOROUGH (1817–1897), English architect, son of William Pearson, etcher, of Durham, was born in Brussels on July 5, 1817. He was articled at 14 to Ignatius Bonomi, architect, of Durham, and afterwards worked under Anthony Salvin and Philip Hardwicke in London. He revived and practised with great proficiency the art of vaulting, though he was by no means a Gothic purist; he also followed Renaissance and classical models. From the erection of his first church of Ellerker, in Yorkshire, in 1843, to that of St. Peter's, Vauxhall, in 1864, his buildings are Geometrical in manner and characterized by elegance of proportion and refinement of detail. His best known work is Truro cathedral (1880), incorporating the south aisle of the ancient church.

Pearson's conservative spirit fitted him for the reparation of ancient edifices, and among cathedrals and other buildings placed under his care were Lincoln, Chichester, Peterborough, Bristol, and Exeter cathedrals, St. George's chapel, Windsor, Westminster Hall and Westminster Abbey. In the surveyorship of the last he succeeded Sir G. G. Scott. Except for porches, the work of Scott, he re-faced the north transept of Westminster Abbey, and designed the organ cases. He was elected A.R.A. in 1874, R.A. in 1880, was a fellow of the Society of Antiquaries, and a fellow and member of the council of the Royal Institute of British Architects. He died on Dec. 11, 1897, and was buried in the nave of Westminster Abbey.

See *Archit. Review,* vol. i. (1897); *Royal Inst. of Brit. Architects Journal,* v. 113 (1897–98).

PEARSON, KARL (1857–), British mathematician, was born in London in 1857, and educated at University college school and at King's college, Cambridge. He was called to the bar in 1882, and afterwards became an authority on the science of eugenics. He was subsequently appointed Galton professor of eugenics at London university and director of the Francis Galton laboratory for national eugenics. He was awarded the Darwin Medal of the Royal Society, of which he was elected fellow in

1896, for his numerous contributions to the mathematical theory of evolution and heredity.

Professor Pearson was the editor of *Biometrika* from 1902–24, and of *The Annals of Eugenics* (1925–26), and his other publications include *The Ethics of Free-thought* (1887, 1901); *The Chances of Death, and other Studies in Evolution* (1897); *Grammar of Science* (1899, 1900, 1911); *National Life from the Standpoint of Science* (1901); *Tables for Statisticians* (1914–24); *The Life, Letters and Labours of Francis Galton* (1915–25).

PEARY, ROBERT EDWIN (1856–1920), American Arctic explorer, was born at Cresson, Pa, on May 6, 1856 In 1877 he graduated at Bowdoin college. He was made a lieutenant in the U.S. navy in 1881, acting as civil engineer and was assistant-engineer in the Nicaragua ship canal surveys in 1884, becoming their director in 1887–88 In 1886, however, he also made a study of the west coast of Greenland, in the region of Disco bay, with reference to its use as a base for polar exploration In 1891 the Philadelphia Academy of Natural Sciences put him in charge of a polar expedition of seven, including his wife. Inglefield gulf, on the north-west coast of Greenland, was the base In the spring of 1892 he went, with the Norwegian Eivind Astrup, to the north-east coast, thereby proving that Greenland is an island The Cape York (Smith sound) Eskimos, the most northerly people in the world, were also studied. This expedition was described by Mrs. Peary in *My Arctic Journal.* In the following year he organized another expedition, also from headquarters in Inglefield gulf, where Mrs. Peary gave birth to a daughter. In 1894 Peary, Matt Henson, the negro member of the expedition, and Hugh Lee, were left alone and again crossed to the east coast In the summer three meteorites, which the Eskimos used in making their iron implements, were found These had been reported in 1818 by Sir John Ross All were eventually brought to the United States In 1898 Peary described his work to date in *Northward Over the Great Ice* In that year also, with the support of the Peary Arctic Club and Morris Jesup, he started on a four year's exploring schedule He used Eskimos in this expedition, which demonstrated, in 1900, that Greenland is bounded on the north by the polar ocean; the north coast of the island was surveyed. In 1902 Peary, with Henson and an Eskimo, advanced as far north as lat 84° 17′ 27″, the highest point then reached in the Western Hemisphere. Lieut Peary had now been promoted to the rank of commander, and on his return he was elected president of the American Geographical Society In Nov 1903 he went to England on a naval commission to inquire into the system of naval barracks in Great Britain, and was presented with the Livingstone Gold Medal of the Royal Scottish Geographical Society Commander Peary then began preparations for another expedition by the construction of a special ship, named the "Roosevelt," the first ever built in the United States for the purpose of Arctic exploration. He sailed from New York on July 16, 1905, having two years' supplies on board. The "Roosevelt" wintered on the north coast of Grant Land, and on Feb 21 a start was made with sleds The party experienced serious delay owing to open water between 84° and 85°, and farther north the ice was opened up during a six days' gale, which cut off communications and destroyed the dêpots which had been established A steady easterly drift was experienced But on April 21, 1906, 87° 6′ was reached—the "farthest north" attained by man—by which time Peary and his companions were suffering severe privations, and had to make the return journey in the face of great difficulties. In 1907 the narrative of his journey, *Nearest the Pole,* was published

In 1908 Peary started in the "Roosevelt" on the journey which was to bring him his final success as the discoverer of the North Pole. He left Etah on Aug 18, wintered in Grant Land, and set forward over the ice from Cape Columbia on March 1, 1909 A party of six started with him, and moved in sections, one in front of another. They were gradually sent back as supplies diminished At the end of the month Capt. Bartlett was the only white man left with Peary, and he turned back in 87° 48′ N, the highest latitude then ever reached. Peary, with Henson and four Eskimos, pushed on, and on April 6, 1909 reached the North Pole. They remained some 30 hours, took observations, and on sounding, a few miles from the pole, found no bottom at 1,500 fathoms. The party, with the exception of one drowned, returned safely to the "Roosevelt," which left her winter quarters on July 18, and reached Indian Harbour on Sept. 5 Peary's *The North Pole: Its Discovery in 1909* was published in 1910

In 1911 he was given the rank of rear-admiral and delegated to the International Polar Commission in Rome. In addition to the works already mentioned he wrote, *The North Pole* (1910) and *Secrets of Polar Travel* (1917). He died in Washington, D.C on Feb 20, 1920.

See Fitzhugh Green, *Peary, the Man Who Refused to Fail* (1926). (R. E. B.)

PEASANT, a countryman, either working for others, or owning or renting and working by his own labour a small plot of ground (Fr. *paysan;* Lat *pagensis,* belonging to the country). (*See* ALLOTMENTS and METAYAGE)

PEASANT MOVEMENT. The World War gave a strong impetus to the political consciousness of a class which had seemed obliterated since the Industrial Revolution During the past century the peasants, even in western Europe, have been dominated by commerce and industry. In eastern Europe they have had no share in public life, except in sporadic risings. Yet in eastern Europe they form the bulk of the populations, and it is naturally in that region that the new peasant movement is asserting itself

Political Traditions of the Peasantry.—From the French Revolution till 1848 the peasants of western and central Europe were gradually freed from all their feudal servitudes The peasants themselves played only an indirect rôle in that emancipation, which was due mainly to the efforts of the urban middle classes, acting under the stimulus of political, economic and social motives.

The political division between town and country was later widened into a gulf by scientific Socialism The angle of Socialist economics was essentially the same as that of Liberalism, except that what the latter regarded as economically well established Socialism looked upon as merely transitory, so that its own heaven was even more remote from the peasant world The peasant holding and tilling land on a small scale was doomed M Vandervelde said (in 1898) that to wish to realise the ideal of the Biblical homestead was as futile as to try "to replace the *Code Napoléon* by the tables of Moses" And not only futile but also pernicious; Marx praised capitalism for having at least rescued "a considerable part of the population from the idiocy of rural life" Hence he and his disciples placed the nationalisation of land and farming on a large scale for public account in the forefront of their programme From that time date the many Conservative agrarian organisations in central and western Europe which found in the peasants credulous recruits; a circumstance whose electoral effects gradually led to a watering down of Socialist agrarian programmes

Populism.—The economic and political incentives which had harnessed the western bourgeoisie to the task of rural emancipation had then little meaning in the eastern half of the Continent. Politically that region was still in the autocratic stage; and its economic structure rested on a primitive agriculture and on artisan manufacture—capitalist industry being altogether absent. But the third, social incentive stirred up reformers in the east if anything more deeply than in the west. In Russia the Slavophil revival had raised the peasant on a pedestal, and that only made his serf's chains more obnoxious in the eyes of the *intelligentsia* The younger intellectuals, imbued with 18th century humanitarian philosophy, centred all their ideals on freeing the peasants But whereas to western Liberals that had been an end in itself, for the Russian reformers it was merely the stepping-stone to an independent and prosperous village life They prided themselves in being Socialists, but, like Proudhon's, theirs was a Socialism for the peasants Marxism was essentially an industrial policy for the transformation of industrial societies The eastern reformers were forced to form alternative conceptions and programmes suited to the problems of their peasant populations "Populism" (*narodnichestvo,* from *narod*—people) became the expression of that current of opinion. (*See* RUSSIA, HISTORY)

The kernel of the Populist position was the rejection of the Marxian economic determinism. Marxism considered a phase of capitalist concentration of production as the inevitable prelude to a Socialist society; the Russian Populists, basing themselves on the existence of the *mir*, contended that the capitalist-proletarian phase was not necessary in Russia, nor even possible in such backward agrarian countries. For capitalism would ruin the peasants, *i.e.*, the only available customers for industrial products. Likewise the Populists held that revolutionary leaders were able to shape and guide events, provided that they acted in line with the needs and wishes of the masses. Above all they believed that a rural democracy offered the masses a better promise of happiness than they could expect from an industrial organisation. All they needed was more "Land and Liberty"; and the backbone of the Populist programme was a plea for equal distribution of land among the peasants.

The later exponents of this policy were the Social-Revolutionaries who were the strongest party of the Left till the Bolshevik Revolution. That the Populist doctrine had its roots in the natural conditions of the region is proved by the way it spread to the other agrarian countries of eastern Europe. It was perhaps natural that Serbia and Bulgaria should come under its influence, as both countries stood in close intellectual dependence on Russia. The decisive test is supplied by Rumania—a Latin country, strongly averse to Slav influence; yet there also the new doctrine engendered the able Poporanist (*popor*, people) current, which together with the other groups never ceased denouncing Marxism. (*See* D. Mitrany, *Marx and the Peasant*, in "London Essays in Economics in Honour of Edwin Cannan.")

The Peasant Renascence.—The Populist movement had remained largely theoretical. In the region in which it was born the peasants were kept under by a rigid political and social tutelage. Political activity among them, and claims for the distribution of land, were treated as revolutionary. The only outlet for their grievances was occasional risings, like those of 1905 in Russia and 1907 in Rumania, which were mercilessly repressed. The World War and the Russian Revolution produced great changes. Sweeping agrarian reforms have transferred the land to the peasants, giving them potential economic independence and reducing in the same degree the influence of their former task-masters. In most of the countries concerned they have at the same time secured full political franchise. And everywhere they have been roused to a consciousness of their interests and of their power as a class. As a consequence powerful Peasant Parties have sprung up in all the countries of eastern Europe in which government is representative. The movement is yet in its infancy; its possibilities reside in the facts that more than half the population of the globe lives in the typically peasant "family economy," and that of the hundred million European voters some 60–70 million are peasants, as against some 20 million industrial workers.

Doctrine and Programme.—Unlike Socialism, which had a fully developed doctrine before it had an organised following, the Peasant Movement has sprung up suddenly and separately in the various countries, though out of similar convulsive events. Hence its sociology is in the making, and the programmes of the several Parties, which hitherto have had little contact with each other, show substantial variations. Essentially it is of course an agrarian movement; but its philosophy and policy are eclectic, having taken over and adapted to its own use elements from all the three chief political divisions—from Conservatism and Liberalism as well as from Socialism. Its fundamental standpoint is a bias for a rural society, based on small peasant property.

The radicalism of the eastern Peasant Movement is due to peculiar conditions in that region. Whereas in the west agrarian parties were a mixture of all rural classes, with the big landowners predominant, as in the German *Landbund*, the new Peasant Parties are exclusively peasant. Secondly, the oppression of the peasantry in the east has till now prevented the growth of a peasant middle class, so that the movement is carried more uniformly by a mass of small peasants. Thirdly, the general peasant antagonism towards towns and capitalists has different effects in the two halves of Europe: in the west finance and industry are moving fast into a phase of international organisation, by means of cartels, trusts, etc., and the outlook of the towns is cosmopolitan; as a reaction the countryside is Conservative and nationalist. In the east the towns, industry and finance concentrate the essence of local nationalism, and the peasantry which has to pay the bill of protectionism, etc., favours in consequence a Liberal and even Radical policy in all respects. Fourthly, in the industrialised States agriculture produces mainly for the home market and is anxious to be protected in it; the peasants produce mainly for themselves with a surplus for export, and desire free trade.

National Organisations.—The new Peasant movement is peculiar to the eastern half of Europe. In the industrialised countries of the west, and even in Holland and Denmark, the peasants have been drawn into agrarian Conservative parties, as a result of a general agrarian antagonism to industry and finance, partly through clerical influence, and largely by the effective use of the Socialist demand for land nationalisation as a bogey. But just as western Socialism has stirred up industrial groups in the east and shaped their outlook, so the eastern Peasant Movement is bound to react upon peasant groups in the west. In France a Peasant Party was founded four weeks before the elections of 1928; none of its three candidates was elected, but the Party secured 80,000 votes and is actively organising itself. In Germany, likewise before that year's elections, the left wing of the old *Landbund* formed the new Christian National Peasant Party and gained 13 seats in the Reichstag. At the same time the Bavarian *Bauernbund* transformed itself into a German Peasant Party; it secured 8 seats in the Reichstag and dominates the parliamentary situation in Bavaria. The formation of a joint Peasant group in the Reichstag is foreshadowed. An attempt to establish a Peasant Party is also being made in Holland.

Some of the eastern Peasant Parties were founded before the World War, but became important only after its end. Most countries have only one Party, but in Poland and other States bordering on Russia the chaos of the revolution is still reflected in a continuous splitting-up and reshuffling of political groupings. In the following list figures refer to 1928 except when otherwise stated.

Bulgaria.—"Agrarian Union," founded 1899 as a professional body, became political in 1901. It polled in 1911 14·45% of the votes cast, 31% in 1919, 38·16% in 1920 and 52% in 1923. In June 1923 there was a military rising; Stamboliski and other Party leaders were murdered. At the following elections 26·8% of the votes, 33 deputies: the Party is recovering, but suffers from lack of leaders. In power from 1919 to 1923, it carried through considerable co-operative developments, also the law for compulsory service (*see* Int. Labour Office pamphlet, Legislative Series 1920), which is still in force.

Czechoslovakia.—"Republican Party of Farmers and Small Peasants." Founded in 1896; first Conservative, veered towards the Left. Polled 603,618 votes in 1920 and 970,498 in 1925 in the Czech territories alone. Its leader has been in office since the establishment of the Republic; since 1922 Antonin Svehla has presided over two Coalition Governments. The Slovak, Dr. Milan Hodža, Minister of Education, is the most forceful exponent of the new movement. Czechoslovakia is the only country to have adopted the eight hours' day for agriculture, also the only one of the eastern countries to have included members of the Minorities in the Cabinet; both measures due to the Party's initiative.

Estonia.—"Peasant Party," founded after the war. 1926 election: 25 members of parliament. Leader Jaan Teemant is president and premier of the State. The Settlers' Party has 14 members of parliament, two leaders in the cabinet; represents the interests of the recently impropriated peasants.

Finland.—"Peasant League": in 1924 had 44 members of parliament, 1927 rose to 52. Leader, Dr. Relander, is premier of the Coalition Government.

Hungary.—"Small Farmers' Party": made promising begin-

ning, but the introduction of open balloting in country districts has checked all political activity on the land.

Latvia.—There are three Centre groups: Peasants' Union with 16 deputies, Latgallian Catholic and Christian Peasants with 5, and Latgallian Peasants with 2 deputies; and three groups of varying Leftward shades: Agrarian Settlers with 3, New Farmers and Small Peasants with 3 and Latgallian Peasant-Labour Party with 2 deputies. They differ mainly in regard to land reform and in their bias for closer relations with the west or with Russia.

Lithuania.—Before the recent coup d'état the Peasant Union had 11 members of parliament.

Poland.—Polish Peasant Parties have been in a continuous state of flux, largely for personal reasons. "Piast," formerly the strongest, now has only 28 deputies; its leader, Vincent Witos, has been twice premier; it is Conservative, admits land reform only against full compensation and is open to Clerical influences. "Wyzwolenie" secured 38 seats at the last election; Jan Dabsky, its leader, is vice-president of the chamber; it is radical, demands land reform without indemnity, regional autonomy for the minorities; it also is anti-clerical. A similar programme is supported by "Stronnictwo Chlopskie," with 25 deputies, representing the small peasants. The "Stapinski" Peasant Party has 3 members and the extreme Radical Peasants' Club has one member in parliament. It is noteworthy that while the political movement is divided by regional, clerical and personal influences, the peasants generally work together in each locality in their co-operative affairs.

Rumania.—The "National Peasant Party"; formed of the fusion two years ago of the Peasant Party and of the National (Transylvanian) Party, has been able to assert itself as the only substantial Opposition in spite of elaborate "doctoring" of elections. It has now about 40 members in the Chamber, but its strength in the country is dominant. Of the leaders, Vaida-Voevod has once held office as premier, and Mihalache, Popovici, etc. have held cabinet positions. The Party secured power in November 1928 and formed the first truly parliamentary government in Rumania.

Yugoslavia.—The "Croatian Peasant Party," founded in 1904, had 3 deputies in 1908, 49 in 1920 and 60 in 1923. It dominates in Croatia and is gaining strength in Herzegovina and Dalmatia. Of the leaders, Stephen Radić, Pavle Radić (recently murdered) and three others have held cabinet office in Coalition Governments. Remarkable for its organisation, and especially for its spiritual strength, it is the only Peasant Party to have been founded in furtherance of a rural creed rather than of agrarian interests, by the brothers Radić (Dr. Ante Radić having previously done original work in rural sociology).

International Organisation.—A number of international agrarian organisations have existed before the war or were formed after it, but of these none had the two distinguishing characteristics of being limited to truly Peasant groups and of being established for political action. Three attempts have been made to set up an international body on these lines:

(1) Soon after the war an attempt was made by Bavarian and Austrian agrarians to join up the Peasant groups of central Europe, the Bavarian Dr. Heim being one of the initiators. The tendency was strongly Conservative, anti-Bolshevik (in this being included all the democratic influences coming from Berlin); and while some of the leaders kept neutral, others had a strong clerical bias. The attempt never materialised.

(2) Though no Peasant Party exists, or would be allowed, in Russia, the Soviets encouraged some of the refugees living in Moscow to set up a Peasant International there. Formed in 1923, it held its first Congress in 1925. It has made no visible impression on the Peasant movement.

(3) On the initiative of the Bulgarian Stamboliski an international agrarian bureau was established in Prague in 1921, the Czech, Bulgarian, Polish and Serbian Peasant Parties being its members; purely for research and information. In May 1928 the organisation was widened, being joined by the Croatian, Rumanian and other Peasant Parties, including the newly-formed French and Dutch Parties. Eight Parties of central and eastern Europe have in addition formed a regional group within the bureau, to act politically in close contact, with a joint central executive. The group, like the bureau, is to work for the solution of political and social problems according to peasant interests; it is to publish in one or more of the western languages the chief writings of Peasant leaders, and prepare a peasant news agency. The regional group was formed especially to resist jointly any attempt at dictatorship, whether from the Left or from the Right.

(D. Mi.)

PEASANT PROPRIETOR: *see* Land Tenure.

PEASE, EDWARD (1767–1858), the founder of a famous industrial Quaker family in the north of England, was born at Darlington on May 31, 1767, the son of Joseph Pease (1737–1808), a woollen manufacturer. Edward Pease made the acquaintance of George Stephenson, and with him took a prominent part in constructing the railway between Stockton and Darlington. He died at Darlington on July 31, 1858.

His grandson, Joseph Albert Pease, Lord Gainford (b. 1860), entered parliament in 1892, was junior Liberal Whip (1897–1905), a lord of the treasury (1905–10), chancellor of the duchy (1910–11), president of the board of education (1911–15), and postmaster-general (1916).

PEAT, a product of decayed vegetation found in the form of bogs in many parts of the world. The principal areas of the peat deposits of the world are as follows:—

Russia	65,000 square miles
Canada	37,000 ,, ,,
Finland	30,000 ,, ,,
Sweden	19,000 ,, ,,
United States	11,200 ,, ,,
Germany	9,900 ,, ,,
Great Britain	9,400 ,, ,,
Ireland	4,700 ,, ,,
Newfoundland	3,000 ,, ,,
Norway	2,900 ,, ,,
Austria	1,500 ,, ,,
Denmark	400 ,, ,,

The plants which give origin to these deposits are mainly aquatic, including reeds, rushes, sedges and mosses. *Sphagnum* is present in most peats, but in Irish peat *Thacomitrum lanuginosum* predominates. It seems that the disintegration of the vegetable tissues is effected partly by moist atmospheric oxidation and partly by anaerobic bacteria, yeasts, moulds and fungi, in depressions containing fairly still but not stagnant water, which is retained by an impervious bed or underlying strata. As decomposition proceeds the products become waterlogged and sink to the bottom of the pool; in the course of time the deposits attain a considerable thickness, and the lower layers, under the superincumbent pressure of the water and later deposits, are gradually compressed and carbonized. The most favourable conditions appear to be a moist atmosphere, and a mean annual temperature of about 45° F: no bogs are found between latitudes 45° N. and 45° S. The peat bogs of Great Britain vary in thickness from 5 to 30 ft.; and those of North America from 5 to 25 ft.

Peat varies from a pale yellow or brown fibrous substance, resembling turf or compressed hay, and containing conspicuous plant remains, to a compact dark brown material, resembling black clay when wet and some varieties of lignite when dry. Two typical forms may be noticed: "Hill peat" (the mountain or brown bogs of Ireland), found in mountainous districts, and consisting mainly of *Sphagnum* and *Andromeda*; and "Bottom peat" (the lowland or red bogs of Ireland), found in lakes, rivers and brooks, and containing *Hypnum.* The latter kind always contains much water, up to 90%, which it is necessary to remove before the product can be efficiently employed as a fuel, and for most other purposes. A specimen dried at 100° C had the following composition: carbon, 60·48%; hydrogen, 6·10%; oxygen, 32·55%; nitrogen, 0·88%; ash, 3·30%; the ash is very variable—from 2 to 15% and even more—and consists principally of clay and sand, with lesser amounts of ferric oxide, lime, magnesia, etc. On air-drying the peat loses from 8 to 20% of its moisture. In a good, dry season peat may be air-dried down to 17 or 18% moisture, while under moderate conditions it may be saved with 25 to 30%

moisture. Average air-dried peat containing 25% moisture may be taken as having a calorific value of about 6,000 B.T.U. The specific gravity has been variously given, owing to the variable water content and air spaces; when dried and compressed, however, it is denser than water. The yield per sq.km. (0·386 sq.m.) for a depth of five metres (16·4 ft.) has been determined in Germany as approximately 800,000 tons of air-dried peat.

Peat-winning presents certain special features. The general practice is to cut a trench about 1 ft. deep with a peculiarly shaped spade, termed in Ireland a "slane," and remove sods from 3 to 4 ft. long. When one layer has been removed, the next is attacked, and so on. If the deposit be more solid step-working may be adopted, and should water be reached recourse may be had to long-handled slanes. The sods are allowed to drain, and then stacked for drying in the air, being occasionally turned so as to dry equally; this process may require about six weeks.

Machine Working.—Mechanical power has been applied, especially in Sweden and Germany, to the winning of peat, the operations involved being:—(1) The excavation and elevation of the raw peat from the bog. (2) The maceration and mixing of the raw peat by means of rotating and fixed knives and a single or double screw conveyor which forces the peat through a nozzle or nozzles in a stream which is cut into lengths for sods. (3) The transport of the formed sods and their deposition on the bog. (4) The collection and stacking of the air-dried peat. In the most recent German practice the operations indicated in (1) (2) and (3) are combined in one machine electrically driven.

Several processes have been invented for the carbonization of peat and recovery of the by-products. Among these is the Ziegler process which is, or was, in operation at Oldenburg in Germany, Rodkino in Russia and Beuerberg in Bavaria The uncondensed gases from the coking plant at Beuerberg gave:—

Carbon dioxide	15·5 per cent
Oxygen	1·1 „ „
Carbon monoxide	20·4 „ „
Methane and other hydrocarbons	12·4 „ „
Hydrogen	28·6 „ „
Nitrogen	21·9 „ „
	99·9

The "coke" contained:

Carbon	73·89 per cent
Hydrogen	3·59 „ „
Oxygen	14.52 „ „
Nitrogen	1·49 „ „
Sulphur	0·20 „ „
Ash	2·50 „ „
Moisture	3·80 „ „
	99·99

and the calorific value of the semi-coke was 12,000 B.T.U. The volume of the gases amounted to 6,759 cu.ft. per ton.

The results of working the process are stated to have been as follows:—

	Per 100 tons of air-dried peat
Ammonium sulphate	900 lb.
Acetate of lime	1,320 „
Methyl alcohol	65 gal.
Light oils	280 „
Heavy oils	95 „
Paraffin	715 lb.
Creosote	3,100 „
Asphalt	40 „

The manufacture of producer gas from peat, in regard to which a number of methods exist, mostly based on the Mond process, has proved more or less successful. The briquetting of peat has also been carried out. The briquettes contain approximately 18% of moisture and are said to yield a high quality charcoal. One of the chief factors operating against the commercial success of peat as a fuel in competition with coal and other fuels has been the cost of drying the peat. With the recently introduced "Peco" process it is claimed however that the peat can be dried down to 10% moisture and that 65% of the peat is recovered, that is to say in order to produce from 100 tons of raw peat 65 tons of dry peat, 35 tons of the raw peat are absorbed in drying. Perhaps Ireland is the largest producer with an output in the neighbourhood of 6,000,000 tons annually of air-dried peat.

See *The Winning, preparation and use of peat*, by the Fuel Research Board (1921); *The Utilization of Peat Fuel*, Department of Mines, Canada (1912). (R. R.)

PEBA, a name for the nine-banded armadillo. (*See* ARMADILLO.)

PEBAN, a group of tribes of South American Indians somewhat doubtfully to be regarded as constituting an independent linguistic stock. The Pebas (who have given their name to the group), the Yameos, and Yaguas, who form the stock, are located on the northern side of the Amazon in the region of the Brazilian-Peruvian border.

See C. F. P. von Martius, *Beiträge zur Ethnographie und Sprachenkunde Amerikas, etc.* (Leipzig, 1867).

PEBBLE WRITING. From the very earliest times to which the energy of man can be traced, date two kinds of writing: (*a*) engraving of a visible object on some hard substance, such as the flat surface of a bone; (*b*) drawing, painting, or engraving marks which could again be identified. Of the first kind are the engravings of reindeer, buffaloes, and other animals by the cave men of prehistoric times; of the second are a large number of pebbles discovered by M. Ed. Piette at Mas d'Azil, on the left bank of the Arize, intercalated between the last layer of the Reindeer age and the first of the Neolithic period. The stones were coloured with peroxide of iron. The characters are of two kinds: (*a*) a series of strokes which possibly indicate numbers, (*b*) graphic symbols. The stones were scattered about without connection or relation one with another. Whatever the meaning may be, it is clear that the markings are not accidental. It has been suggested that, like similar things among the American Indians, they may have been used in playing games or gambling.

PECAN, a North American species of hickory (*q.v.*) valued for its timber and its edible nuts, called pecans, which are commercially cultivated in several Southern States. (*See* NUT.)

PECCARY, the name given to the New World representatives of the swine (*Suidae*), from which they may be distinguished by the fact that the upper canine teeth (tusks) are directed downwards, and by other peculiarities of the teeth, stomach and feet. Peccaries range from New Mexico and Texas to Patagonia. The collared peccary (*Dicotyles tajacu*) is a dark grey animal with a white band across the chest from shoulder to shoulder. It is about 3ft. long, living in small herds of eight to ten, and has an extensive range in S. America. The white-lipped peccary (*D. labiatus*) is about 6in. longer, blackish in colour, with white lips. Peccaries form the sub-family *Dicotylinae* of the *Suidae* (*see* ARTIODACTYLA and SWINE). Extinct peccaries are known as far back as the Miocene in North America, but only in superficial deposits in the southern continent. This indicates that the group entered North America in the Upper Oligocene and subsequently reached their present habitat.

PECHORA, a river of North Russia, which rises in the Urals, almost on lat. 62° N. and flows west and then north, with a double north and south loop about 66° 20′ N. It enters the Gulf of Pechora on the Barents sea by a delta after a course of 1,150 m. Its main tributaries are the Izhma, Tsilma and Sula on the left, and the Ilych, Podcherem, Shugor and Usa on the right; the river and its tributaries provide 3,545 m. of navigable waterways, of which 2,335 are fit for rafts and timber floats only and 580 are suitable for steamer navigation. The drainage basin is, however, mainly coniferous forest, and north of lat. 67° N. bleak tundra, the Great Land Tundra on the east, and the Small Land Tundra on the west. The scanty population consists mainly of Nomad Samoyede reindeer breeders and Zirian hunters.

During the brief summer there is steamer connection between Pustozersk and Kuya on the right of the delta, and Archangel. Short portages connect the Pechora waterway with the Kama and the Volga, and with the Vychegda and Northern Dwina, and longer

portages, used mainly by Samoyedes, link it across the Urals with the Ob. In 1925 a cultural base, with 20 hospital beds, boarding facilities for 30 Samoyede pupils and a medical and veterinary staff was established on the Adzva river, a tributary of the Usa. The chief freightage on the Pechora waterways consists of reindeer products, furs and fish going southward and grain and manufactured goods going north. Seals are caught in Pechora gulf, and fishermen migrate there from June to August, the Pechora salmon being specially valuable.

PECK, a dry measure of capacity, especially used for grain. It contains 8 quarts or 2 gallons, and is $\frac{1}{4}$ of a bushel. The imperial peck contains 554·548 cu.in., and in the United States of America 537·6 cub.in. The word is in M.E. *pek,* and is found latinized as *peccum* or *pekka.* In Med. Lat. are found *picotinus,* "mensura frumentaria," and *picotus,* "mensura liquidorum" (Du Cange, *Gloss. s.vv.*).

PECKHAM, JOHN (d. 1292), archbishop of Canterbury, was probably a native of Sussex, and received his early education from the Cluniac monks of Lewes. About 1250 he joined the Franciscan order and studied in their Oxford convent. Shortly afterwards he proceeded to the university of Paris, where he took his degree under St. Bonaventure and became regent in theology. For many years Peckham taught at Paris, coming into contact with the greatest scholars of the day, among others St. Thomas Aquinas. About 1270 he returned to Oxford and taught there, being elected in 1275 provincial minister of the Franciscans in England, but he was soon afterwards called to Rome as *lector sacri palatii,* or theological lecturer in the schools of the papal palace. In 1279 he returned to England as archbishop of Canterbury, being appointed by the pope on the rejection of Robert Burnell, Edward I.'s candidate. Peckham was always a strenuous advocate of the papal power, especially as shown in the council of Lyons in 1274. The characteristic note of his primacy was an insistence on discipline which offended contemporaries.

In philosophy Peckham represents the Franciscan school which attacked the teaching of St. Thomas Aquinas on the "Unity of Form." He wrote much on scientific, scriptural and moral subjects, and defended the Franciscan rule and practice. His hymns are characterized by a lyrical tenderness which seems typically Franciscan. Printed examples of his work as commentator and hymn writer respectively may be found in the *Firamentum trium ordinum* (Paris, 1512), and his office for Trinity Sunday in the "unreformed" breviary.

The chief authority on Peckham as archbishop of Canterbury, is the *Registrum fratris Johannis Peckham,* edited by C. Trice Martin for the Rolls Series (London, 1882–1885). A sympathetic account of his life as a Franciscan is to be found in L. Wadding, *Annales minorum* (Lyons, 1625, 1654). See also the article by C. L. Kingsford in *Dict. Nat. Biog.,* and Wilkin's *Concilia magnae Britanniae* (London, 1737).

PECOCK (or PEACOCK), **REGINALD** (*c.* 1395–*c.* 1460), British prelate and writer, was probably born in Wales, and was educated at Oriel college, Oxford. Having been ordained priest in 1421, he secured a mastership in London in 1431, and soon became prominent by his attacks upon the religious position of the Lollards. In 1444 he became bishop of St. Asaph, and six years later bishop of Chichester. He was an adherent of the house of Lancaster and in 1454 became a member of the privy council. In attacking the Lollards Pecock put forward religious views far in advance of his age. He asserted that the Scriptures were not the only standard of right and wrong; in general he exalted the authority of reason. Owing to these views the archbishop of Canterbury, Thomas Bourchier, ordered his writings to be examined. This was done and he was found guilty of heresy. He was removed from the privy council and he only saved himself from a painful death by privately, and then publicly (at St. Paul's Cross, Dec. 4, 1457), renouncing his opinions.

Pecock, who has been called "the only great English theologian of the 15th century," was then forced to resign his bishopric, and was removed to Thorney abbey in Cambridgeshire, where he doubtless remained until his death. The bishop's chief work is the famous *Repressor of over-much weeting* [blaming] *of the Clergie,* which was issued about 1455. In addition to its great importance in the history of the Lollard movement the *Repressor* has an exceptional interest as a model of the English of the time, Pecock being one of the first writers to use the vernacular. In thought and style it is the work of a man of learning and ability.

A biography of the author is added to the edition of the *Repressor* published by C. Babington for the Rolls Series in 1860. Pecock's other writings include the *Book or Rule of Christian Religion;* the *Donet,* "an introduction to the chief truths of the Christian faith in the form of a dialogue between father and son"; and the *Folewer to the Donet.* The two last works are extant in manuscript. His *Book of Faith* has been edited from the manuscript in the library of Trinity college, Cambridge, by J. L. Morison (Glasgow, 1909). *See* also John Lewis, *Life of Pecock* (1744; new ed., 1820).

PECORA. Horns, hoofs and a diet of grasses or foliage are the three most obvious characteristics of the very important group of mammals known as the Pecora or true ruminants. The name comes from the Latin *pecus,* cattle, but as used by the zoologist it includes not only oxen, sheep and goats, but the diverse types of antelopes, giraffes and deer. Although most of these animals possess either horns or antlers, all have been derived from hornless ancestors, and a few, like the musk-deer of central and eastern Asia, have never developed them. Apart from the horns, which vary very strikingly in shape and construction, not only from family to family but from species to species, the Pecora are a very homogeneous group; perhaps the most eccentric member is the long-necked giraffe, and even this is linked with the more normal types by the okapi, an animal belonging to the giraffe family but with a shorter neck and shorter limbs than the true giraffes. In the wild state ruminants, like all hoofed mammals, seek safety from their carnivorous enemies in flight, only using their antlers or horns as weapons of defence if driven to bay. Swiftest of all are the deer, antelopes and gazelles, while the goats and mountain sheep have a marvellous power of rapidly scaling steep heights to which few carnivores can follow them. It is therefore among the ruminants that we find a more perfect adaptation to a fugitive life than among any other of the larger mammals. Not only do their skeleton and muscular system form together a perfectly constructed running mechanism, but their digestive system is also elaborately planned so that they may hastily snatch a meal in some favourable grazing ground, and store the food temporarily in a special compartment of their stomach until they have found a refuge where they can masticate and digest it at leisure.

Limbs and Feet.—In the skeleton, the proportions of the limbs and the structure of the feet are particularly noteworthy. As in all running animals the lower leg and foot are very long compared with the upper segment of each limb; this ensures a long stride and at the same time a swift one. The surfaces of the joints are grooved and keeled like pulley wheels, permitting free motion forward and backward but limiting the motion in all other directions; joints of this type are very strong, and are admirably adapted for swift locomotion over a smooth surface, though less efficient on very rough ground. The feet are constructed on the "artiodactyl" plan (*see* ARTIODACTYLA): in each foot no more than two of the ancestral five toes are used, the rest being either lost or reduced to vestiges. The animal steps lightly on the very tip of these two remaining toes, the short terminal segments of which are encased by the hoofs. The upper segments (metapodials) of each toe, fused into a single strong bone termed the *cannon bone,* are, in contrast, very long, so that the joints corresponding to our wrist and ankle are raised high above the ground and are consequently often regarded as elbow and knee. Owing to the shortness of the upper segments of the limbs, corresponding to our upper arm and thigh, the true elbow- and knee-joints of the ruminant are close against its body, enclosed within the skin of the trunk.

Dentition.—Quite as distinctive as the foot of a ruminant is its skull, and especially its dentition. Everyone will have noticed how a sheep, when it feeds, seems not so much to bite off the grass as to tear it off by quickly jerking its head. This is because the front teeth in the upper jaw are replaced by a horny pad, while those of the lower jaw are directed forwards, and simply press the grass tightly against this pad on closure of the mouth; when the head is jerked sideways the grass is cut through by the sharp edges of the lower front teeth. It is also a matter of

common observation that in chewing its food a ruminant swings its lower jaw to the side: it usually swings it first a number of times to one side and then, reversing the direction, about an equal number of times to the other side, so that the grinding teeth on both sides of the mouth are used in turn. These grinding or "cheek teeth" are admirably adapted for triturating hard grasses and coarse foliage. Viewed from the side, they appear to be made up of a number of columns, but looked at from the grinding surface they are seen to have a crown pattern of four crescents or V's, sometimes complicated by little additional folds (*see* figure of giraffe's tooth in ARTIODACTYLA). Each crescent is enclosed by a border of enamel which, as it is a very hard substance, prevents the tooth from wearing down too quickly. Also, as the enamel does not wear down at the same rate as the softer substance within, the surface of the crown is always rough and therefore all the more effective as a grinding mechanism. The great height of the crown also ensures that the tooth shall last out the animal's lifetime before it is quite ground away. Similar devices are characteristic of the molar teeth of all herbivorous mammals, since most grasses contain a great deal of silica and this causes very hard wear to the tooth. In those ruminants which feed on soft leaves rather than on grasses, the cheek teeth are much shorter than in the exclusively graminivorous types and have a less complex crown pattern. However high the grinding teeth, the mandible of a ruminant is a slender bone, slung somewhat loosely on to the skull, and the joint between mandible and skull is shaped so as to permit great freedom of movement in grinding.

Digestive Processes.—The following account of the process of rumination is an abbreviation of that given by T. H. Huxley in his *Anatomy of Vertebrated Animals*. A ruminant does not masticate its food on first taking it into its mouth but swallows it hastily, well mixed with saliva. Only when its appetite is satisfied does it stop grazing and seek a place of safety where it can lie down and "chew the cud" at leisure. If we closely observe a cow which has just lain down in a field after a period of grazing, its body inclined to one side, we notice that after an interval of quiescence a sudden spasm, rather resembling a hiccough, passes over the animal's flanks, and that at the same time something is quickly forced up the gullet into the mouth. This is a bolus of grass which, rendered sodden by the fluids in the stomach, is now returned to be masticated by the grinding teeth. This process is repeated until most of the grass which was originally cropped has been reduced to pulp. A ruminant's stomach is divided into four compartments. When the food is first hastily swallowed it passes no further than the first and second of these. On second swallowing it passes along a groove in the roof of the second, directly into the third compartment; chemical digestion takes place in the fourth compartment, which alone has gastric glands in its walls for secretion of digestive juices.

Horns.—There are four main types of horn construction among the Pecora: (1) The antlers of deer. These are usually found in the male deer only, but in the reindeer they are present in both sexes. They grow out from the frontal bones of the skull as solid processes which rapidly reach their full size. At first they are covered by soft and hairy skin. Then a circular ridge called the burr appears at a short distance from the base of the antler and divides the latter into pedicel, on the skull side of the burr, and beam, on the far side. The circulation in the beam now gradually dwindles, and the skin dies and peels off, leaving exposed the dead bone beneath it. Absorption and sloughing take place at the extremity of the pedicel, beam and burr are shed, and the end of the pedicel scabs over. Fresh skin gradually grows up under the scab, so that the pedicel becomes once more smooth and hairy. The antlers are shed and grown anew every year, usually adding additional branches each time. *See* DEER.

(2) In the bovine ruminants the bony core formed by the frontal bone is covered by a horny sheath. The core itself is hollow, instead of solid as in the deer, and therefore the Pecora in this group are sometimes termed the "hollow-horned ruminants" or Cavicornia. The horny sheath is never shed but persists throughout life and grows with the growth of the core. This type of horn is never branched but may be curved, spirally twisted, or compressed; it is often present in both sexes. *See* SHEEP, GOAT, ANTELOPE, etc. (3) In the giraffes (*q.v.*) the horn-cores are covered with soft and hairy skin and are never shed. (4) In the North American pronghorn, *Antilocapra,* there is a permanent, unbranched horn-core enclosed in a horny sheath as in the Bovidae, but this sheath is forked, and furthermore is shed yearly after the rutting season owing to the development of a new sheath which pushes the old one off. *See* PRONGBUCK.

These four types of horn are characteristic of the four families into which existing Pecora are classified: the Cervidae or deer, the Giraffidae or giraffe and okapi, the Bovidae or oxen, sheep, goats, antelopes, etc., and the Antilocapridae, solely represented by the North American pronghorn. Many other forms, now extinct, are known as fossils. The earliest of these were small forms with no antlers but a pair of long slender tusks in the upper jaw like those of the musk deer. From such as these were derived not only the modern families but several families now quite extinct. Especially noteworthy among these latter are the Merycodontidae and the Sivatheriidae. *Merycodus* was a small North American Miocene form with a pair of simple forked antlers very like those of primitive deer but apparently never shed; many characteristics in the skeleton suggest relationship to *Antilocapra. Sivatherium* of the Indian Pliocene, allied to the giraffes, was a gigantic animal with a pair of large palmate antler-like outgrowths on top of the skull and a smaller conical pair above the orbits.

BIBLIOGRAPHY.—*See* that for ARTIODACTYLA. (H. S. P.)

PÉCS, capital of Baranya county, Hungary, on the south-eastern flank of the Mecsek hills. It is believed to date back to Roman times and has been the see of a bishop since 1009. It was occupied by the Turks from 1543 to 1686 and several of its churches were altered and used as mosques. The town is regularly laid out with an inner old town in the form of a square and four suburbs. A beautiful cathedral, reputed one of the oldest churches in Hungary as well as one of its finest mediaeval buildings, is the principal architectural asset. The 14th century university, which lapsed after the battle of Mohács, has been revived. Pop. (1920), 47,556.

PECTORAL, a word applied to various objects worn on the breast (Lat. *pectus*); thus it is the name of the ornamental plate of metal or embroidery formerly worn by bishops of the Roman Church during the celebration of mass, the breastplate of the Jewish high priest, and the metal plate placed on the breast of the embalmed dead in Egyptian tombs. The "pectoral cross," a small cross of precious metal, is worn by bishops and abbots of the Roman, and by bishops of the Anglican, communion.

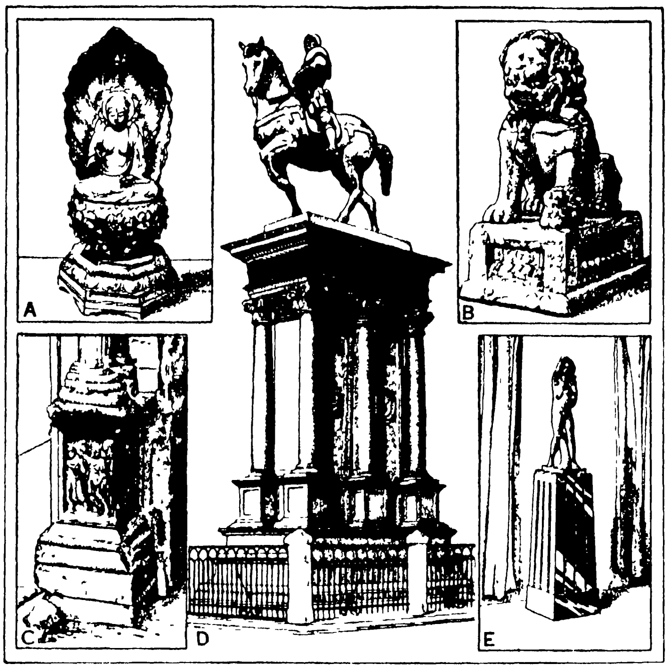
See "Pectoral" in the Catholic Encyclopaedia.

PECULIAR, a term of ecclesiastical law applied to those ecclesiastical districts, parishes, chapels or churches, once numerous in England, which were outside the jurisdiction of the bishop of the diocese in which they were situated, and were subject to a jurisdiction "peculiar" to themselves. They were introduced originally, in many cases by papal authority, in order to limit the powers of the bishop in his diocese. There were royal peculiars, *e.g.*, the Chapel Royal St. James's, or St. George's Windsor, peculiars of the archbishop, over certain of which the Court of Peculiars exercised jurisdiction (*see* ARCHES, COURT OF), and peculiars of bishops and deans (*see* DEAN). The jurisdiction and privileges of the "peculiars" were abolished by statutory powers given to the Ecclesiastical Commissioners, by the Ecclesiastical Commissioners Acts 1836 and 1850, by the Pluralities Act 1838, the Ecclesiastical Jurisdiction Act 1847, and other statutes.

PECULIAR PEOPLE, a small sect of Christian faith-healers founded in London in 1838 by John Banyard. They consider themselves bound by the literal interpretation of James v. 14, and in cases of sickness seek no medical aid but rely on oil, prayer and nursing. Their avoidance of professional medical attendance has led to severe criticism at inquests on children who have died for want of it.

PEDAGOGUE, a teacher or schoolmaster, a term usually implying pedantry, or narrow-mindedness. The Gr. παιδαγωγός (παῖδ boy, ἀγωγός leader) was not strictly an instructor. He was a slave in an Athenian household who looked after the

personal safety of the sons of the master of the house, and took them to and from school and the gymnasium. The Romans adopted the *paedagogus* or *pedagogus* towards the end of the republic. He probably took some part in the instruction of the boys (*see* SCHOOLS). Under the empire the *pedagogus* was specifically the instructor of the boy slaves, in the household of the emperor, the rich nobles and other persons, these boys lived to-



BY COURTESY OF (B) THE MUSEUM OF THE UNIVERSITY OF PHILADELPHIA, (E) LORD & TAYLOR

TYPES OF PEDESTALS FROM ANCIENT TIMES TO THE PRESENT DAY
(A) Statue of Buddha, 700 years old, from Gaya; (B) Chinese lion, Ming Dynasty; (C) Type of Roman Architecture under Septimus Severus, A D. 146–211; (D) Statue of Bartolomeo Colleoni. Venice, begun by Verrocchi, 1481; (E) Modern mahogany pedestal by Auguste Guenot

gether in a *paedagogium*, and were known as *pueri paedagogiani*, a name which has possibly developed into "page "

PEDAL CLARINET, a contrabass instrument invented in 1891 by M F Besson to complete the quartet of clarinets, as the contrafagotto or double bassoon completes that of the oboe family; it is constructed on practically the same principles as the clarinet, and consists of a tube 10ft long It is used in military bands and has a tone rich and full, except for the lowest notes which are unavoidably a little rough in quality

PEDEN, ALEXANDER (*c* 1626–1686), Scottish divine, one of the leading forces in the Covenant movement, was born at Auchinleck, Ayrshire, about 1626, and was educated at Glasgow University He was ordained minister of New Luce in Galloway in 1660, but had to leave his parish under Middleton's Ejectment Act in 1663 His last days were spent in a cave in the parish of Sorn, near his birthplace, and there he died in 1686.

See A Smellie, *Men of the Covenant*, ch. xxiv.

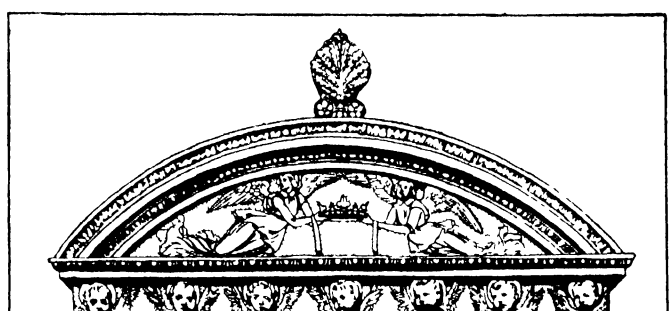
PEDERSEN, CHRISTIERN (*c.* 1480–1554), Danish writer, known as the "father of Danish literature," was a canon of the cathedral of Lund, and took his master's degree in Paris in 1515 In Paris he edited the proverbs of Peder Laale and (1514) the *Historia danica* of Saxo Grammaticus He worked at a continuation of the history of Saxo Grammaticus, and became secretary to Christian II, whom he followed into exile in 1525 In Holland he translated the New Testament (1529) and the Psalms (1531) from the Vulgate, and, becoming a convert to the reformed opinion, he issued several Lutheran tracts After his return to Denmark in 1532 he set up a printing press at Malmo He published a Danish version (*Kronike om Holger Danske*) of the French romance of Ogier the Dane, and another of the Charlemagne legends, which is probably derived immediately from the Norwegian *Karlamagnus saga.* His greatest work, the Danish version of the Holy Scriptures, which is known generally as "Christian III.'s Bible," is an important landmark in Danish literature. It was founded on Luther's version, and was edited by Peter Palladius, bishop of Zealand, and others.

See C. Pedersen's *Danske Skrifter,* ed. C. J. Brandt and B. T. Fenger (5 vols., Copenhagen, 1850–56).

PEDESTAL, a square, polygonal or circular block used as a support. Pedestals were originally employed only to carry statues or votive offerings, but the Romans, in the course of their many experiments in the decorative use of the orders, occasionally placed columns upon pedestals; this is notably the case in connection with such isolated columns as that of Trajan (A D. 114) and in the case of the engaged columns of triumphal arches, where the proportions seemed to demand them Similarly, in superposed orders, as in the Colosseum, at Rome (A D 80), the parapet walls of each storey were projected out under each column as pedestals The Renaissance designers attempted to develop a separate pedestal for each order, with all its dimensions in proportion to those of the column (*see* ORDER). This has no basis in Roman usage

PEDICULOSIS or **PHTHIRIASIS,** the medical term for the pathological symptoms in man due to the presence of lice (*pediculi*), either on the head (*pediculus capitis*), body (*pediculus corporis*, or *vestimentorum*), or pubes (*pediculus pubis*)

PEDIMENT, in architecture, a triangular gable-end, crowned with a raking cornice which follows the slope of its upper edges, or a similar form used decoratively In common usage, the term is restricted to the classic styles, in others, the word gable is used The pediment was given great importance by the Greeks as it was the crowning feature of every temple front In Greek work, the entablature over the columns is carried completely through, horizontally under the pediment; and the tympanum (*q v*), or triangular wall surface, between this horizontal cornice and the raking cornice above was often decorated with sculpture The Romans not only used the pediment in this manner, as the end of a roof, but also adopted it as a purely decorative form to



FROM BUHLMANN "CLASSIC AND RENAISSANCE ARCHITECTURE" (HEFF AND HELBURN)

PEDIMENTS (UPPER) ITALIAN RENAISSANCE "FLORENTINE" PEDIMENT, BY THE DELLA ROBBIAS, (LOWER) GREEK, THE ERECHTHEUM, ATHENS

crown doors, windows and especially niches Where many such decorative pediments occur in a row, the Romans frequently made them alternately triangular and segmental in shape, in this they were copied by the High Renaissance in Italy. Following certain late Roman precedents, in which the line of the raking cornice is broken back in the centre, the designers of the Baroque period developed all sorts of fantastic broken, scrolled and reverse curved pediments; in some cases they even reversed the direction, so that the high part of the broken or sectional pediment was toward the outside of the composition rather than toward the centre, and in

the Churrigueresque, or late Renaissance of Spain, little sections of pediment are used to intricate line patterning.

PEDIPALPI, the name of a group of the class Arachnida (*q.v.*), in some respects connecting the scorpions and the spiders but more nearly related to the latter. The most scorpion-like in appearance are the species of the order Uropygi which takes its name from the termination of the body by a distinct tail formed by the narrowing of the last three segments to form a jointed stalk for a post-anal horny appendage, the homologue of the scorpion's sting, which acts as a tactile organ. In the Urotricha, containing the family Thelyphonidae, this appendage is long, flexible and lash-like; and the legs of the first pair are also tactile, while the palpi, or chelae, are pincer-like and armed with powerful spikes for seizing and impaling prey which consists mostly of beetles and other ground insects. The whip-scorpions, as these Arachnida are sometimes called on account of the lash-like tail, are not poisonous but when handled they emit a pungent, acid secretion which is defensive. They live for the most part in damp places, beneath stones or pieces of wood, in rock-crannies or termites' nests or other crevices where shelter from light and protection from the rays of the sun are obtainable. Some species excavate burrows as dwellings for themselves and their young. The young are hatched from eggs which the female carries about enswathed in a glutinous membrane and attached to the lower side of the abdomen. Most of the species soon die when removed from their humid haunts; but in Florida a species is found which is adapted to dry sandy localities. Whip-scorpions are found in the East Indies where they range from India and Ceylon to southern Japan and the Fiji Islands and in the warmer parts of America from Brazil to the southern states of the Union. There are several genera of which the best known are *Thelyphonus* from India and Java, *Uroproctus* from north-eastern Bengal and *Mistigoproctus* from Brazil, the last two being the largest of the group, measuring about 4 in. in total length.

A degenerate group related to the Urotricha, and known as the Tartarides, contains several genera (*Trithyreus, Schizomus, Hubbardia* belonging to the family Hubbardiidae). The largest measures about ¼ of an inch. Their habits and distribution are similar to those of the whip-scorpions but the group is found in Africa as well as in Asia and America.

The tailless Pedipalpi or Amblypygi recall spiders in appearance, having broader, flatter bodies and longer limbs than the whip-scorpions. Their habits, however, are tolerably similar. They live for the most part under loosened bark or in natural crannies in forests, but do not burrow; and in the East Indies species of the genera *Stygophrynus* and *Catageus* frequent the dark recesses of caves and *Sarax* has been found beneath stones between tide-marks. There are many other genera (*Tarantula, Phrynichus,* etc.), the largest species rivalling the whip-scorpions in size. The group is widely distributed in tropical Asia, Africa and America.

(R. I. P.)

PEDLAR: *see* HAWKERS AND PEDLARS.

PEDRO II. (DOM PEDRO DE ALCANTARA) (1825–1891), second emperor of Brazil, was born in Rio de Janeiro on Dec. 2, 1825. On April 7, 1831, when he was not yet six years old, his father, Pedro I., abdicated in his favour, and for nine years the country was governed by a regency. He was declared of age on July 23, 1840, and was crowned July 18, 1841. He might have perpetuated his dynasty had he been more attentive to political exigencies. On his accession uprisings occurred in several provinces; these were promptly suppressed in São Paulo and Minas Geraes (1842) but held out in Rio Grande do Sul until 1845. The new government persisted in the policy of intervention in Uruguay which had caused the abdication of Pedro I. In 1852 Brazilian troops were chiefly responsible for the defeat of Rosas of Argentina; in 1864 a Brazilian army made Flores *de facto* dictator of Uruguay; and it was owing mainly to Brazilian arms and resources that Solano López, the dictator of Paraguay, was defeated in the Paraguayan War (1864–70). The government had to combat intermittent provincial rebellions (notably that in Pernambuco, 1849), and was faced with diplomatic crises with England, France and the United States. But it left a record unparalleled in South America for conscientious and enlightened rule. The slave trade was prohibited in 1850; in 1871 a law provided for the gradual emancipation of the slaves, and in 1888 an imperial disposition abolished slavery throughout Brazil. The emperor consistently sponsored public improvements, fostered public instruction, and earnestly patronized art and science. He travelled widely, visiting Europe in 1871, 1876 and 1886, and the United States in 1876, affiliating himself closely with foreign intellectual life. In 1889 a crisis arose. The nobility were alienated by the anti-slavery measures and other legislation aimed at reducing their prerogatives; the military was demoralized by long inactivity; the emperor showed too little interest in matters of state. On Nov. 15, Manuel D. da Fonseca (*q.v.*) led a Republican revolt, supported by the army and navy. There was no resistance, the empire ended, and the emperor embarked with his family for Europe on Nov. 17. A Federal republic was proclaimed.

(W. B. P.)

PEEBLES, royal burgh and county town of Peeblesshire, Scotland, at the junction of Eddleston Water with the Tweed. Pop. (1921), 5,537. It is 27 m. S. of Edinburgh by L.N.E.R., and is also the terminus of a branch line of the L.M.S. system from Symington. The burgh consists of the new town on the south of the Eddleston, and the old on the north. Portions of the town walls still exist, and there are cellars constructed in the 16th and 17th centuries as hiding-places against Border freebooters. The old cross stands in High Street. There are several woollen mills, and the town is an agricultural centre.

The name of Peebles is said to be derived from the *pebylls,* or tents, which the Gadeni pitched here in the days of the Romans. The place was a favourite residence of the Scots kings when they came to hunt in Ettrick forest. It probably received its charter from Alexander III., was created a royal burgh in 1367 and was the scene of the poem of *Peblis to the Play,* ascribed to James I. In 1544 the town was damaged in the expedition led by the 1st earl of Hertford, afterwards the protector Somerset, and in 1604 it was partly destroyed by fire. Peebles lost its importance after the union of the Crowns.

On the north bank of the Tweed, stands Neidpath Castle (probably 13th century). It was besieged and taken by Cromwell in 1650.

PEEBLESSHIRE or TWEEDDALE, southern inland county, Scotland, bounded north and north-east by Edinburghshire, east and south-east by Selkirkshire, south by Dumfriesshire, and west by Lanarkshire. Its area is 222,240 ac. (excluding water). The surface consists of a succession of hills, which are highest in the south, and belong to the Silurian uplands of southern Scotland, succeeded by an Ordovician belt. The vale of the Tweed and the glens formed by its numerous tributaries intersect the uplands. South of the Tweed the highest points are Broad Law and Cramalt Craig on the confines of Selkirkshire (each 2,723 ft.), while north of the river the greatest heights reach about 1,800 ft In the north-west a part of the Pentland hills is included, showing upper Silurian and lower Old Red Sandstone rocks. Much glacial boulder clay, in the gravel and sand, rests upon the higher ground, while morainic deposits are found in the valleys. From the fact that for the first 36 m. of its course of 97 m., the river Tweed flows through the south of the shire, the county derives its alternative name of Tweeddale.

The character of the soil varies considerably, peat, gravel and clay being all represented. The low-lying lands consist generally of rich loam, composed of sand and clay. The farming is pastoral rather than arable. About half the holdings are under 100 acres. Under one quarter of the total area is under cultivation.

The L.N.E. railway crosses the county in the north from Leadburn to Dolphinton, and runs down the Eddlestone valley from Leadburn to Peebles and Thornielee, while in the south the L.M.S. railway connects the county town with Biggar in Lanarkshire.

In 1921 the population numbered 15,332. The chief towns are Peebles (pop. 5,539) and Innerleithen (2,403). The shire combines with Midlothian to return two members to parliament, and forms a sheriffdom with the Lothians and Selkirkshire.

The country was early occupied by the Gadeni, a British tribe,

of whom there are many remains in the shape of camps and sepulchral mounds. The standing stones near the confluence of the Lyne and Tweed are supposed to commemorate a Cymric chief. The natives were reduced by the Romans, who have left traces of their military rule in the fine camp at Lyne, locally known as Randal's Walls. On the retreat of the Romans the Gadeni came into their own again, and held the district until the consolidation of the kingdom after Malcolm II.'s victory at Carham in 1018, before which the land, constantly harried by Danes, was nominally included in the territory of Northumbria. This tract of Scotland is closely associated with the legend of Merlin. At Happrew, in the valley of the Lyne, the English defeated Wallace in 1304

PEEKSKILL, a village of Westchester county, New York, U.S.A., on the east bank of the Hudson river, 40 m. above New York city, near the Bear Mountain highway bridge It is served by the New York Central railroad and river steamers Pop (1920) 15,868 (85% native white); 1925 State census, 17,993. There is a U.S. naval magazine on Iona island, off Peekskill, and just above the village, on the river, is the State military camp About 1760 the village took its present name from that of the adjacent creek or "kill," on which Jans Peek, a Dutch trader, had established a trading post. It was incorporated in 1816 During the latter part of the Revolution it was an important outpost of the Continental army.

PEEL, ARTHUR WELLESLEY PEEL, 1st Viscount (1829–1912), English statesman, youngest son of the great Sir Robert Peel, was born on Aug 3, 1829, and was educated at Eton and Balliol college, Oxford He entered parliament in 1865, was parliamentary secretary to the poor law board (1868–71), secretary to the board of trade (1871–73); patronage secretary to the treasury (1873–74); and in 1880 he became under-secretary for the home department On the retirement of Mr Brand (afterwards Viscount Hampden) in 1884, Peel was elected Speaker. He was thrice re-elected to the post, twice in 1886, and again in 1892 He will always rank as one of the greatest holders of this important office On his retirement in 1895 he received a viscounty He was keenly interested in licensing reform, and drafted a report for the royal commission of 1896–99 advocating a large reduction in the number of licensed houses, and that no compensation should be paid from the public rates or taxes the money for this purpose being raised by an annual licence-rental levied on the rateable value of the licensed premises; it at once became a valuable weapon in the hands of advanced reformers Lord Peel died at Sandy, Bedfordshire, on Oct 24, 1912

He was succeeded by his son, William Robert Wellesley Peel, 2nd viscount (b 1867), who was educated at Harrow and at Balliol college, Oxford, and was called to the bar at the Inner Temple in 1893 From 1908 to 1910 he was leader of the Municipal Reform party In 1916 he was chairman of the Committee on the Detention of Neutral Vessels He was appointed under-secretary for war in 1919, chancellor of the duchy of Lancaster (1921), minister of transport (1921–22), and was secretary of State for India from 1922 to 1924 He was made first commissioner of works in Baldwin's second Government in 1924

PEEL, SIR ROBERT, Bart. (1788–1850), English statesman, was born on Feb. 5, 1788, at Chamber Hall, near Bury Lancashire, or, less probably, at a cottage near the Hall His grandfather, Robert Peel, first of Peelfold, and afterwards of Brookside, near Blackburn, was a calico-printer, who took to cotton-spinning with the spinning-jenny and grew a wealthy man His father, Robert Peel (1750–1830), third son of the last-named, carried on the same business at Bury; he was M.P. for Tamworth was a supporter of Pitt, contributed munificently towards Pitt's war policy, and was rewarded with a baronetcy (1800)

Robert Peel was educated at Harrow School and at Christ Church, Oxford, where he took a first class both in classics and mathematics. On leaving Oxford he was entered at Lincoln's Inn, and in 1809, at the age of 21, entered the House of Commons He sat at first for the close borough of Cashel, then for Chippenham

He made his mark in the House by the closest attention to all his parliamentary duties, by a study of all the business of parliament, and by a style of speaking which owed its force to knowledge of the subject in hand, clearness of exposition, close reasoning, and tact in dealing with a parliamentary audience Young Peel's lot, however, was cast, through his father, with the Tory party. In his maiden speech in 1810, seconding the address, he defended the Walcheren expedition, which he again vindicated soon afterwards against the report of Lord Porchester's committee. He began official life in 1810 as Lord Liverpool's under-secretary for war and the colonies under the Perceval administration In 1812 he was transferred by Lord Liverpool (now premier) to the more important but unhappy post of secretary for Ireland. There he was engaged till 1818 in maintaining English ascendancy over a country heaving with discontent, teeming with conspiracy, and on the verge of rebellion Peel plied the established engines of coercion and patronage with a vigorous hand At the same time, he had to combat Grattan, Plunkett, Canning and the other movers and advocates of Roman Catholic emancipation in the House of Commons He promoted joint education in Ireland as a means of reconciling sects But his greatest service to Ireland as secretary was the institution of the regular Irish constabulary, nicknamed after him "Peelers," for the protection of life and property in a country where both were insecure His moderation of tone did not save him from the violent abuse of O'Connell, whom he was ill advised enough to challenge—an affair which covered them both with ridicule. In 1817 he was elected member for the university of Oxford—an honour for which he was chosen in preference to Canning on account of his unwavering hostility to Roman Catholic emancipation, Lord Eldon lending him his best support In the following year he resigned the Irish secretaryship, of which he had long been weary, and remained out of office till 1821 But he still supported the ministers, though in the affair of Queen Caroline he stood aloof, disapproving some steps taken by the government, and sensitive to popular opinion; and when Canning retired on account of this affair Peel declined Lord Liverpool's invitation to take the vacant place in the cabinet During this break in his tenure of office he had some time for reflection, which there was enough in the aspect of the political world to move But early office had done its work It had given him excellent habits of business, great knowledge and a high position; but it had left him somewhat stiff and punctilious, though he was no pedant in business; in corresponding on political subjects he loved to throw off official forms and communicate his views with the freedom of private correspondence Where his confidence was given, it was given without reserve

At this period he was made chairman of the bullion committee on the death of Horner He was chosen for this important office by Huskisson Ricardo and their fellow-economists, who saw in him a mind open to conviction, though he owed hereditary allegiance to Pitt's financial policy and had actually voted with his Pittite father for a resolution of Lord Liverpool's government asserting that Bank of England notes were equivalent to legal coin The choice proved judicious Peel was converted to the currency doctrines of the economists, and proclaimed his conversion in a great speech on May 24 1819, in which he moved and carried four resolutions embodying the recommendations of the bullion committee in favour of a return to cash payments This laid the foundation of his financial reputation, and his co-operation with the economists tended to give a liberal turn to his commercial principles In the course he took he somewhat diverged from his party, and particularly from his father, who remained faithful to Pitt's depreciated paper, and between whom and his schismatic son a solemn and touching passage occurred in the debate The author of the Cash Payments Act had often to defend his policy, and he did so with vigour The act was hard on debtors, including the nation as debtor, because it required debts to be paid in cash which had been contracted in depreciated paper; and Peel, as heir to a great fundholder, was even charged with being biased by his personal interests But the Bank Restriction Acts, under which the depreciated paper had circulated, themselves contained a provision for a return to cash payments six months after peace.

In 1820 Peel married Julia, daughter of General Sir John Floyd, who bore him five sons and two daughters His domestic life was

singularly happy, and he had many fast friends among the ablest men of his time. Cold as he was in public, few men could be more genial in private than Peel.

In 1821 Peel rejoined Liverpool's ministry as home secretary; and in that capacity he had again to undertake the office of coercing the growing discontent in Ireland, of which he remained the real administrator, and had again to lead in the House of Commons the opposition to the rising cause of Roman Catholic emancipation. In 1825, being defeated on the Roman Catholic question in the House of Commons, he wished to resign office, but Lord Liverpool pleaded that his resignation would break up the government. He found a congenial task in reforming and humanizing the criminal law, especially those parts of it which related to offences against property and offences punishable by death. The five acts in which Peel accomplished this great work, as well as the great speech of March 9, 1826, in which he opened the subject to the house, form one of the most solid and enduring monuments of his fame. Criminal law reform was the reform of Romilly and Mackintosh, from the hands of the latter of whom Peel received it. But the bills in which it was embodied were the bills of Peel.

In 1827 the Liverpool ministry was broken up by the fatal illness of its chief, and under the new premier, George Canning, Peel, like the duke of Wellington and other high Tory members of Lord Liverpool's cabinet, refused to serve. Canning and Peel were rivals; but we need not interpret as mere personal rivalry that which was certainly, in part at least, a real difference of connection and opinion. Canning took a Liberal line, and was supported by many of the Whigs; the seceders were Tories, and it is difficult to see how their position in Canning's cabinet could have been otherwise than a false one. Separation led to public coolness and occasional approaches to bitterness on both sides in debate. Their private intercourse remained uninterrupted to the end; and Canning's son afterwards entered public life under the auspices of Peel. The charge of having urged Roman Catholic emancipation on Lord Liverpool in 1825, and opposed Canning for being a friend to it in 1827, made against Sir Robert Peel in the fierce Corn Law debates of 1846, was withdrawn by those who made it.

In January 1828, after Canning's death, the duke of Wellington formed a Tory government, in which Peel was home secretary and leader of the House of Commons. This cabinet, Tory as it was, did not include the impracticable Lord Eldon, and did include Huskisson and three more friends of Canning. Its policy was to endeavour to stave off the growing demand for organic change by administrative reform, and by lightening the burdens of the people. The civil list was retrenched with an unsparing hand, the public expenditure was reduced lower than it had been since the Revolutionary war, and the import of corn was permitted under a sliding scale of duties. Peel also introduced into London the improved system of police which he had previously established with so much success in Ireland. But the tide ran too strong to be thus headed. First the government were compelled, after a defeat in the House of Commons, to acquiesce in the repeal of the Test and Corporation Acts, Peel bringing over their High Church supporters, as far as he could. Immediately afterwards the question of Roman Catholic emancipation was brought to a crisis by the election of O'Connell for the county of Clare. In August Peel expressed to the duke of Wellington his conviction that the question must be settled. He wrote that out of office he would co-operate in the settlement but in his judgment it should be committed to other hands than his. To this the duke assented, but in January 1829, owing to the declared opinions of the king, of the House of Lords, and of the Church against a change of policy, Wellington came to the conclusion that without Peel's aid in office there was no prospect of success. Under that pressure Peel consented to remain, and all the cabinet approved. The consent of the king, which could scarcely have been obtained except by the duke and Peel, was extorted, withdrawn (the ministers being out for a few hours), and again extorted; and on March 5, 1829, Peel proposed Roman Catholic emancipation in a speech of more than four hours. The apostate was overwhelmed with obloquy. Having been elected for the university of Oxford as a leading opponent of the Roman Catholics, he had thought it right to resign his seat on being converted to emancipation. His friends put him again in nomination, but he was defeated by Sir R. H. Inglis. He took refuge in the close borough of Westbury, whence he afterwards removed to Tamworth, for which he sat till his death. Catholic emancipation was forced on Peel by circumstances; but it was mainly owing to him that the measure was complete, and based upon equality of civil rights. This great concession, however, did not save the Tory government. It fell on November 1830, but not before Peel had accomplished further important reforms in the administration of justice.

While in office, Peel succeeded to the baronetcy, Drayton Manor and a great estate by the death of his father (May 3, 1830). The old man had lived to see his fondest hopes fulfilled in the greatness of his son; but he had also lived to see that a father must not expect to fix his son's opinions.

Peel's resistance to the Reform Bill won back for him the allegiance of his party. His opposition was resolute but temperate, and once only he betrayed the suppressed fire of his temper, in the debate of April 22, 1831, when his speech was broken off by the arrival of the king to dissolve the parliament which had thrown out reform. He refused to join the duke of Wellington in the desperate enterprise of forming a Tory government at the height of the storm, when the Grey ministry had gone out on the refusal of the king to promise them an unlimited creation of peers. By this conduct he secured for his party the full benefit of the reaction which he no doubt knew was sure to ensue. The general election of 1832, after the passing of the Reform Bill, left him with barely 150 followers in the House of Commons; but this handful rapidly swelled under his management into the great Conservative party. He frankly accepted the Reform Act as irrevocable, taught his party to register instead of despairing, appealed to the intelligence of the middle classes, whose new-born power he appreciated, steadily supported the Whig ministers against the Radicals and O'Connell, and gained every advantage which parliamentary tactics could afford. To this policy, and to the great parliamentary powers of its author, it was mainly due that, in the course of a few years, the Conservatives were as strong in the reformed parliament as the Tories had been in the unreformed. It is vain to deny the praise of genius to such a leader, though the skill of a pilot who steered for many years over such waters may sometimes have resembled craft. But the duke of Wellington's emphatic eulogy on him was, "Of all the men I ever knew, he had the greatest regard for truth." The duke might have added that his own question, "How is the king's government to be carried on in a reformed parliament?" was mainly solved by the temperate and constitutional policy of Peel, and by his personal influence on the debates and proceedings of the House of Commons during the years which followed the Reform Act.

In 1834, on the dismissal of the Melbourne ministry, power came to Sir Robert Peel before he expected or desired it. He hurried from Rome at the call of the duke of Wellington, whose sagacious modesty yielded him the first place, and became prime minister, holding the two offices of first lord of the treasury and chancellor of the exchequer. He vainly sought to include in his cabinet two recent seceders from the Whigs, Lord Stanley and Sir James Graham. A dissolution gave him a great increase of strength in the house, but not enough. He was outvoted on the election of the speaker at the opening of the session of 1835, and, after struggling on for six weeks longer, resigned on the question of appropriating part of the revenues of the Church in Ireland to national education. His time had not yet come; but the capacity, energy and resource he displayed in this short tenure of office raised him immensely in the estimation of the house, his party and the country. Of the great budget of practical reforms which he brought forward, the plan for the commutation of tithes, the ecclesiastical commission, and the plan for settling the question of dissenters' marriages bore fruit.

From 1835 to 1840 he pursued the same course of patient and far-sighted opposition. In 1839, the Whigs having resigned on the Jamaica Bill, he was called on to form a government, and submitted names for a cabinet, but resigned the commission owing to the young queen's persistent refusal to part with any Whig ladies

of her bedchamber. (*See* VICTORIA, QUEEN.) The elections of 1841 placed the Whigs in a minority of 91; they resigned, and Sir Robert Peel became first lord of the treasury, with a commanding majority in both Houses of Parliament.

The crisis called for a master-hand. The finances were in disorder. For some years there had been a growing deficit, estimated for 1842 at more than two millions, and attempts to supply this by additions to assessed taxes and customs duties had failed. The great financier took till the spring of 1842 to mature his plans. He then boldly supplied the deficit by imposing an income-tax on all incomes above £150 a year. He accompanied this tax with a reform of the tariff, by which prohibitory duties were removed and other duties abated on a vast number of articles of import, especially the raw materials of manufactures and prime articles of food. Increased consumption, as the reformer expected, countervailed the reduction of duty. The income-tax was renewed and the reform of the tariff carried still farther on the same principle in 1845. The result was, in place of a deficit of upwards of two millions, a surplus of five millions in 1845, and the removal of seven millions and a half of taxes up to 1847, not only without loss, but with gain to the ordinary revenue of the country. The prosperous state of the finances and of public affairs also permitted a reduction of the interest on a portion of the national debt, giving a yearly saving at once of £625,000, and ultimately of a million and a quarter to the public. In 1844 another great financial measure, the Bank Charter Act, was passed and, though severely controverted and thrice suspended at a desperate crisis, has ever since regulated the currency of the country. In Ireland O'Connell's agitation for the repeal of the Union had now assumed threatening proportions, and verged upon rebellion. The great agitator was prosecuted, with his chief adherents, for conspiracy and sedition; and, though the conviction was quashed for informality, repeal was quelled in its chief. At the same time the Charitable Bequest Act, which gave Irish Catholics power to endow their own religion, an increased allowance to Maynooth, and three new "Queen's Colleges" open to Catholics and Protestants alike, improved the Irish situation.

The last remnants of the penal laws against Catholics in Great Britain and Ireland were swept from the statute-book, and justice was extended to the Roman Catholic Church in Canada and Malta. In the same spirit acts were passed for clearing from doubt Irish Presbyterian marriages, for settling the titles of a large number of dissenters' chapels in England, and removing the municipal disabilities of the Jews. The grant for national education was trebled, and an attempt was made, though in vain, to introduce effective education clauses into the factory bills. To the alienation of any part of the revenues of the Church of England, Peel never would consent; but he had issued the ecclesiastical commission, and he now made better provision for a number of populous parishes by a redistribution of part of the revenues of the Church. The weakest part of the conduct of Peel's government, perhaps, was its failure to control the railway mania by promptly laying down the lines on a government plan. It passed an act in 1844 which gave the government a right of purchase, and it had prepared a palliative measure in 1846, but was compelled to sacrifice this, like all other secondary measures, to the repeal of the Corn Laws. It failed also to avert the great schism in the Church of Scotland. Abroad it was as prosperous as at home. It had found disaster and disgrace in Afghanistan. It speedily ended the war there, and in India the invading Sikhs were destroyed upon the Sutlej. The sore and dangerous questions with France, touching the right of search, the war in Morocco, and the Tahiti affair, and with the United States touching the Maine boundary and the Oregon territory, were settled by negotiation.

Yet there were malcontents in Peel's party. The Young Englanders disliked him because he had hoisted the flag of Conservatism instead of Toryism on the morrow of the Reform Bill. The strong philanthropists and Tory Chartists disliked him because he was a strict economist and an upholder of the new poor law. But the fatal question was protection. That question was being fast brought to a crisis by public opinion and the Anti-Corn-Law League. Peel had been recognized in 1841 by Cobden as a Free Trader, and after experience in office he had become in principle more and more so. Since his accession to power he had lowered the duties of the sliding scale. He had alarmed the farmers by admitting foreign cattle and meat under his new tariff, and by admitting Canadian corn. He had done his best in his speeches to put the maintenance of the Corn Laws on low ground, and to wean the landed interest from their reliance on protection. The approach of the Irish famine in 1845 turned decisively the wavering balance. When at first Peel proposed to his cabinet the revision of the Corn Laws, Lord Stanley and the duke of Buccleuch dissented, and Peel resigned. But Lord John Russell failed to form a new government. Peel returned to office; and now, with the consent of all the cabinet but Lord Stanley, who retired, he, in a great speech on Jan. 27, 1846, brought the repeal of the Corn Laws before the House of Commons. In the long and fierce debate that ensued he was assailed, both by political and personal enemies, with the most virulent invective, which he ignored. His measure was carried; but immediately afterwards the protectionists, led by Lord George Bentinck and Benjamin Disraeli, coalesced with the Whigs, and threw him out on the Irish Coercion Bill. He immediately resigned.

Though out of office he was not out of power. He had "lost a party, but won a nation." The Whig ministry which succeeded him leant much on his support He joined them in carrying forward free-trade principles by the repeal of the navigation laws. He supported their bill for the emancipation of the Jews. One important measure was his own. While in office he had probed, by the Devon commission of inquiry, the sores of Ireland connected with the ownership and occupation of land. In 1849, in a speech on the Irish Poor Laws, he first suggested, and in the next year he aided in establishing, a commission to facilitate the sale of estates in a hopeless state of encumbrance. The Encumbered Estates Act transferred the land from ruined landlords to solvent owners capable of performing the duties of property towards the people. On June 28, 1850, Peel made a great speech on the Greek question against Palmerston's foreign policy of interference. This speech was thought to show that if necessary he would return to office. It was his last. On the following day he was thrown from his horse on Constitution Hill, and mortally injured by the fall. On July 2, 1850, he died. All the tributes which respect and gratitude could pay were paid to him by the sovereign, by parliament, by public men of all parties, by the country, by the press, and, above all, by the great towns and the masses of the people to whom he had given "bread unleavened with injustice."

Peel was bred a Tory in days when party was a religion; he entered parliament a youth, was in office at twenty-four and secretary for Ireland at twenty-five; his public life extended over a long period rife with change; and his own changes were all forward and with the advancing intellect of the time. He was undoubtedly one of the hardest workers and greatest administrators England has ever had, and the young men trained in his school, Gladstone, Graham, Sidney Herbert, Cardwell, with others who bore the name of Peelites, inherited a great tradition of hard work and disinterestedness in the public service. Peel had a great share in giving practical effect to the great legal and administrative reforms of his day. Of the three great issues with which Peel was confronted, parliamentary reform, Catholic emancipation, and protection, the controversies on the first two are dead; the third is still a matter on which there is a violent conflict of opinon. Nevertheless it was by the repeal of the Corn Laws that he won the masses of the people. If the question is, not whether he was a far-sighted statesman but whether he was a ruler loved and trusted by the English people, there is no arguing against the tears of a nation.

BIBLIOGRAPHY.—Consult his own posthumous *Memoirs* (1856), edited by his literary executors Earl Stanhope and Viscount Cardwell; his private correspondence ed. C. S. Parker (1891–99); the four volumes of his speeches (1835–53); a sketch of his life and character by Sir Lawrence Peel (1860); an historical sketch by Lord Dalling (1874); Guizot's *Sir Robert Peel* (1857); Künzel's *Leben und Reden*

Sir Robert Peel's (1851); Disraeli's *Life of Lord George Bentinck* (1858); Morley's *Life of Cobden;* monographs by F. C. Montague (1888), J. R. Thursfeld (1891), and the earl of Rosebery (1899); *Peel and O'Connell,* by Lord Eversley; the *Life of Sir J. Graham* (1907), by C. S. Parker; Lord Stanmore's *Life of Lord Aberdeen* (1893); and the general histories of the time. (C. S. PA.)

Of Sir Robert Peel's five sons, SIR ROBERT PEEL (1822–1895) sold his father's collection of pictures to the National Gallery for £75,000, SIR FREDERICK PEEL (1823–1906) held various parliamentary appointments and served the state in connection with the railway and canal commission, and SIR WILLIAM PEEL (1824–1858) distinguished himself in the Crimea and in the Indian Mutiny. *See* also PEEL, ARTHUR WELLESLEY, VISCOUNT

For the history of the Peel family *see* Jane Haworth, *A Memoir of the Family of Peel from the year 1600* (1836); Rt. Hon. Sir R. Peel, *The Private Letters of Sir Robert Peel* (1920), pp. 296.

PEEL, seaport, township, watering-place, on the west coast of the Isle of Man, 12 m. W. of Douglas on the Isle of Man railway. Pop. (1921) 2,690. It lies on Peel bay, at the mouth of the river Neb, which forms the harbour. The old town consists of narrow streets and lanes, but a modern residential quarter has grown up to the east. On the west side of the river-mouth St. Patrick's Isle, connected with the mainland by a causeway, is occupied almost wholly by the ruins of Peel castle. St. Patrick is said to have founded here the first church in Man, and a small chapel, dedicated to him, appears to date from the 8th or 10th century. There is a round tower, also of very early date. The ruined cathedral of St. German has a transitional Norman choir, with a very early crypt beneath, and a nave with an early English triplet at the west end. There are remains of the bishops' palace, of the palace of the Lords of Man, of the keep and guardroom above the entrance to the castle, and of the Moare or great tower, while the whole is surrounded by battlements. In 1397 Richard II. condemned the earl of Warwick to imprisonment in Peel castle and in 1444 Eleanor, duchess of Gloucester, received a like sentence. Peel has a long-established fishing industry. It was called by the Northmen *Holen* (island, *i.e.,* St. Patrick's Isle), the existing name is Celtic, meaning "fort."

PEELE, GEORGE (1558?–1597?), English dramatist, was born in London. His father, who appears to have belonged to a Devonshire family, was clerk of Christ's Hospital, and wrote two treatises on book-keeping. George Peele was educated at Christ's Hospital, and entered Broadgates Hall (Pembroke College), Oxford, in 1571. In 1574 he removed to Christ Church, taking his B.A. degree in 1577, and proceeding M.A. in 1579. In 1579 the governors of Christ's Hospital requested their clerk to "discharge his house of his son, George Peele." He went up to London about 1580, but in 1583 when Albertus Alasco (Albert Laski), a Polish nobleman, was entertained at Christ Church, Oxford, Peele was entrusted with the arrangement of two Latin plays by William Gager (*fl.* 1580–1619) presented on the occasion. He was also complimented by Dr. Gager for an English verse translation of one of the *Iphigenias* of Euripides. In 1585 he was employed to write the *Device of the Pageant borne before Woolston Dixie,* and in 1591 he devised the pageant in honour of another lord mayor, Sir William Webbe. This was the *Descensus Astraeae* (printed in the *Harleian Miscellany,* 1808), in which Queen Elizabeth is honoured as Astraea. Peele had married as early as 1583 a lady who brought him some property, which he speedily dissipated. The sorry traditions of his reckless life were emphasized by the use of his name in connection with the apocryphal *Merrie conceited Jests of George Peele* (printed in 1607). Many of the stories had done service before, but there are personal touches that may be biographical. He died before 1598, for Francis Meres, writing in that year, speaks of his death in his *Palladis Tamia.*

His pastoral comedy of *The Araygnement of Paris,* presented by the Children of the Chapel Royal before Queen Elizabeth perhaps as early as 1581, was printed anonymously in 1584. Charles Lamb, sending to Vincent Novello a song from this piece of Peele's, said that if it had been less uneven in execution Fletcher's *Faithful Shepherdess* "had been but a second name in this sort of writing." Peele's other reputed works are *The Famous Chronicle of King Edward the first* (printed 1593); *The Battell of Alcazar—with the death of Captaine Stukeley* (acted 1588–1589, printed [anon.] 1594); *The Old Wives Tale* (printed 1595), a play within a play, with a background of rustic folk-lore; and *The Love of King David and fair Bethsabe* (written *c.* 1588, printed 1599); *Sir Clyomon and Sir Clamydes* (printed 1599) has been attributed to Peele, but on insufficient grounds. Among his occasional poems are "The Honour of the Garter" and "Polyhymnia" (1590). To the *Phoenix Nest* in 1593 he contributed "The Praise of Chastity." Mr. F. G. Fleay (Biog. Chron. of the Drama) credits Peele with *The Wisdom of Doctor Doddipoll* (printed 1600), *Wily Beguiled* (printed 1606), *The Life and Death of Jack Straw, a notable rebel* (1587?), a share in the First and Second Parts of *Henry VI.,* and on the authority of Wood and Winstanley, *Alphonsus, Emperor of Germany.*

Peele belonged to the group of university scholars who, in Greene's phrase, "spent their wits in making playes." Greene went on to say that he was "in some things rarer, in nothing inferior," to Marlowe. This praise was not unfounded. The credit given to Greene and Marlowe for the increased dignity of English dramatic diction, and for the new smoothness infused into blank verse, must certainly be shared by Peele.

Peele's *Works* were edited by Alexander Dyce (1828, 1829–39 and 1861); by A. H. Bullen (2 vols., 1888). An examination of the metrical peculiarities of his work is to be found in F. A. R. Lämmerhirt's *Georg Peele, Untersuchungen über sein Leben und seine Werke* (Rostock, 1882) *See* also Professor F. B. Gummere, in *Representative English Comedies* (1903); an edition of *The Battell of Alcazar,* printed for the Malone Society in 1907; P. Cheffand, *Étude sur George Peele* (1913); W. W. Greg, an ed. of the *Battell of Alcazar* (1922).

PEEP-OF-DAY BOYS, an Irish Protestant secret society, formed about 1785. Its object was to protect the Protestant peasantry, and avenge their wrongs on the Roman Catholics. The "Boys" gained their name from the hour of dawn which they chose for their raids on the Roman Catholic villages. The Roman Catholics in return formed the society of "The Defenders."

PEEPUL or **PIPUL** (*Ficus religiosa*), the "sacred fig" tree of India, is also called the Bo tree. It is not unlike the banyan, and is venerated both by the Buddhists of Ceylon and the Vaishnavite Hindus, who say that Vishnu was born beneath its shade. It is planted near temples and houses; its sap abounds in caoutchouc, and a good deal of lac is obtained from insects who feed upon the branches. The fruit is about the size of a walnut and is not much eaten. (*See* FIG.)

PEERAGE. Although in England the terms "peerage" (Fr. *pairage;* Med. Lat. *paragium;* M.E. *pere;* O.Fr. *per, peer,* later *pair;* Lat. *paris,* "equal"), "nobility," "House of Lords" are commonly regarded as synonymous, in reality each expresses a different meaning. A man may be a peer and yet not be a member of the House of Lords, a member of the House of Lords and yet not strictly a peer; though all peers are members of the House of Lords, either *in esse* or *in posse.* In the United Kingdom the rights, duties and privileges of peerage are centred in an individual, while to the old monarchical notions of the Continent, nobility conveyed the idea of family, as opposed to personal, privilege.

The Origin of Peerage.—Etymologically, "peers" are "equals" (*pares*), and in Anglo-Norman days the word was invariably so understood. The feudal tenants-in-chief of the Crown were all the peers of one another; so, too, a bishop had his ecclesiastical peer in a brother bishop, and the tenants of a manor their peers in their fellow-tenants. That even so late as the reign of John the word was still used in this general sense is clear from Magna Carta, for the term "judicium parium" therein must be understood to mean that every man had a right to be tried by his equals. This right was asserted by the barons as a body in 1233 on behalf of Richard, earl marshal, who had been declared a traitor by the king's command, and whose lands were forfeited without proper trial. In 1233 the French bishop, Peter des Roches, Henry III.'s minister, denied the barons' right to the claim set up, on the ground that the king might judge all his subjects alike, there being, he said, no peers in England (Math. Paris. 389). The English barons undoubtedly were using the word in the sense it held in Magna Carta, while the bishop probably had in his mind the French peers (*pairs de France*), a small and

select body of feudatories possessed of exceptional privileges. The change in England was gradual, and probably gathered force as the gulf between the greater barons and the lesser widened, until in course of time, for judicial purposes, there came to be only two classes, the greater barons and the rest of the people. Ecclesiastics had special privileges for most purposes, being triable only by the Church. The first use of the word "peers," as denoting those members of the baronage who were accustomed to receive regularly a personal writ of summons to parliament, is found in the record of the proceedings against the Despensers in 1321. (Stubbs, *Const. Hist.* ii. 347.)

Anglo-Norman Baronage.—Properly to understand the growth and attributes of the peerage it is necessary to trace the changes which occurred in the position of the Anglo-Norman baronage, first through the gradual strengthening of royal supremacy, with the consequent decay of baronial power locally, and subsequently by the consolidation of parliamentary institutions during the reigns of the first three Edwards. In place of the individual absolute ownership of Saxon days, the Conqueror became practically the sole owner of the soil. The change, though not immediately complete, followed rapidly as the country settled down and the power of the Crown extended to its outlying frontiers. The new owners became direct tenants of the king. All tenants-in-chief were termed generally barons (*see* BARON).

The King's Court.—The king's tenants owed as a duty the service of attending the King's Court (*curia regis*), and out of this custom grew the parliaments of later days. In theory all the king's tenants-in-chief, great and small, had a right to be present as incident to their tenure. The King's Court was held regularly at the three great festivals of the Church and at such other times as deemed advisable. The assembly for several generations neither possessed nor pretended to any legislative powers. Legislative power was a product of later years, and grew out of the custom of the Estates granting supplies only on condition that their grievances were first redressed. The great bulk of the tenants were present for the purpose of assenting to special taxation above and beyond their ordinary feudal dues. When necessary a general summons to attend was sent through the sheriff of every county, who controlled a system of local government which enabled him to reach every tenant. In course of time to a certain number of barons and high ecclesiastics it became customary to issue a personal writ of summons, thus distinguishing them from the general mass summoned through the sheriff.

Magna Carta and Personal Summons to the Majores Barones.—The sequel is found in Magna Carta, wherein it is provided that the archbishops, bishops, abbots, earls and greater barons are to be called up to the council by writ directed to each severally; and all who hold of the king in chief, below the rank of greater barons, are to be summoned by a general writ addressed to the sheriff of their shire. Magna Carta thus indicates two definite sections of the king's tenants, a division which had evidently persisted for some time. The "greater barons" are the parents of the peers of later days. From 1254 to 1295 in varying numbers there were summoned to the King's Councils representatives of the counties, boroughs and cities. The assembly of 1295, called the Model Parliament, is regarded legally as the first of our freely-elected properly representative assemblies.

To every spiritual and temporal baron accustomed to receive an individual writ, one was issued. Every county elected its knights, and every city or borough of any importance was instructed by the sheriff to elect and to return its allotted number of representatives. It may be taken for granted, however, that any assembly held since 1295, which did not conform substantially to the model of that year, cannot be regarded constitutionally as a full parliament. The point is even of modern importance, as in order to establish the existence of a barony by writ it must be proved that the claimant's ancestor was summoned by individual writ to a full parliament, and that either he himself or one of the heirs of his body was present in a full parliament.

Grades of Peerage.—An examination of the early writs issued to individuals shows that the baronage consisted of archbishops, bishops, abbots, priors, earls and barons. While the archbishops and bishops received their writs with regularity, the summonses to heads of ecclesiastical houses and greater barons were intermittent. The prelate held an office which lived on regardless of the fate of its temporary holder, and if by reason of death, deprivation or translation the office became vacant, a writ still issued to the "Guardian of the Spiritualities." The prior or the abbot, on the other hand, often outside the jurisdiction of the English Church, and sometimes even owing allegiance to a foreign order, was but the personal representative of a land-holding community. The conclusion, then, may be drawn that in theory the issue of a writ was at the pleasure of the Crown, and that in practice the moving factor in the case of the prelates was office and personal importance, and in the case of priors, abbots, earls and barons, probably, in the main, extent of possession.

Hereditary Principle.—The next point for consideration is when did the peerage, as the baronage subsequently came to be called, develop into a body definitely hereditary? Here again growth was gradual and somewhat obscure. Throughout the reigns of the first three Edwards summonses were not always issued to the same individual for successive parliaments; and it is quite certain the king never considered that the issue of one writ to an individual bound the Crown to its repetition for the rest of his life, much less to his heirs in perpetuity. Again we must look to tenure for an explanation. The custom of primogeniture tended to secure estates in strict family succession, and if extent of possession had originally extracted the acknowledgment of a personal summons from the Crown it is more than probable that as successive heirs came into their inheritance they, too, would similarly be acknowledged. In early days the summons was a burden to be suffered of necessity, an unpleasant incident of tenure, in itself undesirable, and probably so regarded by the majority of recipients during at least the two centuries following the Conquest. Gradually the free and indiscriminate choice of the Crown became fettered by the principle that, once a summons had been issued to an individual to sit in parliament and he had obeyed that summons, he thereby acquired a right of summons for the rest of his lifetime; and in later years, when the doctrine of nobility of blood became established, his heirs were held to have acquired the same privilege by hereditary right.

The earl's position in the baronage needs some explanation. Modern historical opinion inclines to the view that while originally an earldom may have been something of an office, it rapidly became little more than an added name of dignity conferred on one already a leading member of the baronage. Earls received individual summonses to parliament by the name of Earl (*q.v.*); but there is reason to believe that in early days at any rate they sat by tenure as members of the baronage.

If we review the political situation at the beginning of the 14th century a great change is evident. The line between those members of the baronage in parliament and the rest of the people is firmly and clearly drawn. Tenure as the sole qualification for presence in the national assembly has disappeared, and in its place there appears for the baronage a system of royal selection and for the rest of the people one of representation.

Peerage a Personal Dignity.—Primogeniture, a custom somewhat uncertain in early Anglo-Norman days, had rapidly developed into a definite rule of law. As feudal dignities were, in their origin, inseparable from the tenure of land, it is not surprising that they, too, followed a similar course of descent, although as the idea of a dignity being exclusively personal gradually emerged, some necessary deviations from the rules of law relating to the descent of land inevitably resulted. In the 11th year of his reign Richard II. created by letters patent John Beauchamp "Lord de Beauchamp and baron of Kyddermynster, to hold to him and the heirs of his body." These letters patent were not founded on any right by tenure of land possessed by Beauchamp, for the king makes him "for his good services and in respect of the place which he has holden at the coronation (*i.e.*, steward of the household) and might in future hold in the king's councils and parliaments, and for his noble descent, and his abilities and discretion, one of the peers and barons of the kingdom of England; willing that the said John and the heirs-male of

his body issuing, should have the state of baron and should be called by the name of "Lord de Beauchamp and baron of Kyddermynster." The grant rested wholly on the grace and favour of the Crown, and was a personal reward for services rendered. Here, then, is an hereditary barony entirely a personal dignity and quite unconnected with land. From Richard's reign to the present day, baronies (and, indeed, all other peerage honours) have continued to be conferred by patent. The custom of summons by writ was not in any way interfered with, the patent operating merely to declare the dignity and to define its devolution. Summons alone still continued side by side for many generations with summons founded on patent; but after the reign of Henry VIII. the former method fell into disuse, and during the last 250 years there have been no new creations by writ of summons alone. So, from the reign of Richard II., barons were of two classes, the older, and more ancient in lineage summoned by writ alone, the honours descending to heirs-general, and the newer created by letters patent, the terms of which governed the issue of the summons and prescribed the devolution of the peerage in a line usually of the direct male descendants of the person first ennobled.

Peerages by Tenure.—It was long believed that, originally, there existed peerages by tenure alone and that such could devolve by right of tenure independent of descent. The Berkeley case of 1858–61 (better reported 8 H.C.L. 21) is essential for the student who wishes to examine the question carefully; and may be regarded as finally putting an end to any idea of bare tenure as an existing means of establishing a peerage right. (*See* also Cruise on *Dignities*, 2nd ed., pp. 60 *et seq.*)

The main attribute of a peerage is that hereditary and inalienable quality which ennobles the blood of the holder and his heirs, or, as a great judge put it in 1625, in the earldom of Oxford case, "he cannot alien or give away this inheritance because it is a personal dignity annexed to the posterity and fixed in the blood" (Dodridge, J., at p. 123, Sir W. Jones's *Reports*).

Dukes.—Until the reign of Edward III. the peerage consisted only of high ecclesiastics, earls and barons. The earls were barons with their special name of dignity added, and their names always appear on the rolls before those of the barons. In 1337 King Edward III. created his son, the Black Prince, duke of Cornwall, giving him precedence over the rest of the peerage. Subsequently several members of the royal family were created dukes, but no subject received such an honour until 50 years later, when Richard II. created his favourite, Robert de Vere, earl of Oxford, duke of Ireland (for life). The original intention may have been to confine the dignity to the blood royal, since, with the exception of de Vere, it was some years before a dukedom was again conferred on a subject.

Marquesses.—In 1385 Richard II. had created Robert de Vere marquess of Dublin, thus importing an entirely new and unknown title into the peerage. The grant was, however, only for life, and was, in fact, resumed by the Crown in 1387, when its recipient was created duke of Ireland.

Viscounts.—Under the name of viscount (*q.v.*) Henry VI. added yet another order, and the last in point of time, to the peerage, creating in 1440, John, Baron Beaumont, Viscount Beaumont and giving him precedence next above the barons. The name of this dignity was borrowed from the Continent, having been in use for some time as a title of honour in the king's French possessions. None of the new titles above mentioned ever carried with them any official position; they were conferred as additional honours on men who were already members of the peerage.

Spiritual Peers.—The application of the hereditary principle to temporal peerages early differentiated their holders from the spiritual peers. Both spiritual and temporal peers were equally lords of parliament, but hereditary pretensions on the one side and ecclesiastical exclusiveness on the other soon drew a sharp line of division between the two orders. Gradually the temporal peers, strong in their doctrine of "ennobled" blood, came to consider that theirs was an order above and beyond all other lords of parliament, and before long, arrogated to themselves the exclusive right to be called peers, and as such the only persons entitled to the privileges of peerage.

The pretensions of the lay peers were not admitted without a struggle on the part of the prelates, who made the mistake of aiming at the establishment of a privileged position for their own order while endeavouring to retain every right possessed by their lay brethren. They fell between two stools, lost their position as peers and were beaten back in their fight for ecclesiastical privilege. For themselves Churchmen never claimed the privilege of trial by peers, and when arraigned, alleged to be altogether beyond secular authority. The Standing Orders of the House of Lords for 1625 contain the statement that "Bishops are only Lords of Parliament and not Peers" (*Lords Journals*, iii. 349). In 1640 the "Lords Spiritual" were altogether excluded from the House of Lords by act of parliament, and were not brought back until the second year of the Restoration.

Henry VIII. and the Peerage.—The reign of Henry VIII. brought about far-reaching changes in the position of the peerage. When that king ascended the throne the hereditary element was in a decided minority, but the balance was rapidly redressed until a bare hereditary majority was secured and the dissolution of the monasteries made possible. The peers, many now grown fat on abbey lands, at once began to consolidate their position; precedents were eagerly sought for, and the doctrine of ennobled blood began to find definite and vigorous expression. So long, the peers declared, as there is any ennobled blood, a peerage must exist; and it can be extinguished only by act of parliament, failure of heirs or upon corruption of blood by attainder.

Surrender of Peerages.—From the doctrine of nobility of blood is derived the rule of law that no peerage (a Scots peerage is under Scots Law, which admits surrender) can be surrendered, extinguished or in any way got rid of unless the blood be corrupted. The rule is well illustrated by the earldom of Norfolk case (*Law Reports* [1907], A.C. 10), in which its development was traced, and the principle authoritatively confirmed. Historically, there is little to support such a decision, and, indeed, this rigid application of the law is of comparatively recent date. Without doubt king, nobles and lawyers alike were all agreed, right down to Tudor days, that such surrenders were entirely valid. Many certainly were made, but, according to the decision of 1906, any living heirs of line of those nobles who thus got rid of their peerage honours can, if their pedigrees be provable and no attainders bar the way, come to the House of Lords with a fair chance of reviving the ancient honours.

Attainder and Corruption of Blood.—The application of the doctrine of corruption of blood to peerages arises out of their close connection with the tenure of land, peerage dignities never having been regarded as personal until well on into the 14th century. Conviction for any kind of felony—and treason originally was a form of felony—was always followed by attainder. This resulted in the immediate corruption of the blood of the offender, and its capacity for inheritance was lost for ever. Such corruption, with all its consequences, could be set aside only by act of parliament. This stringent rule of forfeiture was to some extent mitigated by the passing, in 1285, of the statute De Donis Conditionalibus (*q.v.*), which made possible the creation of estates tail, and when a tenant-in-tail was attainted forfeiture extended only to his life interest. The statute De Donis was soon applied by the judges to such dignities as were entailed (*e.g.*, dignities conferred by patent with limitations in tail), but it never affected baronies by writ, which were not estates in tail but in the nature of estates in fee simple descendible to heirs-general. In the reign of Henry VIII. an act was passed (1534) which brought estates tail within the law of forfeiture, but for high treason only. The position then became that peerages of any kind were forfeitable by attainder following on high treason, while baronies by writ remained, as before, forfeitable for attainder following on felony. In 1708, just after the union with Scotland, an act was passed by which, on the death of the Pretender and three years after Queen Anne's death, the effects of corruption of blood consequent on attainder for high treason were to be abolished, and the actual offender only punishable (stat. 7 Anne, c. 21, sec. 10). Owing to the 1745 rising, the operation of this act was postponed until the decease

of the Pretender and all his sons (stat. 17 Geo. II. c. 39, sec. 3). In 1814, forfeiture for every crime other than high and petty treason and murder, was restricted to the lifetime of the person attainted (stat. 54 Geo. III. c. 145). Finally, in 1870, forfeiture, except upon outlawry, was altogether abolished, and it was provided that "no judgment of or for any treason or felony should cause any attainder or corruption of blood, or any forfeiture or escheat."

In many cases there have been passed special parliamentary acts of attainder and forfeiture, and these, of course, operate apart from the general law. In any event, attainder and forfeiture of a dignity, whether resulting from the rules of the common law or from special or general acts of parliament can only be reversed by act of parliament.

Growth of the Lords.—The numbers of the House of Lords grew steadily throughout the Tudor period, and during the reign of the first two Stuarts underwent a still greater increase. In the Great Rebellion the majority of the peers were the king's stoutest supporters, and thus inevitably involved themselves in the ruin of the royal cause. Under Cromwell they disappeared as a legislative body and did not return to their ancient place until the restoration of Charles II.

From the reign of William of Orange the peerage has been freshened by a steady stream of men who, as a rule, have served their country as statesmen, judges, sailors and soldiers. By the Act of Union with Scotland (1707) the Scottish parliament was abolished; but the Scottish peerage was given the privilege of electing, for each parliament of Great Britain, 16 of their number to represent them in the House of Lords. Further creations in the Scottish peerage were no longer to be made. The effect of this act was to leave the great majority of the Scottish peers outside the House of Lords, since only 16 of their number were to become lords of parliament. Close upon 100 years later Ireland was united with Great Britain, the Irish parliament being merged in the parliament of the United Kingdom of Great Britain and Ireland. Twenty-eight Irish peers were to be elected for life by their order to represent it in the House of Lords. One archbishop and three bishops were also chosen in turn to represent the Irish Church in the House of Lords, but when that Church was disestablished in 1867 the spiritual lords lost their seats. The merger of the three kingdoms had an important effect on their peerages. Every peer, in his own country, had been a lord of parliament by hereditary right. The English peer (and, as the Acts of Union were passed, the peer of Great Britain and the peer of the United Kingdom) continued by hereditary right a lord of parliament. Although the Scottish and Irish peers lost this right by the two Acts of Union, they retained every other privilege of peerage. Henceforth they were to be lords of parliament only when their fellow peers elected them.

The erection of southern Ireland into a self-governing dominion of the Crown has indirectly but definitely affected the status of the Irish peerage. This peerage belonged to the old united Ireland; and cannot to-day arbitrarily be divided between its two halves. The Irish Free State Constitution Act, 1922, together with the machinery acts dependent thereon, has destroyed the procedure whereby Irish representative peers are elected; whether intentionally or by accident is not known. Existing representative peers, having been elected for life, remain in the House of Lords, but no vacancies can henceforth be filled. The Irish peerage will thus slowly diminish in numbers as existing peerages die out.

The modern meaning of the term peerage can now be more clearly defined. It will be noted that there have always been separate peerages of England, Ireland and Scotland. After the union of England with Scotland new creations became of the peerage of Great Britain, and after the union of Great Britain with Ireland: of the United Kingdom of Great Britain and Ireland; and now, since the advent of the Irish Free State, probably we must speak of the "United Kingdom of Great Britain and Northern Ireland." Many members of the House of Lords hold peerages in several of these groups.

Several attempts have been made to limit the absolute rights of peers to a writ of summons, but this is a question which belongs rather to the history of the House of Lords as a legislative chamber. It will suffice here to note that in 1856 an attempt was made to create one of the judges a life peer, but the House, after long debate, rejected the writ, and a patent of customary form had to be followed. In 1876 legislation was passed creating two lords of appeal (with power to appoint two more) with a right to sit and vote during the holding of office. In 1887 further legislation conferred on all lords of appeal and ex-lords of appeal life peerages.

The Scottish Peerage.—The Scottish peerage, like that of England, owes its origin to feudalism. When the Scottish earls and barons came to parliament, they did not withdraw themselves from the rest of the people, it being the custom for the estates of Scotland to deliberate together, and this custom persisted until the abolition of their parliament by the Act of Union in 1707. The territorial spirit of the nobles inevitably led them to regard the honour as belonging to, and inseparable from, their land, and until comparatively late in Scottish history there is nowhere any record of the conferment of a personal dignity unattached to land such as that conferred in England on Beauchamp by Richard II. This explains the frequent surrenders and altered grants which are so common in Scottish peerage history, and which, in sharp distinction to the English rule of law, are there regarded as perfectly legal. To-day there exists no Scottish dukedom (except the royal dukedom of Rothesay), marquessate or viscounty created before the reign of James VI. of Scotland (and I. of England). Of the existing Scottish peerages 63 were created in the period between James's accession to the English throne and the Act of Union. There are now only 87 in all.

The Irish Peerage.—The Anglo-Norman conquerors of Ireland carried with them the laws and the system of tenure to which they were accustomed in England, and consequently the growth of the baronage and the establishment of parliamentary government in Ireland proceeded on parallel lines with the changes which occurred in England. Until the reign of Henry VIII. the Irish were without representation in parliament, but gradually the Irish were admitted, and by the creation of new parliamentary counties and boroughs were enabled to elect representatives. In 1613 the whole country shared in representation (Ball's *Legislative Systems of Ireland*). Just as James I. had added many members to the Scottish peerage, so he increased the number of Irish peers.

On the death of a representative peer of Scotland a vacancy occurs and a new election takes place, but in accordance with modern practice promotion to a United Kingdom peerage does not vacate the holder's representative position (May's *Parliamentary Practice*, p. 11 n.). Scottish and Irish peers, if representative, possess all the privileges of peerage and parliament enjoyed by peers of the United Kingdom; if non-representative all privileges of peerage, except the right to a writ of summons to attend parliament and to be present at and vote in the trial of peers.

Though many peers possess more than one peerage, and frequently of more than one country, only that title is publicly used which is first in point of precedence. Every peerage descends according to the limitations prescribed in its patent of creation or its charter, and where these are non-existent (as in the case of baronies by writ) to heirs-general. (*See* ABEYANCE.)

In dealing with English dignities it is essential to realize the difference between a mere title of honour and a peerage. The Crown, as the fountain of honour, is capable of conferring upon a subject not only any existing title of honour, but may even invent one for the purpose. So James I. instituted an order of hereditary knights which he styled baronets, and Edward VII. created the duchess of Fife "Princess Royal"—a life dignity. The dignities of prince of Wales, earl marshal and lord great chamberlain have been for centuries hereditary, and though of high court and social precedence, of themselves confer no right to a seat in the House of Lords—they are not peerages.

There is no limitation on the power of the Crown as to the number of United Kingdom peerages which may be created. As

to Scotland, the Act of Union with that country operates to prevent any increase in the number of Scottish peerages, and consequently there have been no creations since 1707, with the result that the Scottish peerage, as a separate order, is gradually approaching extinction. The Irish peerage is supposed always to consist of 100 exclusively Irish peers, and the Crown (before the erection of the Irish Free State) had power to grant Irish peerages up to the limit. When the limit was reached no more peerages might be granted until existing ones had become extinct or their holders succeeded to United Kingdom peerages. Only four lords of appeal in ordinary may hold office at any one time. The number of archbishops and bishops capable of sitting in the House of Lords is fixed by various statutes at 26.

Since party government became the rule, the new peerages have usually been created on the recommendation of the prime minister of the day, though the Crown, especially in considering the claims of royal blood, is believed in some instances to take its own course; and, constitutionally, such action is entirely legal. By far the greater number of peerage honours granted during the last two centuries have been rewards for political services. The roll of the lords spiritual and temporal for the session of parliament assembling Feb. 1928 numbered 740.

Privileges of Peerage.—As centuries have gone by and customs changed, many privileges once keenly asserted have either dropped out of use or been forgotten. The most important now in being are a seat in the House of Lords and the right to trial by peers on any charge of treason or felony. Whatever the origin of this latter right, and some date it back to Saxon times (Trial of Lord Morley, 1678, *State Trials*, vii. 145), Magna Carta has always been regarded as its confirmatory authority.

The peers have always strongly insisted on this privilege of trial by their own order, and several times the heirs of those wrongly condemned recovered their rights and heritage on the ground that there had been no proper trial by peers (*R.D.P.*, v. 24). In 1442 the privilege received parliamentary confirmation (stat. 20 Henry VI. c. 9). If parliament is sitting the trial takes place before the House of Lords in full session, *i.e.*, the court of our lord the king in parliament; if not, then before the court of the lord high steward. The office of lord high steward was formerly hereditary, but has not been so for centuries and is now only granted *pro hac vice*. When necessity arises, the Crown issues a special commission naming some peer (usually the lord chancellor) lord high steward *pro hac vice* (Blackstone's *Comm.*, iv. 258). When a trial takes place in full parliament a lord high steward is also appointed, but his powers there are confined to the presidency of the court, all the peers sitting as judges of law as well as of fact. Should the lord high steward be sitting as a court out of parliament, he summons a number of peers to attend as a jury, but rules alone on all points of law and practice, the peers present being judges of fact only. Whichever kind of trial is in progress, it is the invariable practice to summon all the judges to attend and advise on points of law. The distinction between the two tribunals was fully discussed and recognized in 1760 (Trial of Earl Ferrers, Foster's *Criminal Cases*, 139). The most recent trial was that of Earl Russell for bigamy (reported 1901, A.C. 446).

Peeresses and non-representative peers of Ireland and Scotland have, with the exception of the right to sit in the House of Lords and its attendant privileges, every peerage privilege. In 1922 Sibyl Viscountess Rhondda presented a petition claiming the right to a writ of summons. The claim was heard and re-heard before the Committee for Privileges and eventually rejected. This decision has disposed of the claims of peeresses in their own right, under the existing law, to sit in the House of Lords. A widowed peeress retains her privilege of peerage while unmarried, but loses it if she marries a commoner (Co. Litt. 166; *Cowley* v. *Cowley* [1901] A.C. 450).

The children of peers are commoners. The eldest son of a peer of the rank of earl (and above) is usually known socially by the name of his father's next peerage, but the courtesy nature of such title is clearly indicated in every public or legal document, the phraseology employed being "John Smith, Esq., commonly known as Viscount Blackacre." Several cases are on record in which peers' eldest sons have actually borne courtesy titles not possessed as peerage honours by their fathers, but inasmuch as such are only accorded by courtesy, no question of peerage privilege arises. The younger sons of dukes and marquesses by custom use the prefix "Lord" before one of their Christian names, and all the daughters of earls as well as of dukes and marquesses are entitled similarly to style themselves "Lady," on the principle that all the daughters are equal in rank and precedence. The younger sons of earls and all the younger children of viscounts and barons, including lords of appeal, use the prefix "Honourable" before one of their Christian names, but this style is one of written address and reference only. Usually, when the direct heir of a peer dies, his children are given, by the Crown, on the death of the peer, the courtesy titles and precedence they would have enjoyed had their father actually succeeded to the peerage.

An alien may be created a peer, but while remaining an alien cannot sit in the House of Lords, nor, if a Scottish or Irish peer, can he vote at elections for representative peers.

Claims to peerages are of two kinds: (1) of right, (2) of grace. In theory the Crown, as the fountain of honour, might settle any claim without reference to the House of Lords, and issue a writ of summons to its petitioner. This would not in any way prevent the House of Lords from examining the patent and writ of summons when the favoured petitioner or any heir claiming through him came to take his seat. If of opinion that the patent was illegal the House might refuse admittance, as it did in the Wensleydale case. In the case of a petitioner who has persuaded the Crown to terminate in his favour as a co-heir the abeyance of an ancient barony and who has received his writ of summons, the matter is more difficult. The House cannot refuse to admit any person properly summoned by the Crown, as the prerogative is unlimited in point of numbers; but it can take into account the precedence of the newcomer. The Crown, therefore, unless there can be no question as to origin and pedigree, seldom terminates an abeyance without referring the matter to the House of Lords, and invariably so refers all claims which are disputed or which involve any question of law.

The Committee for Privileges, which for peerage claims is usually constituted of the law lords and one or two other lords interested in peerage history, sits as an ordinary court of justice and follows all the rules of law and evidence. The attorney-general attends as adviser to the committee and to watch the interests of the Crown. According to the nature of the case the committee reports to the House, and the House to the Crown, that the petitioner (if successful) (1) has made out his claim and is entitled to a writ of summons, or (2) has proved his co-heirship to an existing peerage, and has also proved the descent of all co-heirs that can seasonally be traced. In the first case the writ of summons is issued forthwith, but the second, being one of abeyance, is a matter for the pleasure of the Crown, which need not be exercised at all, but, if exercised, may terminate the abeyance in favour of any one of the co-heirs.

During the parliamentary session of 1926 the House of Lords appointed a select committee to examine the history of abeyant peerages and to report on the advisability of limiting future claims. After debate on the report, the House resolved that these claims ought not to be considered where long abeyance has existed and where the claimants possess only a small fraction of the original heirship. The resolution of the House was duly reported to the Crown. The recommendation of the House does not, and, in law, cannot affect the prerogative of the Crown to terminate any abeyance, but there can be little doubt that the representations made will have due weight with the advisers of the Crown in the consideration of all future claims. The report of and evidence taken by the committee is printed as a House of Lords paper (1927) and should be carefully studied by all interested in peerage history. (G. El.)

PEEWEE, the name (from their cry) of two North American birds of the genus *Myiochanes* (fam. *Tyrannidae*). The wood peewee (*M. virens*) is a little bird about 6 in. long, dark olive

above, with a whitish throat and yellowish belly. The name closely represents its musical call. It breeds in North America and migrates in winter through eastern Mexico to South America. West of longitude 100° it is replaced by *M. richardsonii*, the western wood peewee, which has no olive tinge above, and has the wings and tail slightly longer. It also winters in S. America.

PEEWIT, an alternative name for the lapwing (*Vanellus vanellus*), from its cry. (*See* LAPWING.)

PEGASUS (from Gr. πηγός compact, strong, not from πηγή, a spring), a winged horse said to have sprung from the trunk of the Gorgon Medusa when her head was cut off by Perseus After his service to Bellerophon (*q.v.*) and the latter's fall, Pegasus served Zeus (Hesiod, *Theog.* 281). Later authors identify him with the constellation Pegasus or Equus. The spring Hippocrene or Hippucrene (Horsewell) on Mt Helicon is said to have sprung up from a blow of his hoof; for the connection between horses, or horse-shaped *daimones,* and water, *see* POSEIDON. Hence the erroneous derivation of πήγασος from πηγή. Hence also the fancy of modern poets (first in Boiardo, *Orlando inamorato*) that he is the horse of the Muses and hence a symbol of poetry

See F. Hannig in *Breslauer philologische Abhandlungen* (1902), vol. viii., pt. 4, and in Roscher's *Lexikon der Mythologie* (bibl.).

PEGGING THE EXCHANGE. The phrase and practice of "pegging the exchange" finds its origin in the World War It may be defined as consisting of continued governmental or official action to maintain the foreign exchange value of a country's currency against the principal gold currencies at par or at any fixed point. Thus, during the World War, the Allied Governments pegged their respective rates of exchange upon New York at a point slightly below parity, while from 1926 to 1928 the French Government maintained the "de facto" stabilization of the franc, virtually another name for pegging the franc at a rate which quickly settled down at 124 francs to the pound sterling.

Pegging the exchange theoretically means the maintenance of the exchange between an upper and a lower limit, and that the appreciation as well as the depreciation of the home currency must be prevented.

As shown in the article upon foreign exchange (*q.v.*), a rate of exchange is the price of one currency in terms of another, and this price depends upon supply and demand. Hence, when a Government decides to peg the rate, it must adopt one of two alternatives The first, which evasion rapidly renders impracticable, is to fix the rate by law. This, when tried, has nearly always failed. The second is for the Government, directly or through its agents, to buy and sell on the world's exchange markets its own and foreign currencies in such a way and in such quantities as to counteract immediately any attempt of the rate to go beyond the limits within which the rate is pegged.

During the World War the Allies were largely dependent upon the United States for food-stuffs and munitions The purchase of these involved a steady demand for dollars, and as there was no counteracting supply of dollars at the disposal of the Allies —for export trade to the States was perforce curtailed by the concentration of the Allies' productive energies upon the war— the allied currencies showed a steady tendency to depreciate against the dollar To consider England alone: as early as 1915, the British Government took steps to "maintain" the exchange, though no definite peg was inserted. These steps consisted of the acquisition of dollars by the British Government and their sale in New York by Messrs Pierpont Morgan, who were agents to the British Government, in such quantities as to balance the day to day demand for dollars arising from the Allies' purchases of American commodities. So long as the supply was equal to the demand, the exchange was automatically maintained.

The problem before the British Government was how to acquire dollars in sufficient quantity to meet the abnormal war demand. To solve this, they depended partly upon dollar loans in America, and partly on the large volume of sound American securities held by British nationals as a result of the heavy pre-war investments made by Great Britain in America. These last were acquired by the British Treasury, transferred to their New York agents, and their sale provided the necessary supply of dollars.

Various methods were adopted whereby the Treasury gained control of American securities. Originally, the British Government contented themselves with an appeal to holders of eligible stocks, the appeal being based partly upon patriotism, and partly on the fact that a highly attractive price was offered by the Treasury. This met with a certain degree of response. Later on, peaceful methods of persuasion were reinforced by a special two shillings in the pound income tax imposed upon dividends accruing from such American securities as were required by the Treasury and which the holders declined to surrender Finally, the power of the Defence of the Realm Act was invoked, and these securities were forcibly requisitioned, the original holder receiving a fair price as fixed by the Treasury

When the United States entered the World War these expedients were no longer necessary, as the United States Government could borrow dollars from its own nationals, and lend them to the Allied Governments in such quantities as proved necessary. This kept the peg firmly in place, while the question of repayment was left over till after the war. It will be seen that the debt to America took two forms. One consisted of the loans raised by the Allies on Wall street, due directly to the American investor. The other was debt due to the American government.

The war provided the outstanding example of exchange pegging Other examples can be found in the post-war reconstruction period The method usually employed is for the Government or central bank of the country concerned to have credits opened in London and New York. In case of need, these are drawn upon, and the resulting sterling or dollars sold in the market in amounts sufficient to keep the peg in place. (*See* also EXCHANGE, FOREIGN)

(N E C)

PEGMATITE, the name given by Hauy to those masses of graphic granite which frequently occur in veins. They consist of quartz and alkali felspars in crystalline intergrowth (*see* PETROLOGY) The term (from Gr πῆγμα, a bond) was subsequently used by Naumann to signify also the coarsely crystalline veins rich in quartz felspar and muscovite, which often in great numbers ramify through outcrops of granite and the surrounding rocks This application of the name has now obtained general acceptance, and has been extended by many petrologists, to include vein-rocks of similar structure and geological relationships, which occur with syenites, diorites and gabbros Only a few of these pegmatites have graphic structure or mutual intergrowth of their constituents Many of them are exceedingly coarse-grained; in granite-pegmatites the felspars may be several feet or even yards in diameter, and other minerals such as mica, apatite and tourmaline often occur in gigantic crystals. The pegmatites are always in visible association with plutonic intrusions and they consist largely of minerals similar to those characteristic of the particular magma from which they have been derived.

On the whole pegmatites are most abundant along with acid rocks, especially granites, though they are also well known in association with syenites and gabbros As a rule they are more acid in composition than the average of the parent magma, and this fact has a bearing on their mode of origin. The coarsely crystalline structure is not difficult to explain on physico-chemical principles. The pegmatites are shown by field-evidence to belong to a very late stage in the cooling of the parent magma, and many of them contain minerals rich in water and a number of elements of low atomic weight, such as are known to have a powerful effect in depressing the freezing-points of minerals in silicate melts: such are fluorine, chlorine and boron The final residue of the magma became enriched in water, in these elements, and in others capable of forming volatile compounds with them, such as tin and tungsten Now such a solution would remain fluid down to a very low temperature, and would be extremely mobile, thus facilitating free diffusion of molecules and thereby favouring the formation of large crystals. Further, such a residual solution would naturally tend towards the composition of a eutectic, giving rise to the simultaneous crystallization of two or more minerals in graphic intergrowth.

Among the more common of the minerals above referred to are tourmaline, which contains both boron and fluorine, apatite,

which has varieties with either fluorine or chlorine, or both; muscovite and gilbertite both contain hydrogen as hydroxyl and fluorine; topaz may carry as much as 20% of fluorine. Among the other elements of low atomic weight beryllium is found as beryl and lithium in various lithia-micas, lepidolite, zinnwaldite and spodumene. Tin and tungsten give rise to cassiterite and wolfram, which are common in pegmatites.

There exists in nature a complete transition from pegmatites having, for example, the exact composition of a granite, to veins of nearly pure quartz; many of the last named contain a workable quantity of some metalliferous ore or metal. This transition may be seen not only by a comparison of the different veins of a district, but sometimes occurs along the extent of one individual vein. Nearest to or within the parent granite it may consist of quartz, felspar and mica, with accessories: when traced along the strike away from the parent granite the felspar and mica progressively decrease till the more distant parts constitute a quartz-vein, which may be either metalliferous or barren. This is an example of the process of differentiation applied to a case which may be of great practical importance. Many such instances occur in mining geology (*see* MINERAL DEPOSITS).

The pegmatites of the syenite group, especially those of southern Norway, are remarkable for the number of minerals containing rare earths, which are associated with an unusually high percentage of alkalis, especially soda, in the parent magma. Gabbro pegmatites are often extremely rich in apatite, which is for the most part the chlorine-bearing variety, whereas the apatite of acid pegmatite carries fluorine. Many of the finest specimens of minerals in museums have come from cavities in pegmatites, where there was room for the development of crystal faces.

(R. H. RA.)

PEGOLOTTI, FRANCESCO BALDUCCI (*fl.* 1315–40), Florentine merchant and writer, was a factor in the service of the mercantile house of the Bardi, and in this capacity he was at Antwerp from 1315 (or earlier) to 1317; in London in 1317 and apparently for some time after; in Cyprus from 1324 to 1327, and also in 1335, when he obtained from the king of Little Armenia (*i.e.*, mediaeval Cilicia, etc.) a grant of privileges for Florentine trade. Between 1335 and 1343, he compiled his *Libro di divisamenti di paesi e di misuri di mercatanzie e d'altre cose bisognevoli di sapere a' mercatanti*, commonly known as the *Pratica della mercatura* (the name given it by Pagnini). Beginning with a sort of glossary of foreign terms then in use for all kinds of taxes or payments on merchandise as well as for "every kind of place where goods might be bought or sold in cities," the *Pratica* next describes some of the chief trade routes of the 14th century, and many of the principal markets then known to Italian merchants; the imports and exports of important commercial regions; the business customs prevalent in those regions; and the comparative value of the leading moneys, weights and measures.

There is only one ms. of the *Pratica*, viz., No. 2,441 in the Riccardian Library at Florence (241 fols. occupying the whole volume), written in 1471; and one edition of the text, in vol. iii. of Gian Francesco Pagnini's *Della Decima e delle altre gravezze imposte dal commune di Firenze* (Lisbon and Lucca—really Florence—1766); Sir Henry Yule, *Cathay*, ii. 279–308, translated into English the most interesting sections of Pegolotti, with valuable commentary (London, Hakluyt society, 1866). *See* also W. Heyd, *Commerce du Levant*, ii. (Leipzig, 1886); H. Kiepert, in *Sitzungsberichte der philos.-hist. Cl. der berliner Akad.* (Berlin, 1881); C. R. Beazley, *Dawn of Modern Geography*, iii. (Oxford, 1906).

PEGU, a town and former capital of Lower Burma, giving its name to a district and a division. The town is situated on a river of the same name, 47 m. N.E. of Rangoon by rail; pop. (1921) 18,769. It is still surrounded by traces of the old walls, about 40 ft. wide, on which have been built the residences of the British officials. The most conspicuous object is the Shwe-mawdaw pagoda, 324 ft. high, considerably larger and even more holy than the Shwe-dagon pagoda at Rangoon. Pegu is said to have been founded in 573, as the first capital of the Talaings; but it was as the capital of the Toungoo dynasty that it became known to Europeans in the 16th century. About the middle of the 18th century it was destroyed by Alompra; but it rose again, and was important enough to be the scene of fighting in both the first and second Burmese Wars. It gave its name to the province (including Rangoon) which was annexed by the British in 1852.

The district, which was formed in 1883, consists of a portion of the forested Pegu Yomas and an alluvial tract between the Pegu Yoma range and the Sittang river: area, 4,083 sq.m.; pop. (1921) 445,620, showing an increase of 63,454 in the decade. Christians numbered nearly 9,750, mostly Karens. Almost the only crop grown is rice, which is exported in large quantities to Rangoon. The district is traversed by the railway, and also crossed by the Pegu-Sittang canal, navigable for 85 m., with locks.

The division of Pegu comprises the districts of Rangoon town, Hanthawaddy, Insein, Tharrawaddy, Pegu and Prome, lying east of the Irrawaddy: area 13,707 sq.m.; pop. (1921) 2,030,044.

PÉGUY, CHARLES (1873–1914), French author and poet, born at Orleans in 1873, came of a family which had been vine-growers for generations, and was proud of his peasant origin. He was educated at the *École Normale* and at the Sorbonne. The object of his life is perfectly indicated in the dedication of his first book, *Jeanne d'Arc* (1897), "à toutes celles et à tous ceux qui auront vécu . . . pour l'établissement de la République socialiste universelle." His works from that time until his death in Sept. 1914 are devoted to the glory of France. He was a determined republican; at the same time he was a devout Catholic. A mystical lover of France, and yet a strong socialist, he puzzled anti-clerical socialists and Catholic nationalists equally. His *Notre Patrie,* in which his views of what was necessary for the regeneration of the republic were set out, was written in 1905, but his most important prose works and the majority of his poems were written between 1910 and 1914. *Les Cahiers de la Quinzaine,* founded by him in 1900, were devoted to the expression of truth without regard to party, and in them Péguy's development, and the development of the "new France" he did so much to inspire, may be traced for over a decade. They were primarily imbued with his spirit, though in their pages many now well-known writers first came into public notice. For him truth was not to be found in compromise, and his extreme views were pronounced even at the risk of a subsequent *volte-face*. At the *École Normale* he came under the influence of Bergson, to whom he has done homage in his *Note sur M. Bergson* (1914). He kept his own little shop in the shadow of the Sorbonne, where he was continually amending his works. There he sold the *Cahiers*. He lived in the country, walked into Paris every morning, and brought with him something of the *province*. When war came in 1914 he refused a captaincy, because he wished to go on foot with his men. He fell leading a company on the first day of the battle of the Marne. The first volumes of his collected works were published in 1916.

See R. Johannet, *Péguy et ses Cahiers* (1914); J. E. Roberty, *Charles Péguy* (1916); A. Suarès, *Péguy* (1916); D. Halévy, *Charles Péguy et les Cahiers* (1918); M. Péguy, *La Vocation de C. Péguy* (1926).

PEINE, a town in the Prussian province of Hanover, 16 m. by rail W.N.W. of Brunswick, on the railway to Hanover and Hamburg. Pop. (1925) 17,036. Peine was at one time a strongly fortified place, and until 1803 belonged to the bishopric of Hildesheim. Its industries include iron and steel works, breweries and brickyards, and the manufacture of soap, sugar, malt, machinery and boots. There are also large cattle markets held here.

PEINE FORTE ET DURE, the term for a barbarous torture inflicted on those who, arraigned of felony, refused to plead and stood silent, or challenged more than 20 jurors, which was deemed a contumacy equivalent to a refusal to plead. Before he could be tried, a prisoner must plead "guilty" or "not guilty." By the Statute of Westminster, 1275, the penalty was "strong and hard imprisonment," but in 1406 pressing to death by heavy weights was substituted. This was abolished in 1772; "standing mute" being then made equivalent to conviction. By an act of 1827 a plea of "not guilty" was to be entered against any prisoner refusing to plead, and that is the rule to-day. An alternative to the *peine* was the tying of the thumbs tightly together with whipcord until pain forced the prisoner to speak. This was said to be a common practice at the Old Bailey up to the 19th century.

The last recorded instance of the infliction of the *peine* was

in 1741 at Cambridge assizes, when a prisoner was so put to death; the penalty of thumb-tying having first been tried. The only known American instance was in 1692 at Salem, Massachusetts, when Giles Corey, accused of witchcraft, was pressed to death.

PEIPING: *see* PEKING.

PEIPUS, a lake lying between north-west Russia and Estonia, also known as PEIPSI or CHUDSKOYE OZERO. The boundary between the two countries passes northwards for 60 m. through the centre of the lake, leaving the east bank in Russia and the west in Estonia, but turns east towards the north, thus including the whole northern shore and the outlet of the Narova river, in Estonia Including its southern extension, sometimes known as Lake Pskov or Pihkwa, it has an area of 1,356 sq m. Its shores are flat and sandy, and in part wooded; its waters are deep, and they afford valuable fishing The lake is fed by the Velikaya, which enters it at its southern extremity, and by the Embach or Ema, along which timber is brought to Tartu, and which flows in half way up the western shore of the lake. It drains into the Gulf of Finland by the Narova, which issues at its north-east corner.

PEIRAEEUS or **PIRAEUS** (Gr Πειραιεύς), the port of Athens, with which its story is inseparably connected About 5 m S W of Athens, the sandy bay of Phaleron is closed westward by a rocky promontory which falls abruptly also landwards into the plain Its highest point, called Munychia, is at the north-east end; the lower plateau, Acté, stretches seaward to south-west, beyond the saddle which connects two small coves, Munychia and Zea, on the south-east coast, with the completely landlocked basin of Peiraeeus, with its inner port, Cantharus, running northward between Munychia hill and the detached ridge, Eëtioneia, which dominates the north side of the entrance In early days Athenians used only the sandy Phaleron for sea traffic It was Themistocles who persuaded the Athenians to fortify and utilize Peiraeeus, about 493 B.C, for their new fleet The "long walls" from the base of Munychia hill to Athens were built soon after 460 B.C., and the town of Peiraeeus itself was laid out on a rectangular plan by the architect, Hippodamus of Miletus, probably at the suggestion of Pericles. The fortress of Eetioneia was added during the Peloponnesian war. Traces remain of the ship-houses surrounding Zea and Munychia; the town-plan is followed by the modern streets; and the tomb of Themistocles, on the Act, and the great gate of Fort Eëtioneia are conspicuous (*See* under ATHENS.)

See also Angelopoulos, Περὶ Πειραιῶς καὶ τῶν λιμένων αὐτοῦ (Athens, 1898); Curtius and Kaupert, *Karten von Attica;* Admiralty chart.

PEIRCE, BENJAMIN (1809–1880), American astronomer and mathematician, son of a Harvard university librarian and historian, was born at Salem, Mass, on April 4, 1809. He graduated from Harvard in 1825 and, returning there as a tutor in mathematics in 1831, continued to teach in the university till his death nearly 50 years later. Tributes concur in the estimate that he was a wonderfully inspiring teacher. In the United States he was the leading mathematician of his time. In Europe he was elected an associate of the Royal Astronomical Society, a foreign member of the Royal Society of London, a correspondent of the British Association for the Advancement of Science, an honorary fellow of the Royal Society of Edinburgh, and a correspondent of the Gesellschaft der Wissenschaften in Göttingen. About one-quarter of Peirce's publications deal with topics in pure mathematics and three-quarters with topics mainly in the fields of astronomy, geodesy and mechanics. Of his 11 works, in 12 volumes, six were elementary texts some of which went through several editions. Among his other works were the notable *Analytic Mechanics* (1855), and the remarkably original *Linear Associative Algebra* (lithographed edition of 100 copies, 1870; new ed. by his son C. S. Peirce in *American Journal of Mathematics,* vol. iv., 1881, reprinted 1882), anticipating important work of Study and Scheffers. There are many references in scientific literature to Peirce's criterion for the rejection of doubtful observations, and it was only recently shown (*Popular Astronomy,* 1920) that this was fallacious. The computation of the general perturbations of Uranus and Neptune, and the resulting controversy with Leverrier, was the first work to extend Peirce's reputation. He died on Oct. 6, 1880.

See R. C. Archibald, *Benjamin Peirce 1809–1880, Biographical Sketch and Bibliography* (1925). (R. C A)

PEIRCE, CHARLES (SANTIAGO) SANDERS (1839–1914), American philosopher and logician, was born at Cambridge, Mass, on Sept. 10, 1839 He was the son of Benjamin Peirce, the Harvard mathematician. He graduated at Harvard in 1859, and at the Lawrence scientific school in 1863. Soon thereafter he joined the staff of the U S. coast survey, where his work on the problems of geodesy and his researches on the pendulum received wide recognition In 1877 he was the first American representative to the International Geodesic congress In 1880–81 he gave a series of lectures on philosophical logic at Johns Hopkins university; in the spring of 1903 a series on pragmatism at Harvard and another in 1903–04 on logic at the Lowell institute, Boston He introduced the principle of pragmatism into philosophy, defining his theory in the *Popular Science Monthly* for January 1878 Though he did not there call it *pragmatism,* he is known to have originated the word as well as the idea It is said to have first appeared in print in his article in Baldwin's *Dictionary of Philosophy,* 1901 To avoid confusion with the theories of his contemporaries, he later changed the name to pragmaticism He died at Milford, Pa, on April 14, 1914 In addition to his contributions in mathematical logic, meteorology, psychophysics, philology, and other subjects, his published works include. five papers on logic in *Proc. of Amer. Acad Arts and Sciences,* vol. 7 (1867); *Photometric Researches* (1878); *Studies in Logic* (1883); "The Architecture of Theories," *Monist,* vol i (1890); "What Pragmatism is," *Monist,* vol xv. (1905).

PEIRESC, NICHOLAS CLAUDE FABRI DE (1580–1637), French archaeologist, naturalist scholar and promoter of learning, was born on Dec. 1, 1580, at Beaugensier, Provence Intended by his father for the law he early showed a preference for the study of antiquities, and from 1599 to 1602 travelled in Italy visiting the museums and galleries, meeting and debating with the learned men of the universities—among them Galileo—and studying for his legal degree, which he took at Aix in 1604 In the following year he succeeded his uncle as senator for Provence, and shortly after visited England, having interviews with King James I, Camden, Selden, William Harvey, and John Barclay (*qq v.*)

Apart from his very voluminous private correspondence no writings of Peiresc's are known; but, owing both to his great erudition and his liberality in lending scholars books and in allowing them access to his collections of coins, medals and other antiquities, his influence on the humanism and learning of the early 17th century was very great. It was largely due to him that Barclay's *Argenis* (*see* BARCLAY, JOHN) was published in Paris (1621) shortly after its author's death. he assisted in editing Duchesne's *Historiae Normannorum scriptores antiqui* (1619), and was mainly responsible for the publication of Nicholas Bergier's *L'Histoire des grands chemins de l'Empire Romain* (1622). The astronomers Pierre Gassendi, Grotius, Thomas Campanella, Maria Mersenne and William Camden, were all indebted in various ways to him.

Peiresc was made abbé of the monastery of Guistres in 1618, and as senator was a judge of the parlement of Aix, the highest court for Provence. He was one of the earliest scholars to realize the importance of numismatics to historical research, and as evidence of his wide interests it may be mentioned that he seems to have introduced the Angora cat to Europe, and eider-down quilts and many exotic plants—including tulips—into France, and was the first to verify by experiment Harvey's discovery of the circulation of the blood He died at Aix on June 24, 1637.

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PEISANDER, of Camirus in Rhodes, Greek epic poet, supposed to have flourished about 640 B.C. He was the author of a

Heracleia, in which he introduced a new conception of the hero, the lion's skin and club taking the place of the older Homeric equipment. He is also said to have fixed the number of the "labours of Hercules" at twelve. The Alexandrians admitted it to the epic canon—(but *see* Clement of Alexandria, *Stromata,* vi. 2).

See fragments in G. Kinkel, *Epicorum graecorum fragmenta* (1878); also F. G. Welcker, *Kleine Schriften,* vol. i. (1844).

PEISISTRATUS (605?–527 B.C.), Athenian statesman, was the son of Hippocrates and second cousin to Solon, whose friendship he retained in spite of their political opposition About 570 he became well known and popular as commander in the war with Megara which resulted in the recovery of Salamis He next appears in politics as leader of the third party, the men of the hill-country (Diacrii), who were still discontented in spite of Solon's reforms, which had given them freedom, but not land. Peisistratus' family estates at Marathon were in this district. His eloquence and personal charm soon made him a popular favourite; Solon (frag. 8, Diehl) warned Athens of the danger, but was unheeded. The other two parties were the Shore (Parali), led by the Alcmaeonidae, at the moment represented by Megacles, and the Plain (Pedieis) under Miltiades.

The chronology of Peisistratus' rise to power is disputed, though the sequence of events is known. By feigning an attack on his life, Peisistratus got a guard assigned to him, armed with staves, with whose assistance he seized the Acropolis and established a tyranny in 561–560. Almost at once a coalition between the Plain and the Shore drove him out, but in 560–559 Megacles had fallen out with his allies and recalled Peisistratus. Peisistratus married Coesyra, daughter of Megacles, and apparently refused to have children by her, the Alcmaeonidae being under a curse. The coalition was renewed, and in 556 Peisistratus was again driven out. He settled at Rhaecelus, where he founded a city and established friendly relations with Macedon, and then obtained command of the silver-mines of Mt. Pangaeus. This enabled him to raise a mercenary army, and he strengthened his position by intriguing with Thebes and Argos. Then he moved to Eretria as a base for operations against Athens, and in 564 landed near Marathon, among his own party, defeated the Government forces and established himself as tyrant for good. The Alcmaeonidae fled; Lygdamis, Peisistratus' assistant in the business, he made tyrant of Naxos He ruled Athens peaceably till his death in 527.

There is no doubt that the rule of Peisistratus was generally beneficial to Athens. His foreign policy was remarkably adroit. His own interest demanded that the neighbouring States should not be alienated, or they would have harboured the plots of his exiled opponents. So he contrived to keep peace with Sparta, Argos, Thessaly, Aegina and Thebes all at the same time Further afield he was more ambitious The silver of Pangaeus and Laureium he already controlled. Its effect is seen in the increasing value of the Athenian tetradrachm, which reacted favourably on Athenian commerce. Of his other exploits the most important are in the northern Aegean By recapturing Sigeium and encouraging Miltiades' venture in the Thracian Chersonese he controlled the vital corn route to the Pontus. Of his domestic policy it is admitted that it was just and beneficent, and preserved the form of the Solonian constitution, while keeping the magistracies in the hands of himself and his family. It may be added that he completed Solon's work by giving land (confiscated from his enemies) to those to whom Solon had only given freedom. He put a tax of one-tenth (or one-twentieth) on the produce of the land, and used it partly to advance money to the new proprietors, to the advantage of agriculture, partly on the fortification of the city. Thus Athens was free of wars and internecine struggle, and for the first time for years knew settled financial prosperity.

The money which he accumulated he put to good use in the construction of roads and public buildings. Like Cleisthenes of Sicyon and Periander of Corinth, he realized that one great source of strength to the nobles had been their presidency over the local cults. This he diminished by increasing the splendour of the Panathenaic festival every fourth year and the Dionysiac rites, and so created a national rather than a local religion. With the same idea he built the temple of the Pythian Apollo and began, though he did not finish, the temple of Zeus. To him are ascribed also the original Parthenon on the Acropolis, afterwards burned by the Persians, and replaced by the Parthenon of Pericles. It is said that he gave a great impetus to the dramatic representations which belonged to the Dionysiac cult, and that it was under his encouragement that Thespis of Icaria, by impersonating character, laid the foundation of the great Greek drama of the 5th and 4th centuries. Lastly, Peisistratus carried out the purification of Delos, the sacred island of Apollo of the Ionians; all the tombs were removed from the neighbourhood of the shrine, the abode of the god of light and joy.

He gave equal encouragement to poetry; Onomacritus, the chief of the Orphic succession, and collector of the oracles of Musaeus, was a member of his household. As to the library of Peisistratus, we have no good evidence; it may perhaps be a fiction of an Alexandrian writer. There is a strong tradition that he first collected the Homeric poems, and had them sung at the Panathenaea.

It appears that Peisistratus was benevolent to the last, and, like Julius Caesar, showed no resentment against enemies and calumniators. What Solon said of him in his youth was true throughout, "there is no better disposed man in Athens, save for his ambition." He was succeeded by his sons Hippias and Hipparchus, by whom the tyranny was in various ways brought into disrepute (*See* also GREECE *History;* ATHENS.)

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PEKALONGAN, a residency of Java, Dutch East Indies, area 5,668 sq kilometres. It is in the north central part of the island, bounded on the west by Cheribon, on the east by Semarang, on the south by Banyumas, and on the north by the Java sea. Mountain groups flank all of its southern border—the Dieng, Slamat and Padontelu groups, the spurs of Slamat projecting into its centre, and from which flow its two rivers, the Chomal and Pomali. Along the valleys of these two rivers and the coast, for a considerable distance inland, the land is flat and fertile, and the Chomal and Pomali have built for themselves alluvial promontories at their mouths The chief product of Pekalongan is sugar, and the manufacture of this is its chief industry, although it is noted also for its batik industry, and it is a coffee-, cocoa- and kapok-growing district. Rice is the chief food crop The population of Pekalongan is 2,399,419, almost entirely Javanese. The capital, Pekalongan, on the coast, in the eastern part of the residency, population 60,686 (645 Europeans and Eurasians), the seat of the resident, is a good port, its principal export being sugar, and is on the steam tramway line from Cheribon to Semarang, which runs along the coast of the residency. Tegal, population 33,143, is another port and is also on the tramway line, likewise Brebes, pop 20,619, and Pemalang, 24,645. The railway from Cheribon to Surabaya passes through the residency, along the valley of the Pomali. There is a road along the coast, and one runs by the Pomali through to Purwakerta, in Banyumas Pekalongan was granted to the Dutch by the Susuhanan in 1746.

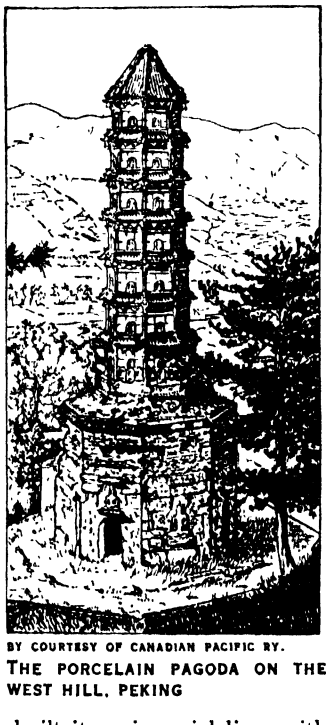
PEKIN, a city of central Illinois, U.S A, on the Illinois river, 10 m. below Peoria; the county seat of Tazewell county It is served by the Big Four, the Chicago and Alton, the Chicago and Illinois Midland, the Illinois Central, the Peoria and Pekin Union, the Peoria Terminal and the Santa Fe railways Pop. (1920) 12,086 (90% native white); estimated locally at 15,500 in 1928. It is in a rich agricultural and coal-mining country Grain and other farm products are shipped in large quantities; there are coal mines within the city limits, and the manufacturing industries are varied, with an aggregate output in 1925 valued at $29,404,654. The city was founded about 1830 and incorporated in 1839.

PEKING (officially renamed PEIPING in 1928), the most renowned of all the cities of China, the capital of the Chinese

Empire from about 1267 to 1368 and again from 1421 to the fall of the Manchu Dynasty in 1911, and of the Republic of China from 1911 to 1928. Peking is situated in lat. 39° 54′ N. and long. 116° 28′ E. at the northern apex of the alluvial Plain of North China, where converge the narrow lowland passage from the Manchurian steppes via Shan-hai-kwan (the "Gate between the mountains and the sea"), and the easiest routes from the Mongolian plateau through the bold scarps which intervene between it and the plain. It is separated by 90 miles of level agricultural country from the coasts of the Gulf of Pe-Chihli, but westwards and northwards the land begins to rise rapidly to the hills which are clearly visible from the walls of the city. It is not placed on any navigable river but lies at the outlet to the plain of the most important road from Mongolia—that which utilizes the valley of the Hun-ho at Kalgan and debouches on to the lowland by the Nankow pass.

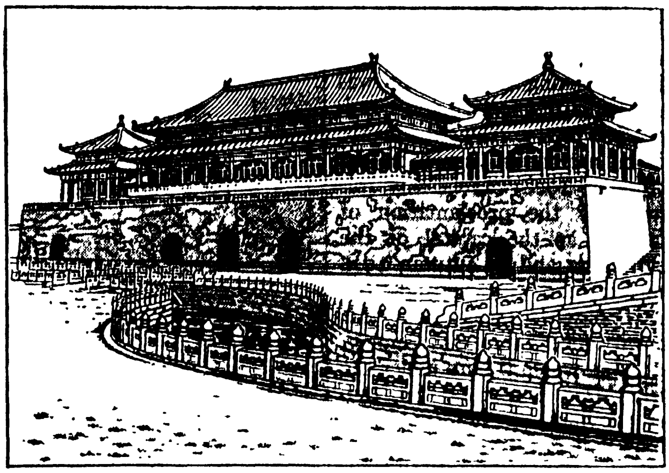
Only 35 miles north-west of the city at its nearest point, the Great Wall of China, following the crests of the scarpland belt at an elevation of 4,000 feet, marks the historic frontier defence of the agricultural plain against the pastoral nomads of the interior plateaux. The narrow apex of the plain is thus the crucial region in the relations of China, Mongolia and Manchuria, and is historically the border zone between two strongly contrasted types of social organisation.

The earliest city of which there is authentic record was that of Ch'i the capital of Yen, the most northerly of the feudal states which acknowledged the authority of the Chou Dynasty in the twelfth century B.C. Thus early was the site of Peking within the Chinese culture area, but Yen was clearly a buffer state, intended to keep back the Tartar hordes, and is significantly mentioned in records of the sixth century B.C. as possessing great numbers of horses. Ch'ien Lung, the famous scholar-Emperor of the Manchu Dynasty, made extensive researches into the exact site of Ch'i and located it slightly to the north of the present city. It was destroyed by Shih Huang Ti, the "First Emperor" and founder of the Chin Dynasty (221 B.C.), who unified China and completed the frontier defences of the Great Wall. Yen was one of the districts which made up his Empire. Under the Han Dynasty a new city arose close to the site of Ch'i and was known first as Yen and later as Yu-chow. It remained a definitely Chinese city until the end of the Han Dynasty but in the ensuing period of anarchy and disintegration was for two centuries under Tartar control. The T'ang dynasty (7th to 10th centuries), like the Han, maintained the frontier defences of the Empire intact, and Yu-chow was the head-quarters of a military governor. But early in the 10th century it came into the hands of the Khitans, one of the most famous of the Tartar groups prior to the rise of the Mongols, who successfully resisted the attempts of the Sung Emperors to recover it for China. The Khitans under the Liao Dynasty (sometimes called the Iron Dynasty) rechristened the city Nan-Ching, signifying southern capital and later (986) rebuilt it on imperial lines with walls said to have been 13 miles in length and 30 feet high.



BY COURTESY OF CANADIAN PACIFIC RY.
THE PORCELAIN PAGODA ON THE WEST HILL, PEKING

From early in the eleventh century it was known as Yenching but the Khitans of the Iron Dynasty continued to hold it until 1122 when it was captured by the chief of the Tartars of the Golden Horde from the northern steppes of Manchuria, who greatly enlarged and beautified it and made it one of the three capitals of his large Empire, that of the Kin or Chin (Gold) Dynasty. The other two capitals were Pien Ching (now Kai Fêng) in Honan and Shêng-Ching (Mukden) in the north, so the future Peking was known at this period as Chung-Tu or the Middle Capital. This phase lasted until early in the thirteenth century when the greatest of all the steppeland powers arose, the Mongol empire. Kublai Khan took the decisive step of making it the metropolitan city of the immense Mongol Empire, which now stretched from the Pacific to beyond the Black Sea. But although this was the technical status of the city after Kublai had moved his headquarters there from Karakorum in 1267, it was as the new capital of China that the choice was of the greatest ultimate significance. Kublai was indeed the "Great Khan who ruled in China" but his descendants were primarily Emperors of China.



EXTERIOR VIEW OF A PALACE IN THE "FORBIDDEN CITY," PEKING
The Inner City, separated by a high wall from the Outer City, is divided into three parts, the innermost being the "Forbidden City," a nest of palaces and old buildings into which "barbarians" at one time were seldom admitted

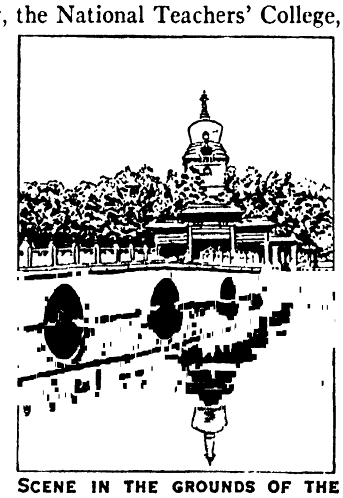
The City Under Kublai Khan.—Under Kublai the city was once again rebuilt and on a more magnificent scale than ever before. It was named Khanbalig (Cambaluc), "city of the Great Khan," but the Chinese knew it as Ta-Tu or "great capital." Thither came Marco Polo, who described its magnificence in glowing terms, its mint and its huge imports to feed the armies and retainers of the Great Khan. Later came the Pope's emissary, Giovanni di Monte Corvina, who was graciously received by Kublai and made archbishop of Khanbalig in 1307. Later under the Ming and early Manchu Dynasties the Jesuit Fathers were in favour at the capital, and were encouraged to practise western mathematics and astronomy. The communications of Khanbalig with the rest of China were actively developed by the construction of radial roads on which well-organized courier services were maintained, and by extending the Grand Canal from the Yellow River to Tientsin and connecting it by the Pai-ho and a small canal, the capital was brought into direct water-communication with the Lower Yang-tze and the rich cities of Manzi.

The Mongols.—Khanbalig continued to be the capital of China throughout the Yüan Dynasty but the city temporarily lost its imperial status when in 1368 Chu Yuan Chang headed the successful revolt against the Mongols and established the native Ming Dynasty. After being under the control of foreign steppeland powers for about 450 years the region was once again under direct Chinese rule and Khanbalig, now known as Peiping-Fu (City of the North Place), served, as in the days of the Han and T'ang Dynasties, the function of a border garrison town, subordinate to the capital city of Nanking (southern capital). This phase lasted until 1421, when the third Ming Emperor, Yung Lo, transferred his court to the North and Peiping was given the name of Peking (northern capital), by which it is known throughout the world. The reason for this decisive step was undoubtedly strategic, for the Mongols were still troublesome and the Manchurian tribes were becoming increasingly strong and restless. Peking was the only frontier capital which could guard both the vulnerable flanks. The menace from the north, increased by internal revolts, culminated in the Manchu conquest of 1644 and China once again came under Tartar domination. The new

Manchu (or Ch'ing) Dynasty transferred their court from Mukden to Peking and administered their newly won Empire from a capital which, while it lay within the Chinese culture area, was in close contact with their own recruiting ground. When two and a half centuries later the rule of the decadent Manchus was ended by the Revolution of 1911 and the Imperial office was abolished, Peking continued to function as the capital of the new Republic. But the disintegrating effects of the civil war and the rise of the Nationalist movement, focussed in the South, meant that the rule of the Peking Government was increasingly ineffective and nominal. The final northward advance of the nationalist armies in the spring of 1928 was quickly followed by the proclamation of Nanking as the capital of the new China and in autumn 1928 the northern city had lost its metropolitan status and was known once more as Peiping, the name which it bore under the early Ming Emperors. So, too, the province, in the centre of which it lies, has reverted to the ancient name of Hopeh ("north of the River," *i.e.*, the Hwang-ho) in place of Chih-li ("Direct Rule").

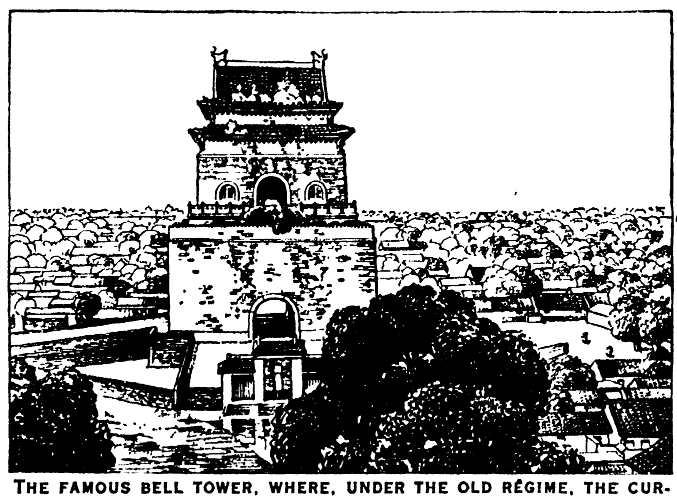
BRONZE LION IN FORBIDDEN CITY
This lion is stationed near the Gate of Supreme Harmony, in the centre of the so-called Purple Forbidden City, which contains the Imperial palace, former residence of the emperor

Political and Intellectual Centre.—Peking has not only been the political capital but also the intellectual centre of China. It has great traditions of learning and scholarship. Here under the old regime was held the highest examination in the Chinese Classics leading to the *Chin Shih* and much coveted *Han Lin* degrees, whose holders were marked out for high public office. This brought to Peking many of the most eminent scholars. Inevitably it became the chief educational centre of the country and this character it retained when the old system was abolished and education of a modern type was introduced. In the last years of the Manchu Dynasty and the early period of the Republic, before the Civil Wars arrested further progress, many schools, colleges and public educational institutions were established. These include the Government University, the National Teachers' College, the Customs College, the Tsing Hua (American Indemnity) College, the College of Languages, the Law School, the Higher Technical School, the Yenching University (under missionary auspices) and the magnificent Medical School and Hospital equipped by the Rockefeller Trust. A few years ago the Ministry of Education estimated the number of students of all grades in Peking as 55,000, of whom about 7,000 were women and girls. Many of the teachers in the higher colleges have been trained at foreign Universities and to them is mainly due the remarkable movement known as the Chinese Renaissance or New Thought Movement, which has been particularly associated with the National University. Its most practical result is the literary revolution which has replaced the classical and "dead" language (Wên-li) by the "national language," the Mandarin vernacular, as the medium of literary expression; this has given birth to a considerable modern literature of books, periodicals and papers dealing, often in a revolutionary way, with almost every department of intellectual and social life, and has had a profound influence on the thought of Young China. (*See* under CHINA.) Another circumstance which in recent times has contributed to intellectual activity in Peking is that the social cleavage between natives and foreigners is less pronounced than in most Chinese cities. Peking has never been a "Treaty Port" and, apart from the Legation Quarter with its representatives of the Diplomatic Corps and Customs service, there is no foreign quarter. But, subject to certain conditions, foreigners have been allowed to rent houses in various parts of the city and over 1,500 live outside the Legation quarter. To a greater extent than in the Treaty Port communities is there interest in the cultural aspects of Chinese life and some measure of social intercourse and exchange of thought between representatives of Eastern and Western culture.



SCENE IN THE GROUNDS OF THE WINTER PALACE, PEKING

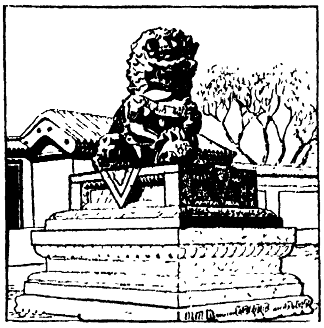
New Developments.—Few cities are richer in interest and romance than Peking. In recent years it has been much modernised and "cleaned up" but it retains most of its historic buildings and ancient features and the new developments have not so far involved the wholesale clearances that have been the fate of some westernised cities of the Orient. This is in part due to the truly imperial lines on which it was designed by Kublai Khan. The spacious, rectangular ground-plan which he adopted was maintained by the later Ming and Manchu builders and lends itself to modern development. Essentially it consists of two main "cities," the northern or "Tartar City" in the form of a square with walls nearly 15 miles in length, and the southern or "Chinese" city in the form of an oblong with walls 14 miles in length, including 4 miles of the south wall of the Tartar city. Within the Tartar city is the Imperial City, also in the form of a square and with red-plastered walls, six and a half miles in length, and within that again the Inner or Forbidden City, with walls two and a quarter miles long, plastered with a violet coloured mortar, whence comes the popular name of the Purple City. Extending in an irregular chain from the north wall of the Tartar city to the south wall of the Imperial City are seven artificial lakes supplied from a moat outside the Walls, which is itself fed by a canal from the Jade Fountain in the "Western Hills" six miles north-west of Peking. This also feeds the famous lake round the "Summer Palace" at the foot of the Western Hills. Grouped around the three most southerly of the seven lakes in the heart of the Imperial city is a great series of imperial palaces, gardens and temples, and here until the recent change of capital, was the official residence of the President of the Chinese Republic.



THE FAMOUS BELL TOWER, WHERE, UNDER THE OLD RÉGIME, THE CURFEW WAS SOUNDED NIGHTLY

Government Buildings.—The Government offices, built in modern European style, line the broad Imperial roadway which leads from the Forbidden City through the Ch'ien Men, the main gateway to the Chinese city, and so to the spacious grounds of the Temple of Heaven and Altar of Agriculture, which were the scene of the great ceremonial acts of sacrifice and supplication performed by the Emperor. In close proximity to the Government offices is the large Legation Quarter, adjacent to the Tartar City's south wall, from which cannon fired on the British Legation during the Boxer siege of 1900. By the terms of the subsequent

Protocol the portion of the wall overlooking the Legation was placed under their control and patrolled by their guards. In the north-east corner of the Tatar city stand close together some of the most historic buildings in China, including the Lama Temple, the Hall of Classics and the simple but beautiful Temple of Confucius. The northern portion of the Chinese city is essentially the commercial quarter and the most congested part of Peking and is in close proximity to the terminus of the Peking-Hankow and Peking-Mukden Railways just outside the Ch'ien Men. In great contrast, much of the southern part of the south city is agricultural land and the grounds of the Temple of Heaven and Altar of agriculture take up a considerable space, which is sometimes used for public meetings.



BY COURTESY OF CANADIAN PACIFIC STEAMSHIP CO.
ONE OF THE BRONZE LIONS IN FRONT OF THE SUMMER PALACE, PEKING

The government of the city has been extremely complex, various functions having been exercised by the National Government, the Provincial Government, the Military Guard, the Municipal Council and the Police Board. For about three centuries Peking has been the centre of a special Metropolitan District, including all territory within 75 miles of the city. This is under a Governor who in recent times has introduced many improvements in the surrounding districts, including the construction of macadamized roads. Within the city itself most of the official work is carried on by the Municipal Council and the Police Board. The latter is invested with many responsibilities and Peking has been called "the best policed city in the Orient." Apart from ordinary police functions, the Board is in charge of the fire and street-cleaning departments, the Census Bureau and of many public charitable institutions. The expenses of the Police Board have been mainly borne by the National Government and, with the removal of its headquarters to Nanking, the whole administration of the city is likely to be changed. Among the modern improvements of Peking may be noticed the metalling of the chief streets, the introduction of tramways and the installation of water, sewage and electric light systems.

The population of the city was estimated at 1,181,400 in 1923 but the presence of large bodies of troops has abnormally swollen its numbers for several years past. The removal of the seat of government has already caused considerable distress among the merchant class and will probably lead to a decrease of population, at any rate temporarily. Peking must, however, remain the regional capital of North China.

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PELAGIA, ST. An Antiochene saint of this name, a virgin of fifteen years, who chose death by a leap from the housetop rather than dishonour, is mentioned by Ambrose (*De virg.* iii. 7, 33; *Ep. xxxvii. ad Simplic.*), and is the subject of two sermons by Chrysostom. Her festival was celebrated on Oct. 8 (Wright's *Syriac Martyrology*). In the Greek *synaxaria* the same day is assigned to two other saints of the name of Pelagia—one, also of Antioch, and sometimes called Margarito and also "the sinner"; the other, known as Pelagia of Tarsus, in Cilicia. The legend of the former of these two is famous. She was a celebrated dancer and courtesan, who, in the full flower of her beauty and guilty sovereignty over the youth of Antioch, was suddenly converted by the influence of the holy bishop Nonnus, whom she had heard preaching in front of a church which she was passing with her gay train of attendants and admirers. She was baptized, and, disguising herself in the garb of a male penitent, retired to a grotto on the Mount of Olives, where she died after three years of penance.

See *Acta sanctorum*, October, iv. 248 *seq.;* H. Usener, *Legenden der heiligen Pelagia* (Bonn, 1879); H. Delehaye, *The Legends of the Saints* (London, 1907), pp. 197–205.

PELAGIUS I., pope, 555 to 561, was a Roman by birth, and first appears in history at Constantinople as apocrisiarius of Pope Silverius, whose overthrow in favour of Vigilius his intrigues promoted. He was sent by the emperor Justinian in 542 to Antioch on ecclesiastical business; he afterwards took part in the synod at Gaza which deposed Paul of Alexandria. When Vigilius was summoned to Byzantium in 544, Pelagius, now archdeacon, was left behind as his vicar, and by his tact in dealing with Totila, the Gothic invader, saved the citizens from murder and outrage. He appears to have followed Vigilius to Constantinople; for refusing, with him, to accept the decrees of the fifth general council (the 2nd of Constantinople, 553) he shared his exile.

But when Vigilius died (June 7, 555), he accepted the council, and was designated by Justinian to succeed the late pope. But the Roman clergy, suspecting his orthodoxy, and believing him to have had some share in the removal of his predecessor, shunned his fellowship. He enjoyed, however, the support of Narses, and, after he had publicly purged himself of complicity in Vigilius's death in the church of St. Peter, he was accepted in his own immediate diocese. The rest of the western bishops, however, still held aloof, and the episcopate of Tuscany caused his name to be removed from the diptychs. Other bishops withheld their fellowship, but neither Narses, nor Childebert, king of the Franks, to whom Pelagius appealed, was willing to interfere. Pelagius died on March 4, 561, and was succeeded by John III.

PELAGIUS II., a native of Rome, of Gothic descent, was pope from 579 to 590, having been consecrated successor of Benedict I., without the sanction of the emperor, on Nov. 26. To make his apologies for this irregularity he sent Deacon Gregory, who afterwards became Pope Gregory the Great, as his apocrisiarius to Constantinople. In 588 John, patriarch of Constantinople, by reviving the old and disputed claim to the title of oecumenic patriarch, elicited a vigorous protest from Pelagius; but the decretal which professes to convey the exact words of the document is now known to be false. He died in Jan. 590, and was succeeded by Gregory I.

PELAGIUS (*c.* 360–*c.* 420), early British theologian. Of the origin of Pelagius almost nothing is known. He seems to have been one of the earliest, if not the very earliest, of that remarkable series of men who issued from the monasteries of Scotland and Ireland, and carried back to the Continent in a purified form the religion they had received from it. Coming to Rome in the beginning of the 5th century (his earliest known writing is of date 405), he found a scandalously low tone of morality prevalent. But his remonstrances were met by the plea of human weakness. To remove this plea by exhibiting the actual powers of human nature became his first object. It seemed to him that the Augustinian doctrine of total depravity and of the consequent bondage of the will both cut the sinew of all human effort and threw upon God the blame which really belonged to man. His favourite maxim was, "If I ought, I can." Judging from the general style of his writings, his religious development had been equable and peaceful, not marked by the prolonged mental conflict, or the abrupt transitions, which characterized the experience of his great opponent. With no great penetration he saw very clearly the thing before him, and many of his practical counsels are marked by sagacity, and are expressed with the succinctness of a proverb ("corpus non frangendum, sed regendum est").

The peculiar tenets of Pelagius, though indicated in the commentaries which he published at Rome previous to 409, might not so speedily have attracted attention had they not been adopted by Coelestius, a much younger and bolder man than his teacher. Coelestius, probably an Italian, had been trained as a lawyer, but abandoned his profession for an ascetic life. When Rome was sacked by the Goths (410) the two friends crossed to Africa. There Pelagius once or twice met with Augustine, but very shortly sailed for Palestine, where he justly expected that his opinions would be more cordially received. Coelestius remained in Car-

thage with the view of receiving ordination. But Aurelius, bishop of Carthage, being warned against him, summoned a synod, at which Paulinus, a deacon of Milan, charged Coelestius with holding the following six errors: (1) that Adam would have died even if he had not sinned; (2) that the sin of Adam injured himself alone, not the human race; (3) that new-born children are in the same condition in which Adam was before the fall; (4) that the whole human race does not die because of Adam's death or sin, nor will the race rise again because of the resurrection of Christ; (5) that the law gives entrance to heaven as well as the gospel; (6) that even before the coming of Christ there were men who were entirely without sin To these propositions a seventh is sometimes added, "that infants, though unbaptized, have eternal life," a corollary from the third Coelestius did not deny that he held these opinions, but he maintained that they were open questions, on which the Church had never pronounced. The synod condemned and excommunicated him. Coelestius, after a futile appeal to Rome, went to Ephesus, and there received ordination.

In Palestine Pelagius lived unmolested and revered, until in 415 Orosius, a Spanish priest, came from Augustine to warn Jerome against him The result was that in June of that year Pelagius was cited by Jerome before John, bishop of Jerusalem, and charged with holding that man may be without sin, if only he desires it This prosecution broke down, and in December of the same year Pelagius was summoned before a synod of fourteen bishops at Diospolis (Lydda) The proceedings, being conducted in various languages and by means of interpreters, lacked certainty, and justified Jerome's application to the synod of the epithet "miserable." But there is no doubt that Pelagius repudiated the assertion of Coelestius, that the divine grace and help consists only in free will, and in the giving of the law and instruction; at the same time he affirmed that a man is able, if he likes, to live without sin and keep the commandments of God, inasmuch as God gives him this ability. The synod was satisfied with these statements, and pronounced Pelagius to be in agreement with Catholic teaching Pelagius naturally plumed himself on his acquittal, and provoked Augustine to give a detailed account of the synod, in which he shows that the language used by Pelagius was ambiguous, but that, being interpreted by his previous written statements, it involved a denial of what the Church understood by *grace* and by man's dependence on it The North African Church as a whole resented the decisions of Diospolis, and in 418 Zosimus, bishop of Rome, was prompted to draw up a circular inviting the bishops of Christendom to subscribe to a condemnation of Pelagian opinions Nineteen Italian bishops refused, among them Julian of Eclanum in Apulia, a man of good birth, approved sanctity and great capacity, who now became the recognized leader of the movement But not even his acuteness and zeal could redeem a cause which was rendered hopeless when the Eastern Church (Ephesus, 431) confirmed the decision of the West Pelagius himself disappears after 420; Coelestius was at Constantinople seeking the aid of Nestorius in 428

The first principle of Pelagianism is a theory which affirms the freedom of the will, in the sense that in each volition and at each moment of life, no matter what the previous career of the individual has been, the will is in equipoise, able to choose good or evil We are born characterless (non pleni), and with no bias towards good or evil (ut sine virtute, ita et sine vitio). It follows that we are uninjured by the sin of Adam, save in so far as the evil example of our predecessors misleads and influences us (non propagine sed exemplo). There is, in fact, no such thing as original sin, sin being a thing of will and not of nature; for if it could be of nature our sin would be chargeable on God the creator. This will, capable of good as of evil, being the natural endowment of man, is found in the heathen as well as in the Christian, and the heathen may therefore perfectly keep such law as they know But, if all men have this natural ability to do and to be all that is required for perfect righteousness, what becomes of grace, of the aid of the Holy Spirit, and, in a word, of Christianity? Pelagius appears to have confused the denial of original *sin* (in the sense of inherited *guilt*) with the denial of inherited nature or disposition of any kind. Hence he vacillates considerably in his use of the word "grace." In his most careful statements he appears to allow to grace everything but the initial determining movement towards salvation. He ascribed to the unassisted human will power to accept and use the proffered salvation of Christ. It was at this point his departure from the Catholic creed could be made apparent: Pelagius maintains, expressly and by implication, that it is the human will which takes the initiative, and is the determining factor in the salvation of the individual; while the Church maintains that it is the divine will that takes the initiative by renewing and enabling the human will to accept and use the aid or grace offered. This was the position most strongly contested by Augustine (*q.v.*). The result was the rise of Semipelagianism, which was an attempt to hold a middle course between the harshness of Augustinianism and the obvious errors of Pelagianism It appeared simultaneously in North Africa and in southern Gaul. In the former Church, which naturally desired to adhere to the views of its own great theologian, the monks of Adrumetum found themselves either sunk to the verge of despair or provoked to licentiousness by his predestinarian teaching. When this was reported to Augustine he wrote two elaborate treatises to show that when God ordains the end He also ordains the means, and if any man is ordained to life eternal he is thereby ordained to holiness and zealous effort. But meanwhile some of the monks themselves had struck out a *via media* which ascribed to God sovereign grace and yet left intact man's responsibility. A similar scheme was adopted by Cassian of Marseilles (hence Semipelagians are often spoken of as *Massilians*), and was afterwards ably advocated by Vincent of Lerins and Faustus of Rhegium. The differentia of Semipelagianism is the tenet that in regeneration and all that results from it, the divine and the human will are co-operating (synergistic) coefficient factors Pelagius was familiar with the Greek language and theology, and frequented Rufinus, upholder of Greek theology.

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(M D; S H. M.)

PELARGONIUM, a genus of plants belonging to the geranium family (Geraniaceae, *q v*) and including most of the cultivated ornamentals known as "geraniums" There are 250 species, chiefly South African. (*See* GERANIUM)

PELASGIANS. Various traditions were current among the Greeks with regard to the pre-Greek inhabitants of their country. They were inclined to call all these by the general name of Pelasgians, although they recognized Carians and Leleges as distinct The Dorians claimed that the Ionians were Pelasgian or at least mainly so, and that they themselves were true Greeks The inhabitants of Attica, who were regarded as Ionian, boasted that they were autochthonous, the original inhabitants of the land.

In the Homeric poems Pelasgians appear as allies of Troy. They appear to be settled in south-eastern Thrace close to the Hellespont in a district called Larissa (*Il*, ii 840–843, x. 429). Some suppose that the Larissa here mentioned is the town of that name in Thessaly, but the catalogue of ships, in which the passage occurs, appears to follow a definite geographical order. Larissa stands between the Hellespont and Thrace. The Iliad also refers to the district of Argos near Mt. Othrys in Thessaly as Pelasgic, and also uses the same epithet in a famous passage of the Zeus of Dodona (*Il.*, ii. 681–684, xvi. 233-235). In the *Odyssey* Pelasgians appear in Crete (*Od* xvii. 175–177). Hesiod refers to Dodona as "seat of Pelasgians," while Hecataeus refers to Pelasgus as king of Thessaly. To Aeschylus and Sophocles Argos in the Peloponnese is the Pelasgian land Herodotus knows of actual Pelasgians at Placie and Scylace on the Asiatic coast of the Hellespont as well as near Creston on the Strymon. The islands of Lemnos and Imbros had also, he informs us, a Pelasgian population, conquered by Athens at the close of the 6th century. Apart from these actual instances of Pelasgians, both Herodotus

and Thucydides appear to regard any survival from pre-Greek times as Pelasgic. A well-known example of this is the prehistoric wall of the Athenian acropolis, anciently regarded and still commonly referred to as Pelasgian, and the epithet spread to all similar prehistoric masonry, especially that built of large blocks, in any part of Greece.

It has been held that the common Greek tradition arose from a misunderstanding, particularly perhaps by Hesiod and Hecataeus, of the two passages in the *Iliad* in which the Zeus of Dodona and the Thessalian Argos are referred to as Pelasgic. Where Homer used a general epithet meaning "remotely ancient," later writers have wrongly concluded that he referred specifically to actual Pelasgians as inhabitants of these places. If this is so, the problem is merely thrown farther back, for an explanation is needed of how the epithet Pelasgic had attained the general meaning of "ancient" by the time of the composition of the Homeric poems. To certain people at a certain period "Pelasgic" must have been a specific epithet. The Pelasgians must have been regarded either as very ancient people or as former inhabitants of the land. Much turns upon the meaning of the epithet Pelasgic as applied in the *Iliad* to the Zeus of Dodona. Zeus is the last one would expect to be referred to as Pelasgic, for of all the gods' names his is most certainly Greek. The simplest explanation is perhaps that there existed at Dodona a very ancient pre-Greek or pre-Achaean shrine occupied by Greeks who attached to the deity the name of their own god Zeus.

All instances of actual Pelasgians from Homer to Herodotus point to their being a northern people. Thrace, Epirus and Thessaly are their homes. It is certain that there were pre-Achaean inhabitants of Greece. The simplest view now held is that Greek-speaking peoples broke down into Greece from the north in three successive waves, Ionian, Achaean and Dorian, subduing a previous "Helladic" population and setting up, after the second invasion (*i.e.,* of Achaeans), the Mycenean civilization in the Peloponnese. If this is the simplest view, it does not solve all problems and it does not as yet rest upon a certain foundation of fact. An early stratum of population in Greece was in close touch with Anatolia. A large number of Greek place-names point to the conclusion that Greece was colonized from Anatolia. By whom we do not know, and we are also ignorant of what language these early people spoke. It is also possible that the Achaeans themselves were in Asia Minor before they were in Greece and that they brought thither the Anatolian place-names. It is no more than tradition that connects such early people with the Pelasgians.

The name Pelasgi which almost certainly stands for Pelak-skoi or Pelag-Skoi has been connected with πέλαγος, "the sea," and the people consequently regarded as sea-faring. The connection is not very convincing. It has also been related to the name of the semi-Illyrian Pelagones of Macedonia, and it is possible, though unproven, that the names do represent the same stem. Possibly the Pelasgians were no more than Vlachs, or Wallachian shepherds, who in classical as in modern times have been in the habit of wandering in large numbers down into Greece. The name is perhaps no more than Velak-ski. If this were so, it would account for their being dotted over various regions in Thrace and the north and also, if their habits were the same at the dawn of history as afterwards, of their being an ancient and integral part of Greek tradition and life. G. Serdi describes as "Pelasgian" one branch of the Mediterranean or Eur-African race.

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PELECYPODA, a name, now replaced by Lamellibranchia (*q.v.*), for the bivalve Mollusca (*q.v.*).

PELEUS, in Greek legend, king of the Myrmidones of Phthia in Thessaly, son of Aeacus, king of Aegina, and usually brother of Telamon. The two, having killed Telamon's third son Phocus, were banished. Peleus took refuge in Phthia with his uncle Eurytion, who purified him from the guilt of murder and gave him his daughter Antigone to wife and a third of the kingdom as her dowry. Having accidentally killed his father-in-law at the Calydonian boar-hunt, Peleus was again obliged to flee, this time to Iolcus, where he was purified by Acastus (*q.v.*). The most famous event in the life of Peleus was his marriage with the sea-goddess Thetis (*q.v.*). Peleus survived both his son Achilles and his grandson Neoptolemus, and was carried away by Thetis to dwell for ever among the Nereids.

See Apollodorus, iii. 12, 13; Ovid, *Metam.* xi.; Pindar, *Isthmia,* viii. 70; *Nemea,* iv. 101; Catullus, lxiv.; schol. Apoll. Rhod. iv. 816; Euripides, *Andromache,* 1242–60.

PELEW ISLANDS: *see* Pacific Islands.

PELHAM, the name of an English family, derived from Pelham in Hertfordshire, which was owned by a certain Walter de Pelham under Edward I., and is alleged to have been in the possession of the same family before the Norman conquest. The family dignities included the barony of Pelham of Laughton (1706–1768), the earldom of Clare (1714–1768), the dukedom of Newcastle (1715–1768), the barony of Pelham of Stanmer from 1762, the earldom of Chichester from 1801 and the earldom of Yarborough from 1837.

In the reign of Queen Elizabeth Sir William Pelham (*c.* 1530–1587), third son of Sir William Pelham (d. 1538) of Laughton, Sussex, became lord justice of Ireland. After much service abroad he was sent to Ireland in 1579, when he was knighted by Sir William Drury, the lord justice. Drury died in October, and Pelham was provisionally made his successor, an appointment subsequently confirmed by Elizabeth. Elizabeth protested strongly against Pelham's action in proclaiming Gerald Fitzgerald, 15th earl of Desmond, a traitor, though his action was soon justified by the sack of Youghal by Desmond. Thomas Butler, 10th earl of Ormonde, was entrusted with the campaign in Munster, but Pelham joined him in February 1580. The English generals laid waste northern Kerry, and proceeded to besiege Carrigafoyle Castle, which they stormed, giving no quarter to man, woman or child. Other strongholds submitted on learning the fate of Carrigafoyle. Pelham vainly sought for help from the gentry of the county, who sympathized with Desmond, and were only brought to submission by a series of "drives." After the arrival of the new deputy, Lord Grey of Wilton, Pelham returned to England. Leicester desired his services in the Netherlands, but it was only after much persuasion that Elizabeth set him free to join the army by accepting a mortgage on his estates as security for his liabilities. Pelham was wounded at Doesburg in 1586, and accompanied Leicester to England in 1587. He died at Flushing on Nov. 24, 1587.

From Sir William are descended the Pelhams of Brocklesby, Lincolnshire, earls of Yarborough (cr. 1837). From Sir Nicholas Pelham, elder brother of William, were descended the Dukes of Newcastle (*q.v.*). Among the other distinguished members of this family were Thomas Pelham, earl of Chichester (1728–1805), who held many offices under George III.; Henry Pelham (*q.v.*), George Pelham (1766–1827), bishop successively of Bristol, Exeter and Lincoln; Thomas Pelham, 2nd earl of Chichester (1756–1826), who held office under Pitt and Addington.

See Lower, *Pelham Family* (1873).

PELHAM, HENRY (1696–1754), prime minister of England, younger brother of Thomas Holles Pelham, duke of Newcastle, was born in 1696. He was a younger son of Thomas, 1st Baron Pelham of Laughton (1650–1712; cr. 1706) and of Lady Grace Holles, daughter of the 3rd earl of Clare. He was educated by a private tutor and at Christ Church, Oxford, which he entered in July 1710. In 1717 he entered parliament for Seaford, Sussex. Through strong family influence and the recommendation of Walpole he was chosen in 1721 a lord of the treasury. The following year he was returned for Sussex county. In 1724 he became secretary for war, exchanging this office in 1730 for the more lucrative one of paymaster of the forces. He supported Walpole on the question of the excise, and in 1743 a union of parties resulted in the formation of an administration in which Pelham was prime minister, with the office of chan-

cellor of the exchequer; his brother, the duke of Newcastle, was very powerful in the cabinet, and there were occasional disputes between them. Being strongly in favour of peace, Pelham carried on the war with indifferent success. The king, thwarted in his favourite schemes, made overtures in 1746 to Lord Bath, but his purpose was upset by the resignation of the two Pelhams (Henry and Newcastle), who, however, at the king's request, resumed office. Pelham remained prime minister till his death on March 6, 1754, when his brother succeeded him. His very defects were among the chief elements of Pelham's success, for one with a strong personality, moderate self-respect, or high conceptions of statesmanship could not have restrained the discordant elements of the cabinet for any length of time.

See W. Coxe, *Memoirs of the Life of Henry Pelham* (2 vols., 1829).

PELHAM, HENRY FRANCIS (1846–1907), English scholar and historian, was born at Bergh Apton, Norfolk, on Sept. 19, 1846, son of John Thomas Pelham (1811–1894), bishop of Norwich, third son of the 2nd earl of Chichester. He was educated at Harrow, under Butler and Westcott, and at Trinity college, Oxford, where he took a first class in *litterae humaniores* in 1869. He was a tutor of Exeter college from 1869 to 1890, taking over the teaching of ancient history from C. W. Boase. In 1887 he became university reader in ancient history and, two years later, Camden professor. He became curator of the Bodleian library in 1892, and in 1897 president of Trinity college. He was also an honorary fellow of Exeter, a fellow of the British Academy and of other learned societies, and a governor of Harrow school. His chief contribution to ancient history was his article on Roman history in the 9th edition of the *Encyclopædia Britannica* (1886), which was republished with additions as the *Outlines of Roman History* (1890). His university lectures were full of original research and learning. He married, in 1873, Laura Priscilla, daughter of Sir Edward North Buxton. He died on Feb. 13, 1907.

Apart from the *Outlines* he published only *The Imperial Domains and the Colonate* (1890), *The Roman Frontier System* (1895) and articles in periodicals of which the most important was an article in the *Quarterly Review* on the early Caesars (April 1905). Many of these articles were published in collected form after his death by Professor F. Haverfield (*Essays on Roman History,* 1911).

PELICAN, a large fish-eating water-fowl, remarkable for the big extensible skin-pouch between the flexible rami of the lower jaw of its long, weak bill. The common pelican (*Pelecanus onocrotalus*) inhabits south-east Europe, south-west Asia and north-east Africa. It haunts the margins of large lakes and rivers, where fish are plentiful; and companies may be seen in a shallow bay, stretched out in a long line, fishing. The nest is on the ground among the reeds; the two white eggs, with chalky shells, hatch into greyish-brown plumaged young. The adult, except for the black primaries, is white, tinged with pink and, on the head, yellow. A larger eastern species, *P. crispus,* has a crest of curled feathers. Two humeri of pelicans have been found in the English fens and probably belong to this species. There are two American forms, whose methods of feeding and plumage are quite different, *P. occidentalis,* the brown pelican, individually seeking its prey from the air, is marine; *P. erythrorhynchos,* the white pelican, often combining in companies to drive fish into the shallows. In summer it haunts fresh-water. Remarkable ceremonies of courtship and relieving guard at the nest occur. (*See* F. Chapman, *Camps and Cruises of an Ornithologist.*) Allied species occur in south Asia and in Africa. It may be mentioned that the legend of the pelican feeding (and revivifying) its young with the blood from its own breast is entirely unfounded.

AUSTRALIAN PELICAN, DISTINGUISHED FROM THE ORDINARY PELICAN BY ITS BLACK TAIL AND WING-COVERTS

PELION, a mountain in Thessaly in the district of Magnesia, between Volo and the east coast (mod. Plessidi, 5,340 ft.). In Greek mythology, the giants piled it on Ossa to scale Olympus, the abode of the gods. It was the home of the centaurs, especially of Chiron, who in a cave near its summit educated many youthful heroes. On its summit at an altar of Zeus Actaeus, a festival was held in the dog-days, by worshippers clad in skins.

PÉLISSIER, AIMABLE JEAN JACQUES (1794–1864), duke of Malakoff, marshal of France, was born on Nov. 6, 1794, at Maromme (Seine Inférieure). His early service was mainly in Algeria. The severity of his conduct in suffocating a whole Arab tribe in the Dahra or Dahna caves, near Mustaganem, where they had taken refuge (June 18, 1845), awakened such indignation in Europe that Marshal Soult, the minister of war, publicly expressed his regret; but Marshal Bugeaud, the governor-general of Algeria, gave it his approval, and secured for Pélissier the rank of general of brigade, which he held till 1850, when he was promoted general of division. On May 16, 1855, he succeeded Canrobert as commander-in-chief of the French forces before Sevastopol. (*See* CRIMEAN WAR.) His perseverance was crowned with success in the storming of the Malakoff on Sept. 8. On the 12th he was promoted marshal. On his return to Paris he was named senator, created duke of Malakoff (July 22, 1856), and rewarded with a grant of 100,000 francs per annum. From March 1858 to May 1859 he was French ambassador in London, being recalled to take command of the army of observation on the Rhine. In the same year he became grand chancellor of the Legion of Honour. In 1860 he was appointed governor-general of Algeria, and he died there on May 22, 1864.

See Marbaud, *Le Maréchal Pélissier* (1863); Castille, *Portraits historiques,* 2nd series (1859).

PELL, JOHN (1610–1685), English mathematician, was born on March 1, 1610, at Southwick in Sussex, where his father was minister. He was educated at Steyning, and entered Trinity College, Cambridge, at the age of thirteen. Pell was professor of mathematics at Amsterdam (1643–46) and at Breda (1646–52). He was Cromwell's agent in Switzerland for some years. After the Restoration he took orders and held a living in Essex. He studied mainly algebra and Diophantine analysis. He introduced the sign $\div$ into England; and the indeterminate equation $ax^2+1=y^2$ bears his name although his connection with it consists simply of the publication of solutions of it in his edition of *Brounker's Translation of Rhonius's Algebra* (1668). He died on Dec. 12, 1685, in London in great poverty.

PELLA, the capital of ancient Macedonia, about 32 m. N.W. of Salonika, at the village Neochori (Turkish Yeni-keui). The seat of government was transferred hither from Edessa by Philip II., and his son Alexander was born here. Under Hadrian it was still of some importance. Scanty remains are visible and neighbouring springs are known as the "baths of Pel."

PELLAGRA, the name given to a chronic disease of comparatively modern recognition. For some time it was supposed to be practically confined to the peasantry in parts of Italy (particularly Lombardy), France, the Asturias, Rumania and Corfu. But it has been identified in various outlying parts of the British Empire (Barbadoes, India) and in both Lower and Upper Egypt; also among the Zulus and Basutos. In the United States sporadic cases had been observed up to 1906, but since then numerous cases have been reported. Probably the disease is even more widely spread through the world. The indications usually begin in spring, decline towards autumn, and recur with increasing intensity and permanence in the spring seasons following. A peasant who is acquiring the malady feels unfit for work, suffers from headaches, giddiness, singing in the ears, a burning of the skin, especially in the hands and feet, and diarrhoea. An erysipelatoid rash appears on the skin, the red or livid spots being tense and painful, especially where directly exposed to the sun. About July or August of the first season these symptoms disappear, the spots on the skin remaining rough and dry. The spring attack of the year following will probably be more severe and more likely to leave traces behind it; with each successive year the patient becomes more like a mummy, his skin shrivelled and sallow, or even black at certain

spots, his angles protruding, muscles wasted, movements slow and languid, and sensibility diminished.

Meanwhile there are more special symptoms relating to the nervous system, including drooping of the eyelid, dilatation of the pupil, and other disorders of vision, together with symptoms relating to the digestive system, such as a red and dry tongue, a burning feeling in the mouth, pain on swallowing, and diarrhoea. Ultimately there is profound disorganization of the nervous system with melancholy, imbecility, and a curious mummified condition of body. After death a general tissue degeneration is observed. The condition is believed to be diabetic in origin, possibly due to vitamin deficiency. It has been produced experimentally by withholding fresh meat, eggs and milk from the diet and has been observed to occur secondarily in disease of the stomach interfering with nutrition. Consequent on these experiences minor forms of the disease have been recognized, and it may well be that in these forms the disease is more common than was supposed.

See G. D. Head, Arch. Int. Med., 1924, 34, 93; W. L. Bender, Jn. Amer. Med. Assn. 1925, 84, 1250.

PELLICANUS, CONRAD (1478–1556), German humanist, whose original name was Kürsner, was born at Ruffach, Alsace, on Jan. 8, 1478. He studied at Heidelberg and at Tübingen, where he became a favourite pupil of the guardian of the Minorite convent there, Paulus Scriptoris, and began the study of Hebrew. He had no teacher and no grammar; but Paulus Scriptoris brought him a huge codex of the prophets borne on his own shoulders all the way from Mainz. He learned the letters from the transcription of a few verses in the *Star of the Messiah* of Petrus Niger, and, with a subsequent hint or two from Reuchlin, who also lent him the grammar of Moses Ḳimḥī, made his way through the Bible for himself with the help of Jerome's Latin. In 1501 he composed the first Hebrew grammar in the European tongue. It was printed in 1503, and afterwards included in Reysch's *Margarita philosophica*. The chief fruit of his Hebrew studies is the vast commentary on the Bible (Zürich, 7 vols., 1532–39).

Pellicanus was ordained priest in 1501, and continued to serve his order at Ruffach, Pforzheim and Basel till 1526. At Basel he did much laborious work for Froben's editions. He abandoned his habit on receiving through Zwingli a call to Zürich as professor of Greek and Hebrew. He died on April 6, 1556.

Pellicanus's Latin autobiography (*Chronicon C.P.R.* ed. Riggenbach, 1877) is one of the most interesting documents of the period. *See* also Emil Silberstein, *Conrad Pellicanus; ein Beitrag zur Geschichte des Studiums der hebr. Sprache* (1900).

PELLICO, SILVIO (1788–1854), Italian dramatist, was born at Saluzzo, Piedmont, on June 24, 1788. At the age of ten he composed a tragedy under the inspiration of Caesarotti's translation of Ossian. His tragedy *Francesca da Rimini*, was brought out with success by Carlotta Marchionni at Milan in 1818 (Eng. trs. 1915). The representation of his next tragedy *Eufemio da Messina*, was forbidden. Pellico attempted to weaken the hold of the Austrian despotism by indirect educational means. He acted as secretary to the powerful literary executive which gathered about Counts Porro and Confalonieri, the management of the *Conciliatore*, which appeared in 1818–19 as the organ of the association, resting largely upon him. In 1820 Pellico was arrested on the charge of carbonarism and after his removal to the Piombi at Venice in 1821, he composed several *Cantiche* and the tragedies *Ester d'Engaddi* (Eng. trs. 1836) and *Iginia d'Asti*. The sentence of death pronounced on him in Feb. 1822 was commuted to fifteen years *carcere duro*, and in the following April he was placed in the Spielberg at Brünn. Here he composed the tragedy *Leoniero da Dertona*, for the preservation of which he was compelled to rely on his memory. After his release in 1830 *Ester* was played at Turin in 1831, but immediately suppressed. In 1832 appeared his *Tre nuovi tragedie*, and the famous *Le Mie prigioni* (Eng. trs. 1915), an account of his sufferings in prison. In 1834 the Marchesa di Barolo, the reformer of the Turin prisons, bestowed on him a yearly pension of 1200 francs and in 1838 gave him a home in her palace. His tragedy *Tommaso Moro* appeared in 1833 and his *Opere* in 1837. He died on Jan. 31, 1854. The simple and naïve egotism of *Le Mie prigioni* established his fame.

See Piero Maroncelli, *Addizioni alle mie prigioni* (1834); G. Briano *Della Vita e delle Opere di S. Pellico* (1854); P. Giuria: *S. Pellico e il suo tempo* (1854) and A. Gustarelli: *La Vita, "Le Mie Prigioni" e di Pellico. Saggio Biografico-critico* (Florence 1917).

PELLISSON, PAUL (1624–1693), French author, was born at Béziers on Oct. 30, 1624. In 1653 he published a *Relation contenant l'histoire de l'académie française*. He was rewarded by a promise of the next vacant place and by permission to attend their meetings. In 1657 Pellisson became secretary to the minister of finance, Nicolas Fouquet, and when in 1661 the minister was arrested, his secretary was imprisoned in the Bastille. Pellisson stood by Fouquet, in whose defence he issued in 1661, *Discours au roi, par un de ses fidèles sujets sur le procès de M. de Fouquet*, and *Seconde défense de M. Fouquet*. Pellisson was released in 1666. He became historiographer to the king, and wrote a fragmentary *Histoire de Louis XIV.*, covering the years 1660 to 1670. In 1670 he was converted to Catholicism and obtained rich ecclesiastical preferment. He died on Feb. 7, 1693. He was very intimate with Mlle. de Scudéry, in whose novels he figures as Herminius and Acante.

See Sainte-Beuve, *Causeries du lundi*, vol. xiv.; and F. L. Marcon, *Étude sur la vie et les œuvres de Pellisson* (1859).

PELLITORY, a small hairy perennial herb which grows on old walls, hedgebanks and similar localities in the British Isles and is known botanically as *Parietaria officinalis*. It has a short woody rootstock from which spring erect or spreading stems 1 to 2 ft. long, bearing slender leafy branches, and axillary clusters of small green flowers. It belongs to the nettle family (*Urticaceae*), and is nearly allied to the nettle, *Urtica*, but its hairs do not sting. A similar species, *P. pennsylvanica*, is widely distributed in North America.

PELLOUX, LUIGI (1839–1924), Italian general and politician, was born on March 1, 1839, at Laroche (Haute-Savoie) of Italian parents. Entering the army as lieutenant of artillery in 1857, he fought at Custozza (1866) and at the siege of Rome (1870). He was minister of war in the Rudini and Giolitti cabinets of 1891–1893, and in the Rudini cabinet of 1896, and was appointed senator. In May 1897 he secured the adoption of the Army Reform Bill, fixing Italian military expenditure at a maximum of £9,560,000 a year, but in December of that year he was defeated in the Chamber on the question of the promotion of officers. Resigning office, he was in May 1898 sent as royal commissioner to Bari, where, without recourse to martial law, he restored public order. General Pelloux succeeded Rudini as prime minister in 1896, resigned in 1899, but again took office to repress the revolutionary elements in southern Italy. His new cabinet was military and conservative, and Pelloux was forced to resign office after the general election in June. In 1901 he was appointed to the command of the Turin army. He died on Oct. 26, 1924.

PELOPIDAS (d. 364 B.C.), Theban statesman and general. In 385 B.C. he served in a Theban contingent sent to the support of the Spartans at Mantineia, where he was saved, when dangerously wounded, by Epameinondas (*q.v.*). Upon the seizure of the Theban citadel by the Spartans (383 or 382) he fled to Athens, and took the lead in a conspiracy to liberate Thebes. In 379 his party surprised and killed their chief political opponents, and roused the people against the Spartan garrison, which surrendered to an army gathered by Pelopidas. In this and subsequent years he was elected *boeotarch*, and about 375 he routed a much larger Spartan force at Tegyra (near Orchomenus). This victory he owed mainly to the valour of the Sacred Band, a picked body of 300 infantry. At the battle of Leuctra (371) he contributed greatly to the success of Epameinondas's new tactics by the rapidity with which he made the Sacred Band close with the Spartans. In 370 he accompanied his friend Epameinondas as *boeotarch* into Peloponnesus. On their return both generals were unsuccessfully accused of having retained their command beyond the legal term. In 369, in response to a petition of the Thessalians, Pelopidas was sent with an army against Alexander, tyrant of Pherae. After driving Alexander out, he passed into Macedonia and arbitrated between two claimants to the throne. In order to secure the influence of Thebes, he brought home hostages, includ-

ing the king's brother, afterwards Philip II., the conqueror of Greece. Next year Pelopidas was again called upon to interfere in Macedonia, but, being deserted by his mercenaries, was compelled to make an agreement with Ptolemaeus of Alorus. On his return through Thessaly he was seized by Alexander of Pherae, and two expeditions from Thebes were needed to secure his release. In 367 Pelopidas went on an embassy to the Persian king and induced him to prescribe a settlement of Greece according to the wishes of the Thebans. In 364 he received another appeal from the Thessalian towns against Alexander of Pherae. Though an eclipse of the sun prevented his bringing with him more than a handful of troops, he overthrew the tyrant's far superior force on the ridge of Cynoscephalae; but wishing to slay Alexander with his own hand, he was cut down by the tyrant's guards.

Plutarch and Nepos, *Pelopidas;* Diodorus xv. 62–81; Xenophon, *Hellenica,* vii. 1. *See* also THEBES.

PELOPONNESIAN WAR, THE, was the great war waged towards the end of the 5th century B.C. by Sparta and the other members of the Peloponnesian Confederacy upon Athens and the Athenian empire. The cities of the Boeotian Confederacy under Theban leadership were Sparta's allies from the first. Syracuse and other Sicilian cities gave active help in the last part of the war. Argos, her hands tied by a treaty with Sparta, remained neutral during the first ten years, but, as a democracy, was benevolently inclined towards Athens. Persia at first held aloof, waiting her opportunity to reassert her dominion over the Greek cities of the Asiatic seaboard which Athens had liberated and added to her own empire. Athens, indubitably unpopular with many members of her empire, found small sympathy beyond its limits. Her maritime supremacy however held the malcontents firmly in check. As the war progressed, the whole Greek world became divided practically into two hostile groups, and both sides resented neutrality bitterly, as the cruel fate of Melos in 416 B.C. showed. The war began on April 4, 431 B.C., by a Theban attempt to surprise Plataea, Athens' ally and outpost on the northern base of Cithaeron. It ended on April 25, 404 B.C., when Athens capitulated. Thus it lasted 27 years, and Thucydides, writing its history after its close, definitely regards it as a single war, though a peace concluded between Athens and Sparta on April 11, 421 B.C., lasted technically some seven years. During these years there was heavy fighting in the Peloponnese in which Spartan and Athenian troops were engaged on opposite sides, and Thucydides' view is so far justified. The war divides into three main sections: (1) The "First" or "Archidamian" War, 431–421 B.C.; (2) The "Sicilian" War, 421–413 B.C.; (3) The "Later" or "Ionian" or "Decelean" War, 412–404 B.C.

CAUSE OF THE WAR

The true cause of the war was Sparta's fear of the growth of the power of Athens. This is Thucydides' own final judgment. The whole history of the rise and power of the Athenian empire in the 50 preceding years justifies this view, though the immediate occasions of the war concerned Corinth, Sparta's chief naval ally, rather than Sparta. Since the peace of 445 B.C. Pericles had consolidated Athenian resources, made Athens' navy incomparable, concluded, in 433 B.C., a defensive alliance with the strong naval power Corcyra (Corinth's most bitter enemy), and renewed alliances with Rhegium and Leontini in the West. The very food supply of the Peloponnese from Sicily was endangered. In the Aegean, Athens could always enforce a monopoly of seaborne trade. To this extent the Peloponnesian War was a "Trade War," and on this ground chiefly Corinth appealed to Sparta to take up arms. The appeal was backed by Megara, well-nigh ruined by Pericles' economic boycott (he hoping thereby to compel her once more to join Athens), and by Aegina, reluctant member of the Athenian empire, heavily taxed, and claiming as a right established by treaty that Home Rule which Athens refused her. But had not Sparta herself been eager for war, peace would have lasted. She was but waiting the opportunity, which came when Athens was temporarily embarrassed by the revolt of her subject-ally Potidaea in Chalcidice in the spring of 432 B.C. The rebel city held out until the winter of 430 B.C. and its blockade meant a constant drain upon Athenian military and naval resources. Sparta seized the chance. Confident of speedy victory, she refused the offer of arbitration upon all disputed questions made her by Pericles, though the peace of 445 B.C. bound her to accept it. The ultimatum despatched to Athens was tantamount to the destruction of the prestige if not of the actual existence of the Athenian empire. At Pericles' urging the Athenian people stood firm and Sparta declared war. She had a bad conscience but a good war-cry, liberation of the Hellenes from Athenian despotism.

THE FIRST YEARS, 431–427 B.C.

In a war between the chief military and the chief naval power in Greece a decisive issue was unlikely to come speedily. Sparta relied on the old traditional strategy of Greek warfare. She hoped by invading Attica and devastating the crops to induce such war-weariness in the Athenians as to make them sue for peace, unless they could be provoked first to fight the one pitched battle which must end the war. In the numbers, as in the discipline and efficiency of the troops, Athens was markedly inferior to the Peloponnesian-Boeotian levy. The flaw in this strategy was that Athens, unlike other Greek cities, could not be starved into submission. For her food supply she was independent of the produce of Attic soil. The old king of Sparta, Archidamus, realized this, and warned his folk that the war would be bequeathed to their children. But the Spartans were confident of speedy victory.

Upon this confidence Pericles based his own strategy. He was fighting for the *status quo ante bellum,* for the survival, not for the aggrandisement, of the empire. To the enemy's "Strategy of Annihilation" he opposed his own "Strategy of Exhaustion" which should give the foe no opportunity of any success in battle. Upon invasion by the enemy the country-folk took refuge within the walls of the "linked-fortress" Athens-Peiraeus. So Athens became "an island," impregnable to attack. The great fleet should secure the empire against disaffection within and attack without, and, offensively, was to raid the Peloponnesian coast. Meanwhile every spring and autumn the Athenian land army should waste the Megarid when the Peloponnesians were busy with their own crops at home, and compel Megara to renew her former alliance with Athens. All access from the Peloponnese by land into Attica would then be denied the enemy, and the dangerous Boeotian army on the north, invaluable allies to a Spartan force in Attica, would not dare cross the Cithaeron-Parnes range unsupported. So the baffled enemy should offer acceptable terms of peace.

This Periclean strategy also had elements of grave weakness, quickly revealed, mainly psychological. The Athenian temper proved unequal to the strain. The Spartans, though disappointed of their hopes, stuck doggedly to the war. Then chance struck Athens a heavy blow. In June 430 B.C. plague, imported by merchant vessels from Egypt or Libya, seized on the city, and the crowding of the refugees within the walls in the glaring summer heat spread the infection horribly. No adequate provision of housing or sanitation had been made. Reinforcements sent to the army blockading Potidaea carried the pestilence on the troopships, and here too the mortality was great. No other Greek city of any importance suffered. The devastation of the fields and the ravages of the plague overcame Athens' will to endure, despite all Pericles' noble oratory. There were as yet no compensatory successes. Megara, though starving, refused to submit. The naval raids round Peloponnese, one conducted on a great scale by Pericles himself, were futile pinpricks. Sparta cared nothing for them. It was Athens which first became "exhausted," thanks to the Periclean strategy. Even her great financial superiority at the beginning of the war began rapidly to vanish. Pericles, in fact, in framing his strategy, had been too fearful of the "casualty-list," always a matter of grave peril to any statesman in a Greek democracy. And, himself an admiral of repute, he had been curiously blind to the opportunities afforded an army, even admittedly inferior, by co-operation with a powerful fleet to harass and distract the enemy. A strong expeditionary force based on Cythera, which should have been seized at once (actually the island was taken first—and uselessly—in June 424 B.C.) would at least have kept Peloponnesian armies out of Attica, and have

encouraged Athenian hopes. Pericles flung away the strategical chance offered him in the proper use of naval predominance.

As early as August 430 B.C. Athens sent a peace embassy to Sparta. It was fruitless, and the war continued. In the following winter Potidaea capitulated, and next year two remarkable naval victories at Chalcis and Naupactus at the mouth of the Corinthian Gulf, won by Phormio, the Nelson of Athens, further cheered the Athenians. In September 429 B.C. Pericles died, and when in the June following, Mitylene, chief city of Lesbos, revolted, the very truth of the dead statesman's main contention, that Athens' maritime empire was unassailable, seemed questionable. It was however soon triumphantly vindicated. The Spartan admiral Alcidas, sent a year later to redeem a promise of help to the rebels, was a coward and fled back home after a hurried raid on Ionia at a mere glimpse of two Athenian warships. Mitylene surrendered at discretion in July 427 B.C. The city was cruelly punished, though more mercy was shown than pleased an Athenian politician then coming into prominence, Cleon "the tanner," *bête noire* of the playwright Aristophanes. In August 427 B.C. Plataea at last surrendered, when its tiny garrison was on the brink of perishing of hunger. At the insistence of their Theban enemies the Plataeans were slaughtered in cold blood and their city was utterly destroyed. Corcyra was finally secured for Athens by its democratic faction amid scenes of unspeakable barbarity, consummated in 426 B.C. by a ferocious massacre. But the whole war languished and drew near to stalemate.

ATHENS' "SECOND STRATEGY," 426–421 B.C.

At last, in 426 B.C., Athens bestirred herself, under direction of Cleon and of Demosthenes, the latter her best tactician in the war. The new leaders, though always hampered by the wealthy and influential Nicias, trusted chief and representative of the *bourgeoisie*, initiated a strategy of offence far more vigorous than the Periclean. Sicily, Boeotia, the Peloponnese itself, were all to be spheres of Athenian activity. To meet the cost, Cleon in 425 B.C. largely increased the tribute imposed on all members of the empire, in many cases up to or even beyond 50%. In June 426 B.C. Demosthenes with a handful of Athenian troops proceeded to Acarnania, ostensibly to consolidate Athenian influence in the district at the expense of Ambracia, Sparta's chief ally there. His real hopes were centred upon an invasion of Boeotia by way of Phocis in co-operation with the main Athenian army which, under Nicias, was to invade by way of Tanagra on the south-east and threaten Thebes directly. The plan was a dismal failure. Demosthenes with his large army of local levies without any real stiffening by Athenian hoplites was trapped in the heart of the forests of Aetolia at Aegitium at the very outset of his enterprise, and his whole force was cut to pieces by the natives. He himself barely escaped with his life to the Athenian base at Naupactus, whence he did not dare to return to Athens to become the scapegoat of the people's indignation. Nicias won an insignificant victory at Tanagra and then withdrew. Sparta entered on vigorous reprisals. A large army under Eurylochus marched from Delphi, threatened Naupactus (which Demosthenes secured just in time), and laid siege eventually to Amphilochian Argos, Athens' ally on the Ambraciot gulf. Then Demosthenes redeemed his reputation. Two brilliant victories, those of Olpae and Idomene, won by tactical devices novel in the humdrum warfare of the time, finally destroyed all Peloponnesian and Ambraciot influence in the entire district and shattered Spartan honour. Though Acarnanians and Ambraciots henceforward observed the war from a distance, the way was henceforth clear for Athenian ships to Sicily, and Demosthenes returned in triumph to Athens.

Next year, 425 B.C., Athens, thanks to Demosthenes and Cleon, achieved the "crowning mercy" of Sphacteria. A fleet *en route* for Sicily put in to Navarino bay and Demosthenes built and himself garrisoned a rude fort here on Pylos promontory. The angry Spartans came down upon him by land and sea. He beat off the assault on the fort, and the Athenian fleet returning on his summons from its slow voyage to the north penned up the Spartan navy in the bay and cut off a Spartan force landed on the island of Sphacteria from all hope of rescue. A temporary armistice secured to Athens the peaceful surrender of the hostile fleet, which she refused to return when negotiations were broken off. So Sparta for a dozen years ceased to have a fleet in being. The blockade of the island was protracted, and the approach of winter seemed likely to secure the escape of the garrison. Cleon, appointed general upon Nicias' pusillanimous, even malignant, resignation, brought Demosthenes needful reinforcements, and the latter, landing at last in overwhelming numbers on Sphacteria, overcame the Spartans' heroic resistance and brought the remnant of survivors, 292 in all, alive as prisoners to Athens. The moral effect of their surrender was prodigious throughout the Greek world. Not until the victory of Mantinea seven years later did Sparta wipe out the disgrace. Strategically the effect was to safeguard Attica from all invasion, so long as Spartan prisoners were in Athens' dungeons. Sparta now in her turn sued for peace, which Cleon refused.

Then came the black year, 424 B.C. All the Athenians' main offensive schemes miscarried. In the spring a congress held at Gela, persuaded by the Syracusan statesman Hermocrates, decided to adopt the "Monroe doctrine" of Sicily for the Sicilians, and the Athenian admirals had no choice but to return home, where they were heavily punished for a quite unavoidable failure. In the summer the renewed plan of a converging attack on Boeotia, this time from three sides, resulted in November in a crushing defeat of the main Athenian army at Delium, inflicted by the resolution and tactical ability of the Theban Pagondas. His device of a deepened wing and his skilful use of cavalry for shock tactics anticipated the coming renown of the Theban army under Epaminondas. Meanwhile an attempt to capture Megara by treachery had been frustrated when on the very point of success by the sudden dash to the city's rescue by Sparta's greatest soldier Brasidas, and only Megara's port Nisaea remained in Athenian hands. Then Brasidas completed the discomfiture of the Athenian "Second Offensive." Marching at top speed through Boeotia and Thessaly he appeared in the early winter in Chalcidice, the Achilles-heel of the Athenian empire, offering liberty and protection to cities revolting against the tyrant Athens. Amphipolis quickly surrendered herself, and the historian Thucydides, then in naval command in the north Aegean, arrived in hot haste from Thasos only in time to save Eion at the Strymon's mouth. Cleon's vengeance punished him unjustly with 20 years' exile. Athens sought to check Brasidas' triumphant progress by concluding a truce, the "Truce of Laches," in April 423 B.C., with Sparta, whose only anxiety was to recover the prisoners of Sphacteria. Brasidas paid no heed, taking Scione and Mende defiantly. The indignant Athenians hurried reinforcements to what was now the only scene of active war. Nicias recovered Mende this year, and in 422 B C. Cleon hoped to end the matter. To carelessness in a reconnaissance outside Amphipolis he added cowardice. Brasidas sallied from the city, routed the enemy, and Cleon himself was slain. But the Spartan, like Wolfe, fell in the moment of victory. So the two great advocates of bitter war unexpectedly perished, and Nicias was able, on April 11, 421 B.C., to conclude with Sparta that peace, called after his own name, which he hoped would end the Peloponnesian War for all time.

PEACE AND WAR, 421–417 B.C.

There followed a period of uneasy peace between the Greek cities; of alliances projected, spoilt, effected; of recriminations and of diplomatic *finesse*, much of it wasted, all of it suspicious. Corinth and Boeotia refused stoutly to be parties to the Peace of Nicias. Neither Sparta nor Athens fulfilled its conditions, though the latter did surrender her Spartan prisoners in good faith. But she retained Pylos and Nisaea when Sparta professed her inability to render up Amphipolis. And when, in July 420 B.C., a new Quadruple Alliance of Athens, Argos, Mantinea and Elis confronted a Spartan-Boeotian Alliance, the already moribund peace was doomed. This new democratic League was the work of one man at Athens, Nicias' political rival Alcibiades. Like Disraeli entering on a public career about the age of 30, like him a man of brilliant talents and unbounded ambition, he too in-

curred the undying distrust, even hatred, of the "respectable" majority of his fellow-citizens. Though henceforward to the end of the war Alcibiades' personality dominates Athenian life and politics, his unquestioned oratorical and military abilities could not surmount finally this handicap, and the party-animosity which he provoked was the final cause of Athens' downfall. This is Thucydides' own certain judgment.

Athens' "Third Offensive Strategy" was in idea her best. Thanks to her new Peloponnesian allies she now threatened Sparta at home and made her rival stake her very existence upon the fortunes of a single fight. Then, to her salvation, Sparta discovered in her King Agis the second of her great soldiers, one remarkable alike for strategical and for tactical ability. Taking the initiative, Agis assembled a powerful army at Phlius by a masterly piece of night-marching and descended from the north upon Argos. His Boeotian contingent failed him at the critical moment, and, forced to extricate the remainder from peril as best he could, he concluded a much misunderstood treaty with the enemy. A few months later Argos, at Alcibiades' insistence, denounced the treaty, and the allies, though including only a miserably inadequate Athenian contingent and weakened further by the selfish absence of the Eleans, threatened Tegea. Agis hastened to the rescue, and the resulting battle of Mantinea in August 418 B.C. was so striking a Spartan victory that by this, the greatest land battle of the war, Sparta redeemed her lost reputation. Argos henceforward ceased to count. That the Third Athenian Strategy was so disastrous a failure was largely due to the blind folly of Alcibiades' political enemies, through whom he himself was not elected general in this the decisive year of its trial.

THE EXPEDITION AGAINST SYRACUSE, 416–413 B.C.

One hope only of bold offence now remained for Athens. In 416 B.C., on an appeal for help made by Egesta, Alcibiades advocated vigorous intervention again in Sicily. To conquer Syracuse, subdue the whole island, crush Carthage, and then return with triumphant prestige and added forces to finish the war at home was a strategy which might seem to promise a great, even if a temporary success, and did in fact come within an ace of succeeding at Syracuse itself. The expedition to Sicily was no error of judgment, and the glamour of the west which cast its spell over the vigorous youth of Athens was no false gleam. In vain Nicias urged the dreary alternative of continued operations in Chalcidice. Expedition after expedition had been sent there in 419–417 B.C. and all had been dolefully futile. Only in the west could Athens win the war. The expedition was voted with enthusiasm. On May 22, 415 B.C., the Hermae busts in Athens' streets were mysteriously mutilated. Despite the omen the great armada sailed in June, under three generals of equal authority, Alcibiades the author, Nicias the resolute opponent of the plan, and Lamachus, a straightforward soldier. Hardly had it reached western waters when Alcibiades was recalled to stand his trial at Athens for sacrilege. He had in vain demanded a trial before he sailed. In his absence his enemies played upon the religious credulity of the pious and upon the general dread of oligarchic plots. Alcibiades' own adherents were with him on shipboard. At Athens a death sentence awaited him. He eluded his escort and fled, furious, to Sparta.

Some progress at first was made in Sicily. A preliminary landing at Dascon in Syracuse Great Harbour in November 415 B.C. resulted in a useless Athenian victory. But in April 414 B.C. the whole fleet and army moved from Catana on Syracuse, and the Athenians began to encompass the city with a wall on the landward side while the fleet blocked the harbour approaches. But presently everything went wrong. Lamachus was killed, the fleet was heavily defeated, supplies ran short, a Spartan commander-in-chief, Gylippus, sent at Alcibiades' prompting, arrived to stiffen the Syracusan defence, and the circumvallation was stopped by a cross-wall. In response to Nicias' pitiful despatches Athens sent out Demosthenes with a second armada of 73 vessels. On his arrival, in July 413 B.C., he led an attack by night on the cross-wall. It was ruinously defeated. Nicias still dallied and refused Demosthenes' urgent entreaty to leave Syracuse. At last he had consented, after criminal delay, when, on August 27, an eclipse of the moon worked on the men's superstitious fears and Nicias bowed to the soothsayers' mandate to remain. The Syracusans under Hermocrates and Gylippus seized the unexpected chance. The Athenian fleet was penned up in the Great Harbour by a boom across its mouth, and, in a final desperate engagement, was heavily worsted. The Athenians, abandoning the ships, struck inland for the hills, then, their road here blocked by the enemy, turned south again in two divisions. The rear, under Demosthenes, was surrounded on Sept. 14 in the olive-yard of Polyzelus and surrendered. The van, under Nicias, struggled on for two more days until, cut off on the banks of the river Assinarus, the survivors of a bloody massacre surrendered also. The two captured generals were put to death, against Hermocrates' pleading, in cold blood. Many prisoners perished in the horrors of the quarries at Syracuse. Scarcely a man returned to Athens. The great armada was annihilated. Thucydides' story of this disaster remains the masterpiece of Greek historical writing. In its stark simplicity, sombre majesty, and tragic intensity, his narrative has never been surpassed.

ATHENS' RECOVERY, 412–408 B.C.

The whole Greek world now expected Athens' immediate downfall. Sparta, who had resumed war officially in August 414 B.C., had the disposal of a fleet of equal or superior strength, with naval reinforcements added from the west. Athens' own best mariners were dead. Her treasury was practically empty. In March 413 B.C. King Agis at Alcibiades' suggestion had occupied Decelea and kept her in a state of semi-blockade, and 20,000 of her slaves deserted to the king. The cities of her empire fell away from her in a series of revolts in 412–411 B.C. Persia now for the first time intervened actively in the war, and Sparta seemed able to count on the support of Tissaphernes, satrap of Sardis. Finally there was a successful conspiracy in Athens herself against the utterly discredited democracy, and the oligarchic extremists, Antiphon, Peisander and Phrynichus, seizing the power in June 411 B.C., opened secret and treasonable negotiations with the enemy. Two men saved Athens in this extremity. At home the "Moderate" leader Theramenes frustrated and crushed the extremists and established the "Constitution of the Five Thousand," which guarded the city and maintained the struggle. Alcibiades meanwhile had fled from Sparta to Sardis and by his charm so prevailed upon Tissaphernes that the satrap's aid to Sparta in gold was niggardly and in ships was nil. The Athenian navy, strongly democratic in sympathy, recalled Alcibiades to command at Samos, its base, and at Theramenes' urging the people in the city confirmed the election. Athens once more had a powerful fleet in being, but it was her last, and could not with safety be divided, however strenuously reinforced. The last stages of the war are purely naval.

Presently operations shifted to the Hellespont, where a victory won by the Athenian commanders Thrasybulus and Thrasylus over the Spartan Mindarus at Cynossema in Sept. 411 B.C., if far from decisive, at least restored Athenian confidence, though all hopes of Persian support had by this time been proved fallacious. At this point Thucydides' narrative breaks off short, and Xenophon, an inferior and dull, though an honest and trustworthy writer, takes up the tale. But in March 410 B.C. Alcibiades and his colleagues won so crushing a victory over the hostile navy and its supporting Persian army on land at Cyzicus in the Sea of Marmora that the Athenians were once again indisputable masters of the sea and Sparta actually suggested peace. The newly restored democracy under the demagogue Cleophon's guidance let slip the opportunity. Next year Alcibiades recaptured rebel Byzantium, cleared the Bosporus, secured Athens' corn supply, and so on June 16, 408 B.C., was able to make a triumphal entry into Athens after seven years' absence. He received a rapturous welcome, though there were many who cherished bitter ill-will against him secretly; was appointed general with autocratic powers; and so left to rejoin the fleet, now once again at Samos. He never saw his city again.

ATHENS' DOWNFALL, 407–404 B.C.

Sparta at last discovered a great admiral in Lysander. Coming to his naval base at Ephesus in the autumn of 408 B.C. he built up a large well-equipped fleet, assisted by the new satrap, Prince Cyrus, second son of the Persian king, who co-operated enthusiastically with the Spartan, placing Persia's illimitable resources and his own private purse at the latter's command. Persian vacillation thus ended, the only flaw in Sparta's naval organization was the rule forbidding the same man to hold the admiral's office in two consecutive years. In 407 B.C. Lysander resisted steadily all Alcibiades' efforts to entice him out to battle. Then that weakness, shortage of supplies, which hampered all Athenian operations in the "Ionian War," compelled Alcibiades to divide his fleet. He himself sailed north to plunder enemy coast towns, leaving in observation at Notium a squadron under one Antiochus, a good seaman and an old friend from boyhood, with strict orders not to offer battle. During his superior's absence at hostile Cyme Antiochus challenged Lysander insultingly to combat. The latter sallied out of harbour and routed him. Alcibiades returned and renewed the blockade of the foe, but the mischief was done. His personal enemies at Athens persuaded the people to dismiss him from his command. He withdrew quietly to a castle on the Hellespont, and a new board of generals next year replaced him.

Lysander, too, was superseded by Callicratidas, a brave and energetic officer. The latter, overcoming all hindrances placed in his way by Lysander and Cyrus, blockaded the Athenian Conon in Mitylene harbour. A large Athenian fleet, raised with desperate energy, sailed from Peiraeus to this general's succour. At the resulting battle of Arginusae in August 406 B.C. the fleets engaged were the largest hitherto seen on both sides in the war, but the tactics were nearly as clumsy as in the days before Phormio. Callicratidas was defeated heavily and he himself was drowned. Again Sparta offered peace. Again Cleophon, in drunken madness, secured its rejection. The very victory was marred by a failure, due in part only to heavy weather, to rescue many hundred drowning Athenian sailors from sinking or waterlogged ships. The generals were recalled to Athens. Six who obeyed were put on trial and, illegally condemned *en bloc,* were executed, Theramenes, whom they had tried to make their scapegoat, being largely responsible for their doom. By their removal he may have hoped to achieve Alcibiades' recall even at the eleventh hour. In this he failed. The new generals of 405 B.C. were, with one exception, Alcibiades' political opponents.

These proceeding to Ionia, moved the entire fleet up to the open roadstead of Aegospotami in the Hellespont. Lysander lay opposite in security at Abydos. In vain Alcibiades rode down to warn his compatriots of their perilous position. Insults rewarded this, the last of his many efforts to save his city. By a clever *ruse de guerre* Lysander in Sept. 405 B.C. captured the whole of the opposing fleet without a blow and "in one single hour brought the longest of wars to an end." Only Conon and some 20 Athenian ships escaped. So Athens lost her fleet and, with it, the war, thanks to incompetence and political partisanship combined. With slow deliberation Lysander sailed upon the city and blockaded Peiraeus. King Pausanias lay with his army outside the walls. After six terrible months of slow starvation Theramenes secured terms from Sparta tolerable compared with the utter destruction of the city demanded by Corinth and Thebes. On April 25, 404 B.C., Athens capitulated, and the Spartans marched in. Her long walls were pulled down to the merry sound of flutes. Her empire was dissolved. Samos, alone defiant, was taken. The oligarchy of the "Thirty Tyrants" was established at Athens, and Critias, its chief, presently secured the judicial murder of Theramenes in the city and the assassination of Alcibiades at Phrygian Melissa. "Liberty returned to Hellas." The Peloponnesian War was ended.

With the war the greatest, if not the happiest days of Athens' history are ended. Her political pre-eminence passes away. Interest centres rather on Thebes and Macedon in the 4th, on Achaea and Sparta in the 3rd century. Hence it is that the Peloponnesian War enjoys such importance in world-history. Apart from this, it is the genius of Thucydides which has raised to the rank of a world-epic, almost of a world-tragedy, a struggle which has seemed to some little better than a petty quarrel of ancient days.

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(2) Modern: J. B. Bury, *The Ancient Greek Historians,* ch. iii. (1909); G. B. Grundy, *Thucydides and the History of his Age* (1911); *Cambridge Ancient History,* vol. v., chs. viii.–xii. (F. E. Adcock and W. S. Ferguson; (1927), full bibliography; B. W. Henderson, *The Great War between Athens and Sparta, a companion to the military history of Thucydides* (1927). Index IV. contains references to modern writers. Chief among general histories of Ancient Greece dealing with the war are those of Evelyn Abbott, J. B. Bury, E. A. Freeman, George Grote, Adolf Holm, Julius Beloch, Georg Busolt, Eduard Meyer, K. Pöhlmann, Gustav Gilbert, *Beiträge zur innern Geschichte Athens* (1877); F. M. Cornford, *Thucydides Mythistoricus* (1907); Admiral Sir Reginald Custance, *War at Sea* (1919); G. F. Abbott, *Thucydides; a study in historical reality* (1926). (B. W. H.)

PELOPONNESUS ("Island of Pelops"), the ancient (and modern Greek official) name for the part of Greece south of the Isthmus of Corinth. In mediaeval times it was called the Morea, from its resemblance to a mulberry-leaf in shape.

PELOPS, in Greek legend, the grandson of Zeus, son of Tantalus and Dione, and brother of Niobe. His father's home was on Mt. Sipylus in Asia Minor. Tantalus one day served up to the gods his own son Pelops, boiled and cut in pieces. The gods detected the crime, and none of them would touch the food except Demeter, who, distracted by the loss of her daughter Persephone, ate of the shoulder. The gods restored Pelops to life, and the shoulder consumed by Demeter was replaced by one of ivory. Poseidon carried Pelops off to Olympus, where he dwelt with the gods, till, from his father's sins, he was cast out from heaven. Then, taking much wealth with him, he went to Pisa in Elis and won Hippodameia by the treachery of Myrtilus (*cf.* OENOMAUS). When Myrtilus claimed his promised reward, Pelops flung him into the sea near Geraestus in Euboea, and from his dying curse sprang the woes of the house of Pelops. Among the sons of Pelops by Hippodameia were Atreus, Thyestes and Chrysippus. Pelops is closely connected with Olympia. A mound there was supposed (falsely) to be his tomb; his sacrifice was an important part of the festival; he is said to have celebrated the Games "more notably than any man before him" (Paus. v., 8, 2). It is likely that his family is of the eastern branch of the Achaeans known from Hittite records to have existed in Asia Minor in early times.

PELOTA, a Spanish word meaning ball. It is also used to denote various ball games whose traditional home is in the Basque provinces of France and Spain, but which are played regularly or occasionally in many places, *e.g.,* Madrid, Barcelona. Buenos Aires, Havana, etc. In the Basque country these games are the national pastime and every town and village has a court or courts.

PELOTAS, a city of the State of Rio Grande do Sul, Brazil, on the left bank of the São Gonçalo river near its entrance into the Lagôa dos Patos, about 30 m. N.W. of the city of Rio Grande. Area of *municipio* 1,037 sq.m.; pop. (1920) 82,294. The Rio Grande-Bagé railway communicates with the city of Rio Grande, and with the railways extending to Bagé, Cacequy, Santa Maria, Passo Fundo, Uruguayana and Porto Alegre. The São Gonçalo river is the outlet of Lagôa Mirim, and Pelotas is therefore connected with the inland water routes. The city is built on an open grassy plain (*campo*) little above the level of the lake (28 ft. above sea-level). Pelotas is the centre of the *xarque* (jerked beef) industry of Rio Grande do Sul. In its outskirts and the surrounding country are an immense number of *xarqueadas* (slaughter-houses), with large open yards where the dressed beef, lightly salted, is exposed to the sun and air. There are many factories or packing-houses where the by-products are prepared for market. Pelotas became a *villa* in 1830 and a city in 1835.

PELTASTS, properly, ancient Greek soldiers, carrying a light shield (πέλτη) instead of the heavier shield (ὅπλον), carried by the Hoplites. They were light infantry and were

recruited originally from Thracian mercenaries. After Iphicrates made them an efficient fighting force the term peltasts was applied to all light infantry (*cf.* Xen. *Hell.* iv., 4, 16 and 5, 12).

PELTIER, JEAN CHARLES ATHANASE (1785–1845), French physicist, born at Ham (Somme), found that heat is absorbed or liberated at the junction of two dissimilar metals in a circuit carrying an electric current. This is known as the "Peltier effect" (*see* ELECTRICITY: *Thermoelectricity*). Peltier died in Paris on Oct. 27, 1845.

PELUSIUM, an ancient city and port of Egypt, now represented by two large mounds close to the coast and the edge of the desert, 20 m. E. of Port Said. It lay in the marshes at the mouth of the most easterly (Pelusiac) branch of the Nile, which has long since been silted up, and was the key of the land towards Syria and a strong fortress, which, from the Persian invasion at least, played a great part in all wars between Egypt and the East.

PEMBA, an island in the Indian ocean off the east coast of Africa, forming part of the sultanate of Zanzibar. Pemba lies 30 m. N.N.E. of Zanzibar island between 4° 80′ and 5° 30′ S., and 39° 35′ and 39° 50′ E. It is some 40 m. long and 10 across at its broadest part, and has an area of 380 sq.m. It is of coral origin. From its luxuriant vegetation it gets its Arabic name of Al-huthera—"The Green." The average rainfall is 83 inches a year; the mean temperature about 80° F. Pop. (1924) 87,649. Most of the inhabitants are of Bantu stock and are known as Wapemba. The land is chiefly owned by Arab proprietors, who work their plantations with Swahili labour, and with negroes from the mainland. Up to 1897 the labourers were slaves. The great majority of the plantations are devoted to cloves, the number of plantations of coco-nut palms being comparatively small. The preponderance of clove plantations dates from a cyclone which in 1872 destroyed nearly all the clove-trees in the island of Zanzibar. Thereupon, to benefit from the great rise in the price of cloves, the Pemba planters cut down their palms and planted cloves. The Llandolphia rubber-vine is indigenous, and since 1906 Ceara rubber-trees have been planted. Rubber is a minor export. Rice, the chief of Pemba's imports, could be grown. Shaki-Shaki, the capital and the centre of trade, is centrally situated at the head of a shallow tidal creek partly blocked by dense growths of mangroves. Mkoani is on the south-west coast, Kishi-Kashi on the north-west coast; at the last-named port there is a deep and well-sheltered harbour. (*See* also ZANZIBAR.)

PEMBROKE, EARLS OF. The title of earl of Pembroke has been held successively by several English families, the jurisdiction and dignity of a palatine earldom being originally attached to it. The first creation dates from 1138, when the earldom of Pembroke was conferred by King Stephen on Gilbert de Clare (d. 1148), son of Gilbert Fitz-Richard, who possessed the lordship of Strigul (Estrighoiel, in *Domesday Book*), the modern Chepstow, and who, after the battle of Lincoln (1141), in which he took part, joined the party of the empress Matilda, and married Henry I.'s mistress, Isabel, daughter of Robert de Beaumont, earl of Leicester. For his son Richard, 2nd earl and for William Marshal, earl of Pembroke, who succeeded to the title through his marriage with Isabel, Richard's daughter and heiress, *see* separate articles.

Marshal's eldest son, WILLIAM MARSHAL (d. 1231), 2nd earl of Pembroke of this line, passed some years in warfare in Wales and in Ireland, where he was justiciar from 1224 to 1226; he also served Henry III. in France. His second wife was the king's sister, Eleanor, afterwards the wife of Simon de Montfort, but he left no children. His brother RICHARD MARSHAL (d. 1234), 3rd earl, came to the front as the leader of the baronial party, and the chief antagonist of the foreign friends of Henry III. Fearing treachery he refused to visit the king at Gloucester in Aug. 1233, and Henry declared him a traitor. He crossed to Ireland, where Peter des Roches had instigated his enemies to attack him, and in April 1234 he was overpowered and wounded, and died a prisoner. His brother GILBERT (d. 1241), who became the 4th earl, was a friend and ally of Richard, earl of Cornwall. When another brother, ANSELM, the 6th earl, died in Dec. 1245, the male descendants of the great earl marshal became extinct. The extensive family possessions were now divided among Anselm's five sisters and their descendants, the earldom of Pembroke reverting to the Crown.

The next holder of the lands of the earldom of Pembroke, WILLIAM DE VALENCE (d. 1296), a younger son of Hugh de Lusignan, count of La Marche, by his marriage with Isabella of Angoulême (d. 1246), widow of the English king John, was born at Valence, near Lusignan. In 1247 William and his brothers, Guy and Aymer, crossed over to England at the invitation of their half-brother, Henry III., who arranged a marriage between William and Joan de Munchensi (d. 1307) a grand-daughter of William Marshal, 1st earl of Pembroke. He was hated as one of the most prominent of the rapacious foreigners. He quarrelled with Simon de Montfort, refused to comply with the provisions of Oxford, and took refuge in Wolvesey castle at Winchester, where he was besieged and compelled to surrender and leave the country. In 1259 he and Earl Simon were formally reconciled in Paris, and in 1261 he was again in England. He fought for Henry at the battle of Lewes, and then, after a stay in France, he landed in Pembrokeshire, and took part in 1265 in the siege of Gloucester and the battle of Evesham. After the royalist victory he was restored to his estates and accompanied Prince Edward, afterwards Edward I., to Palestine. He died at Bayonne on June 13, 1296, and was buried in Westminster abbey.

His eldest surviving son, AYMER (*c.* 1265–1324), fought at Bannockburn; in 1317, when returning to England from Rome, he was taken prisoner and was kept in Germany until a large ransom was paid. In 1318 he again took a conspicuous part in making peace between Edward and his nobles, and in 1322 assisted at the formal condemnation of Earl Thomas of Lancaster, and received some of his lands. His wife, Mary de Chatillon, was the founder of Pembroke college, Cambridge.

In 1339 LAURENCE, LORD HASTINGS (d. 1348), a great-grandson of William de Valence, having inherited through the female line a portion of the estates of the Valence earls of Pembroke was created, or recognized as, earl of Pembroke. His son JOHN (d. 1376) married Margaret Plantagenet, daughter of King Edward III., and on the death without issue of his grandson in 1389 the earldom of Pembroke reverted again to the Crown, while the barony of Hastings was dormant till 1840.

In 1414 HUMPHREY PLANTAGENET, fourth son of King Henry IV., was created duke of Gloucester and earl of Pembroke for life, these titles being subsequently made hereditary, with a reversion as regards the earldom of Pembroke, in default of heirs to Humphrey, to WILLIAM DE LA POLE, earl of Suffolk. Accordingly, on the death of Humphrey, without issue, in 1447 this nobleman became earl of Pembroke. He was beheaded in 1450 and his titles were forfeited. In 1453 the title was given to SIR JASPER TUDOR, half-brother of King Henry VI. Sir Jasper being a Lancastrian, his title was forfeited during the predominance of the house of York, but was restored on the accession of Henry VII. On his death without heirs in 1495, his title became extinct.

During his attainder Sir Jasper was taken prisoner by SIR WILLIAM HERBERT (d. 1469), a Yorkist, who had been raised to the peerage as Baron Herbert by Edward IV., and for this service Lord Herbert was created earl of Pembroke in 1468. His son William (d. 1491) received the earldom of Huntingdon in lieu of that of Pembroke, which he surrendered to Edward IV., who thereupon conferred it (1479) on his son EDWARD, PRINCE OF WALES; and when this prince succeeded to the throne as Edward V., the earldom of Pembroke merged in the Crown. ANNE BOLEYN, a few months previous to her marriage with Henry VIII., was created marchioness of Pembroke in 1532.

The title of earl of Pembroke was next revived in favour of SIR WILLIAM HERBERT (*c.* 1501–1570), whose father, Richard was an illegitimate son of the 1st earl of Pembroke of the house of Herbert. He had married Anne Parr, sister of Henry VIII.'s sixth wife, and was created earl in 1551. The title has since been held by his descendants.

His elder son HENRY (*c.* 1534–1601), who succeeded as 2nd earl, was president of Wales from 1586 until his death. He married in 1577 MARY SIDNEY, the famous countess of Pembroke

(*c.* 1561–1621), third daughter of Sir Henry Sidney and his wife Mary Dudley. Sir Philip Sidney, her eldest brother, wrote the *Countess of Pembroke's Arcadia* for her pleasure. The two also worked at a metrical edition of the Psalms. On his death she made herself his literary executor, correcting the unauthorized editions of the *Arcadia* and of his poems, which appeared in 1590 and 1591. Spenser dedicated his *Ruines of Time* to her, and refers to her as Urania in *Colin Clout's come home againe;* in Spenser's *Astrophel* she is "Clorinda" In 1599 Queen Elizabeth was her guest at Wilton, and the countess composed for the occasion a pastoral dialogue in praise of Astraea

The Countess's other works include· *A Discourse of Life and Death,* translated from the French of Plessis du Mornay (1593), and *Antoine* (1592), a version of a tragedy of Robert Garnier.

William Herbert, 3rd earl of Pembroke (1580–1630), son of the 2nd earl, was a conspicuous figure in the society of his time and at the court of James I. He was lord chamberlain of the royal household (1615 to 1625) and lord steward (1626 to 1630). He was chancellor of the University of Oxford in 1624 when Thomas Tesdale and Richard Wightwick refounded Broadgates Hall and named it Pembroke college in his honour. By some Shakespearian commentators Pembroke has been identified with the "Mr. W. H" referred to as "the onlie begetter" of Shakespeare's sonnets in the dedication by Thomas Thorpe, the owner of the published ms, while his mistress, Mary Fitton (*q v.*), has been identified with the "dark lady" of the sonnets (*See* Shakespeare, William.) He and his brother Philip are the "incomparable pair of brethren" to whom the first folio of Shakespeare is inscribed The earl left no sons when he died in London on April 10, 1630.

His brother, Philip Herbert, the 4th earl (1584–1650), was for some years the chief favourite of James I In 1605 the king created him earl of Montgomery and Baron Herbert of Shurland, and since 1630, when he succeeded to the earldom of Pembroke, the head of the Herbert family has carried the double title of earl of Pembroke and Montgomery. Charles I, made him lord chamberlain in 1626 and frequently visited him at Wilton He worked to bring about peace between the king and the Scots in 1639 and 1640, but when in the latter year the quarrel between Charles and the English parliament was renewed, he deserted the king who soon deprived him of his office of chamberlain Trusted by the popular party, Pembroke was made governor of the Isle of Wight, and he was one of the representatives of the parliament on several occasions, notably during the negotiations at Uxbridge in 1645 and at Newport in 1648, and when the Scots surrendered Charles in 1647 In 1649, although a peer, he was elected and took his seat in the House of Commons as member for Berkshire.

His eldest surviving son, Philip (1621–1669), became 5th earl of Pembroke, and 2nd earl of Montgomery; he was twice married, and was succeeded in turn by three of his sons, of whom Thomas, the 8th earl (*c.* 1656–1733), was a person of note during the reigns of William III and Anne

His son Henry, the 9th earl (*c* 1689–1750), was a soldier, but was better known as the "architect earl" He was largely responsible for the erection of Westminster Bridge The title descended directly to Henry, 10th earl (1734–1794), a soldier, who wrote the *Method of Breaking Horses* (1762); George Augustus, 11th earl (1759–1827), an ambassador extraordinary to Vienna in 1807; and Robert Henry, 12th earl (1791–1862), who died without issue George Robert Charles, the 13th earl (1850–1895), was a grandson of the 11th earl and a son of Baron Herbert of Lea (*q v*), whose second son Sidney 14th earl (1853–1913), inherited all the family titles at his brother's death Sidney's son Reginald Herbert (b 1880) succeeded his father as 15th earl in 1913.

See G. T. Clark, *The Earls, Earldom and Castle of Pembroke* (Tenby, 1880); J R. Planché, "The Earls of Strigul" in vol x. of the *Proceedings of the British Archaeological Association* (1855); and G. E. C(okayne), *Complete Peerage*, vol. vi. (1895).

PEMBROKE, RICHARD DE CLARE, 2nd Earl of (d. 1176), commonly known as "Strongbow," son of Gilbert de Clare, the first earl, succeeded to his father's estates in 1148, but had forfeited or lost them by 1168. In that year Dermot, king of Leinster, driven out of his kingdom by Roderick, king of Connaught, came to solicit help from Henry II He secured the services of Earl Richard, promising him the hand of his daughter Eva and the succession to Leinster. The earl crossed over in person (1170), took both Waterford and Dublin, and was married to Eva. But Henry II., jealous of this success, ordered all the troops to return by Easter 1171. In May Dermot died; this was the signal of a general rising, and Richard barely managed to keep Roderick of Connaught out of Dublin. Immediately afterwards he hurried to England to solicit help from Henry II., and surrendered to him all his lands and castles Henry crossed over in Oct. 1172; he stayed in Ireland six months, and put his own men into nearly all the important places, Richard keeping only Kildare. In 1173 Richard went in person to France to help Henry II, and was present at Verneuil, being reinstated in Leinster as a reward. In 1174 he advanced into Connaught and was severely defeated, but fortunately Raymond le Gros re-established his supremacy in Leinster. Early in 1176 Richard died, just as Raymond had taken Limerick for him As he had no male issue his daughter, Isabel, became countess of Pembroke in her own right, and the title was borne by her husband, Sir William Marshal (*See* below) Strongbow was the statesman, as the Fitzgeralds were the soldiers, of the conquest He was buried in the cathedral church of Dublin, where his effigy and that of his wife are still preserved.

See Giraldus Cambrensis, *Expugnatio hibernica;* and the *Song of Dermot*, ed G H. Orpen (1892).

PEMBROKE, WILLIAM MARSHAL, 1st Earl of (? – 1219), English statesman, second son of John le Maréchal, by Sibylle, the sister of Patrick, earl of Salisbury, succeeded to the title through his marriage with Isabel, daughter of Richard, 2nd earl of Pembroke (*q v*). In 1170 he was admitted to the household of Prince Henry, the heir-apparent, and remained there until the death of his young patron (1183) He undertook a pilgrimage to the Holy Land, where he served as a crusader with distinction for two years Although he had abetted the prince in rebellion he was pardoned by Henry II and admitted to the royal service about 1188. In 1189 he covered the flight of Henry II. from Le Mans to Chinon, and, in a skirmish, unhorsed the undutiful Richard Coeur de Lion None the less Richard, on his accession, promoted Marshal and confirmed the old king's licence for his marriage with the heiress of Strigul and Pembroke. This match gave Marshal the rank of an earl, with great estates in Wales and Ireland, and he was included in the council of regency which the king appointed on his departure for the third crusade (1190). He took the side of Prince John when the latter expelled the justiciar, William Longchamp, from the kingdom, but in 1193 he joined with the loyalists in making war upon the prince. Richard allowed him to succeed his brother, John Marshal, in the hereditary marshalship, and on his death-bed designated him as custodian of Rouen and of the royal treasure during the interregnum.

Though he quarrelled more than once with John, Marshal was one of the few English laymen who clung to the royal side through the Barons' War He was one of John's executors, and was subsequently elected regent of the king and kingdom by the royalist barons in 1216 He prosecuted the war against Prince Louis and the rebels with remarkable energy In the battle of Lincoln (May 1217) he charged and fought at the head of the young king's army, and he was preparing to besiege Louis in London when the war was terminated by the naval victory of Hubert de Burgh in the straits of Dover He was criticized for the generosity of the terms he accorded to Louis and the rebels (Sept. 1217); but his desire for an expeditious settlement was dictated by sound statesmanship Self-restraint and compromise were the key-notes of Marshal's policy. Both before and after the peace of 1217 he reissued Magna Carta He fell ill early in the year 1219, and died on May 14, at his manor of Caversham near Reading. He was succeeded in the regency by Hubert de Burgh, in his earldom by his five sons in succession.

See the metrical French life, *Histoire de Guillaume le Maréchal*

(ed. P. Meyer, 3 vols., 1891–1901); G. J. Turner, "Minority of Henry III." (*Trans. Royal Hist. Soc.*, new series, vol. xviii., pp. 245–295); and W. Stubbs, *Constitutional History*, chs. xii. and xiv. (Oxford, 1896–97).

PEMBROKE, a town of Ontario, Canada, capital of Renfrew county, 74 m. W.N.W., of Ottawa by rail on the south shore of Allumette lake, an expansion of the Ottawa river, and on the Canadian Pacific and Canadian National railways. Pop. (1921) 8,875. It is the seat of a Roman Catholic bishopric, an important centre in the lumber trade.

PEMBROKE, municipal borough and county town of Pembrokeshire, Wales. Pop. (1921) (together with Pembroke Dock) 15,472. It is a walled town on a creek of Milford Haven, and consists of a long street running from the station on the east to the mediaeval castle on the west. A stone fortress seems to have been built here by Arnulf de Montgomery about 1090, and in the 12th and 13th centuries the castle was enlarged by the Earls palatine of Pembroke who made it their chief seat. The circular vaulted keep built by William Marshall (*c.* 1200) is 75 ft. high with walls 7 ft. thick. The Great Hall is built over the "Wogan," a natural subterranean passage giving access to the harbour. As capital of the Palatinate, and the nearest port for Ireland, Pembroke was one of the most important fortified sites of the west. Facing the castle are the remains of Monkton Priory founded by Arnulf de Montgomery in 1098 for Benedictine monks as a cell of Sées in Normandy, but given to St. Albans in 1473. The town grew around the castle and was first incorporated by Henry I. in 1109, and again by Richard de Clare in 1154, and its privileges were later confirmed and extended. With the Act of Union (England and Wales) 1536 the county Palatine of Pembroke was abolished and in 1835 the corporation of Pembroke town was remodelled. At the outbreak of the Civil War the castle was garrisoned for the Parliament by the Mayor John Poyer, but in 1647 he declared for the king. Cromwell himself besieged the castle which fell and Poyer was executed. The new town that grew around the government dockyard, established in 1814, is known as *Pembroke Dock*. The dockyard was closed down in 1926.

PEMBROKESHIRE (*Sir Benfro, Dyfed*), the most westerly county of South Wales, bounded north-east by Cardigan, east by Carmarthen, south by the Bristol Channel, and west and northwest by St. Bride's bay and Cardigan bay of St. George's Channel. The coastline is much indented and over 140 m. in length. Area (administrative county) 393,003 acres. Pop. (1921) 91,978.

Geology.—The region falls naturally into an upland northern section of older rocks, and a lowland southern section of somewhat newer rocks. In the north the rocks range from pre-Cambrian near St. Davids to the Ordovician and Silurian, forming the mass of the Preseli hills which reach 1,760 ft. in Preseli Top. The general strike of the beds is south-west to north-east. From the Carmarthenshire border westward the rocks of the northern section of the county become older and older,—Silurian, Ordovician (Arenig, Llandeilo and Bala beds) Cambrian (Lingula Flags and Treinadoc beds) and finally pre-Cambrian granitic (Dimetian) and volcanic (Pebedian) rocks near St. Davids. As the rocks get older to the west so the elevation of the hills becomes reduced and the Preseli finger out to sea forming numerous headlands, islands and bays. The rocks of the north and west are interspersed with igneous material such as the gabbros and diabases of Strumble Head, Fishguard, Llanwnda and Preseli; diorites north-west of St. Davids, bostonites and porphyrites about Abercastle and the basaltic laccolite of Pen Caer, besides various contemporaneous acid lavas and tuffs. The Ordovician and Silurian rocks extend southward to the neighbourhood of Narberth and Haverfordwest, where Arenig, Llandeilo, Bala and Llandovery beds are recorded. Silver-bearing lead has been mined at Llanfyrnach. The southern plain is open to the sea and may be looked upon geologically as a continuation westwards of the south Wales coalfield, with associated Lower Carboniferous, Old Red Sandstone and narrow belts of Silurian rocks, the whole having been considerably folded and faulted, producing a general north-west to south-east strike. The coal measures, highly inclined and anthracitic, stretch across from Carmarthen bay to the shore of St. Bride's bay; they are bordered on the north and south-east by the Millstone Grits, Carboniferous Limestone series and Old Red Sandstone. On account of the folding the limestone appears again farther south at Pembroke, Caldy island and St. Gowan's Head; most of the remaining ground about Milford Haven being occupied by Old Red Sandstone with infolded strips of Silurian. There has been much general subsidence of the coastline and the lower sections of many of the valleys have been drowned. The submerged lower reaches of the eastern and western Cleddan form Milford Haven. There are submerged forests in the vicinity Amroth.

History and Early Settlement.—The outstanding feature of the early history of Pembrokeshire is its importance in Megalithic times. The north-west section of the county (including the southern slopes of the Preseli hills) is especially rich in Megalithic remains—dolmens, alignments, standing stones and stone circles. There are similar remains in the southern half of the county but they are not nearly so marked, as a group, as in the north-western district. This wealth of Megalithic remains suggests that northwest Pembrokeshire had cultural relations with many of the northwest coastal promontories of Europe in the days when metal was beginning to be known in the west. The interest of the stone circle culture in Pembrokeshire was increased when it was shown that the stones forming the inner circle at Stonehenge were derived from rocks in Pembrokeshire (*see* H. H. Thomas "The Source of the Stones of Stonehenge," *Antiquaries Jour.* vol. iii., 1923). There are well preserved dolmens at Longhouse near Mattery, Pentre, Evan, Nevern and near Moylgrove. The stone circle known as Parc-y-Marw near Fishguard is well preserved.

The county does not show a wealth of Bronze Age objects though isolated finds fringe, as it were, the megalithic area. The number of hill-top camps, presumably of Romano-British type and date, is important, especially guarding ways in from the coast, though actual Roman influence in the county is very slight. Castell Flemish on the south-west slopes of the Preseli was probably a military site. It is probable that the hill-top camps continued to be occupied through the post-Roman centuries as the county suffered badly from raiders from over the sea. In Pembrokeshire, as in Ireland, the native cultures lived on uninterrupted by Roman influences, and Pembrokeshire was apparently invaded by the Irish Deisi about A.D. 270. In the early centuries of our era the county maintained its contacts with Ireland and Brittany and became a great centre of Celtic Christianity. Memorials of this period remain in the numerous church dedications and in the beautiful Celtic crosses such as those of Carew, Penally and Nevern. Stones with Ogham inscriptions have been found at Caldy, Bridell, St. Dogmells, Cilgerran and other places. The route that had linked Ireland, Pembrokeshire, Cornwall, Brittany and north-west Spain in Megalithic times became the route of the Celtic saints and, in the middle ages, an important pilgrim's way to the shrine of Santiago da Compostella (north-west Spain) (*see* A. Hartwell Jones, *Y Cymmrodor*, 1912). In a sheltered valley, at a focus of roads from a number of little landing places on the north-west coast of Pembrokeshire, there grew up the great cathedral of St. Davids (*q.v.*), soon to become itself a centre of pilgrimage, and at the landing places were built chapels for the pilgrims. St. Non's and St. Patrick's are probably very early.

Pembrokeshire was known to the Welsh in these early times as Dyfed. On the death of Rhodri Mawr in 877, Dyfed fell nominally under the sway of the princes of Deheubarth, or south Wales; their hold was never very secure, nor were they able to protect the coast towns from the Scandinavian pirates. This is shown by the large number of Scandinavian place names that are found in the coastal districts, especially near the south coast. In 1092 Arnulf de Montgomeri, son of Roger, earl of Shrewsbury, did homage to the king for the Welsh lands of Dyfed. With the building of Pembroke castle, the Normans began to spread over southern Dyfed; whilst Martin de Tours, landing in Fishguard bay and building the castle of Newport at Trêfdraeth, won for himself the extensive lordship of Kemes (Cemmaes) between the river Teifi and the Preseli mountains. Flemish settlers were

planted in the hundred of Rhôs, or Roose, in or about the years 1106, 1108 and 1111 with the approval of Henry I., and again in 1156 under Henry II. The castles of Haverfordwest and Tenby were erected to protect these aliens, and despite the fierce attacks of the Welsh princes their domain grew and their district became known as "Little England beyond Wales." In 1138 Gilbert de Clare was created earl of Pembroke with the full powers of an earl palatine in Dyfed.

Examination of the mediaeval record shows a marked contrast between the *Englishery* of the south with its compact villages and cultivation, and the *Welshery* of the north with its scattered farms and tribal groups. The south was better populated than the north and maintained a closer contact with the affairs of the English plain. It was also the Norman stronghold and the south of the county has long been famous for its mediaeval castles. The finest examples are to be observed at Pembroke; Manorbier, built in the 12th century and interesting as the birthplace and home of Giraldus Cambrensis; Carew, exhibiting many interesting features of both Norman and Tudor architecture; and Picton. Other castles are the keep of Haverfordwest and the ruined fortresses at Narberth, Tenby, Newport, Wiston, Benton, Upton and Cilgerran. There are remains of monastic houses at Tenby and Pembroke, but the most important religious communities were the priory of the Augustinian friars at Haverfordwest and the abbey of the Benedictines at St. Dogmells. The latter, founded by Martin de Tours in the 11th century, owned the priories of Pill and Caldy. Considerable ruins of the abbey exist near the left bank of the Teifi about 1 m. below Cardigan. Of the ancient preceptory of the Knights of St. John at Slebech scarcely a trace remains, but of the college of St. Mary at St. Davids founded by Bishop Houghton in 1377, the shell of the chapel survives.

Interesting examples of mediaeval domestic architecture are the ruins of the former episcopal mansions at Llawhaden, St. Davids and Lamphey, the two latter of which were erected by Bishop Gower between the years 1328–47. The cathedral at St. Davids is, of course, the greatest ecclesiastical monument in the county as well as in the principality. The nave dates largely from 1180–98 and the building was continued into the 13th century. Bishop Gower (1328–47) altered the windows and lifted the roofs of the aisles. Bishop Vaughan (1509–22) built a beautiful chapel with fan-vaulting and increased the height of the tower. The Rood Screen (14th cent.), the mediaeval bishop's throne, the pardon screen, and the stall for the king as a prebend of the cathedral are noteworthy features. St. Mary's, Haverfordwest, is of the 13th century, altered in the 15th.

By the Act of Union (27 Henry VIII.), the king abolished all special jurisdiction in Pembrokeshire. Some parts of the county were for the king in the 17th century, though the influence of the parliament grew as the castles of Tenby and Haverfordwest fell to their arms. In February 1797 some French frigates appeared off Fishguard Bay, but the crews surrendered.

Climate, Occupations and Communications.—The south of the county has more sunshine and less rain than any other region in Wales although it is open to the south-west winds. The chief industry is agriculture, wherein stock-raising is preferred to the growing of cereals. Of cattle the long-horned, black Castlemartin breed is conspicuous. The 19th century saw the establishment of the naval dockyard at Pembroke (Paterchurch) and the building of docks and quays at Neyland and Milford. The closing of the Pembroke Dockyard soon after the war of 1914–18 has seriously affected employment in south Pembrokeshire. The improvements during the early part of the 20th century at Fishguard in the north of the county have made it an important packet station for Ireland, though the attempt to make it a port of call for ocean going liners has failed. The south Wales coalfield extends into south Pembroke, and coal is worked at Saundersfoot, Begelly, Templeton, Kilgetty and other places.

The south Wales branch of the G.W. railway enters Pembrokeshire from the east near Clynderwen Junction, whence the main line leads to Fishguard Harbour. Other lines proceed to Neyland and Milford Haven by way of Haverfordwest, and a branch line from Clynderwen to Goodwick joins the main line at Letterston. The Whitland-Cardigan branch traverses the north-east by way of Crymmych and Cilgerran. Another line running south-west from Whitland proceeds by way of Narberth and Tenby to Pembroke Dock.

Administration.—Municipal boroughs are Pembroke, Haverfordwest (also a county of itself) and Tenby. The hamlet of Bridgend and a part of St. Dogmell's parish are included within the municipal limits of Cardigan. Newport (Trêfdraeth), once the chief town of the barony of Kemes, or Cemmaes, still possesses a mayor and corporation under a charter granted in 1215 by Sir Nicholas Marteine, lord of Kemes, whose hereditary representative still nominates the mayor and aldermen. Milford Haven, Narberth and Fishguard are urban districts. Pembrokeshire lies in the South Wales circuit. By the act of 1918 the county returns one member to parliament. Ecclesiastically, it contains 153 parishes and lies wholly in the diocese of St. Davids.

See R. Fenton, *A Historical Tour through Pembrokeshire* (1810); E. Laws, *History of Little England beyond Wales* (1888); Basil Jones and E. A. Freeman, *History and Antiquities of St. David's* (1856), etc. Ancient Monuments Commission Report, *Pembrokeshire* (1925).

PEMMICAN. A North American Indian (Cree) word for a meat prepared in such a way as to contain the greatest amount of nourishment in the most compact form. As made by the Indians it was composed of the lean parts of the meat, dried in the sun, and pounded or shredded and mixed into a paste with melted fat. It is flavoured with acid berries. If kept dry it will keep for an indefinite time, and is thus particularly serviceable in arctic or other explorations.

PEMPHIGUS, a skin disease, in which large blebs appear, on a red base, containing a clear or yellowish fluid; the blebs occasion much irritation, and when they burst leave raw ulcerated surfaces. The disease is principally known in unhealthy or neglected children. A variety of the malady *pemphigus foliaceus*, affects the whole body, and gradually proves fatal. Pemphigus of an acute septicaemic type may occur in butchers or those who handle hides. In chronic pemphigus, streptococci have been found in the blebs, and improvement has followed injection of a vaccine of streptococci.

PEN, an instrument for writing or for forming lines with an ink or other coloured fluid (Lat. *penna*, a feather, pen). The earliest writing implement was probably the stilus (Gr. γραφίς), a pointed bodkin of metal, bone or ivory, used for producing incised or engraved letters on boxwood tablets covered with wax. The calamus (Gr. κάλαμος) or arundo, the hollow tubular stalk of grasses growing in marshy lands, was the true ancient representative of the modern pen; hollow joints of bamboo were similarly employed. An early specific allusion to the quill pen occurs in the 7th century writings of St. Isidore of Seville, but there is no reason to assume that it was not in use at a still more remote date. The quills still occasionally employed among Western communities as writing instruments are obtained principally from the wings of the goose (*see* FEATHER). In 1809 Joseph Bramah devised and patented a machine for cutting up the quill into separate nibs by dividing the barrel into three or even four parts, and cutting these transversely into "two, three, four and some into five lengths." Bramah's invention first familiarized the public with the appearance and use of the nib slipped into a holder. But a more distinct advance was effected in 1822, when J. I. Hawkins and S. Mordan patented the application of horn and tortoise-shell to the formation of pen-nibs, the points of which were rendered durable by small pieces of diamond, ruby or other very hard substance, or by lapping a small piece of thin sheet gold over the end of the tortoise-shell.

Metal Pens.—Metallic pens, though not unknown in classical times—a bronze pen found at Pompeii is in the Naples museum—were little used until the 19th century and did not become common till near the middle of that century. It is recorded that a Birmingham split-ring manufacturer, Samuel Harrison, made a steel pen for Dr. Joseph Priestley in 1780. Steel pens made and sold in London by a certain Wise in 1803 were in the form of a tube or barrel, the edges of which met to form the slit, while the sides were cut away as in the case of an ordinary quill. Their

price was about five shillings each, and as they were hard, stiff and unsatisfactory instruments they were not in great demand. To John Mitchell probably belongs the credit of introducing machine-made pens, about 1822, and James Perry is believed to have been the first maker of steel slip pens. In 1828 Josiah Mason, who had been associated with Samuel Harrison in the manufacture of split rings, saw Perry's pens on sale in Birmingham, and after examining them saw his way both to improve and to cheapen the process of making them. He therefore put himself in communication with Perry, and the result was that he began to make barrel pens for him in 1828 and slip pens in 1829. Perry, who did much to popularize the steel pen and bring it into general use, in his patent of 1830 sought to obtain greater flexibility by forming a central hole between the points and the shoulders and by cutting one or more lateral slits on each side of the central slit; and in 1831 an improvement, which consisted in forming elongated points on the nibs of the pens, was described by Joseph Gillott.

The metal used consists of rolled sheets of cast steel of the finest quality made from Swedish charcoal iron. These sheets, after being cut into strips of suitable width, annealed in a muffle-furnace and pickled in a bath of dilute sulphuric acid to free the surface from oxidized scale, are rolled between steel rollers till they are reduced to ribbons of an even thickness, about $\frac{1}{180}$ inch. From these ribbons the pen blanks are next punched out, and then, after being embossed with the name of the maker or other marks, are pierced with the central perforation and the side or shoulder slits by which flexibility is obtained. After another annealing, the blanks, which up to this point are flat, are "raised" or rounded between dies into the familiar semi-cylindrical shape. The next process is to harden and temper them by heating them in iron boxes in a muffle-furnace, plunging them in oil, and then heating them over a fire in a rotating cylindrical vessel till their surfaces attain the dull-blue tint characteristic of spring-steel elasticity. Subsequently they are "scoured" in a bath of dilute acid, and polished in a revolving cylinder. The grinding of the points with emery follows, and then the central slit is cut by the aid of two very fine-edged cutters. Finally, the pens are again polished, are coloured by being heated over a fire in a revolving cylinder, and in some cases are coated with a varnish of shellac dissolved in alcohol. Birmingham was the first home of the steel-pen industry, and continues its principal centre. The manufacture on a large scale was begun in the United States about 1860 at Camden, N.J.

Metals other than steel have frequently been suggested by inventors, those most commonly proposed being gold, silver, zinc, German silver, aluminium and aluminium bronze. The latest development, introduced in 1926, is the manufacture of pens made from stainless steel. These pens are unaffected by the acids in all inks and are impervious to extreme climatic conditions.

Various devices have been adopted in order to increase the time for which a pen can be used without a fresh supply of ink. For these, *see* FOUNTAIN PEN.

PENALTY: *see* DAMAGES.

PENANCE, strictly, repentance of sins. Thus in the Douai version of the New Testament the Greek word μετάνοια is rendered "penance," where the Authorized Version has "repentance." The two words, similar in their derivation and original sense, have however come to be symbolical of conflicting views of the essence of repentance, arising out of the controversy as to the respective merits of "faith" and "good works." The Reformers, upholding the doctrine of justification by faith, held that repentance consisted in a change of the whole moral attitude of the mind and soul (ἐπιστρέφεσθαι, Matt. xiii. 15; Luke xxii. 32), and that the Divine forgiveness followed true repentance and confession to God without any reparation of "works." In the Roman Catholic Church the sacrament of penance consists of three parts: *contritio, confessio, satisfactio. Contritio* is in fact repentance as Protestant theologians understand it, *i.e.*, sorrow for sin arising from love of God; but "reconciliation" can not follow such contrition without the other parts of the sacrament, which form part of it. The word "penance," applied to the whole sacrament, is also used of the works of satisfaction imposed by the priest on the penitent, *i.e.*, the temporal punishment (*poena*). (*See* CONFESSION.)

PENANG, the town and island which, after Singapore, form the most important part of the British crown colony of Straits Settlements. The island is situated in 5° 24′ N. and 100° 21′ E., and distant about 2½ m. from the west coast of the Malay peninsula. It is about 15½ m. long by 10½ m. wide at its broadest point. Its area is 108 square miles. The town, which is built on a promontory nearest to the mainland, is largely occupied by Chinese and Tamils, though the Malays are also well represented. Behind the town, Penang hill rises to a height of 2,428 ft., and upon it are built several government and private bungalows and a hotel. There is a fine hill-railway. The town possesses European clubs, a racecourse, and golf links. Coconuts are grown along the seashore, and rice is cultivated at Balek Pulau and in the interior. Penang has an excellent harbour, but has suffered from its proximity to Singapore.

Since 1867 Penang has been under the administrative control of a resident councillor who is responsible to the governor of the Straits. He is aided by officers of the Malayan Civil Service. Unofficial members of the legislative council of the colony, which holds its sittings in Singapore, are appointed, with the sanction of the secretary of state for the colonies, to represent Penang. Their term of office is for three years. The official name of the island is Prince of Wales island and that of the town is Georgetown.

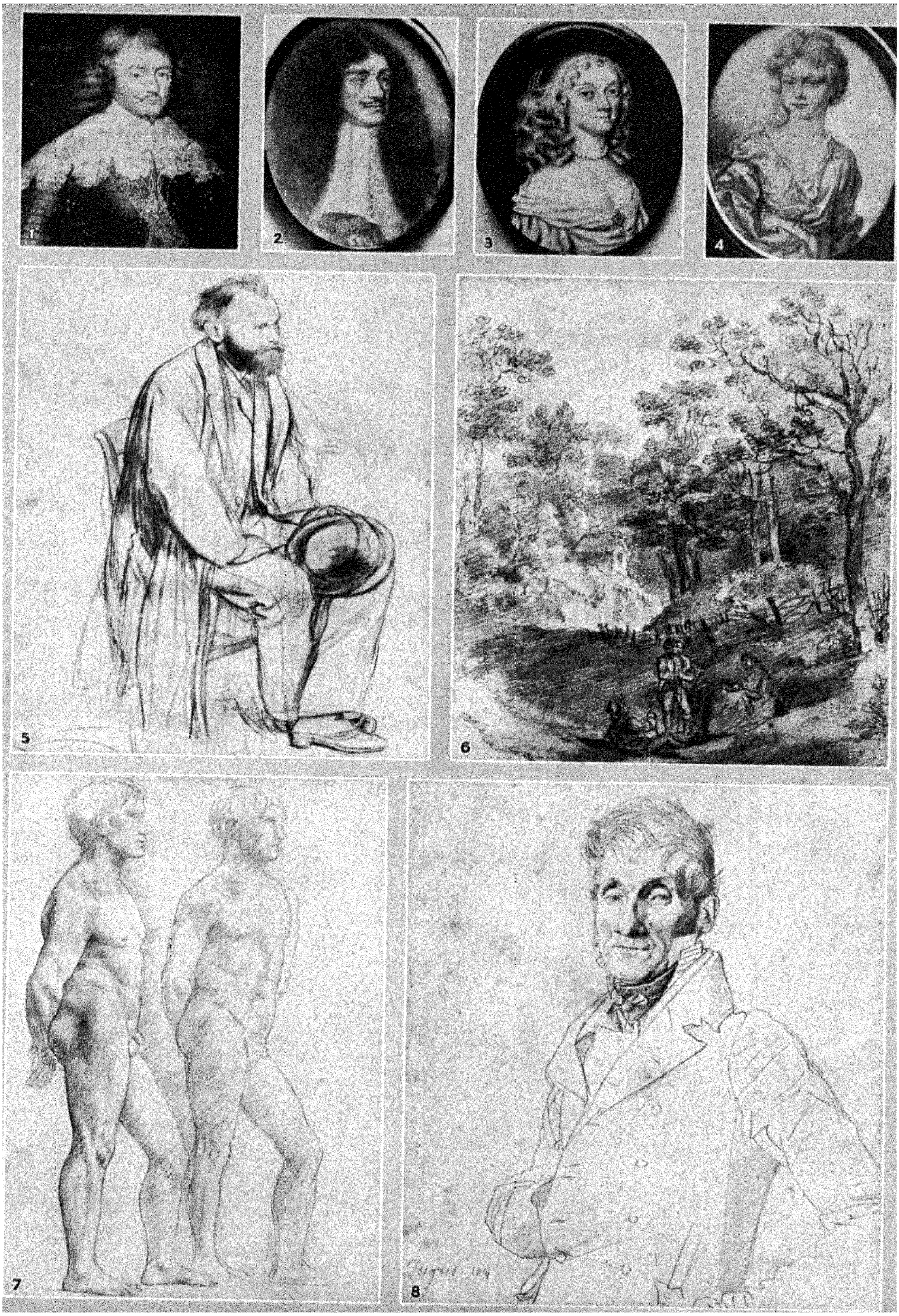
The population of the whole settlement of Penang at the census of 1921 was 304,335; population of municipality, 123,069 in 1921.

The number of ships which entered and left the port of Penang during 1926 was 6,217 with an aggregate tonnage of 11,408,303. Of these 4,497 were British with an aggregate tonnage of 7,412,642. There are no port dues.

Penang was founded on July 17, 1786, having been ceded to the East India Company by the sultan of Kedah in 1785 by an agreement with Captain Light. It was then almost uninhabited, and was made a penal settlement. In 1805 Penang was made a separate presidency, and when in 1826 Singapore and Malacca were incorporated with it, Penang continued to be the seat of government. In 1837 Singapore was made the capital of the Settlements. In 1867 the Straits Settlements were created a Crown colony, in which Penang and Malacca were included.

PENARTH, an urban district and seaport, suburb of Cardiff, Glamorganshire, Wales, situated on rising ground on the south side of the mouth of the Ely opposite Cardiff. Pop. (1921) 17,104. With modern additions the length of the tidal harbour is 13,000 ft. with a total frontage, Penarth and Cardiff sides, of 15,000 ft. The average width at high water for the first reach of the river is 600 ft., length 4,000 ft., area 55 acres. The Windsor double slipways between Penarth and Cardiff take vessels 350 ft. and of 3,500 gross tonnage. Penarth mainly exports coal although the tonnage has fallen considerably since 1921 due to the depression following the World War. Timber, pulp, iron ore are imported. The G. W. R. Co. owns the docks. Penarth is a seaside resort.

PENATES, Roman gods of the store-room, properly *di penates* (Lat. *penus*). This was, in old times, beside the *atrium*, the room which served as kitchen, parlour, and bedroom in one; but in later times was in the back part of the house. In private cult they were associated with Vesta (*q.v.*), if indeed Vesta is not to be accounted one of them (*see* Servius on Virgil, *Aen.* xi. 211), and the *lares* (*q.v.*). A little offering of food was made at each meal on such occasions as birthdays, marriages, and safe returns from journeys, the images were crowned and offerings made to them of cakes, honey, wine, incense, and sometimes a pig (*see* ROMAN RELIGION). As each family had its own penates, so the State, as a collection of families, had its public penates. The other towns of Latium had their public penates as well as Rome. The sanctuary of the whole Latin league was at Lavinium. To the penates at Lavinium the Roman priests brought yearly offerings, and the Roman consuls, praetors, and dictators sacrificed both when they entered on and when they laid down their office. To them, too, the generals sacrificed before departing for their province. Alba Longa had also its ancient penates, and the Romans maintained the worship on the Alban



BY COURTESY OF (5-8) THE METROPOLITAN MUSEUM OF ART, NEW YORK; FROM (1-4) THE G. C. WILLIAMSON COLLECTION

FRENCH AND ENGLISH PENCIL DRAWINGS

1. Drawing in "plumbago," with some wash work, of Sir Bevil Grenville, dated 1636, by Peter Oliver (1594–1648), English. 2. Drawing in "plumbago" of Charles II., by David Loggan (1635–1700). 3. Drawing of Mary, daughter of the 1st Marquis of Lothian, by David Paton (fl. 1650–1700), English. 4. Drawing in "plumbago" on vellum of Elizabeth, Viscountess Tracy, by Thomas Forster (fl. 1695–1712), English. 5. Portrait of Edward Manot, by Edgar Degas (1834–1917), French. 6. Landscape by Thomas Gainsborough (1727–88), English. 7. Study by Alphonse Legros (1837–1911), French. 8. Portrait of an Unknown Man, by J. A. D. Ingres (1780–1867), French

mount long after the destruction of Alba Longa. The penates had a temple of their own at Rome. It was on the Velia near the Forum, perhaps on the site of the church of SS. Cosma e Damiano (*see* P. B. Whitehead in *Amer. Journ. Archae.* xxxi. p. 1 *et seq.*, 1927). In this and many other temples the penates were represented by two images of youths seated holding spears.

The origin and nature of the *penates publici* was a subject of much discussion to the Romans themselves. They were traced to the mysterious worship of Samothrace; Dardanus, it was said, took the penates from Samothrace to Troy, and after the destruction of Troy, Aeneas brought them to Italy and established them at Lavinium. From Lavinium Ascanius carried the worship to Alba Longa, and from Alba Longa it was brought to Rome. Others said they were the great gods to whom we owe breath, body, and reason, viz., Jupiter representing the middle æther, Juno the lowest air and the earth, and Minerva the highest æther, to whom some added Mercury as the god of speech (Servius, on *Aen.* ii. 296; Macrobius, *Sat.* iii. 4, 8; Arnobius, *Adv. Nat.* iii. 40). Others identified them with Apollo and Neptune. The so-called Etruscan penates were said to be Ceres, Pales, and Fortuna, to whom others added *Genius Iovialis* (Servius on *Aen.* ii. 325; Arnob. *loc. cit.*). Martianus Capella places the penates in the first of his 16 celestial regions.

See G. Wissowa, *Gesammelte Abhandlungen*, p. 95 *et. seq.* (*Hermes*, xxii. p. 29 *et seq.*); and in Roscher's *Lexikon* (*s.v.*); R. Thulin, *Die Götter des Martianus Capella.*

PENCIL, a name originally applied to a small, fine pointed brush used in painting, and still employed to denote the finer camel's-hair and sable brushes used by artists (Lat. *penicillus*, brush; literally, little tail), but now commonly signifying a solid rod of marking material used for writing and drawing, either encased in wood or enclosed in some form of holder.

It has been asserted that a manuscript of Theophilus shows signs of having been ruled with a black-lead pencil; but the first distinct allusion to a pencil occurs in the treatise on fossils by Conrad Gesner of Zurich (1565) who describes an article for writing formed of wood and a piece of lead, or as he believed, an artificial composition called by some *stimmi anglicanum* (English antimony). The famous Borrowdale mine in Cumberland having been discovered about that time, it is probable that we have here the first allusion to that great find of graphite. While the supply of the Cumberland mine lasted, the material for English pencils consisted simply of the native graphite as taken from the mine.

Strenuous efforts were made, however, to render manufacturers independent of the Cumberland mine, whose supplies showed signs of exhaustion. In Nuremberg, where the great business of the family Faber (*q.v.*) was established in 1760, pencils were made from pulverized graphite cemented into solid blocks by means of gums, resins, glue, sulphur and similar adhesives, but none of these preparations yielded useful pencils. In 1795 N. J. Conté first produced pencils made of graphite which had been ground with certain clays, pressed into sticks and fired in a kiln. This method forms the basis of manufacture of all modern pencils.

Manufacture of Pencils.—Graphite (*q.v.*) and selected clays are mixed together in proportions determined by experiment and research. The materials are mixed in water and ground in heavy mills. Here is determined quality and degree; the quality by the selection of material and the intensity of grinding; the degree by the proportions of clay and graphite. After grinding, the mass is transferred to a specially prepared filter press and subjected to intense pressure, usually hydraulic, to squeeze out surplus moisture and obtain close texture. The mass so made, of a very firm consistency and just plastic, is inserted into heavy power-driven presses to be forced through an aperture of the desired diameter and shape, whence there exudes a thin, still plastic, string-like strip which is laid on boards to dry. After drying, the leads are sealed in crucible boxes and fired in kilns to a suitable heat to vitrify the clay; the temperature varies from 600° to 1,200° C.

Cedar for Pencils.—Cedar wood is found in many countries, but the fine aromatic, soft, straight-grained wood most suitable for the manufacture of pencils (*Juniperus virginiana*) comes from the United States. Wood of similar class is grown in large quantities in the parallel belt of Africa, particularly in Kenya, but the Kenya wood is harder, heavier, and inferior to the American variety. Owing to the steady exhaustion of cedar wood from Virginia, Californian Incense Cedar was introduced to the industry about 1900 and is now largely used for the cheaper grades of pencils.

The slats of cedar require careful maturing to prevent warp. They are cut into various widths according to the size and growth of the log, but where possible they are produced wide enough to enable seven pencils to be manufactured simultaneously. The slats are planed and grooved in such a manner that when the two planed surfaces are brought together the grooves form either a round or other aperture which correctly embraces the lead. The surfaces are glued and the boards are clamped in piles, to be subsequently transferred to automatic shaping machines where they are reduced to single pencils, by appropriate machine tools.

The manufacture of "leads" for coloured pencils varies from the method used for the graphite pencils, the basis being kaolin blended with suitable waxes and gums, which are ground together with the necessary colour to obtain the tint required. The firing process is eliminated.

"Copying" pencils used to be constructed on the same lines, with a substitution of aniline dye as the colouring matter. About 1898 improvements were made in copying pencils by blending graphite and aniline dye together. (F. P. Do.)

PENCIL DRAWING. A pencil drawing is one made by a piece of graphite sharpened into a fine point, and held in a porte-crayon, and the term is usually applied to a drawing made with this material upon vellum or parchment. The greatest masters of this particular art were Dutchmen, and the best productions were those of the 17th century. In a great many instances it is quite certain that the extremely elaborate plumbago (graphite) drawings done by Dutch artists were intended for the purpose of engravings, and of several of them, this can be proved by putting the finished engraving by the side of the elaborate plumbago drawing. Considering the clumsiness of the material, it is amazing that the artists elaborated such exceedingly delicate and beautiful work as many of these plumbago drawings exhibit. It seems almost certain that they must have been drawn under a lens, and it is clear that the artist possessed a steady hand to a very unusual degree.

One of the earliest workers in plumbago was Simon van de Pass (1595?–1647) whose pencil drawings were almost certainly either for reproduction on silver tablets or counters or for engraved plates. Abraham Blooteling, the Dutch engraver, executed a very few portraits, but they appear to have been only first sketches, from which eventually he made larger ones, and from these engraved his plates. He was followed by the man who is perhaps the greatest exponent of the art of drawing in plumbago, David Loggan (1635–1700), a pupil of Van de Pass, and a man well known for his long series of engravings representing the colleges of Oxford and Cambridge. He executed portraits with the utmost dexterity, and with marvellous minuteness, the lines representing the intricacies of a lace ruffle, or the curls of a wig, being unusually perfect. Better known is William Faithorne (*q.v.*).

Next in eminence and skill comes Thomas Forster (*fl.* 1695–1712). He was one of the greatest draughtsmen in this particular form of portraiture. Forster was responsible for a few prints, but examples of them are of the utmost rarity. His work can be studied with advantage in the Holburne Museum at Bath, at Welbeck Abbey, or at the Victoria and Albert Museum, London.

There are two other Englishmen who should be mentioned, Robert and George White, father and son. The former (1645–1704) was a pupil of David Loggan (who originally came from Danzig); he was a prolific engraver, most of whose drawings in plumbago on vellum were evidently executed for the purpose of engraving. George White, his son (1684–1732) was taught by his father, and finished some of his father's plates.

Reference must also be made to the use of plumbago by the painters of miniatures in colour. Hilliard used plumbago for preparing designs for jewels and for seals, Isaac and Peter Oliver for sketches in portraiture. A draughtsman in plumbago whose works are exceedingly scarce was David Paton, who worked in

1670. Then there were early engravers, such as George Glover (d. 1618) and Thomas Cecill (*fl.* 1630), who executed plumbago drawings, evidently studies for engravings. Of Glover's work the only known signed example is in the writer's collection. The work of Jonathan Richardson (1665–1745) and also the work of his son must be alluded to, but it is believed that, by their time, the graphite had been enclosed in a wooden rod, and that therefore the drawings may more naturally be called pencil drawings.

Draughtsmen in Indian ink have prepared portraits on very much the same lines. Among them were the two Fabers (1660?–1721 and 1695?–1756) in Holland, the elder having been born at The Hague, as he himself stated on his portrait which was in Vertue's collection. Of the two the son was the greater artist, although both of them were responsible for many very fine portraits drawn in Indian ink, as a rule circular, often set within lined borders and frequently adorned with coats of arms and inscriptions, equally minute and wonderful. Another able worker in Indian ink was a Swede, Charles Bancks (*c.* 1748), and another, a Swiss, Joseph Werner, born 1637, who made his drawings upon brown paper, and in some cases heightened the work with touches of white paint. Amongst other exponents of this art are the following: Thomas Worlidge (1700–1766), F. Steele (*c.* 1714), W. Robins (*c.* 1730), G. A. Wolfgang (1692–1775).

PENCILS IN ART

Architectural draftsmen, renderers, engineering draftsmen and artists find lead pencils indispensable in their work. Hard, medium and soft pencils are necessary with every pencil artist, and he must make his own selection to fit his own needs. The uses of the various degrees of hardness are shown in the following table:—

Perspective and Object Drawing	Grades 3B to HB
Nature Drawing	Grades 3B to H
Pose Drawing	Grades 3B to B
Scientific Drawings	Grades HB to 9H
Mechanical and Architectural Drawing	Grades HB to 3H
Lettering	Grades 2B to H
Commercial Art	Grades 3B to HB
Artists' Sketching	Grades 6B to 3H
Architectural Renderings	Grades 4B to 3H
Engineering Drawings	Grades HB to 9H
Commercial Drafting and Design	Grades HB to 9H

Broadly speaking, a soft pencil is used for dark tones and a hard pencil is used for light tones. A very soft pencil will produce a light tone, but the quality is not as fine, and a fuzzy appearance is likely to occur instead of the easy, flowing quality of a hard lead. The pressure can be determined only by constant practice, and both hard and soft pencils, as well as various qualities of paper, should be used by the young artist.

(*See* also DRAWING, ENGINEERING; DRAWING, ANATOMICAL; RENDERING, ARCHITECTURAL; PEN-DRAWING; CARTOON; ILLUSTRATION.) (J. LEC.)

PENCK, ALBRECHT (1858–), German geographer, was born at Reuditz, near Leipzig, on Sept. 25, 1858. He studied at Leipzig and afterwards taught in Munich. He was a professor at Vienna from 1885 to 1906 when he removed to Berlin. His chief work in Berlin was the extension of the marine museum and the geographical institute of the university, of which he became director. During a long series of travels in different parts of the world Penck made special studies in connection with the Ice Age and the formation of glaciers in the Tertiary and Diluvial periods, and also some outstanding contributions to scientific knowledge in the sphere of hydrography. Before the World War he acted for a time as professor at Columbia university, New York City. In the field of practical geography Penck did valuable work in promoting the production of a map of the earth on a scale of 1:1,000,000 (*see* MAP).

His publications include *Die Vergletscherung der deutschen Alpen* (1882); *Die Donau* (1891); *Morphologie der Erdoberfläche* (2 vols., 1894); *Die Alpen im Eiszeitalter,* with E. Brückner (3 vols., 1901–09).

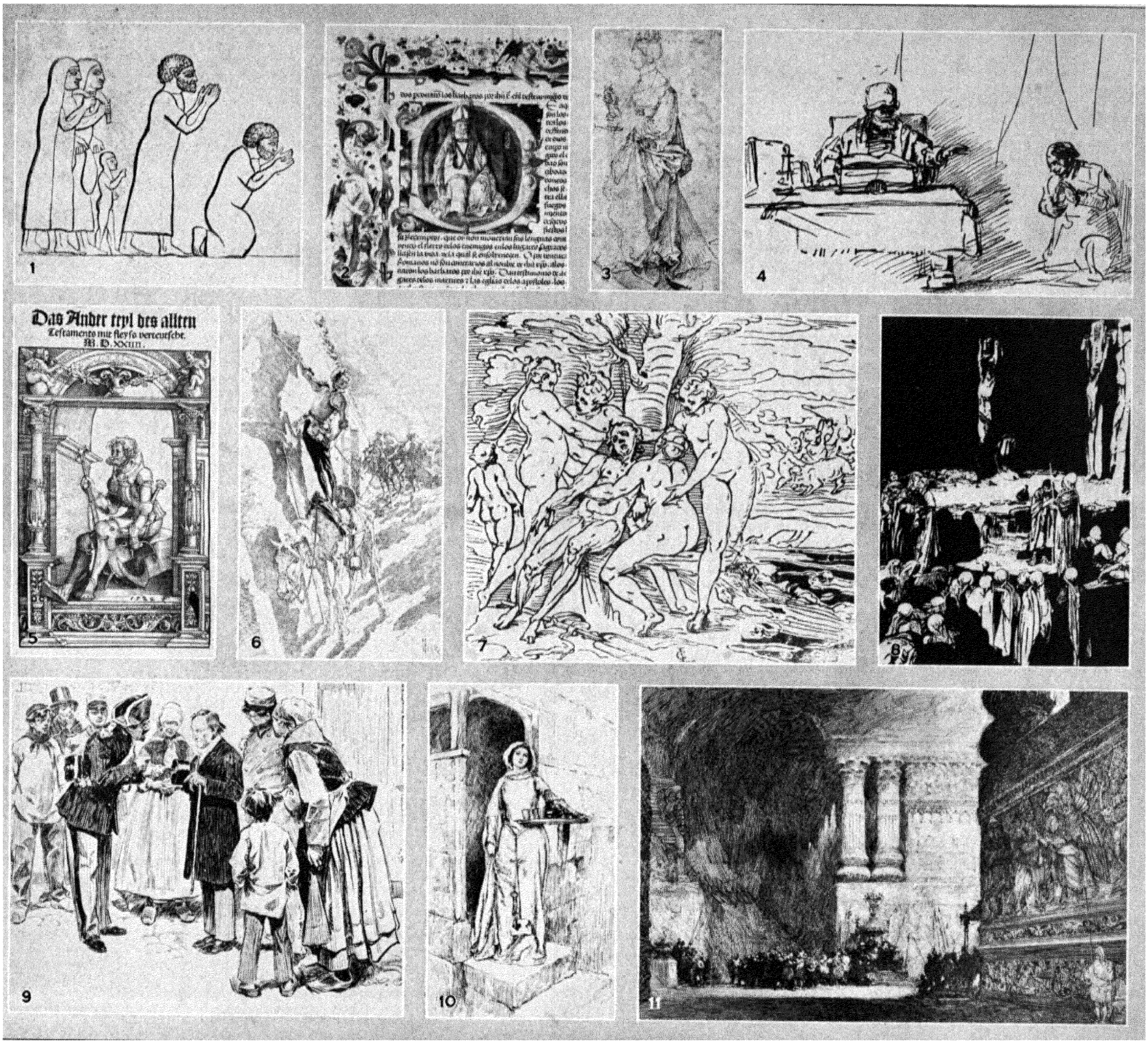
PENDA, king of Mercia (d. 654 or 655), son of Pybba, probably came to the throne in 626, but it is doubtful whether he actually became king of Mercia until 633, the year of the defeat and death of Edwin of Northumbria. According to the Anglo-Saxon Chronicle he was eighty years old at his death, but the energy of his administration and the evidence with regard to the ages of his children and relatives render it almost impossible. In 628 the Chronicle records a battle between him and the West Saxons at Cirencester in that year. In 633 Penda and Ceadwalla overthrew Edwin at Hatfield Chase; but after the defeat of the Welsh king Oswald at "Hefenfelth" in 634, Mercia seems to have been for a time subject to Northumbria. In 642 Penda slew Oswald at a place called Maerfeld. He was continually raiding Northumbria and once almost succeeded in reducing Bamborough. He drove Cenwalh of Wessex, who had divorced his sister, from his throne. In 654 he attacked the East Angles, and slew their king Anna. (*See* EAST ANGLIA.) In 654 or 655 he invaded Northumbria in spite of the attempts of Oswio to buy him off, and was defeated and slain on the banks of the "Winwaed." In the reign of Penda the districts corresponding to Cheshire, Shropshire and Herefordshire were probably acquired, and he established his son Peada as a dependent prince in Middle Anglia. Although a pagan, he allowed his daughter Cyneburg to marry Alchfrith, the son of Oswio, and it was in his reign that Christianity was introduced into Middle Anglia by his son Peada.

See Bede, *Hist. Eccl.* (ed. C. Plummer, Oxford, 1896); *Anglo-Saxon Chronicle* (ed. Earle and Plummer, Oxford, 1899).

PENDENTIVE, in architecture, a triangular segment of a spherical surface, filling in the upper corners of a square, rectangular or polygonal room, in order to form, at the top, a circular support for a dome. Its intersections with the walls against which it abuts are semi-circles, and are usually carried by arches. The problem of supporting a dome over a square or polygonal hall was of continually growing importance to the late imperial Roman builders. This they attempted to solve, either by corbelling out the corners, projecting each course of masonry slightly over the one below, or by throwing across the corner diagonal arches or niches, which are known as squinches (*q.v.*). An early approximation of the pendentive form occurs in a domed room in one of the side buildings of the baths of Caracalla (A.D. 217). This form, however, was obtained by corbelling, whereas the true pendentive is built like a portion of a dome with radiating joints, and it remained for the Byzantine architects to recognize the possibilities of the form and give it definitive development. One of the earliest examples is also one of the largest—that of the great church of S. Sophia at Constantinople (begun 532). Pendentives occur commonly in the domed Romanesque churches of Aquitania in France, as in S. Front at Perigueux (begun 1120). They occur spasmodically in Romanesque work in Italy. During the Renaissance the development of domed churches gave great importance to the pendentive. Owing to Byzantine influence, pendentives are frequent in Mohammedan architecture, often decorated with stalactite ornament, or sometimes, as in Persia, with delicate ribbing. A vaulting form in which the curve of the pendentive and dome is continuous, without a break, is known as a pendentive dome. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE; DOME.)

PENDER, SIR JOHN (1816–1896), British cable pioneer, was born in the Vale of Leven, Scotland, on Sept. 10, 1816. His name is chiefly known in connection with submarine cables, of which on the commercial side he was promoter. He was one of the 345 contributors who each risked a thousand pounds in the Transatlantic Cable in 1857, and when the Atlantic Telegraph Company was ruined by the loss of the 1865 cable he formed the Anglo-American Telegraph Company to continue the work. Subsequently he fostered cable enterprise in all parts of the world, and at the time of his death, which occurred at Footscray Place, Kent, on July 7, 1896, he controlled companies having a capital of 15 millions sterling and owning 73,640 nautical miles of cables. He represented Wick Burghs in parliament from 1872 to 1885 and from 1892 to 1896. He became G.C.M.G. in 1892.

PENDLETON, EDMUND (1721–1803), American lawyer and statesman, was born in Caroline county, Va., on Sept. 9, 1721. In 1774 he became president of the Virginia provincial convention and in 1776, as president, he drew up the instructions to the Vir-



BY COURTESY OF (2, 3, 5, 7) THE METROPOLITAN MUSEUM OF ART, NEW YORK, (10) MRS. E. A. ABBEY; PHOTOGRAPHS, (1) JOHN P. NEWMAN "THRONES AND PALACES OF NINEVEH" (HARPER AND BROTHERS), (4) JOSEPH PENNELL, "PEN DRAWING AND PEN DRAUGHTSMEN" (MACMILLAN), (6) CERVANTES, "DON QUIXOTE" (E. BENN, LONDON, AND CHARLES SCRIBNER, NEW YORK), (8) FROM "GLI ADORNATORI DEL LIBRO IN ITALIA" (CESARE RATTA), (9) C. D. GIBSON, "EDUCATION OF MR. PIP" (LIFE PUBLISHING COMPANY)

EXAMPLES OF PEN DRAWING AND ITS PROTOTYPES

1. "Jewish Captives," a bas-relief in simple outline on the palace wall of Sardanapalus in ancient Nineveh (*c.* 668–628 B.C.)
2. Page from a 14th century Italian manuscript with border; combined pen and brush lettering
3. "St. Catherine" by Albrecht Dürer (1471–1528), German painter and etcher
4. "The Unfaithful Servant" by Rembrandt van Rijn (1606–74). Dutch
5. Title page of Old Testament from the Luther Bible, 1524, drawn and designed by Erhard Schoen, printed at Nürnberg by Friedrich Peypus
6. "Don Quixote Tied to the Window," an illustration drawn by Daniel Vierge for Thomas Shelton's translation of Cervantes' "Don Quixote," 1906
7. "Venus Lamenting the death of Adonis" by Luca Cambiasi (1527–85), signed with his monogram, L. C. Italian
8. "The Crucifixion" by G. Aristide Sartorio (1861–). Contemporary. Italian
9. "Mr. Pip loses his way." From the "Education of Mr. Pip," 1898, by Charles Dana Gibson, American
10. "Enter Mistress Ann Page with wine," from the "Comedies of Shakespeare" series, 1896, by Edwin Austin Abbey (1852–1911). American
11. "The House of Rimmon" by Franklin Booth, American, contemporary

ginia members of Congress directing them to advocate the independence of the American colonies. In the same year he was chosen the first speaker of the House of Delegates. With Jefferson and Chancellor George Wythe he drew up a new law code for Virginia. He was president of the court of chancery from 1777 to 1788, and was president of the Virginia court of appeals from 1779 until his death at Richmond, Va., on Oct. 23, 1803.

PENDLETON, GEORGE HUNT (1825–1889), American lawyer and legislator, was born in Cincinnati, O., on July 25, 1825. He was educated at the University of Heidelberg, studied law, was admitted to the bar, and began to practise at Cincinnati. He was a member of the Ohio Senate in 1854 and 1855, and from 1857 to 1865 was a Democratic member of the national House of Representatives, in which he opposed the war policy of Lincoln. In 1864 he was the Democratic candidate for Vice-President. After leaving Congress he became one of the earliest champions of the "Ohio idea" (which he is said to have originated), demanding that the government should pay the principal of its 5-20 year 6% bonds in the "greenback" currency instead of in coin. The agricultural classes of the west regarded this as a means of relief, and Pendleton became their recognized leader and a candidate for the Democratic nomination to the Presidency in 1868, but he failed to receive the requisite two-thirds majority. In 1869 he was the Democratic candidate for governor of Ohio, but was defeated by Rutherford B. Hayes. For the next ten years he devoted himself to the practice of law and to the supervision of the Kentucky Railroad Company, of which he had become president in 1869. From 1879 to 1885 he was a Democratic member of the United States Senate, and introduced the so-called Pendleton Act of 1883 for reforming the civil service, hostility to which lost him his seat in 1885. He was minister to Germany from 1885 to the summer of 1889, and died at Brussels on Nov. 24, 1889.

PENDLETON, a city of north-eastern Oregon, U.S.A., on the Umatilla river, at an altitude of 1,070 ft., 220 m. E. of Portland; the county seat of Umatilla county. It is on the Oregon Trail and the Oregon-Washington highway, and is served by the Northern Pacific and the Union Pacific railways and motor-coach lines. Pop. (1920) 7,387 (89% native white); 1928 local estimate 8,000. The city lies in the midst of vast tracts of wheatlands, cultivated by large-scale methods, and considered one of the highest yielding sections in the north-west. The county produces annually 6,000,000 bu. of grain, 1,500,000 lb. of wool, 175,000 tons of hay, and fruits, live stock, dairy products and poultry to the value of over $4,000,000. Pendleton is the principal distributing centre for this region, and has important manufacturing industries, including flour, woollen and planing mills, a large packing plant and factories making roofing material, weeders and harness and saddles. Its retail trading area has a radius of 40 miles. The assessed valuation of property in 1927 was $7,200,000. Pendleton is the seat of the Eastern Oregon Hospital for the Insane and of a summer session conducted by the State normal school. The Umatilla Indian Reservation lies a few miles east of the city. Pendleton was founded in 1869 and was incorporated as a city in 1880.

PEN DRAWING. The art of line drawing is perhaps the oldest of the graphic arts. The Greeks seem to have considered drawing and writing as essentially the same process, since they used the same word for both. This points to the early identity of the two arts when drawing was a kind of writing and when such writing as men had learned to practise was essentially what we should call drawing, though of a crude and simple kind.

Materials.—The earliest pens were made of the bamboo reed, the hollow stalk of the calamus, or other wood with the end frayed or pulped. Greek and Roman scribes at a later time used reeds cut to a point and slit like the modern pen; copper pens of the same type, of Roman manufacture, are to be found in museums to-day. This pen possibly antedated the common use of the quill pen made from the wing feather of the goose. Ink, in its earliest form, was made from soot and charcoal mixed with gum; there were also vegetable stains and berry juices. In China the invention of ink is credited to Tien-Tcheu who lived between 2697 B.C. and 2597 B.C. One of the oldest books known, the maxims of that ancient Egyptian ruler Ptah-hotep, dating from beyond the 25th century B.C., shows the use of red and black inks. The development of these mediums, however, was not toward a graphic art, but rather toward the written word, of history and literature, devoid of design or pictorial embellishment. (*See* INK.)

For paper, the barks of trees (especially lime trees), papyrus, linen and the prepared skins of calf or sheep, as well as vellum and parchment, were used. Finally the use of parchment replaced that of papyrus because of its susceptibility to ready erasures, its two usable sides and its thinness. The old scroll and the triptych of wax gave way to the codex with its leaves of vellum. With this convenient form under his hand the scribe for once became the artist and his pen found a facility which brought forth some of the most treasured contributions to the graphic arts; these are the hand-lettered, illuminated books which began to appear a little later than the 4th century and reached their greatest beauty during the following two or three centuries.

The basis of the many beautiful designs in these books is the pen line, with flat tones of colour and applications of burnished gold. With the invention of printing, which began with Gutenberg, with the first printed date of 1454, and the development of means of reproducing the line drawing, the art of the book continued. This was, in fact, the beginning of pen and ink art and, incidentally, of illustration, which is that art that accompanies the written word and adorns the printed page.

Development.—The art of pen and ink, as we know it, began with outline drawing as practised by Villard de Honnecourt and others in the Gothic period. The Florentine masters of the early Renaissance such as Pollaiuolo and Botticelli excelled in the rendering of form; shapes were well defined by means of a continuous and rhythmic outline, and Leonardo da Vinci combined the well defined outline with delicate shading in parallel lines. Michelangelo modelled the muscles in detail by numerous little crosslines and his outline is not continuous; Raphael excelled in sureness of line and in the suggestion of form by the simplest means; in north Italy Pisanello, by delicate pen strokes, rendered the texture of things such as the hairy furs of animals; the Caraccis and the Bolognese school developed a pictorial style by the close study of nature and the practice of engraving; Guercino's and Barocci's brilliant studies were highly prized though not free from mannerism. This pictorial style reached its height in the drawings of two Flemings, Rubens and Vandyck, who were deeply impressed with Italian art. Their drawings are inspired by a very robust reality in which the visible surface of things is observed in detail; their style is curiously informal. The deliberate, ordered calligraphy of the earlier northern engravers, of Dürer, Schongauer, Lucas and Leyden, is replaced by a fluent literal draughtsmanship where colour and tone are suggested by cross-hatching or washes.

Rembrandt is the greatest exponent of the pen and wash technique. He relied mainly on delicately toned washes for the rendering of light and shade in his expressive drawings. Other followers of this method, each in his distinctive style, were Claude de Lorraine with his fine pen-drawings of Italian landscapes, Nicolas Poussin with his careful preliminary studies for composition, and Tiepolo with his sketchy technique. Many more draughtsmen might be mentioned, their drawings pretended no detached place as works of art, and no strict adherence to the limitations of the pen was observed. It was with the development of process reproduction at the beginning of the 19th century that pen and ink art as a separate art came into being.

Technique.—Three main divisions appear in the method of the pen and ink drawing, which have been vaguely mentioned in speaking of the drawings of Rembrandt, da Vinci and Rubens. The first of these deals with sheer line or draughtsmanship with slight or strong allowance toward tone; the second deals with tone conception, as of the colourist, with much or little allowance toward line; and the third deals with line and tone or colour equally estimated and treated consciously as in design. Upon closer study, however, these general methods fall into six more specific divisions: (1) The outline or open drawing, in which much or little may be included. The range of this method may run from the

fragmentary or the compact line, of the manner of Holbein, to the manner of Heinrich Kley, who plays so continuously upon outline, even upon the outlines of the inner bones of animals and men, that tone finally appears. (2) Outline with shadow massings in slow or fast line tone, as in the case of much of Vierge's work and that of Charles Keene and of Griggs. In this method much is made of the two-tone effect with white the strong value; it may reach the other extreme, wherein the low tone becomes a brush black, dominating the whole drawing with the white high-lights arising out of it constituting the structure of the picture, as in the work of Sartorio, the Italian. (3) Outline, freely or otherwise done, with the introduction of local colour, arbitrarily and more or less flatly applied This typifies much of the work of Phil May and of Charles Dana Gibson (4) An approach to form and colour with or without outline, suggested by loose and delicate strokes of the pen, wherein form and colour emerge delicately from the white paper This is well seen in the work of Abbey and of Norman Lindsay of Australia. (5) The same method as the above with a more positive introduction of local colour and textures and, by reason of more general or background tone, a decided localization of white with touches of flat black This is seen in the pen work of Fortuny and of Casanova. (9) The method that belongs to the decorator or ornamentist, of men like Crane and Beardsley. It is the flat presentation with a main viewpoint not toward reality and truth but toward romance and formalism, with the slow conscious line and tone laid in with intent for surface design and beauty.

All pen and ink drawing will be found to touch upon these few methods, with variations in effect and technique. Technique is like handwriting, while it may be cultivated, it soon becomes the sign of an inner sense and feeling back of the hand. The artist with the pen, observing objective life, whether it be primarily structural or tonal, or both, and with pen to paper, interpreting the feel of the contact there, comes naturally to the line that is his own; and in his tones, where the artist with the brush might escape confession or lose expression, the artist with pen and ink puts on expression and meaning over and above the main content of his work. Thus in the work of Thomas Fogarty, in the touch and play of his pen, may be perceived a fine gentility and a sense of relationships that are rich and subtle; while in the drawings of J. Coll, one feels the strong dramatic gesture and sees the subjective qualities. In like manner, in the pen drawings of Marold and Meissonier, neither of whom seemed to feel or to stress the line greatly but strove for full tone by fine cross-hatchings, lightly stroked surfaces and values semi-stippled with whites apparently scratched with a knife, is observed a sureness determined, it seems, by an allegiance to things academic The decorative drawings of Garth Jones have a classic and mural bigness, with a free and bold yet conscious line, while the decorative works of T. M. Cleland are executed as if by a master craftsman with a hand expert at the laying in of ebony and gold.

The work of the author of this article is characterized by partial or full tone with line made use of not so much for the presentation of form in drawing as to designate the movement and stir of things not seen but felt, as of the wind and the movements in sensation of distances and height. The line and its direction are employed also to present, through the effect of broken colour, the qualities of depth and solidity and a visual activity in tone or a compositional treatment of tone areas.

Present-day Uses.—Considerably less pen and ink art is found in the weekly and monthly popular periodicals of the United States and Great Britain since the advent of the half-tone process reproduction Behind this, of course, is the aim of editors to meet only the desires of the readers who seek only a photographic presentation of fact; the half-tone printed on coated paper suggests this reality. However, many of the high-class magazines continue the use of the pen and ink drawing, seeking always to improve the quality of illustration, and laying special emphasis on decorative values. In England the most distinguished pen and ink artists are often associated with *Punch* Outside the periodical field, where they are used for both illustrative and decorative purposes, pen and ink drawings are widely used in textbooks and encyclopaedias. (*See* also ILLUSTRATION; PENCIL DRAWING; LINE ENGRAVING.)

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PENELOPE (Gr. pĕn-ĕl-ŏ-pā; angl. pĕn-ĕl′ŏ-pē), in the *Odyssey*, the wife of Odysseus (*q.v.*), and daughter of Icarius of Sparta and the nymph Periboea. During the course of the long absence of her husband after the fall of Troy many chieftains of Ithaca and the islands round about became her suitors; and, to rid herself of their importunities she bade them wait till she had woven a winding-sheet for old Laërtes, the father of Odysseus But every night she undid the piece which she had woven by day. This she did for three years, till her maids revealed the secret. She was relieved by the arrival of Odysseus. In the *Telegonia*, she married Telegonus, the son of Odysseus and Circe, after he had killed his father, and dwelt with him in the island of Aeala or in the Islands of the Blest. Probably quite distinct from her is an Arcadian Penelope, mother of Pan (*q v*).

BIBLIOGRAPHY.—Homer, *Odyssey*; Engammon, *Telegonia* (in Kinkel, *Epic frag*, or Allen, *Homeri opera*, vol. v); *see* also Roscher, *Lexikon* (*s.v.*).

PENGELLY, WILLIAM (1812–94), English geologist and anthropologist, was born at East Looe in Cornwall on Jan 12, 1812, the son of the captain of a small coasting vessel. He began life as a sailor, after an elementary education in his native village, but in 1828 he abandoned a seafaring life. He had developed a passion for learning, and about 1836 he removed to Torquay and started a school, in 1846 he became a private tutor in mathematics and natural science. Geology had in early years attracted his attention, but it was not until he was about 30 years of age that he began seriously to cultivate the study In 1837 he was instrumental in the reorganization of the Torquay Mechanics' Institute, in 1844 mainly owing to his energy the Torquay Natural History Society was founded and in 1862 he assisted in founding the Devonshire Association for the Advancement of Literature, Science and Art Meanwhile he had been occupied in collecting fossils from many parts of Devon and Cornwall, and in 1860 the Baroness Burdett-Coutts acquired and presented them to the Oxford Museum, where they form "The Pengelly Collection." The same lady provided funds to enable him to investigate the lignites and clays of Bovey Tracey, in conjunction with Dr Oswald Heer, who undertook the determination of the plant remains Their report was published by the Royal Society (1862), and Pengelly was elected F R S. in 1863 He aided in the investigations of the Brixham bone-cavern from its discovery in 1858, the full report being issued in 1873; and he was the main explorer of Kent's Hole Torquay, and from 1864 for more than 15 years he examined and recorded the exact position of the numerous organic remains that were disinterred during a systematic investigation of this cave His observations assisted in establishing the important fact of the contemporaneity of Palaeolithic man with various Pleistocene mammalia, such as the mammoth, cave-bear, etc He was awarded the Lyell medal by the Geological Society of London in 1886 He died at Torquay on March 16, 1894.

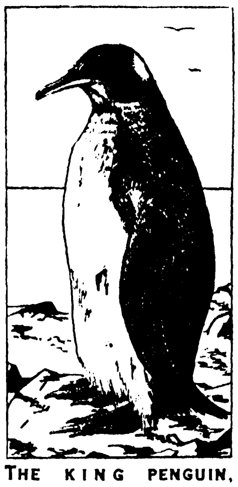
See *Memoir of William Pengelly*, ed by his daughter Hester Pengelly with a summary of his scientific work by T. G. Bonney (1897).

PENGÖ, the name of the new monetary unit of Hungary, adopted by the currency law of 1925. The pengo is divided into 100 filler. One pengo is equal to 0·0359388 pound sterling or 0·1748985 dollar. *See* HUNGARY.

PENGUIN, the name originally given to the garefowl (*q.v.*) but now applied to the flightless sea-birds forming the family *Sphenicidae*. The wings lack quills and are incapable of flexure though they move freely at the shoulder-joint. In the water the birds use them as paddles, and on land they are employed for fighting and, in some species, in walking. The plumage consists of small scale-like feathers and the three metatarsals are imperfectly united. Penguins feed on fish and crustacea; they have few enemies, the leopard-seal or sea-leopard (*q v.*) and McCormick's skua (*Megalestris maccormickii*) being perhaps the worst, though man is even more serious as a foe when he has easy access to a "rookery." The penguins belong to the southern hemisphere, none extending farther north than the Galapagos islands, while the

majority do not reach the tropics. They breed in immense "rookeries," often in the most desolate parts of Antarctica. Two white eggs (one in the case of the Emperor penguin) are laid in a rough nest on the ground and the young penguin is at first clad in down. The young are helpless, needing care for an unusually long time.

The largest forms are the Emperor (*Aptenodytes fosteri*) and King (*A. longirostris*) penguins. The former breeds in the height of the Antarctic winter in order that the young may be fully fledged before the next winter. The brooding instinct is so strong that birds may brood lumps of ice. The young birds are in many species cared for communally and not only by their parents. Many penguins progress on ice either by walking upright or flat on their bellies, kicking with their legs. The little Adélie penguin (*Pygosceles adeliae*) may breed several miles from the sea; it may continue to brood though completely covered with snow. It is very playful, and takes "joy-rides" on pieces of floating ice. The birds have interesting mutual courtship and greeting ceremonies. The genus *Endyptes* comprises the "Rock-hoppers." About 14 species altogether are known. For an account of this peculiar group *See* Levick's *Antarctic Penguins.*



THE KING PENGUIN, SECOND LARGEST IN SIZE OF ITS FAMILY

PENINGTON, ISAAC (1616–1679), eldest son of Sir Isaac Penington was one of the most notable of the 17th-century Quakers. In 1661 Penington was imprisoned for refusing to take the oath of allegiance, and on several subsequent occasions he passed long periods in Reading and Aylesbury gaols. He died on Oct. 8, 1679. Edward Penington (1667–1711), son of Isaac Penington, emigrated to Pennsylvania, where he founded a family. Isaac Penington's stepdaughter, Gulielma Springett, married William Penn.

See Maria Webb, *The Penns and Peningtons of the 17th Century* (1867); Willem Sewel, *History of the Quakers* (6th ed., 2 vols., London, 1834).

PENINSULAR AND ORIENTAL STEAM NAVIGATION COMPANY. This British steamship company, familiarly known as the "P. & O.," was founded by Messrs. Willcox & Anderson, a firm of London shipowners as the "Peninsular Service" in 1834, changing its name in 1840. In 1842 the company embarked upon a mail contract service to India.

The route via Suez to India and Australia was for many years known as "the overland route." Caravans numbering more than 3,000 camels were needed to transport the cargo and mails of a single steamer between Suez and Cairo, but the merchandise carried—indigo, tea, silk and precious metals—was of a kind and value to make this expensive form of transport practicable.

The opening of the Suez Canal in 1870 synchronised with the practical adoption of the compound engine as the motive power of the mercantile marine; the elaborate organisation built up by the company for its overland route became almost valueless, and its fleet was, at the same time, rendered practically obsolete. The directors consequently revised the company's financial resources to create a new fleet, despite reduced, and at one time vanished, profit. Their difficulties were not lessened by the refusal of the post office to allow the mails to be transported through the canal. While their rivals were reaping the full advantage of the new waterway, they were forced to continue the transit of mails by land between Alexandria and Suez; and this objection was not finally overcome until the year 1888.

The quarter of a century which followed was a period of continuous advance in the character and dimensions of the P. & O. steamers. The steamers, "Naldera" and "Narkunda," marked another leap in size. They were projected in 1913, but the war prevented their being brought into normal service until the spring of 1920. These vessels are of 16,000 tons. In 1914 there was a fusion of the P. & O. and British India companies, and Sir Thomas Sutherland, after thirty-four years' occupancy of the presidential chair, was succeeded by Lord Inchcape as chairman of the joint boards of the two companies.

The P. & O. lost 17 steamers in the war, and these have all been replaced by larger vessels. The total tonnage of the P. & O. fleet at Jan. 1, 1928, was 572,333 tons gross. The paid-up capital of the company is over £7,600,000 and debenture stock has been issued to the extent of nearly £8,500,000. (L. C. M.)

PENINSULAR WAR (1808–1814). This term is applied to the operations conducted by the British, Spanish and Portuguese armies against the French in the Iberian Peninsula during the years above noted. The British make the most of it first, because they were, with one or two trifling exceptions, their only successful military operations in the whole period 1794–1814; secondly, because they justly raised British military reputation to the highest point; and thirdly, because they contributed very materially to the exhaustion of France and the downfall of Napoleon.

The immediate cause of the war was Napoleon's endeavor, since he was powerless at sea, to reduce England to submission by starving her trade. With this object he had on Nov. 21, 1806, issued his Berlin decrees, ordering all Continental ports to be closed to British subjects. The next thing was to enforce those decrees. The situation seemed so formidable in England that the British ministers thought seriously of abandoning all effort to trade with the Old World, and of seeking new markets in Spanish America. England had but two friends in Europe: Sweden and Portugal. Napoleon left it to Russia to deal with Sweden, and resolved to take Portugal in hand himself. In Aug. 1807 he called upon her to comply with his decrees, and being answered by a protest, overawed the weak king of Spain, Charles IV., and his corrupt minister, Godoy, into granting free passage for French troops through Spain to Portugal. Moreover, by a secret treaty signed at Fontainebleau, on Oct. 27, 1807, it was agreed that Spanish troops should assist the French, that Portugal should be divided between France and Spain, and that a principality should be carved out of it for Godoy. But already on Oct. 19, 30,000 bad French troops under Gen. Junot had crossed the Spanish frontier; and, under eager orders from Napoleon, these hastened their march upon Lisbon. After long and painful vacillation between the demands of England and France the Portuguese regent fled to Brazil with the Portuguese fleet; and Junot, with an army reduced by haste and hardship to a mob of undisciplined, half-starved and half-armed stragglers, occupied Lisbon.

Next, Napoleon turned his designs against Spain herself. First he persuaded the king to send 15,000 of his best soldiers to help the French in the Baltic. Next he massed French troops upon the Spanish frontier, the treaty of Fontainebleau allowing him to send 40,000 men through Spain to the support of Junot. In Jan. 1808 he ordered from 70,000 to 80,000 men to cross the marches; in February and March the fortresses of San Sebastian, Pamplona, Figueras and Barcelona were treacherously occupied; by the middle of March there were over 90,000 French troops in Spain, and on the 26th Murat occupied Madrid as Napoleon's vice-gerent and commander-in-chief. The Spaniards, after a first outbreak of rage against Godoy and the king, accepted the situation in mute stupefaction. King Charles IV. abdicated in favour of his son Ferdinand, who threw himself abjectly upon Napoleon's mercy; but Napoleon, setting Ferdinand aside, resolved to substitute for him his own brother Joseph. Murat intimidated his Spanish council at Madrid into requesting, on May 13, that Joseph might reign over them; but meanwhile the Spaniards had realized that they were subjected to France and on May 2 had risen in revolt.

The insurrection at Madrid was ruthlessly quelled by Murat; but the movement spread like wildfire. In province after province a "junta," or committee of administration, was appointed. Troops were levied; armies were formed; some 100,000 men were collected in different parts of Spain, all alike brave and enthusiastic, but without arms, discipline, organization or commanders. Portugal likewise rose in revolt; and Junot, cut off by the Spanish insurgents from the French armies in Spain, withdrew the whole of his force into Lisbon. The Spanish province of Asturias sent emissaries to England to ask for help, and meanwhile the governor of Gibraltar, Sir Hew Dalrymple, offered such aid as could be

given by British ships and by a force of 5,000 men under Gen. Brent Spencer, awaiting orders in Gibraltar harbour.

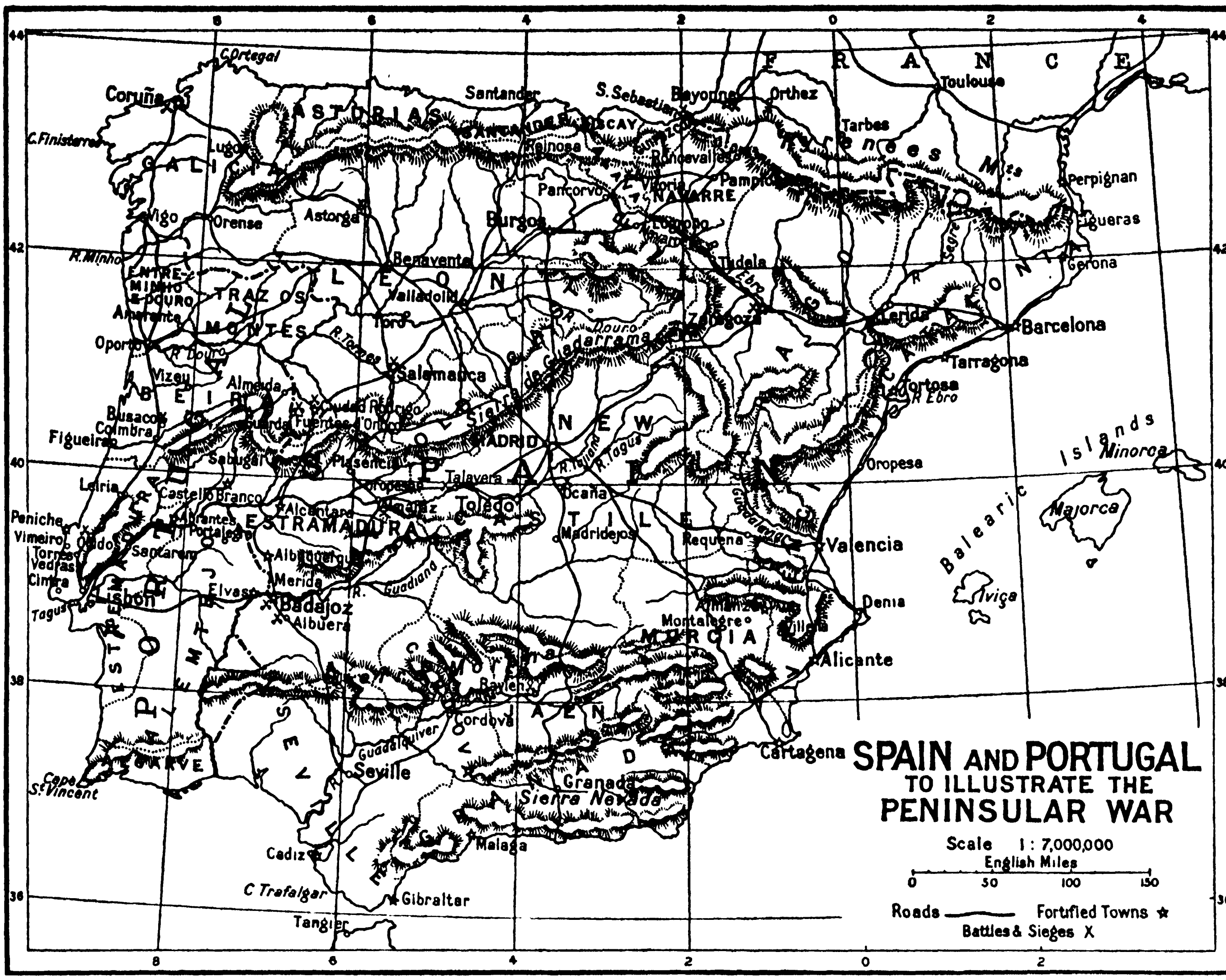
Napoleon took action against the Spaniards at once. Their most formidable force lay in Andalusia, on his front, and in Galicia on his right flank; and he judged it further most important to secure the ports on the east coast and to seize the fortress of Zaragoza, as a link of union between his forces in Catalonia and in central Spain. He accordingly detached Gen. Dupont with 20,000 men towards Andalusia, Moncey with 9,000 more to advance along the east coast, and Lefebvre-Desnouettes with 4,000 more to deal with Zaragoza, while Gen. Merle with a smaller column was ordered to restore order on the northern coast. All except Merle failed. On the east coast not only Valencia but Gerona repulsed French attacks; Zaragoza defended itself with desperate tenacity; and Dupont, thanks in part to useful demonstrations made by Spencer's force on the coast, so mismanaged his operations that on July 23 he was forced at Baylen, to capitulate with 18,000 men. Had not the Spanish army of Galicia, under Gen. Blake imprudently accepted battle and been totally defeated at Medina de Rio Seco by Bessières (July 14), practically the whole of Napoleon's operations would have been fruitless.

The Campaign in Portugal, 1808.—Meanwhile the British Government had in June decided to comply with the Spanish appeal for help. Not many troops were available, for 12,000 had been sent under Sir John Moore upon a hopeless enterprise to Sweden. However, between 10,000 and 11,000 men were embarked under Sir Arthur Wellesley. He was empowered to add Spencer's force to these; and his first objective was to be the Tagus. His information was that Junot had but 20,000 men in all, of which at least 6,000 were at a distance from Lisbon, so he landed without hesitation on Aug. 1 at the mouth of the Mondego. Thence moving south he drove back an advanced French division under Gen. Delaborde at Roliça (Aug. 17) and took up a position at Vimeiro to cover the landing of reinforcements, which were waiting off the coast to join him. Further reinforcements were on their way, including Moore's 12,000 men; but, since Moore, who was senior to Wellesley, had offended the Government by returning from Sweden, two officers, Sir Harry Burrard and Sir Hew Dalrymple, had been specially appointed to keep Moore out of the chief command. Burrard appeared off the coast on the 20th; and on the 21st Junot with 13,000 men attacked Wellesley, who had 17,000, at Vimeiro, and was hopelessly worsted. Left to himself Wellesley would have captured Junot and his whole army, but Burrard interposed; and before Burrard had held command 24 hours, Dalrymple appeared to supersede him. Though an excellent administrator, Dalrymple was inexperienced and nervous in the field. He would not follow up the beaten French; and ultimately Junot and his army were sent back to France by sea under the Convention of Cintra (Aug. 31). The Ministry made Dalrymple the scapegoat for the mistakes, mainly its own, which had led to the convention; but at least Lisbon had been secured as a base for future operations.

The British Government decided to prosecute the advantage gained. The Spaniards had driven the French behind the line of the Ebro; and four Spanish armies, so-called, under four different commanders, each of them jealous and unskilled, with no commander-in-chief, were ranged along the river from Tudela to Reinosa, talking big of expelling the enemy from Spain. A space in this line was left for the English, and in September the British Government resolved that it should be filled with 40,000 British troops. Although Sir Harry Burrard had been expressly appointed to exclude Sir John Moore from the chief command, it was now determined to supersede Burrard by Moore, a decision which Burrard received not only with obedience, but in an ideal spirit of loyalty and patriotism. But meanwhile, upon the news of the disaster of Baylen, Napoleon had ordered 80,000 men to march into Spain; and early in September he organized the army of Spain into six corps and a reserve, with a total strength of 200,000 men. By the end of October he had not far short of 120,000 effective men on the Ebro; on Nov. 6 he took personal command. The Spaniards likewise had been reinforced by the transport of 9,000 out of Romana's 15,000 men from the Baltic to Santander by the British fleet; but nothing could give strength to ill-organized and half-disciplined levies. On Oct. 29 one Spanish army was dispersed at Zornosa. On Nov. 10 another was utterly routed at Gamonal, on the 11th and 13th another underwent the same fate at Espinosa and Reinosa; and on the 23rd yet another army was signally defeated at Tudela. Briefly, the Spanish army of the left had ceased to exist, and those of the centre and right had been broken and routed. The way to Madrid was open and on Dec. 4 the capital was occupied by the French.

Sir John Moore's Campaign of 1808–09.—Meanwhile Moore, much hampered by want of transport and money, had set his troops in motion at the end of October. He had actually with him about 22,000 men, but a further body of some 18,000 more under Sir David Baird was under orders to sail from England to Corunna; and Moore decided that, with the Spanish armies lying between him and the enemy, he might safely effect his junction with Baird by land. While, therefore, he himself moved north-east upon Ciudad Rodrigo and Salamanca, Baird was to strike south-eastward from Corunna, and meet him at Valladolid, or even farther to the east. Owing to the lack of roads, however, Moore was obliged to send the cavalry and artillery under Sir John Hope by the valley of the Guadiana, to move eastward through Talavera to Madrid, and thence north-westward through the Escorial pass of the Guadarrama—a very considerable detour. On his march northward Moore received only disquieting news of the Spanish dispositions, and upon reaching Salamanca on Nov. 14 he heard definitely that the Spaniards had been routed at Zornosa, and that the French were advancing on Valladolid. Plainly, it was madness to think of advancing farther to effect his junction with Baird, and he therefore halted and wrote to inform the Government that the plan of campaign which they had prescribed for him was visionary, that the Spaniards themselves had no definite plans, and that it was impossible for him to get any authority in Spain to take any notice of his presence.

Baird, meanwhile, had reached Corunna with his infantry on Oct. 13, but had found his arrival anything but welcome to the junta of Galicia. However, by Nov. 13 the whole of his cavalry had also joined him, and by the 22nd he had reached Astorga. There he received news of the rout of the Spaniards at Zornosa and Espinosa, not from any Spanish source—for the Spaniards ignored his existence—but from his own intelligence-officers; and he made up his mind to retreat. On the 28th Moore at Salamanca heard of the defeat of the Spanish right at Tudela, and at once decided to retire upon Portugal. He therefore sent orders to Hope, who was already across the Guadarrama, to hasten to him with all speed, and to Baird to fall back to Corunna and join him at Lisbon by sea. Baird began his retirement at once; and Hope, by a forced march by way of Avila, Fontiveros, Peñeranda and Alba de Tormes, regained touch with Moore on Dec. 4. Urgent messages now reached Moore from Frere, the British minister at Madrid, to make an effort to save the capital, which was preparing for a desperate resistance; and Moore, though distrustful, countermanded his orders to Baird, and bade him return to Astorga. On the 9th he learned of the fall of Madrid; and he now resolved to make a dash upon the French communications at Burgos. On the 13th he moved his headquarters from Salamanca north-eastward to Alaejos, where, by great good fortune, an intercepted despatch from Berthier, Napoleon's chief of staff, to Soult, gave him the key to the French dispositions and showed that Soult's corps, little over 20,000 strong, lay isolated on the Carrion some 90m. to north-east of him. Incidentally, he learned that the French in Spain now numbered 250,000, but, though fully alive to the risk, he resolved to advance and strike at Soult. Moving northward he joined hands with Baird at Mayorga on Dec. 17, his advanced parties more than once brushing against the French on the way, and marched upon Sahagun, where, on the 21st, his cavalry fought a brilliant little action against the French horse. On the 23rd he had made all his preparations for falling upon Soult on the morrow, when intelligence reached him that the French under the emperor in person were moving against him in great force. Thereupon he gave orders for immediate retreat. He had been expecting that he would have to "run for it" and



now the time was come.

Napoleon had been fully convinced that the British had withdrawn into Portugal and could hardly give credence to Moore's audacity. He realized it, however, on Dec. 19, and taking 42,000 men in hand himself, and entrusting as many more to Junot and Soult, he flew to the pursuit, hoping to make an end of Moore by a great enveloping movement. Moore retired upon Corunna; but the emperor could never overtake him, and on Jan. 1, 1809, he made over the chase to Soult. The discipline of the British began to fail very early in some regiments, but Moore hustled them on, fighting many petty rearguard actions on the way, and after much hardship in crossing the mountains of Galicia, on Jan. 11, brought his army, sadly thinned indeed but safe, to Corunna. The transports having been delayed in their arrival by foul winds, he was obliged to take up a position to cover his embarkation. The ships arrived on the 14th; and on the 16th Soult, with 20,000 men and 40 guns, attacked Moore with 15,000 men and nine light cannon. Soult was repulsed, but Moore was mortally hurt; Baird was disabled by a severe wound; and it fell to Gen. Hope to re-embark the troops and bring them safely to England. The result of the campaign seemed to be a failure; but Moore had dislocated the whole of Napoleon's plans and, moreover, had caused him to scatter his troops far too widely over the surface of the Peninsula, with fatal consequences.

Campaign in Portugal and Spain, 1809.—Austria was preparing again to take up arms against Napoleon; and the question was where England should act in her support. Moore had quite correctly declared the Portuguese frontier to be indefensible. Wellesley, who was now consulted, opined that, if the Portuguese army and militia were reorganized and 20,000 British were added to them, the French would need 100,000 men to conquer Portugal, and that if the Spaniards continued to resist, the French could not spare so many. The cabinet resolved to make its main effort on the Scheldt; and only with great difficulty Castlereagh persuaded them to send Wellesley out to the Peninsula and to give him 26,000 men. Wellesley reached the Tagus at the end of April. He found that Soult, after his march to Corunna, had invaded Portugal and taken Oporto; that Ney, who had also joined in the chase of Moore, was subjugating Galicia and that Marshal Victor was lying at Merida within 40m. of the eastern Portuguese frontier, threatening invasion by the line of the Tagus. The Spaniards had not done well during the winter. Gen. St. Cyr had beaten them badly in Catalonia, and the army of the centre had sustained defeats at Ucles (Jan. 12), Ciudad Real (Feb. 18) and Medellin (March 28). There was nothing to stop Soult except some disheartened Portuguese levies, nor to check Victor except the demoralized army of Gen. Cuesta, which had just been beaten at Medellin. However, both Soult and Victor were stationary; their headquarters were 200m. apart; and, although they were supposed to be acting in concert, they were not in communication with each other. Gen. Beresford and other British officers had by this time brought 15,000 Portuguese troops into a fairly efficient condition; and with these and 25,000 British, Wellesley, on May 7, advanced northward against Soult. The marshal, suspecting nothing, had scattered his troops in considerable depth to south and north of Oporto, and Wellesley tried to cut off the southern detachments, but failed. He crossed the Douro just above Oporto, however, under Soult's very nose, and catching the French army by surprise drove it away as a mere disorderly mob, which would have been destroyed but for the timidity of Gen. Murray, one of Wellesley's

divisional commanders. Following Soult, Wellesley drove him north through a miserable country; and only by desperate marches and after desperate perils did the marshal finally make his way to Lugo, having lost 6,000 men and the whole of his artillery. He owed his safety mainly to the fact that Wellesley had, on the 18th, been obliged to abandon the pursuit, having received news that Victor was in motion on the Tagus.

Victor's movement proved to be nothing but a reconnaissance in force, designed to obtain intelligence of Soult; and King Joseph at Madrid, having learned, not from Soult but from Paris, of the mishaps which had befallen that marshal, recalled Victor up the Tagus to Talavera. Soult, having called upon Ney at Lugo to re-equip his army, the two commanders and their respective armies had quarrelled violently, with the result that joint operations planned between them against the Galician insurgents came quite to nought, and the French were driven out of Galicia for ever. Rather by accident than design Ney and Soult drifted southward; and by the beginning of July their corps, as also that of Mortier, some 50,000 men in all, were assembled at Astorga, Benavente and Valladolid within 50m. of the valley of the Tagus. Joseph had in and near Madrid 27,000 men, and Victor's corps numbered about 23,000; so that he was in a position at short notice to concentrate at this time 100,000 men in that valley. Such was the situation when Wellesley, having returned to Abrantes from northern Portugal, proposed that he, with 23,000 British, and Cuesta with as many Spaniards, should march on Madrid by way of the Tagus. The supreme Government of Spain eagerly accepted the suggestion, undertaking to provide everything; and, quite unconscious of the storm that was gathering before him, Wellesley marched (June 27) to join Cuesta at Plasencia. On July 17 the two armies advanced. The march was one long story of wrangling and distress. Cuesta was old, infirm, incompetent and obstinate. His army was without order or discipline; and no measures had been taken for transport and supply. Victor fell back before the allies till reinforced by Joseph to a strength of 46,000 men; then the allies fell back in turn, the Spaniards turning their retreat into a flight. With much difficulty Wellesley stopped the panic and took up a position at Talavera (July 27). Victor attacked the key of the position on the same night and was repulsed; and renewing the onslaught in force on the next day was again repelled with a loss of 7,000 men and 17 guns. Wellesley himself had lost 5,000 men, but being reinforced by the Light Brigade on the 29th, was eager to advance. Cuesta fortunately refused, and on Aug. 1 Soult came down the pass of Baños, which Cuesta, in spite of Wellesley's urgent entreaties, had declined to defend, into the valley of the Tagus. Wellesley, awaking to his danger, abandoned his wounded, crossed the river by the bridge of Arzobispo, and led his starving army back to Portugal by way of Badajoz. Though the preoccupation of Napoleon with the Austrian war justified Wellesley in making an extraordinary effort, he had taken an unwarrantable risk. He had been warned that the Spanish troops were worthless and their supply system chaotic; and he had disregarded the warning. Having now learned his lesson, he resolved to have nothing to do with the Spaniards in the future. However, for his victories he was created Viscount Wellington.

Campaign of 1810–11.—During the winter Wellington thought matters out. The Spaniards, untaught by experience, embarked on a new winter campaign which resulted in the total defeat of Cuesta's successor, Areizaga, at Ocaña, (Nov. 19). But out of this evil came good. Soult and Joseph, from sheer cupidity, invaded Andalusia, failed from carelessness to master Cadiz and found themselves set down to the siege of a place which, without a naval force, was impregnable. Wellington gladly spared a few troops, which were made up from England to 8,000, to aid in the defence of Cadiz. The more troops squandered by the French in useless enterprises, the better for him. But the situation was serious. Napoleon had reduced Austria to submission at Wagram and would doubtless use every available soldier to master the Peninsula in 1810. Yet Wellington, so long as he had Lisbon, saw his way to thwart him. The French had three things against them. First, the sea was not open to them. Secondly, the Spanish population was to a man against them, and though the Spanish armies were valueless, the people were always cutting off stragglers and small parties, insomuch that a letter could not be sent by the French with a smaller escort than 25 men. Thirdly, the French armies always lived on the country. Wellington reasoned somewhat in this fashion: "I have to encounter 300,000 men with 40,000. I must train the Portuguese army with the help of English officers so as to make my 40,000 into 50,000." This task he committed to Beresford. "The French," he argued next, "live on the country and therefore cannot stay long in one place. I have the sea to furnish me with all that I want; and if I organize my service for feeding my army perfectly, I can go when I please and stay where I wish as long as I wish." So he set himself to organize an efficient service for transport and supply. "But," he went on, "everything depends on my base on the sea, Lisbon, and I must make Lisbon impregnable." He did so by throwing up the fortified lines of Torres Vedras, 25m. north of the city. "Now," he argued, "if I have 50,000 men the French must bring 60,000 to beat me. The removal of 60,000 men must weaken them in some part of Spain, and there the Spaniards will make trouble. If they advance against me, I shall retire before them, accepting battle if they give me a favourable opportunity, for the missile action of my lines is superior to the shock-action of their columns; but, if not, retreating steadily till I reach my fortified lines. They cannot wait long before them, because they live on the country and will exhaust it. They *must* retreat in time, through territory which they have already eaten up, and I, carrying my food with me, can pursue them and cause them heavy loss. I can go on playing this game as long as they like. I *must* win in the end. The only trouble is that, though the natural access for the French to Portugal is from the north-east, by way of Salamanca and Almeida, they can enter it also from the east by the line of the Tagus, so that I must divide my force to secure both routes. If they advance by both routes in strength, it may be awkward; but that is unlikely. The way by the Guadiana, south of the Tagus, is luckily sealed up for the present by the Spanish fortress of Badajoz. But even if driven from Portugal, I can land my army at Cadiz and play the same game there. I *must* win in the end, and the more certainly because the French generals are always quarrelling among themselves, and pay no obedience to King Joseph, their nominal commander."

And so it came about. Napoleon gave Masséna the command of 65,000 men as the army of Portugal, and Soult the command of as many as the army of Andalusia. Wellington with 18,000 British and 14,000 Portuguese awaited Masséna near Almeida, leaving Gen. Hill with about 20,000 men, mostly Portuguese, to guard the route by the Tagus. Masséna first besieged and captured Ciudad Rodrigo, which barred his way (July 10), and then pushed his advanced troops across the frontier. Gen. Craufurd with the Light Division engaged these most unnecessarily on the Coa (July 23), happily without serious mishap, though the odds against him were four to one. Then Masséna advanced, and Wellington retreated steadily before him. At Bussaco, having summoned Hill to him, Wellesley offered battle with 50,000 men in a very strong position. Masséna accepted it (Sept. 27) and was repulsed with 4,600 casualties, whereas Wellington's did not exceed 1,250. Then the retreat began again, and Wellington entered the lines of Torres Vedras (Oct. 10). Masséna lingered before them for a month, till compelled by want of subsistence to retire 30m. to Santarem. Here he waited with persistence, for it was expected that the British Ministry would fall and be supplanted by the Whigs, who would certainly withdraw the British army from the Peninsula. It was an anxious time for Wellington, for in Jan. 1811, Soult appeared with another army before Badajoz, and the Spanish army on the spot offered battle, which Wellington had begged that it would on no account do, and was, of course, beaten. Wellington detached Beresford with ten British battalions and some Portuguese to watch Soult; and at last, on March 5, Masséna began to retreat. Wellington followed him up with 44,000 men, but was obliged immediately to send 8,000 of them to Beresford, since Badajoz had (March 10) been treacherously surrendered to Soult. With the remainder he con-

tinued his pursuit; and by April 8 Masséna had recrossed the Portuguese frontier on his way to Salamanca, with his army in rags, starved and demoralized. The campaign had cost him 25,000 men killed, captured, or dead from sickness.

Campaign of 1811.—Meanwhile Sir Thomas Graham and the Spaniards had fallen upon the besiegers of Cadiz, and the British had fought a brilliant action against them at Barrosa (March 5). Thereupon Soult hurried back from Badajoz to Andalusia; and Wellington, reinforcing Beresford, set him down to beleaguer Badajoz (April 22), with the option of fighting Soult or refusing battle as soon as the marshal should march back, as he certainly would, to relieve the fortress. He then returned to his own army, which had stopped its pursuit of Masséna on the Portuguese frontier, and was now covering the blockade of Almeida. Masséna advanced from Salamanca to relieve it, and Wellington offered him battle (May 3) at Fuentes de Oñoro, just across the Spanish frontier. Masséna assailed the village on the 3rd and was repulsed with 650 casualties, Wellington's not exceeding 250. On the 5th Masséna made a general attack; and then, as Wellington said, "if Boney had been there, we should have been beat" But, though Wellington's position was defective, the steadiness of his troops enabled him to hold his own His casualties were 1,530, Masséna's 2,200; and on the 7th Masséna retreated to Salamanca, leaving Almeida to its fate. The fortress was presently abandoned and blown up by the French, the garrison, to Wellington's great vexation, escaping Masséna was shortly afterwards recalled and replaced by Marmont; but Wellington always considered Masséna the ablest of all the French generals with whom he had to do in the Peninsula.

Meanwhile, for want of proper artillery, Beresford's siege of Badajoz had not prospered Soult with 24,000 men and 50 guns returned from Andalusia to its relief in May, and on the 16th Beresford, with 8,000 British and 21,000 Spaniards, engaged him at Albuera. Beresford mismanaged the action and would have lost it but for one of his staff, Capt Henry Hardinge. He was saved by the steadiness of his British troops, who suffered 4,000 casualties The Spaniards lost 3,000 and Soult 8,000 The marshal retired, and all was safe for the present; but Wellington, with his little force, had actually fought two general actions on the two main lines of entry into Portugal—a very severe strain upon his strength.

He now (May 29) re-opened the siege of Badajoz with bad Portuguese cannon, for, living in almost daily dread of orders to evacuate the Peninsula, he had all this time kept his own siege-train on its ships in Lisbon harbour. On June 10 the prospective junction of Marmont with Soult obliged him to raise the siege and withdraw his troops, 37,000 British and 17,000 Portuguese, to the Caia, a little to west of Badajoz. Soult and Marmont having joined forces at Merida (June 17) advanced against him with nearly 60,000 men, but decided to leave him alone The two marshals then quarrelled; and Soult returned (June 28) to Andalusia, leaving troops which raised Marmont's strength to 43,000 men On July 13 Marmont withdrew to the valley of the Tagus Wellington then landed his siege-train, and moved north to the blockade of Ciudad Rodrigo, leaving the bulk of his force under Graham and Hill to protect the eastern frontier Marmont, collecting 58,000 men, marched to its relief, and Wellington, calling up troops which gave him a strength of 30,000 British and 16,000 Portuguese, raised the blockade and awaited him. On Sept. 25 Marmont made a reconnaissance in force which brought on a lively little combat at El Bodon, but he was afraid to go farther, and on Oct 1 retired to his cantonments on the Tagus. The campaign ended by a spring of Gen. Hill upon an isolated French detachment at Arroyo Molinos, to the north-east of Merida, when 2,000 French were killed or captured at a cost of 100 British casualties (Oct. 28).

Campaign of 1812.—Throughout the perilous year 1811, when Wellington had borne the brunt of the attack of the armies both of Portugal and Andalusia, the Spaniards had accomplished very little. But their armies had now been in large measure replaced by guerrilla-bands of irregulars, frequently under very able leaders, which made the task of holding Spain in subjection more difficult to the French than ever. To paralyse one of these chiefs, Ballesteros, in the south, Soult (Dec 1811) directed an attack upon one of his principal bases, Tarifa, which was repelled with trifling loss to the little garrison, half Spanish, half English, but cost the French 500 casualties. And now Napoleon, intent on the invasion of Russia, decided that he would draw upon Marmont's army to subdue the eastern provinces and Andalusia thoroughly, and then turn all his strength upon Portugal Wellington for his part had planned the capture of Ciudad Rodrigo, so as to close the north-eastern gate of Portugal; and on Jan. 8 he invested the place, battered a breach and on the 19th stormed it out of hand, with no more than 500 casualties, before Marmont could even assemble troops to save it. Marmont was left gasping with dismay. Ciudad Rodrigo, with a garrison of 5,000 raw Spaniards, had defied Marshal Ney for 25 days, and Wellington had snatched it from a French garrison in 12 days. Wellington then dispersed his troops innocently into cantonments, as did Marmont, being unable to keep them concentrated for want of supplies. On Feb 16 Wellington advanced to the siege of Badajoz, stationing Hill at Merida to cover the operation from the east. Ground was broken on March 17, a breach was battered, and on April 5 the place was taken by escalade, the storming parties having failed in their assault. The capture of Badajoz cost Wellington 5,000 casualties, and for 48 hours the troops were out of all control; but the gain was great, for he had captured the French siege-train at Ciudad Rodrigo and their pontoon-train at Badajoz He then detached Hill to destroy the French bridge of boats over the Tagus at Almaraz (May 17), thereby reducing Soult and Marmont to the bridge of Toledo for communication between their armies, and then leaving Hill at Merida with 22,000 men to parry any movement of Soult, he advanced (June 13) with 28,000 British and 15,000 Portuguese against Marmont at Salamanca. The marshal fell back to the Douro till, being reinforced, he took the offensive (July 16) and manoeuvred against Wellington's communications On more than one day the two armies raced each other in two parallel columns, only a few hundred yards apart, ready to wheel into line and engage at any moment. At last on July 22 Marmont made a false movement, leaving his left wing in isolation, and Wellington sprang upon him instantly and inflicted a crushing defeat. He had 50,000 men, including Spaniards, and 60 guns; Marmont had 47,000 and 78 guns The French losses were 14,000 men, 20 guns and two eagles; Wellington's casualties were 5,000 The French retreated north-east upon Burgos, and Wellington, having entered Madrid in triumph (Aug. 12) invested Burgos. The siege was most unskilfully conducted; and Wellington was obliged to raise it (Sept 22) upon the advance of the French against him in force from all parts of Spain. With difficulty he gained time for Hill to join him as he retreated, and on Nov 11, with 68,000 British, Portuguese and Spaniards, he offered battle to 90,000 French on the field of Salamanca. The French declined the challenge; and Wellington pursued his retirement, with some suffering to his troops but little molestation from the enemy, to Ciudad Rodrigo, where the campaign came to an end (Nov. 19) His losses in the retreat were 9,000, but foreign critics count it his greatest achievement The advance on Madrid was no doubt a mistake; but the campaign had been brilliant It had cost him 20,000 men; but it had cost the French 40,000 and some hundreds of guns, and lastly it had cleared the French out of all Spain south of the Tagus

Campaign of 1813.—The new year found Wellington an earl and a marquis, and Napoleon the poorer by some 400,000 men lost in the snows of Russia. The emperor was fain to draw many troops from the Peninsula, and of those that remained the unfortunate King Joseph had less control than ever. The *cortes* of Spain, on the other hand, had nominated Wellington commander-in-chief of their armies, of which a contingent, 20,000 strong, was under his immediate orders for the coming campaign. Furthermore, in 1812 the British Government had landed some 9,000 troops from the Mediterranean on the east coast of Spain —a sphere beyond the reach of Wellington—and these, with the addition of 20,000 Spanish troops in English pay, seemed likely to give trouble to the French in that quarter. Their commander,

however, Sir John Murray, the general who had failed Wellington on the Douro in 1809, was a feeble creature of whom little could be expected. He succeeded in repelling an attack by Gen. Suchet at Castalla (April 12) and with a little enterprise might have turned his success to great account. His army, though composed of five different nations, was 17,000 strong, whereas Suchet had at most 15,000; and Suchet's casualties in the action numbered 1,000 against Murray's 500. But Murray allowed the opportunity to slip; and a subsequent operation which he undertook against Tarragona was so disgracefully mismanaged that it brought Murray to a court-martial.

This, however, was only a minor incident in the Peninsular operations. In the main field Wellington marched from Portugal with a full strength of about 100,000 men, 47,000 of them British and the remainder Spanish and Portuguese. The Spanish guerrilla-leaders were so active and so formidable in Biscay and Navarre that they found full employment for no fewer than four French divisions under Gen. Clausel. Thus weakened, the French army could make no stand on the Douro, but fell back north-eastward, abandoning Burgos, to the line of the Ebro. Wellington forced it to retire by turning its northern flank; and Joseph, with Marshal Jourdan for his adviser, decided to fight a delaying action in the basin south of Vittoria, to cover his further retreat. He had only 50,000 men, for Clausel, in spite of repeated orders, had not joined him; whereas Wellington had 72,000; and had Wellington's orders been followed few of the French would have escaped. As things fell out Joseph got away with the loss of all his artillery, 150 pieces, and every scrap of baggage, but of no more than 7,000 men, Wellington's casualties being 5,000. The French retreated over the Pyrenees into France, and Wellington, having pursued them as far as Pamplona, decided to abandon the chase. It was essential to master the fortresses of Pamplona and San Sebastian before he could advance farther, and until these should fall he occupied the main western passes of the Pyrenees on a front of about 50m. south-eastward from San Sebastian. Pamplona was blockaded by the Spaniards, and the siege of San Sebastian, a tiny fortress, was entrusted to Sir Thomas Graham with one British division and one Portuguese brigade.

Meanwhile Napoleon had displaced Joseph, sending Soult to take command of all the troops that had retreated from Spain. The marshal arrived on July 13, and having received fresh artillery and restored, more or less, the organization and discipline of his 70,000 men, he on July 20 launched a great counter-attack along the three main valleys of the Pyrenees which lead to Pamplona. He met with some initial success, for Wellington's divisional generals were always rather helpless unless their commander-in-chief was at hand; but Soult's plans were not fulfilled as he had intended, and it was rather by accident than design that on July 26 he found himself at Sorauren, facing 16,000 of Wellington's troops with 30,000 of his own men. He attacked, but was repulsed with heavy loss, and Wellington then taking the offensive in his turn drove the French back after six days' fighting, as a mere demoralized mob, to their former position on the northern slopes of the Pyrenees. Soult admitted a loss of 13,000 men, whereas Wellington's did not exceed 7,000.

In the course of these operations the first assault on San Sebastian was delivered on July 25, and repulsed with a loss of 400 men. Want of ammunition then compelled the turning of the leaguer into a blockade till Aug. 22, when the siege was renewed; and on the 31st the place was successfully stormed though at great cost of life. First and last the casualties at San Sebastian were over 3,700. On the day of the storm Soult made a final effort to save the fortress, but was beaten back with a loss of 3,800, the casualties of the allies being 2,600. The brunt of the two days' fighting fell upon the Spaniards, whose losses exceeded 1,600. Soult now resolved to stand on the defensive and fortified lines of excessive extent to the south of the Bidassoa. These Wellington attacked on Oct. 7, and carried with little difficulty after three days' combat, wherein both sides lost about 1,600 men. Soult then began to fortify another position a little to the northward on the Nivelle, and Wellington, bringing his troops forward to the high ground to north of the Bidassoa, halted till the fall of Pamplona should allow him to advance farther.

He was not quite happy notwithstanding all his successes. His relations with the Spanish Government were such that he had resigned his command of the Spanish armies (Oct. 9), and with the Portuguese Government they were little better. It was clear to him that, in case of a reverse, retreat into Spain would be out of the question. Moreover, though Napoleon's star was already on the wane, Wellington as yet knew only that he was standing up to his enemies in Germany; and it was always possible that he might win a great victory, come to terms with them, as his custom was, and return to launch all his forces against his foes in the Pyrenees. Moreover, on the east coast of Spain the latest British commander, Lord William Bentinck, had contrived to sustain at Ordal a reverse at the hands of Suchet (Sept. 13). However, on Oct. 25, Pamplona fell, and on Nov. 10 Wellington attacked Soult's position on the Nivelle and carried it, capturing 69 guns; the casualties, 4,300, being about the same on both sides. He was now fairly established on the plains of France, and recognized that it was vital to him to have the population on his side. He could by this time count upon the good behaviour of his own troops towards the inhabitants; but the Spaniards had suffered too much at the hands of the French and could not be kept from maltreating them. "With 40,000 Spaniards I don't know where I should stop," he wrote at this time, "but if they plunder they will ruin all." Reluctantly and regretfully he sent most of them back to Spain.

On Dec. 8 came the great news that Napoleon had been utterly overthrown at Leipzig, with orders that Wellington was to press the invasion of France. Thrown back from the Nivelle, Soult had entrenched himself on the river Nive, south of Bayonne, and here Wellington attacked him on Dec. 9. The operations lasted five days, Soult counter-attacking without success on the 10th and 11th, and were greatly complicated by the sudden rise and fall of the rivers, fed by the glaciers of the Pyrenees. Owing to the destruction of a bridge by a flood Soult was able to attack with 30,000 men and 30 guns a force of 14,000 men and 14 guns under Gen. Hill, which stood in isolation about St. Pierre (Dec. 13), but after a very severe action he was repulsed, his losses being 3,000 and the British 1,700. The casualties on the French side for the five days were 5,600 and of the allies 5,000.

Soult then withdrew to a position on the Adour; and meanwhile the European situation again gave Wellington anxiety. The allies after their victory at Leipzig had all fallen at variance with each other, and their military plans seemed to Wellington to be insane. Napoleon, moreover, was negotiating for the detachment of Spain from the side of the allies, in order to withdraw Suchet's troops thence. On this latter point Wellington's mind was soon set at ease (Jan. 9, 1814) through the rejection of Napoleon's overtures by the Spanish Government; but his misgivings as to the military projects of the allies were justified. However, after much delay through bad weather, by a series of skilful movements (Feb. 17–24, 1814) he manoeuvred Soult out of his position on the Adour, crossed the river—500 yards wide—on a bridge of most ingenious construction, and thus forced Soult into the open. Leaving Sir John Hope to invest Bayonne and the strong garrison installed there by Soult, Wellington followed the marshal in his retreat eastward, overtook him at Orthez (Feb. 27), and with 34,000 men against 37,000, drove him off with a loss of 4,000 killed, wounded and prisoners, his own casualties being just under 2,000. Soult continued his retirement eastward with Wellington in close pursuit, till days of heavy rain brought the British to a standstill, and contact was lost between the two armies (March 3). Wellington took the opportunity to occupy Bordeaux as his new base on the sea, but Soult hurried his troops as a disorderly mob towards Toulon, not halting till he reached Tarbes (March 8). Then at last he realized that his enemies were stationary some 35m. to the north-west of him, and on March 13 he moved up to Wellington's outposts as if to attack, but thought better of it and on the 16th moved away slowly to southward. He had orders from Napoleon to keep his field of action as near as possible to the Pyrenees, and endeavoured thus to fulfil them. For all that he knew the emperor would yet hold his own.

These had in fact been most critical days farther north. The Prussians had given Napoleon an opportunity, and he had struck at them a succession of telling blows. Austrians, Prussians and Russians alike were terrified, for all that they outnumbered him by three to one, and staggered back in dismay. Matters remained in doubt till March 25, when Napoleon resolved to manoeuvre against the rear and communications of the allies, and they in turn plucked up courage to ignore him and continue their march to Paris.

On March 18 Wellington, with a force raised to nearly 50,000 men by the arrival of a contingent of Spaniards, resumed his pursuit of Soult and on the 19th was constantly engaged with his rearguard. On the 20th Soult fought a useless little combat at Tarbes, which only delayed his retreat to no purpose, and compelled him to take the longer of two roads to his next point, Toulouse. Wellington followed the shorter road, and Soult, in order to anticipate him, was compelled to hurry his wretched troops on with a speed which reduced them to a rabble. Nevertheless Wellington moved on slowly and cautiously. For one thing the rain was incessant, but even more disturbing was a report which had reached him that Napoleon had fallen back to Orléans. This might mean that he intended to join Soult and raise all southern France against the British and their allies, which would be a serious matter indeed. Not till the 26th did he come up before Toulouse, unaware, of course, that on the previous day Napoleon's doom had been sealed.

The position taken up by Soult was very strong, and could not soon be approached without preparatory operations of extreme delicacy. But, having a beaten army before him, Wellington took every imaginable liberty, and finally attacked on April 10 in a most primitive and hazardous fashion. His casualties, 4,000 men, were twice as great as Soult's, and the French later were inclined to claim the fight as a victory. But Soult knew better and, evacuating Toulouse on the 12th, continued his retreat. On that day news reached Wellington of the fall of Napoleon. He at once informed Soult, but, through no fault of the marshal, the garrison of Bayonne made a sortie on the night of the 14th, which cost them 900 and the allies 800 casualties. This was the last blood shed. On the 18th an agreement for the suspension of arms was signed and the Peninsular War was over.

The heroes of the war were, whatever the British may think, the Spaniards. It is true that their provisional Government was inefficient, their improvised armies of little military value, and their most prominent commanders, such as Cuesta, Castaños and La Romana, incompetent. Their heads were turned by their initial success at Baylen, when they had to do with a frightened man, and they were always trying to repeat Baylen with raw levies under unskilled leaders. There were, moreover, endless jealousies between rival authorities, provinces and commanders. But the spirit of the nation as a whole was beyond praise, and was quickened by a savage hatred of the French. Every French straggler's throat was cut and small bodies of men were destroyed without mercy. The French tried to quell this spirit by reprisals —burning villages and shooting villagers—but the Spaniards retorted in kind, and before the close of 1808 both sides had exhausted their powers of terror, the French by burning Spaniards alive in their houses, the Spaniards by sawing a captured French general asunder. But the losses thus inflicted upon the French were very formidable. Marbot reckoned the average number of deaths of French soldiers, from all causes, from the beginning to the end of the war as 100 daily. From the year 1812 the guerrilla-leaders took matters very much out of the hands of the regular military commanders, and proved to be much more efficient than the regular generals. These leaders were drawn from all classes—one of the best was a priest—and, as their followings swelled to three, four and even five thousand men of all three arms, they became most dangerous opponents. Their knowledge of the country in the wild mountainous districts which they preferred gave them enormous advantages over their enemies, while if closely pressed they could disperse for the time and reassemble when the peril was over. Their quality varied very greatly. Some were composed of every description of desperate adventurer, not excluding British and French deserters, and were rather wild. Others were under far stricter restraint. At least one was subjected to discipline as stern as that of Cromwell's Ironsides, and began every day with mass. Taken altogether they wrought great things for the liberation of their country, and were perhaps the best expression of the national will to victory. But the sufferings of Spain from French oppression and extortion and from the ravages of war were terrible. They were the source of many of her troubles during the 19th century, and she has not yet, perhaps, recovered from the effects of those awful years. But she has good right to be proud of her *Guerra de Independencia*.

In Portugal likewise the national spirit was admirable. There is no more frugal, patient, docile, industrious man than the Portuguese peasant, and with British officers in the higher regimental ranks to superintend his training, he made an excellent soldier. When he failed, as at one moment he did, it was owing to his Government's neglect of him; but when, in response to British protests, that fault was amended, the Portuguese soldier speedily recovered himself. The Portuguese are still proud of a phrase written by Wellington from the Pyrenees in 1813, in which he described their countrymen as "the fighting-cocks of the army." It must be added, that when once the French had been driven across the Pyrenees, the Portuguese began to manifest considerable jealousy of the British officers in their army, and that Wellington's efforts to obtain some of his old Portuguese regiments for the campaign of Waterloo failed completely. Still this was, perhaps, no more than natural. The Portuguese, like the Spaniards, suffered terribly from the war and still suffer from it. They have, however, retained two things British—their rule of the road and their bugle-calls.

The fact, nevertheless, remains that, without the little British army under the command of Wellington, Spaniards and Portuguese could hardly have worked out their deliverance. At first, as has been seen, Wellington did not realize all the difficulties of the problem set him; but after the experience of 1809 he was under no illusions, and there and then thought out the solution. His first task, however, was to train his own troops, for the army had no regular administrative services in those days and indeed was subject to three different departments—the cavalry and infantry under the commander-in-chief and War Office, the artillery and engineers under the Board of Ordnance, and supply and transport under the Treasury. The last named was that which gave him most trouble, for the Treasury's commissaries, even after 14 years of war, had little experience of the needs of an army in the field; and on landing on the Mondego in 1808 he was obliged to draw up for them a complete table for the hiring and organization of transport. Roads in Portugal hardly permitted the use of wheeled vehicles; and he was obliged later to form his transport entirely of pack-mules, which he gradually brought up to a perfect system.

As has been seen, this formed an essential part of his plan for getting the better of the French, but it was also the principal means to the great end of discipline. Soldiers regularly fed had no excuse for helping themselves, and no commander was more keenly alive than Wellington to the demoralizing effects of marauding, nor more resolute to check it. Unfortunately the House of Commons, in defiance of all military opinion, had insisted in 1805 in altering the procedure of regimental courts martial, with the result that for a long time these courts were ineffective for enforcing discipline. It was the uncertainty of punishment which allowed the men to get out of hand in the retreats from Talavera and from Burgos, and after the assaults on Ciudad Rodrigo, Badajoz and San Sebastian; and indeed it was not until Wellington in 1812 imported a lawyer to help him through the intricacies of the new procedure that discipline began to improve. The establishment of a corps of military police—the first of its kind in the British army—materially contributed towards the same object, with the result that the behaviour of the British troops in France was exemplary. Thus it came about that the French peasants sold their produce and their cattle to the English commissaries, while Soult and their own countrymen went away empty. Thus also it was that at the conclusion of the war a British division marched

almost the whole length of France without a single complaint of any French inhabitant against a British soldier.

In addition to the transport and supply service, Wellington gradually trained a staff of extreme efficiency with an intelligence department of great excellence. He had, of course, the advantage of fighting in a country where every inhabitant was eager to give information to him and to withhold it from his enemy, but none the less the work of his intelligence officers was most remarkable. In other respects his staff required much training from him, but improved steadily; and, in fact, during the fighting in the Pyrenees in 1813–14, the chief of the staff (who bore the title of quartermaster-general) did not hesitate to give orders (and very good orders) on his own initiative. When the army latterly swelled to some 100,000 men of all nations it was divided, practically, into three corps of which one was under Wellington's immediate command; and the staff proved itself perfectly competent to handle it. This training of the army and staff was perhaps the most remarkable achievement of Wellington, carried out amid a thousand distractions from both civil and military authorities in Spain and Portugal and under the disadvantage of a permanent dearth of specie. The exchange in the Peninsula was at a discount of 25% against the British, and hence the payments, whether to Spanish muleteers or to English private soldiers, were generally six months at least in arrear. Nevertheless Wellington kept the force together somehow, and it is no exaggeration to say that the Peninsular army, including the King's German legion with the British, was the most effective military machine, for its size, in Europe. It must be added that, with the help of Sir James McGrigor, the father of British military hygiene, Wellington brought the organization and working of the medical service to a pitch of perfection till then unapproached in any European army. Nor was he less careful of his animals than of his men. He was a good horse-master and knew that horses are not machines.

In the matter of tactics, when occupying a defensive position he always hid away his troops on the reverse side of a hill, a practice which was confined to him and which was one reason for the cautiousness of the French generals, in the later stages of the war, in offensive movements against him. His habit of meeting French columns with English lines is too well known to need more than mere mention, though no other army in Europe ventured to imitate either of these peculiarities. In respect of artillery his resources, as compared with those of the French, were of somewhat mixed value. The heaviest of the French field-guns—the 12-pounders, called by Napoleon his "pretty girls"—were of greater range and calibre than any of the English field-pieces. But, on the other hand, the English had the advantage of the spherical case-shot invented by Maj. Shrapnel, which practically enabled the English gunners to rain grape-shot upon an enemy at the then enormous ranges of 800, 1,000 and even 1,200 yards. Shrapnel shell first came by its own in the Peninsular War and contributed more powerfully to its successful issue than is generally recognized.

Wellington's system of conducting a siege is almost contemptuously dismissed by Continental critics; and he practically admitted that he relied too much upon the methods which he had found successful in India. But if military engineering did not shine in his army, the topographical work and the civil engineering performed by the staff corps (the quartermaster-general's engineers as opposed to those of the master-general of the ordnance) was very remarkable indeed; their feats of bridging were notable; and they designed and constructed the first suspension-bridge in military history.

To come last to the French, their misfortunes were due mainly to the injustice of their cause, to the fact that sea-transport was denied to them, to their dependence upon the invaded country not only for subsistence but for money, to the jealousy and cupidity of their generals, and to Napoleon's great blunder in endeavouring to control the operations from a distance instead of appointing a commander-in-chief upon the spot and insisting that he should be obeyed. No attempt was made to conciliate the Spaniards and much was done to exasperate them, with the result that the invaders were loathed beyond human bounds. The closing of the sea compelled the transport of all stores of war to be made by land, which was a great strain, and every French infantry soldier had to march into Spain on his feet, which signified great wear and tear of shoes and clothing, with countless casualties from fatigue and sickness. Subsistence upon the country again frequently meant that the stronger men took such food as was to be obtained, while the weaker went empty and died of starvation. Moreover, when one year's harvest in some district had been consumed, Wellington could count that his enemy was food-bound, so to speak, till next harvest and could take liberties accordingly. Again for want of a commander-in-chief the French operations were ill-concerted and executed with ill-will. Every French general wished to be independent and many of them thought only of filling their pockets. Soldiers were often employed by them in herding merino-sheep instead of in their legitimate business; and the example set in high places was only too faithfully imitated by subordinate officers. High commanders, again, set the example of taking women into the field. Junot carried a mistress with him to Vimeiro; Masséna took with him the wife of one of his officers throughout the campaign of 1810. This evil reached such a pitch that a French officer captured at Vittoria said bluntly to an English officer, "O! sir, you are an army; we are a travelling brothel (*un bordel ambulant*)." From all these causes discipline suffered; the morale of the French troops deteriorated; and by 1812 every French commander was afraid to meet the British. As Napoleon drew more and more of his soldiers from the Peninsula to make good his losses in Russia, the quality of Soult's force sank lower and lower. This naturally reacted upon the officers; and the French historian, Capt. Vidal de Lablache, contrasts eloquently the co-operation of the British divisional commanders with each other against the sulky helplessness of many of their French peers. By the end of 1813 the French army in southern France had become almost contemptible. The more honour to Soult, its commander, and to his officers and men that they strove at least to fight on to the end.

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PENITENTIAL, a manual used by priests of the Catholic Church for guidance in assigning the penance due to sins. Such manuals played a large rôle in the early middle ages; they were mainly composed of canons drawn from various councils and of *dicta* from writings of some of the fathers. Disciplinary regulations in Christian communities are referred to from the very borders of the apostolic age, and a system of careful oversight of those admitted to the mysteries developed steadily as the membership grew and dangers of contamination with the outside world increased. The treatment of the lapsed produced what has frequently been called the first penitential, the *libellus* in which, according to Cyprian (*Ep.* 51), the decrees of the African synods of 251 and 255 were embodied for the guidance of the clergy in dealing with their repentant and returning flocks. This manual, which has been lost, was evidently not similar to the code-like compilations of the 8th century, and it is somewhat misleading to speak of it as a penitential. Certain patristic letters had acquired almost the force of decretals; the most important were the three letters of St. Basil of Caesarea (d. 379) to Bishop Amphilochius of Iconium containing over eighty headings.

Three things tended to develop these rules into something like a system of penitential law. These were the development of auricular confession and private penance; the extension of the penitential jurisdiction among the clergy owing to the growth of a parochial priesthood; and the necessity of adapting the penance to the primitive ideas of law prevailing among the newly converted barbarians, especially the idea of compensation by the *wergild*. In Ireland in the middle of the 5th century appeared the "canons of St. Patrick." In the first half of the next century these were followed by others, notably those of St. Finian (d. 552). At the same time the Celtic British Church produced the penitentials of St. David of Menevia (d. 544) and of Gildas (d. 583) in addition to synodal legislation. These furnished the material to Columban (d. 615) for his *Liber de poenitentia* and his monastic rule, which had a great influence upon the continent of Europe. The Anglo-Saxon Church was later than the Irish, but under Theodore of Tarsus (d. 690), archbishop of Canterbury, the practice then in force was made the basis of the most important of all penitentials. The *Poenitentiale Theodori* became the authority in the Church's treatment of sinners for the next four centuries. (*See* Haddan and Stubbs's *Councils and Ecclesiastical Documents relating to Great Britain and Ireland*, iii. 173 *seq.*) A *Poenitentiale Commeani* (St. Cumian), dating apparently from the early 8th century, was the third main source of Frankish penitentials. Bishop Halitgar was commissioned (in 829) by Ebo of Reims to prepare a definitive edition; he used among his other materials, a so-called *poenitentiale romanum*, which was really of Frankish origin. The canons printed by David Wilkins in his *Concilia* (1737) as being by Ecgbert of York (d. 766) are largely a translation into Anglo-Saxon of three books of Halitgar's penitentials. In 841 Hrabanus Maurus undertook a new *Liber poenitentium* and wrote a long letter on the subject to Heribald of Auxerre about 853. Then followed the treatise of Regino of Prum in 906, and finally the collection made by Burchard, bishop of Worms, between 1012 and 1023. The codification of the canon law by Gratian and the change in the sacramental position of penance in the 12th century closed the history of penitentials.

Bibliography.—In addition to the works mentioned above the one important work on the penitentials was L. W. H. Wasserschleben's epoch-making study and collection of texts, *Die Buszordnungen der abendländischen Kirche nebst einer rechtsgeschichtlichen Einleitung* (Halle, 1851). *See* articles in Wetzer and Welte's *Kirchenlexikon*, Hauck's *Realencyklopädie*, and Haddan and Stubbs's *Councils*. *See* also Seebasz in *Zeitschrift für Kirchengeschichte*, xviii. 58. On the canons of St. Patrick *see* the *Life of St. Patrick* by J. B. Bury (pp. 233–275).

PENMARC'H, a village of western France in the department of Finistère, 18 m. S.W. of Quimper by road. Pop. (1926) 823. At the end of the peninsula on which it stands are fortified remains of a town important from the 14th to the 16th centuries, which included Penmarc'h, St. Guénolé and Kerity. The Newfoundland fisheries and the pillage by La Fontenelle in 1595 because of its cod-banks, caused its decline. The Gothic church of St. Nonna (early 16th century) at Penmarc'h, the church of St. Guénolé and the church of Kerity (15th century) are of interest. The coast is very dangerous. There are numerous megalithic monuments in the vicinity.

PENN, WILLIAM (1621–1670), British admiral, son of Giles Penn, merchant and seaman of Bristol, served his apprenticeship at sea with his father. In the first Civil War he fought on the side of the parliament, and was in command of a ship in the squadron maintained against the king in the Irish seas. In 1648 he was arrested, probably on suspicion of being in correspondence with the king, and sent to London, but was soon released, and sent back as rear admiral in the "Assurance" (32). After 1650 he was employed in the Ocean, and in the Mediterranean in pursuit of the Royalists under Prince Rupert. When the first Dutch War broke out Penn was appointed vice-admiral to Blake, and was present at the battle of Sept. 28, off the Kentish Knock. In the three days' battle off Portland, February 1653, he commanded the Blue squadron, and he also served with distinction in the final battles of the war in June and July. He sat on the commission of admirals and generals at sea, who exercised the military command of the fleet, as well as on the board of management. In 1654 he offered to carry the fleet over to the king, but in October he commanded the expedition to the West Indies sent out by Cromwell, which conquered Jamaica. He was not responsible for the shameful repulse at San Domingo, which was due to a panic among the troops. On their return he and his military colleague Venables were sent to the Tower. When released he retired to the estate he had received in Ireland.

He continued in communication with the Royalists, and in 1660 had a rather obscure share in the Restoration. He was reappointed commissioner of the navy by the king, and in the second Dutch War served as "great captain commander" or captain of the fleet, with the duke of York (afterwards King James II.) at the battle of Lowestoft (June 3, 1665). Penn died on Sept. 16, 1670, and he was buried in the church of St. Mary Redcliffe, Bristol. His portrait by Lely is in the Painted Hall at Greenwich. By his wife Margaret Jasper, he was the father of William Penn, the founder of Pennsylvania. Penn was one of the authors of the first code of tactics provided for the navy; it was the base of the "Duke of York's Sailing and Fighting Instructions," which continued for long to supply the orthodox tactical creed of the navy.

See the *Memorials of the Professional Life and Times of Sir William Penn*, by Granville Penn.

PENN, WILLIAM (1644–1718), English Quaker and founder of Pennsylvania, son of Admiral Sir William Penn (1621–1670) and Margaret Jasper, a Dutch lady, was born at Tower Hill, London, on Oct. 14, 1644. During his father's absence at sea he lived at Wanstead in Essex, and went to school at Chigwell close by, in which places he was brought under strong Puritan influences. Like many children of sensitive temperament, he had times of spiritual excitement; when about twelve he was "suddenly surprised with an inward comfort, and, as he thought, an external glory in the room, which gave rise to religious emotions, during which he had the strongest conviction of the being of a God, and that the soul of man was capable of enjoying communication with Him." Upon the death of Cromwell, Penn's father, who had served the Protector because there was no other career open, remained with his family on the Irish estates which Cromwell had given him. On the resignation of Richard Cromwell he at once declared for the king and went to the court in Holland, where he was received into favour and knighted; and at the elections for the convention parliament he was returned for Weymouth. Meanwhile young Penn studied under a private tutor on Tower Hill until, in October 1660, he was entered as a gentleman commoner at Christ Church. He appears in the same year to have contributed to the *Threnodia*, a collection of elegies on the young duke of Gloucester.

The rigour with which the Anglican statutes were revived, and the Puritan heads of colleges supplanted, roused the spirit of

resistance at Oxford to the uttermost. With this spirit Penn, who was on familiar terms with John Owen (1616–1683), and who had already fallen under the influence of Thomas Loe the Quaker, then at Oxford, actively sympathized. He and others refused to attend chapel and church service, and were fined in consequence. There is no doubt that in January 1662 his father was anxious to remove him to Cambridge, and consulted Pepys on the subject; and in later years he speaks of being "banished" from the college, of being whipped, beaten and turned out of doors on his return to his father, in the anger of the latter at his avowed Quakerism. A reconciliation was effected; and Penn was sent to France to forget this folly. He appears to have entered into the gaieties of the court of Louis XIV., and to have become acquainted with Robert Spencer, afterwards earl of Sunderland, and with Dorothy Sidney. Somewhat later he placed himself under the tuition of Moses Amyraut, president of the Protestant college of Saumur, and the exponent of liberal Calvinism, from whom he gained the patristic knowledge which is so prominent in his controversial writings. He afterwards travelled in Italy, returning to England in August 1664, with "a great deal, if not too much, of the vanity of the French garb and affected manner of speech and gait."[1]

Until the outbreak of the plague Penn was a student of Lincoln's Inn. For a few days also he served on the staff of his father—now great captain commander—and was by him sent back in April 1665 to Charles with despatches. Returning after the naval victory off Lowestoft in June, Admiral Penn found that his son had again become settled in seriousness and Quakerism. The admiral sent him in February 1666 with introductions to Ormonde's court in Ireland, and to manage his estate in Cork. When the mutiny broke out in Carrickfergus Penn volunteered for service, and acted under Arran, with the result that in May 1666 Ormonde offered him his father's company of foot, but, for some unexplained reason, the admiral demurred to this arrangement. It was at this time that the well-known portrait was painted of the great Quaker in a suit of armour; and it was at this time, too, that the conversion, begun when he was a boy by Thomas Loe in Ireland, was completed at the same place by the same agency.

On Sept. 3, 1667, Penn attended a meeting of Quakers in Cork, at which he assisted to expel a soldier who had disturbed the meeting. He was in consequence, with others present, sent to prison by the magistrates. From prison he wrote to Lord Orrery, the president of Munster, a letter, in which he first publicly makes a claim for perfect freedom of conscience. He was immediately released, and at once returned to his father in London, with the distinctive marks of Quakerism strong upon him. Penn now became a minister of the denomination, and at once entered upon controversy with two tracts, *Truth Exalted* and *The Guide Mistaken*. He appealed, not unsuccessfully, to Buckingham, who on Clarendon's fall was posing as the protector of the Dissenters, to use his efforts to procure parliamentary toleration.

Penn's first public discussion was with Thomas Vincent, a London Presbyterian minister, who had reflected on the "damnable" doctrines of the Quakers. The discussion, which had turned chiefly upon the doctrine of the Trinity, ended uselessly, and Penn at once published *The Sandy Foundation Shaken,* a tract of ability sufficient to excite Pepys's astonishment, in which orthodox views were so offensively attacked that Penn was placed in the Tower, where he remained for nearly nine months. The imputations upon his opinions and good citizenship, made as well by Dissenters as by the Church, he repelled in *Innocency with her Open Face,* in which he asserts his full belief in the divinity of Christ, the atonement, and justification through faith, though insisting on the necessity of good works. He now published the most important of his books, *No Cross, No Crown,* which contained an able defence of the Quaker doctrines and practices, and a scathing attack on the loose and unchristian lives of the clergy. While completely refusing to recant Penn addressed a letter to Arlington in July 1669, in which, on grounds of religious freedom, he asked him to interfere. He was almost at once set at liberty.

An informal reconciliation now took place with his father, and Penn was again sent on family business to Ireland. At the desire of his father, whose health was fast failing, Penn returned to London in 1670. Having found the usual place of meeting in Gracechurch Street closed by soldiers, Penn, as a protest, preached to the people in the open street. With William Mead he was at once arrested and indicted at the Old Bailey on Sept. 1, for preaching to an unlawful, seditious and riotous assembly, which had met together with force and arms. The Conventicle Act not touching their case, the trial which followed, and which may be read at length in Penn's *People's Ancient and Just Liberties Asserted,* was a notable one in the history of trial by jury. With extreme courage and skill Penn exposed the illegality of the prosecution, while the jury, for the first time, asserted the right of juries to decide in opposition to the ruling of the court. They brought in a verdict declaring Penn and Mead "guilty of speaking in Gracechurch Street," but refused to add "to an unlawful assembly"; then, as the pressure upon them increased, they first acquitted Mead, while returning their original verdict upon Penn, and then, when that verdict was not admitted, returned their final answer "not guilty" for both. The court fined the jurymen 40 marks each for their contumacy, and, in default of payment, imprisoned them, whereupon they vindicated and established for ever the right they had claimed in an action (known as Bushell's case from the name of one of the jurymen) before the court of common pleas, when all twelve judges unanimously declared their imprisonment illegal.

Penn himself had been fined for not removing his hat in court, had been imprisoned on his refusal to pay, and had earnestly requested his family not to pay for him. The fine, however, was settled anonymously, and he was released in time to be present at his father's death on Sept. 16, 1670, at the early age of forty-nine. Penn now found himself in possession of a fortune of £1,500 a year, and a claim on the Crown for £16,000, lent to Charles II. by his father. Upon his release Penn at once plunged into controversy, challenging a Baptist minister named Jeremiah Ives, at High Wycombe, to a public dispute and, according to the Quaker account, easily defeating him. Hearing at Oxford that students who attended Friends' meeting were rigorously used, he wrote a vehement and abusive remonstrance to the vice-chancellor in defence of religious freedom. This found still more remarkable expression in the *Seasonable Caveat against Popery* (Jan. 1671).

In the beginning of 1671 Penn was again arrested for preaching in Wheeler Street meeting-house by Sir J. Robinson, the lieutenant of the Tower, formerly lord mayor. Legal proof being wanting of any breach of the Conventicle Act, and the Oxford or Five Mile Act also proving inapplicable, Robinson, who had some special cause of enmity against Penn, urged upon him the oath of allegiance. This, of course, the Quaker would not take, and consequently was imprisoned for six months. During this imprisonment Penn wrote several works, the most important being *The Great Case of Liberty of Conscience* (Feb 1671), a noble defence of complete toleration. Upon his release he started upon a missionary journey through Holland and Germany; at Emden he founded a Quaker society, and established an intimate friendship with the princess palatine Elizabeth.

Upon his return home in the spring of 1672 Penn married Gulielma Springett, daughter of Mary Pennington by her first husband, Sir William Springett. She appears to have been equally remarkable for beauty, devotion to her husband, and firmness to the religious principles which she had adopted when little more than a child. Penn now settled at Rickmansworth, Hertfordshire, and gave himself up to controversial writing. To this year, 1672, belong the *Treatise on Oaths* and *England's Present Interest Considered.* In the year 1673 Penn secured the release of George Fox, addressed the Quakers in Holland and Germany, carried on public controversies with Thomas Hicks, a Baptist, and John Faldo, an Independent, and published his treatise on the *Christian Quaker and his Divine Testimony Vindicated,* the *Discourse of the General Rule of Faith and Practice, Reasons against Railing* (in answer to Hicks), *Counterfeit Christianity Detected,* and a *Just Rebuke to One-and-twenty Learned Divines* (an answer to Faldo and to the publication entitled *Quakerism no Christianity*). His last public controversy was in 1675 with Richard Baxter, in which, of course, each party claimed the victory.

[1]Pepys, August 30, 1664.

At this point Penn's connection with America begins. For the proceedings by which Penn acquired a large proprietary interest in New Jersey *see* NEW JERSEY: *History*. For the new colony Penn drew up a constitution, under the title of "Concessions." Great care is taken to make this constitution "as near as may be conveniently to the primitive, ancient and fundamental laws of the nation of England." But a democratic element is introduced, and the new principle of perfect religious freedom stands in the first place (ch. xvi.). With regard to the liberty of the subject, no one might be condemned in life, liberty or estate, except by a jury of twelve, and the right of challenging was granted to the uttermost (ch. xvii.). Imprisonment for debt was not abolished (as Dixon states), but was reduced to a minimum (ch. xviii.), while theft was punished by twofold restitution either in value or in labour to that amount (ch. xxviii.). The provisions of ch. xix. deserve special notice. All causes were to go before three justices, with a jury. "They, the said justices, shall pronounce such judgment as they shall receive from, and be directed by, the said twelve men, in whom only the judgment resides, and not otherwise. And in case of their neglect and refusal, that then one of the twelve, by consent of the rest, pronounce their own judgment as the justices should have done." The justices and constables, moreover, were elected by the people, the former for two years only (ch. xli.). Suitors might plead in person, and the courts were public (ch. xxii.). Questions between Indians and settlers were to be arranged by a mixed jury (ch. xxv.). An assembly was to meet yearly, consisting of a hundred persons, chosen by the inhabitants, freeholders and proprietors, one for each division of the province. The election was to be by ballot, and each member was to receive a shilling a day from his division, "that thereby he may be known to be the servant of the people." The executive power was to be in the hands of ten commissioners[1] chosen by the assembly. Such a constitution soon attracted large numbers of Quakers to West Jersey.

It was shortly before these occurrences that Penn inherited through his wife the estate of Worminghurst in Sussex, whither he removed from Rickmansworth. He now (July 25, 1677) undertook a second missionary journey to the continent along with George Fox, Robert Barclay and George Keith. He visited particularly Rotterdam and all the Holland towns, renewed his intimacy with the princess Elizabeth at Herwerden, and, under considerable privations, travelled through Hanover, Germany, the lower Rhine and the electorate of Brandenburg, returning by Bremen and The Hague. It is worthy of recollection that the Germantown (Philadelphia) settlers from Kirchheim, one of the places which responded in an especial degree to Penn's teaching, are noted as the first who declared it wrong for Christians to hold slaves. Penn reached England again on Oct. 24. He tried to gain the insertion in the bill for the relief of Protestant Dissenters of a clause enabling Friends to affirm instead of taking the oath, and twice addressed the House of Commons' committee with considerable eloquence and effect. The bill, however, fell to the ground at the sudden prorogation.

In 1678 the popish terror came to a head, and to calm and guide Friends in the prevailing excitement Penn wrote his *Epistle to the Children of Light in this Generation*. A far more important publication was *An Address to Protestants of all Persuasions*, by William Penn, Protestant, in 1679; a powerful exposition of the doctrine of pure tolerance and a protest against the enforcement of opinions as articles of faith. This was succeeded, at the general election which followed the dissolution of the pensionary parliament, by *England's Great Interest in the Choice of this New Parliament*, in which he insisted on the following points: the discovery and punishment of the plot, the impeachment of corrupt ministers and councillors, the punishment of "pensioners," the enactment of frequent parliaments, security from popery and slavery, and ease for Protestant Dissenters. Next came *One Project for the Good of England*, perhaps the most pungent of all his political writings. But he was not merely active with his pen. He was at this time in close intimacy with Algernon Sidney, who stood successively for Guildford and Bramber. In each case, owing in a great degree to Penn's eager advocacy, Sidney was elected, only to have his elections annulled by court influence. Toleration for Dissenters seemed as far off as ever.

[1]Penn's letter of the 26th of August 1676 says twelve, and Clarkson has followed this; but the Concessions, which were not assented to by the inhabitants until the 3rd of March 1676–1677, say ten.

Penn now again turned his thoughts to America. In repayment of the debt mentioned above he now asked from the Crown, at a council held on the 24th of June 1680, for "a tract of land in America north of Maryland, bounded on the east by the Delaware, on the west limited as Maryland (*i.e.* by New Jersey), northward as far as plantable"; this latter limit Penn explained to be "three degrees northwards." This formed a tract of 300 m. by 160, of extreme fertility, mineral wealth and richness of all kinds. Disputes with James, duke of York, and with Lord Baltimore, who had rights over Maryland, delayed the matter until March 14, 1681, when the grant received the royal signature, and Penn was made master of the province of Pennsylvania. His own account of the name is that he suggested "Sylvania," that the king added the "Penn" in honour of his father, and that, although he strenuously objected and even tried to bribe the secretaries, he could not get the name altered. It should be added that early in 1682 Carteret, grandson of the original proprietor, transferred his rights in East Jersey to Penn and eleven associates, who soon afterwards conveyed one-half of their interest to the earl of Perth and eleven others. It is uncertain to what extent Penn retained his interest in West and East Jersey, and when it ceased. The two provinces were united under one governor in 1699, and Penn was a proprietor in 1700. In 1702 the government of New Jersey was surrendered to the Crown.

By the charter for Pennsylvania Penn was made proprietary of the province. He was supreme governor; he had the power of making laws with the advice, assent and approbation of the freemen, of appointing officers, and of granting pardons. The laws were to contain nothing contrary to English law, with a saving to the Crown and the privy council in the case of appeals. Parliament was to be supreme in all questions of trade and commerce; the right to levy taxes and customs was reserved to England; an agent to represent Penn was to reside in London; neglect on the part of Penn was to lead to the passing of the government to the Crown (which event actually took place in 1692); no correspondence might be carried on with countries at war with Great Britain. The importunity of the bishop of London extorted the right to appoint Anglican ministers, should twenty members of the colony desire it, thus securing the very thing which Penn was anxious to avoid—the recognition of the principle of an establishment.

He negotiated with James and Lord Baltimore with the view, ultimately successful, of freeing the mouth of the Delaware, wrote to the Indians in conciliatory terms, and encouraged the formation of companies to work the infant colony both in England and Germany, especially the "Free Society of Traders in Pennsylvania," to whom he sold 20,000 acres, absolutely refusing, however, to grant any monopolies. In July he drew up a body of "conditions and concessions." This constitution, savouring strongly of Harrington's *Oceana*, was framed, it is said, in consultation with Sidney, but the statement is doubtful. Until the council of seventy-two (chosen by universal suffrage every three years, twenty-four retiring each year), and the assembly (chosen annually) were duly elected, a body of provisional laws was added.

It was in the midst of this extreme activity that Penn was made a Fellow of the Royal Society. Leaving his family behind him, Penn sailed with a hundred comrades from Deal in the "Welcome" on Sept. 1, 1682. His *Last Farewell to England* and his letter to his wife and children contain a beautiful expression of his pious and manly nature. He landed at New Castle on the Delaware on Oct 27, his company having lost one-third of their number by small-pox during the voyage. After receiving formal possession, and having visited New York, Penn ascended the Delaware to the Swedish settlement of Upland, to which he gave the name of Chester. The assembly at once met, and on the 7th of December passed the "Great Law of Pennsylvania." The idea which informs this law is that Pennsylvania was to be a Christian state on a Quaker model. Philadelphia was now founded, and within

two years contained 300 houses and a population of 2,500. At the same time an act was passed, uniting under the same government the territories which had been granted by feoffment by James in 1682. Realistic and entirely imaginative accounts (*cf.* Dixon, p. 270), inspired chiefly by Benjamin West's picture, have been given of the treaty which there seems no doubt Penn actually made in November 1683 with the Indians. His connection with them was one of the most successful parts of his management, and he gained at once and retained through life their intense affection.

Penn now wrote an account of Pennsylvania from his own observation for the "Free Society of Traders," in which he shows considerable power of artistic description Tales of violent persecution of the Quakers, and the necessity of settling disputes, which had arisen with Lord Baltimore, his neighbour in Maryland, brought Penn back to England (Oct 2, 1684) after an absence of two years. In the spring of 1683 he had modified the original charter at the desire of the assembly, but without at all altering its democratic character He was, in reference to this alteration, charged with selfish and deceitful dealing by the assembly.

Within five months Charles II died, and Penn found himself at once in a position of great influence. Penn now took up his abode at Kensington in Holland House, so as to be near the court. His influence there was great enough to secure the pardon of John Locke, who had been dismissed from Oxford by Charles, and of 1,200 Quakers who were in prison. At this time he wrote a further account of Pennsylvania, a pamphlet in defence of Buckingham's essay in favour of toleration, in which he is supposed to have had some share, and his *Persuasive to Moderation to Dissenting Christians,* very similar in tone to the *One Project for the Good of England.* When Monmouth's rebellion was suppressed he appears to have done his best to mitigate the horrors of the western commission, opposing Jeffreys to the uttermost (Burnet iii. 66; Dalrymple i. 282.) Macaulay has accused Penn of being concerned in some of the worst actions of the court at this time His complete refutation by Forster, Paget, Dixon and others renders it unnecessary to do more than allude to the cases of the Maids of Taunton, Alderman Kiffin, and Magdalen College (Oxford)

In 1686, when making a third missionary journey to Holland and Germany, Penn was charged by James with an informal mission to the prince of Orange to endeavour to gain his assent to the removal of religious tests He gained no satisfaction either from the prince or from Burnet, who disliked him On his return he went on a preaching mission through England His position with James was undoubtedly a compromising one, and it is not strange that, wishing to tolerate Papists, he should, in the prevailing temper of England, be once more accused of being a Jesuit. In 1687 James published the Declaration of Indulgence, and Penn probably drew up the address of thanks on the part of the Quakers It fully reflects his views, which are further ably put in the pamphlet *Good Advice to the Church of England, Roman Catholics and Protestant Dissenters,* in which he showed the wisdom and duty of repealing the Test Acts and Penal Laws. At the Revolution he behaved with courage He was one of the few friends of the king who remained in London, and, when twice summoned before the council, spoke boldly in his behalf. He admitted that James had asked him to come to him in France; but at the same time he asserted his perfect loyalty During the absence of William in 1690 he was proclaimed by Mary as a dangerous person, but no evidence of treason was forthcoming It was now that he lost by death two of his dearest friends, Robert Barclay and George Fox It was at the funeral of the latter that, upon the information of the notorious informer William Fuller (1670–1717?), an attempt was made to arrest him, but he had just left the ground; the fact that no further steps were then taken shows how little the government believed in his guilt. He now lived in retirement in London, though his address was perfectly well known to his friends in the council. In 1691, again on Fuller's evidence, a proclamation was issued for the arrest of Penn and two others as being concerned in Preston's plot. In 1692 he began to write again, both on questions of Quaker discipline and in defence of the sect *Just Measures in an Epistle of Peace and Love, The New Athenians* (in reply to the attacks of the *Athenian Mercury*), and *A Key opening the Way to every Capacity* are the principal publications of this year.

Meantime matters had been going badly in Pennsylvania. Penn had, in 1686, been obliged to make changes in the composition of the executive body, though in 1689 it reverted to the original constitution; the legislative bodies had quarrelled; and Penn could not gain his rents. The chief difficulty in Pennsylvania was the dispute between the province—*i.e.,* the country given to Penn by the charter—and the "territories," or the lands granted to him by the duke of York by feoffment in August 1682, which were under the same government but had differing interests. The difficulties which Quaker principles placed in the way of arming the colony—a matter of grave importance in the existing European complications—fought most hardly against Penn's power. On Oct. 21, 1692 an order of council was issued depriving Penn of the governorship of Pennsylvania and giving it to Colonel Benjamin Fletcher, the governor of New York To this blow were added the illness of his wife and a fresh accusation of treasonable correspondence with James. In his enforced retirement he wrote the most devotional and most charming of his works—the collection of maxims of conduct and religion entitled *The Fruits of Solitude.* In December, thanks to the efforts of his friends at court, among whom were Buckingham, Somers, Rochester, and Henry Sidney, he received an intimation that no further steps would be taken against him. The accusation, however, had been public, and he insisted on the withdrawal being equally public. He was therefore heard in full council before the king, and honourably acquitted of all charges of treason. It was now that he wrote an *Essay towards the Present and Future Peace of Europe,* in which he puts forth the idea of a great court of arbitration, a principle which he had already carried out in Pennsylvania.

In 1694 (Feb. 23) his wife Gulielma died, leaving two sons, Springett and William, and a daughter Letitia, afterwards married to William Aubrey Two other daughters, Mary and Hannah, died in infancy. He consoled himself by writing his *Account of the Rise and Progress of the People called Quakers.* The coldness and suspicion with which he had been regarded by his own denomination had now ceased, and he was once more regarded by the Quaker body as their leader. About the same time (Aug 20) he was restored to the governorship of Pennsylvania; and he promised to supply money and men for the defence of the frontiers. In 1695 he went on another preaching mission in the west, and in March 1696 he formed a second marriage, with Hannah Callowhill, his son Springett dying five weeks later. In this year he wrote his work *On Primitive Christianity,* in which he argues that the faith and practice of the Friends were those of the early Church In 1697 Penn removed to Bristol, and during the greater part of 1698 was preaching with great success against oppression in Ireland, whither he had gone to look after the property at Shannangarry.

In 1699 he was back in Pennsylvania where the success of Colonel Robert Quary, judge of the admiralty in Pennsylvania—who was in the interests of those who wished to make the province an imperial colony—and the high-handed action of the deputy Markham in opposition to the Crown, were causing great difficulties Penn carried with him particular instructions to put down piracy, which the objections of the Quakers to the use of force had rendered audacious and concerning which Quary had made strong representations to the home government, while Markham and the inhabitants apparently encouraged it. Penn and Quary, however, came at once to a satisfactory understanding on this matter, and the illegal traffic was vigorously and successfully attacked. In 1696 the Philadelphian Yearly Meeting had passed a resolution declaring slavery contrary to the first principles of the gospel Penn, however, did not venture upon emancipation; but he insisted on the instruction of negroes, permission for them to marry, repression of polygamy and adultery, and proposed regulations for their trial and punishment. The assembly, however, a very mixed body of all nations, now refused to accept any of these proposals except the last-named. His great success was with the Indians; by their treaty with him in 1700 they promised not to help any enemy of England, to traffic only with those

approved by the governor, and to sell furs or skins to none but inhabitants of the province. At the same time he showed his capacity for legislation by the share he took with Lord Bellomont at New York in the consolidation of the laws in use in the various parts of America.

Affairs now again demanded his presence in England. The king had in 1701 written to urge upon the Pennsylvania government a union with other private colonies for defence, and had asked for money for fortifications. The difficulty felt by the Crown in this matter was a natural one. A bill was brought into the lords to convert private into Crown colonies. Penn's son appeared before the committee of the house and managed to delay the matter until his father's return. On Sept. 15, Penn called the assembly together, in which the differences between the province and the territories again broke out. He succeeded, however, in calming them, appointed a council of ten to manage the province in his absence, and gave a borough charter to Philadelphia. In May 1700, experience having shown that alterations in the charter were advisable, the assembly had, almost unanimously, requested Penn to revise it. On Oct. 28, 1701 he handed it back to them in the form in which it afterwards remained. An assembly was to be chosen yearly, of four persons from each county, with all the self-governing privileges of the English House of Commons. Two-thirds were to form a quorum. The nomination of sheriffs, coroners and magistrates for each county was given to the governor, who was to select from names handed in by the freemen. Moreover, the council was no longer elected by the people, but nominated by the governor, who was thus practically left single in the executive. The assembly, however, which, by the first charter, had not the right to propound laws, but might only amend or reject them, now acquired that privilege. In other respects the original charter remained, and the inviolability of conscience was again emphatically asserted. Penn reached England in December 1701. He once more assumed the position of leader of the Dissenters and himself read the address of thanks for the promise from the Throne to maintain the Act of Toleration. He now took up his abode again at Kensington, and published while here his *More Fruits of Solitude.*

In 1703 he went to Knightsbridge, where he remained until 1706, when he removed to Brentford, his final residence being taken up in 1710 at Field Ruscombe, near Twyford. In 1704 he wrote his *Life of Bulstrode Whitelocke.* He had now much trouble from America. The territorialists were openly rejecting his authority, and doing their best to obstruct all business in the assembly; and matters were further embarrassed by the injudicious conduct of Governor John Evans in 1706. Moreover, pecuniary troubles came heavily upon him, while the conduct of his son William, who became the ringleader of all the dissolute characters in Philadelphia, was another and still more severe trial. This son was married, and had a son and daughter, but appears to have been left entirely out of account in the settlement of Penn's proprietary rights on his death.

Penn's deficiency in judgment of character was especially shown in the choice of his steward Ford, from whom he had borrowed money, and who, by dexterous swindling, had managed, at the time of his death, to establish, and hand down to his widow and son, a claim for £14,000 against Penn. Penn, however, refused to pay, and spent nine months in the Fleet rather than give way. He was released at length by his friends, who paid £7,500 in composition of all claims. Difficulties with his government of Pennsylvania continued to harass him. Fresh disputes took place with Lord Baltimore, the owner of Maryland, and Penn also felt deeply what seemed to him the ungrateful treatment which he met with at the hands of the assembly. He therefore in 1710 wrote, in earnest and affectionate language, an address to his "old friends," setting forth his wrongs. So great was the effect which this produced that the assembly which met in October of that year was entirely in his interests; revenues were properly paid; the disaffected were silenced and complaints were hushed; while an advance in moral sense was shown by the fact that a bill was passed prohibiting the importation of negroes. This, however, when submitted to the British parliament, was cancelled. Penn now, in February 1712, being in failing health, proposed to surrender his powers to the Crown. The commission of plantations recommended that Penn should receive £12,000 in four years from the time of surrender, Penn stipulating only that the queen should take the Quakers under her protection; and £1,000 was given him in part payment. Before, however, the matter could go further he was seized with apoplectic fits, which shattered his understanding and memory. A second attack occurred in 1713. He died on May 30, 1718, leaving three sons by his second wife, John, Thomas and Richard, and was buried along with his first and second wives at Jourdans meeting-house, near Chalfont St. Giles in Buckinghamshire. In 1790 the proprietary rights of Penn's descendants were bought up for a pension of £4,000 a year to the eldest male descendant by his second wife, and this pension was commuted in 1884 for the sum of £67,000.

Penn's *Life* was written by Joseph Besse, and prefixed to the collected edition of Penn's *Works* (1726). The *Selected Works* were published again in 1771 (4th ed. 3 vols., 1825), and *Some Fruits of Solitude* was reprinted in 1900 with an introduction by Edmund Gosse. See *Selections from the Works of William Penn* (ed. I. Sharpless, 2nd ed., 1915). W. Hepworth Dixon's biography, refuting Macaulay's charges, appeared in 1851. In 1907 Mrs. Colquhoun Grant, one of Penn's descendants, published *Quaker and Courtier; the Life and Work of William Penn. See* also J. W. Graham, *William Penn* (2nd ed., 1918).

PENNE, a town and episcopal see of Italy, in the province of Teramo, 26 m. S.E. of Teramo, and 16 m. from the Adriatic, 1,437 ft. above sea-level. Pop. (1921), 4,289 (town); 10,471 (commune). The church of S. Giovanni has a fine cross by Nicola di Guardiagrele. Many of the houses have fine terra-cotta friezes. It occupies the site of the ancient Pinna, the chief city of the Vestini, who entered into alliance with Rome in 301 B.C. and remained faithful to her through the Hannibalic wars.

See G. Colasanti, *Pinna* (Rome, 1907).

PENNELL, JOSEPH (1860–1926), American artist and author, was born in Philadelphia (Pa.), on July 4, 1860, and first studied there, but like his compatriot and friend, J. M. Whistler, he afterwards went to Europe and made his home in London. He produced numerous books (many of them in collaboration with his wife, Elizabeth Robins Pennell), but his chief distinction is as an original etcher and lithographer, and notably as an illustrator. Their close acquaintance with Whistler led to Mr. and Mrs. Pennell undertaking a biography of that artist in 1906, and, after some litigation with his executrix on the right to use his letters, the book was published in 1908. In 1919, Pennell published *Etchers and Etching,* and in 1921 he edited the *Whistler Journal.* He died on April 23, 1926.

PENNINE CHAIN, an extensive system of hills in the north of England. The name is probably derived from the Celtic *pen,* high, appearing in the Apennines of Italy and the Pennine Alps. The English system is comprised within the following physical boundaries. On the N. a well-marked depression, falling below 500 ft. in height, between the upper valleys of the Irthing and the south Tyne, from which it is known as the Tyne Gap, separates the Pennines from the system of the Cheviots. On the N.E., in Northumberland, the foothills extend to the North Sea. On the N.W. the Eden valley forms part of the boundary between the Pennines and the hills of the Lake District, and the division is continued by the upper valley of the Lune. For the rest the physical boundaries consist of extensive lowlands—on the E. the vale of York, on the W. the coastal belt of Lancashire and the plain of Cheshire, and on the S. and S.E. the valley of the river Trent. The Pennines thus cover parts of Cumberland, Westmorland and Northumberland, Lancashire and Yorkshire, Cheshire and Derbyshire, while the southern foothills extend into Staffordshire and Nottinghamshire.

The Pennine system is hardly a range, but the hills are in effect broken up into numerous short ranges by valleys cut back into them in every direction, for the Pennines form a north and south watershed which determines the course of all the larger rivers in the north of England. The chain is divided into two sections by a gap formed by the river Aire flowing east, a member of the Humber basin, and the Ribble flowing west and entering the Irish Sea through a wide estuary south of Morecambe Bay.

The northern section of the Pennine system is broader and generally higher than the southern. Its western slope is generally short and steep, the eastern long and gradual; this distinction applying to the system at large. In the north-west a sharp escarpment overlooks the Eden valley. This is the nearest approach to a true mountain range in the Pennine system and indeed in England. It is known as the Cross Fell Edge from its highest point, Cross Fell (2,930 ft.), to the south-east of which a height of 2,780 ft. is reached in Milburn Forest, and of 2,591 ft. in Mickle Fell. This range is marked off eastward by the upper valleys of the south Tyne and the Tees, and, from the divide between these two, branch ranges spring eastward, separated by the valley of the Wear, at the head of which are Burnhope Seat (2,452 ft.) and Dead Stones (2,326 ft.). In the northern range the highest point is Middlehope Moor (2,206 ft.), and in the southern, Chapel Fell Top (2,294 ft.). It is thus seen that the higher elevations, like the steeper slopes, lie towards the west. Cross Fell Edge terminates southward at a high pass (about 1,400 ft.) between the head of the Belah, a tributary of the Eden, and the Greta, a tributary of the Tees. This pass is followed by the Tebay and Barnard Castle line of the North Eastern railway. The hills between the Lune valley on the west and the headstream of the Eden and the Ribble on the east are broken into masses by the dales of tributaries to the first-named river—here the chief elevations are Wild Boar Fell (2,323 ft.), Whernside (2,414 ft.), and Ingleborough (2,373 ft.). The Ribble and Eden valleys afford a route for the main line of the Midland railway. Well-marked eastward ranges occur here between Swaledale and the river Ure, which traverses the celebrated Wensleydale, and between the Ure and Wharfe. In the first the highest points are High Seat (2,328 ft.) and Great Shunner Fell (2,340 ft.); and in the second Buckden Pike (2,302 ft.) and Great Whernside (2,310 ft.). There is then a general southerly slope to the Aire gap.

The southern section of the system calls for less detailed notice. Heights exceeding 2,000 ft. are rare. The centre of the section is the well-known Peak (*q.v.*) of Derbyshire. Both here and throughout the system the summits of the hills are high uplands, rounded or nearly flat, consisting of heathery, peaty moorland or hill pasture. The profile of the Pennines is thus not striking as a rule, but much fine scenery is found in the narrow dales throughout; Wensleydale, Wharfedale and other Yorkshire dales being no less famous than the dales of Derbyshire. In the parts about Settle below Ingleborough, in Derbyshire, and elsewhere, remarkable caverns and subterranean watercourses in the limestone have been explored to great depths. In Ingleborough itself are the Ingleborough cave, near Clapham; the chasm of Gaping Ghyll, over 350 ft. deep; Helln or Hellan Pot, a vast swallow-hole 359 ft. deep, only exceeded by Rowten Pot (365 ft.) near Whernside; and many others. Malham Tarn, near the head of the Aire, is drained by a stream which quickly disappears below ground, and the Aire itself is fed by a brook gushing forth in full stream at the foot of the cliffs of Malham Cove. A notable example in Derbyshire is the disappearance of the Wye into Plunge Hole, after which it traverses Poole's Cave, close to Buxton. There may also be noted the remarkable series of caverns near Castleton. Lakes are few and small in the Pennine district, but in some of the upland valleys, such as those of the Nidd and the Etherow, reservoirs have been formed for the supply of the populous manufacturing districts of Lancashire and the West Riding of Yorkshire, which lie on either flank of the system between the Aire gap and the Peak.

See ENGLAND and CUMBERLAND, YORKSHIRE, etc.

PENNS GROVE, a borough of Salem county, New Jersey, U.S.A., on the Delaware river, opposite Wilmington, Del.; served by the Pennsylvania railroad and river steamers. Pop. (1920) 6,060 (81% native white); 1928 local estimate 7,000. It is a shipping point for agricultural produce, and has manufacturing plants making smokeless powder, dyes and chemicals. The borough was incorporated in 1894.

PENNSYLVANIA, popularly known as the "Keystone" State because of its central position among the original 13 Colonies, is one of the Commonwealths of the United States of America, lying mostly between lat. 39° 43′ (the Mason and Dixon line) and 42° N. and long. 74° 43′ and 80° 31′ W. of Greenwich. The State is in the form of a rectangle, except in the north-west where a triangular projection, extending to 42° 15′ N. lat., gives it a shore-line of almost 40 m. on Lake Erie, and in the east where the Delaware river with two large bends makes deep indentations into New York and New Jersey. Pennsylvania is bounded north by New York; east by New York and New Jersey, from which it is separated by the Delaware river; south by Delaware, Maryland and West Virginia, and west by the "Panhandle" of West Virginia and by Ohio. The total area is 45,126 sq.m., of which 294 sq.m. are water surface.

Physical Features.—Pennsylvania skirts the coastal plain in the south-east below Philadelphia and is traversed from north-east to south-west by the three divisions of the Appalachian province—Piedmont or older Appalachian belt, younger Appalachian ridges and valleys, and the Allegheny plateau. In the north-west corner is a small part of the Erie plain. The entire surface has a mean elevation of about 1,100 ft. above the sea, varying from sea level on the Delaware river to 3,212 ft. (Negro mountain) in Somerset county. On the north and west borders of the lowland extending along the Delaware are two parts of a chain of semi-detached and usually rounded hills, known as the South mountains. The north-east part extends from New Jersey through Easton to Reading. The south-west part is a north-eastern prolongation of the Virginia Piedmont, known as the Cumberland prong. The Pennsylvania portion of the younger Appalachian ridges and valleys, known as the central province of the State, embraces the region between the South mountains on the south-east, and the crest of the Allegheny plateau or Allegheny front on the north-west. It extends from south-west to north-east about 230 m. and has a nearly uniform width of 50 m., except that it narrows rapidly as it approaches the north-east corner of the State. The crest lines are often of nearly uniform height for miles and generally are little broken except by an occasional V-shaped wind gap, a narrow water gap or a rounded knob. The valleys, except the Appalachian or Great valley, rarely exceed more than a few miles in width. The Pocono plateau, into which the central province merges at its north-east extremity, is a continuation of the Catskill plateau southward from New York. It is little broken, except by shallow valleys and occasional knobs. The Allegheny plateau, which extends from the crest of the Allegheny front to and beyond the west and north borders of Pennsylvania and covers more than one-half of the State, is much dissected and contains the highest elevations within the State.

The Pocono plateau in the north-east, nearly all of the central and south-east provinces and the north-east portion of the Allegheny plateau in the north-west are drained by the Susquehanna and Delaware river systems into the Chesapeake and Delaware bays. The greater part of the Allegheny plateau is drained by the Allegheny and Monongahela rivers into the Ohio river. The extreme southern portion of the central province and the extreme western portion of the south-east province are drained by tributaries of the Potomac; the Erie plain is drained by short streams into Lake Erie; and a very small section of the Allegheny plateau, in the northern part of Potter county, is drained by the Genesee river into Lake Ontario. The Susquehanna is a wide and shallow stream with a zigzag course and numerous islands, but both the Susquehanna and the Delaware, together with their principal tributaries, flow for the most part transverse to the geological structure. In the gorges and water-gaps through which they pass in the mountain region is some of the most picturesque scenery in the State. These gorges, too, are of great economic importance as passages for railways and highways. The lower portion of the Delaware river has been entered by the sea as the result of the depression of the land, giving a harbour, at the head of which developed the city of Philadelphia.

Climate and Soil.—The temperature of Pennsylvania is mild and equable in the south-east province where the ocean influences it and where the mountains bounding it on the north and north-west are some protection from the colder winds. The crests of the higher ridges in the central province are delightfully cool

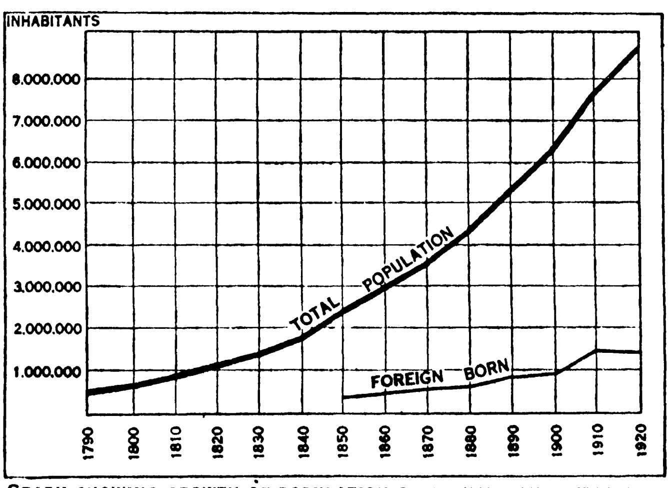
in summer, but the adjacent valleys are subject to excessive heat. In winter the mountain valleys may experience severe cold. The mean annual temperature is about 52° F. in the south-east, 50° in the centre, 47° in the north-west and 49° on the shore of Lake Erie. The summer maxima on the mountains are usually 8° to 10° less than in the valleys directly below them. There are many summer resorts in the mountains. The average annual rainfall is 44 inches.

Government.—Pennsylvania is governed under a constitution adopted in 1873 which has been amended frequently. An amendment, to be adopted, must be approved by majorities in two successive legislatures and by a majority of a subsequent popular vote.

The governor, elected for four years, is ineligible for the next succeeding term. He controls a large amount of patronage, appointing, subject to the advice and consent of two-thirds of the senate, the heads of all departments except the auditor-general, State treasurer and secretary of internal affairs. He also appoints the members of all independent administrative boards and commissions, the members of all advisory boards, and, with few exceptions, the members of all departmental boards and commissions, and fills vacancies in various offices which occur during the recess of the senate. He has a right of veto, extending to items in appropriation bills, which may be overridden by a two-thirds vote in each house. His power of pardon is limited, being subject to the recommendation of three members of a board which consists of the lieutenant governor, secretary of the commonwealth, attorney general and secretary of internal affairs.

All the elective officials, except the secretary of internal affairs, are ineligible for a second consecutive term. By a law of 1923 as amended by an act of April 13, 1927 the administrative agencies of the State were consolidated into 17 departments; viz., State, justice, attorney general, treasury, public instruction, internal affairs, military affairs, agriculture, forests and waters, labour and industry, health, highways, welfare, banking, insurance, mines, property and supplies. Six department heads designated by the governor meet with him as the executive board which standardizes employment in the various departments and approves the establishment or discontinuance of bureaux or other divisions within the departments.

There were in the two houses of the legislature in 1927 50 senators, elected for four years, and 207 representatives, elected



GRAPH SHOWING GROWTH OF POPULATION OF PENNSYLVANIA, 1790–1920

for two years. The powers of the two houses are the same except that the senate exercises the usual right of confirming appointments and of sitting as a court of impeachment, while the house of representatives initiates money bills and impeachment cases. The legislature meets in odd numbered years on the first Tuesday of January.

The supreme court consists of seven justices elected for terms of 21 years by the voters of the State at large. Minority representation is secured by the provision that each elector shall vote for one less than the number of justices to be chosen at each election. In 1895 the work of the supreme court had increased to such an extent that an act was passed by the general assembly creating the superior court of Pennsylvania which consists of a president judge and six judges. The supreme court handles all appealed cases involving over $2,500, or cases of felonious homicide and is the court of last resort. The superior court handles all other appealed cases. The State is divided into districts in which are courts of common pleas. Justices of the peace are elected in wards, districts, boroughs and townships.

Population.—The population of Pennsylvania increased from 434,373 in 1790 to 2,906,215 in 1860 and to 8,720,017 in 1920. In 1928 the U.S. census estimated it to be 9,864,000. In 1920 there were 1,392,557 foreign-born including 22,764 Italians, 177,770 Poles, 161,124 Russians, 122,755 Austrians, 121,601 Irish, 120,194 Germans and 90,666 English. The negroes increased from 156,845 in 1900 to 284,568 in 1920, owing mostly to migration from the South to Philadelphia and Pittsburgh; in 1925 only 4,914 negroes lived on farms. From 1910 to 1925 the farm population decreased from 1,050,050 to 910,847. The urban (those living in towns of 2,500 or more) population increased from 60·4% in 1910 to 64·3% in 1920.

The growth in population of the chief cities for 1910, 1920 and (estimated) 1928 is as follows: Philadelphia, 1,549,008, 1,823,779, 2,064,200; Pittsburgh, 533,905, 588,343, 673,800; Scranton, 129,867, 137,783, 144,700; Reading, 96,071, 107,784, 115,400; Erie, 56,525, 93,372 (no estimate); Allentown, 51,913, 73,502, 99,400; Harrisburg, 64,186, 75,915, 86,900; Wilkes-Barre, 67,105, 73,833, 91,900; Johnstown, 55,482, 66,327, 73,700; Chester, 38,537, 58,030, 73,200; Altoona, 52,127, 60,331, 69,100; Bethlehem, 12,837, 50,358, 67,600; Lancaster, 47,227, 53,150, 58,300; New Castle, 36,290, 44,938, 52,500; McKeesport, 42,694, 46,781, 50,400; York, 44,750, 47,512, 49,900.

Finance.—The wealth of Pennsylvania (estimated value of all tangible property) was placed in 1922 at $28,834,000,000, an increase over 1912 of $12,600,000,000. The average per caput holding was $3,187 as compared with $2,918 average for the entire United States. The assessed value in 1926 of property subject to the general property tax was $10,995,000,000 of which $8,355,000,000 was real estate and $2,640,000,000 personal property. Receipts of the State treasury for 1926 amounted to $124,836,000 ($13.10 per caput) of which but $33,504,000 was raised by property taxes. The chief sources of revenue upon which the State depends are taxes on corporations—such as the taxes on capital stock, on corporation loans and on gross receipts—automobile licences and fees, the gasolene tax, inheritance tax and anthracite coal tax. In general it is the policy to leave the general property taxes to the counties and smaller units. About two-thirds of the State income is used for the two items, highways and education. The State debt on Jan. 1, 1927, amounted to $98,029,000, of which $97,999,000 was for highway purposes.

On June 30, 1927, the total number of commercial and savings banks was 1,650, with total resources and liabilities of $6,512,856,000, capital, surplus and undivided profits of $1,107,044,000 and deposits of $4,706,824,000.

Education.—Since 1895 education has been free to all between the ages of 6 and 21 and compulsory for all children between the ages of 8 and 16. In 1926 there were 1,849,163 children enrolled in the public schools of whom 1,581,767 were in the elementary and 267,396 in secondary schools; there were also 293,785 pupils in private and parochial schools. The number of high schools in the public school system was 1,150 (634 of them of four-year approved rating); the number of private high schools and academies was 145. There were 297,231 high school students and 15,023 high school teachers. There are 14 State-owned normal schools designed to meet the need for new teachers. Eight of these, situated at Mansfield, Indiana, Shippensburg, Edinboro, East Stroudsburg, West Chester, Bloomsburg and Slippery Rock, gave four-year courses in 1925–26. The established legal minimum of preparation required of teachers in the elementary schools is the completion of a four-year high school course and not less than two years of professional preparation or its equivalent. Partial certificates and emergency certificates are issued to the extent that

fully qualified teachers are not available.

There were in 1926 about 8,500 one-roomed schools in the rural districts of the State with about 250,000 pupils in attendance. The legislatures of 1921 and 1923 provided for relatively larger aid for the poorer districts. The legislature of 1925 provided for State aid to school districts in the education of handicapped children, and also provided for the establishment of evening classes in day school subjects, and in English and citizenship classes for adults. Illiteracy decreased from 5·9% in 1910 to 4·6% in 1920, in which year 18·9% of the foreign-born whites, 6·1% of the negroes, and 0·8% of the native whites were unable to read or write.

There are seven institutions of higher learning which receive State subsidies. Chief of these is Pennsylvania State college at the borough of State College (pop. 4,000) in the central part of the State. The other six are the University of Pennsylvania at Philadelphia (16,087 students, 1926–27), University of Pittsburgh at Pittsburgh (12,026 students, 1926–27), Temple university and the Women's Medical college at Philadelphia, Jefferson Medical college and Hahnemann Medical college. In the biennium, 1927–29, $7,149,000 was allotted to these institutions, of which $4,000,000 was for the Pennsylvania State college which is State owned.

Charities and Corrections.—Penal and charitable institutions are under the supervision of the State welfare department. The western penitentiary at Allegheny opened in 1826, and the eastern penitentiary at Philadelphia opened in 1829. In the middle district, instead of a third penitentiary, the industrial reformatory was established in 1889. At Morganza there is a house of refuge. The system of juvenile courts, created under a statute of 1901, has done much to ameliorate the condition of dependent and delinquent children. There are one State and two semi-State schools for delinquent children, and two State institutions for delinquent adults. Nine hospitals for mental diseases, four hospitals for mental defectives, and 31 mental clinics are partly or wholly supported by State funds. The State supports three sanatoria for tuberculosis and ten general hospitals, the latter chiefly in the mining districts. Of the 242 hospitals in the State in 1923, 149 were partly or wholly supported by the State. There are two State hospitals for veterans and their children, and five schools for the deaf and two for the blind. The system of poor relief was reorganized by a law of 1925. Altogether there are 85 almshouses in the State maintained by county funds. In 1923 a system of old age assistance was inaugurated. In 1927–29 appropriations of the welfare department for State-owned and State-aided institutions totalled $29,775,300.

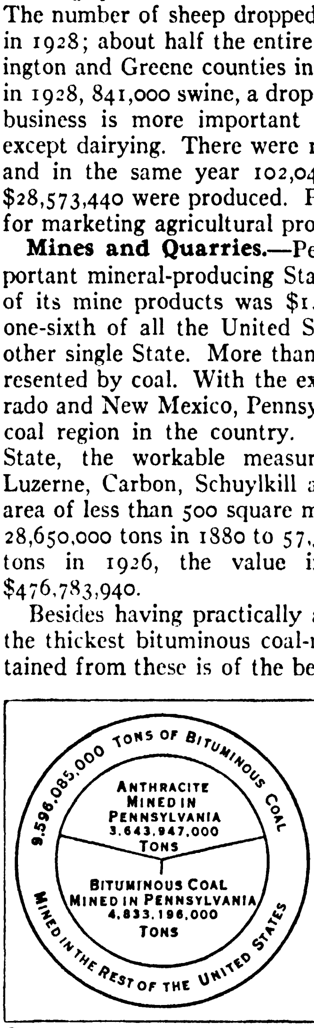
Agriculture.—Although Pennsylvania is a mining and manufacturing rather than an agricultural State, its farming interests are more extensive than is generally supposed. In 1920 about three-fifths of its area was included in farms and a little more than two-thirds of its farm land was improved. The number of farms increased from 127,577 in 1850 to 224,248 in 1900, but declined to 200,443 in 1925. In 1925, 163,695 farms were worked by owners or part owners. The total value of all farm property in 1925 was $1,460,702,000, of which the land value represented $555,146,000 and the value of farm buildings $615,026,000. The value of farm crops for the year 1927 amounted to $249,100,000.

For the most part farming is of the general and live stock type. In most counties all of the rough and most of the concentrated food for stock is produced on the farm. Tame hay is the chief crop, about two-fifths of the crop acreage in 1927 being devoted to it. The yield was 5,085,000 short tons valued at $68,350,000. Nearly half the crop acreage in 1927 was devoted to cereals, the yields and values of which were as follows: Indian corn, 50,165,000 bu. ($45,650,000); wheat, 20,301,000 bu. ($25,787,000); oats, 39,600,000 bu. ($21,384,000); buckwheat, 4,935,000 bu. ($4,194,750); rye, 1,326,000 bu. ($1,392,000); barley, 588,000 bu. ($488,000). Pennsylvania ranked first among the States in buckwheat production. Most of the buckwheat, barley and oats is grown in the northern and western counties, while Indian corn, wheat and rye are raised more extensively in the south-east. Potatoes also were a major crop, the 1927 yield of 26,400,000 bu. being valued at $31,680,000. The 1927 tobacco crop of 44,880,000 lb., of which about nine-tenths was produced in Lancaster county, added $5,834,000 to the total crop value. In 1926 17,000,000 bu. of apples were raised, Pennsylvania ranking fourth among the States in production, but in 1927 the crop fell to 6,300,000 bu. ($8,820,000). The apple district is centred in Adams county in the south-central part of the State, though Erie county is an important producer and also ranks first in grapes. Peaches are also grown in most of the southern orchards, the production being 2,498,000 bu. in 1926 and 947,000 bu. in 1927. Pears, once grown in considerable quantities, have declined greatly, only 400,000 bu. being raised in 1927.

Dairy farming predominates in the northern tier of counties where a shorter growing season and glaciated soil favour pastures and the raising of hay. In 1924 the total value of dairy products ($73,999,263) was exceeded in but three States. In 1928 the number of milch cows was 855,000, valued at $88,065,000. All cattle numbered 1,332,000, a decrease of 214,000 since 1920. Live stock farming predominates in southern and western Pennsylvania. The number of sheep dropped from 1,531,066 in 1900 to 437,000 in 1928; about half the entire number were to be found in Washington and Greene counties in the south-west corner. There were in 1928, 841,000 swine, a drop of 350,000 since 1920. The poultry business is more important than any other live stock branch except dairying. There were raised in 1924, 19,346,000 chickens; and in the same year 102,048,000 dozen eggs with a value of $28,573,440 were produced. Pennsylvania is strategically situated for marketing agricultural products.

Mines and Quarries.—Pennsylvania is by far the most important mineral-producing State in the Union. In 1926 the value of its mine products was $1,055,766,000, or slightly more than one-sixth of all the United States and nearly twice that of any other single State. More than three-fourths of the total was represented by coal. With the exception of two small areas in Colorado and New Mexico, Pennsylvania contains the only anthracite-coal region in the country. This is in the eastern part of the State, the workable measures being mostly in Lackawanna, Luzerne, Carbon, Schuylkill and Northumberland counties in an area of less than 500 square miles. The output rose steadily from 28,650,000 tons in 1880 to 57,368,000 tons in 1900 and 84,837,000 tons in 1926, the value in the latter year amounting to $476,783,940.

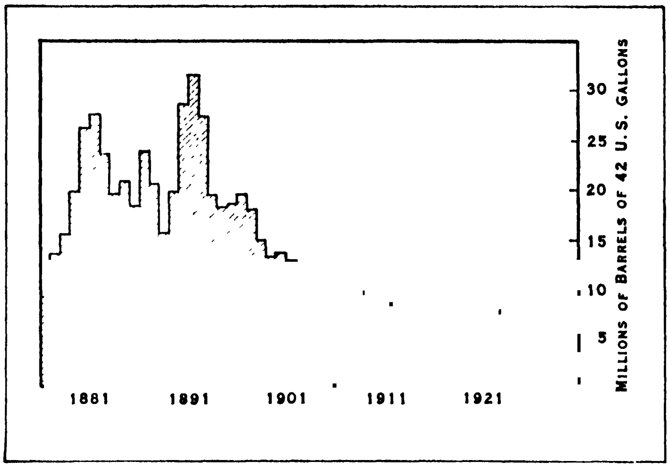
Besides having practically all the anthracite, Pennsylvania has the thickest bituminous coal-measures, and most of the coal obtained from these is of the best quality. They form the northern extremity of the great Appalachian coal-field and underlie an area of 15,000 sq.m. or more in the west of the State. The Pittsburgh district, comprising the counties of Allegheny, Washington, Fayette and Westmoreland, is exceptionally productive, and the coal in Allegheny and Washington counties is noted for its gas-producing qualities, while in Fayette and Westmoreland counties the famous Connellsville coking coal is obtained. Pennsylvania's bituminous output increased from 18,425,000 tons in 1880 to 79,842,000 tons in 1900 and 153,042,000 tons in 1926, valued in the latter year at $315,266,520.



COAL MINED IN PENNSYLVANIA SINCE THE BEGINNING OF PRODUCTION IN 1807 THROUGH 1927, COMPARED WITH THAT MINED IN THE UNITED STATES

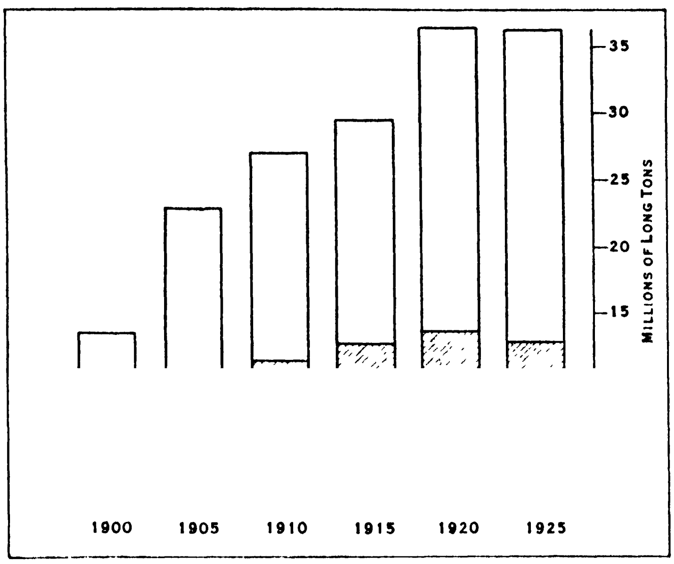
Extending from the south-west corner of the State is the Pennsylvania section of the Appalachian oil-field, which, with a small section in New York, furnished nearly all of the country's supply of petroleum for some years following the discovery of its value for illuminating purposes. The first petroleum well was drilled in 1859 at Titusville. The State's yearly output continued to increase until 1891, when it amounted to 31,424,206 barrels. Since then, however, with fewer important developments, the output declined to 7,824,000 bbl. in 1924. In 1927 it was 9,596,000 bbl.,

valued at $14,873,000. The value of the State's natural gas output increased from approximately $75,000 in 1882 to approximately $19,282,000 in 1888, the total value of its output during these and the intervening years being more than 80% of that of all the United States. In 1924 the output was valued at $45,546,000, nearly 20% of that of the entire country.



PETROLEUM PRODUCED IN PENNSYLVANIA (1876–1927): FIGURES FOR 1876 THROUGH 1881 AND 1888 THROUGH 1890 INCLUDE SMALL AMOUNTS PRODUCED IN NEW YORK

There are deposits of various kinds of iron-ore in the eastern, south-eastern, middle and some of the western counties, and from the middle of the 18th century until near the close of the 19th century, Pennsylvania ranked high among the iron-ore producing States. As late as 1880 it ranked first, with a product amounting to 1,951,496 long tons. But after the first successful experiments in making pig-iron with bituminous coal in 1845, the State's iron foundries moved rapidly westward and thus away from the chief producing centres. The discovery still later that rich ore could be transported to the western part of the State at less cost from the Lake Superior region resulted in a further decline of iron-mining within the State until in 1924 the ore mined amounted to only 807,000 long tons. By 1927 it had increased to 1,170,000 long tons.



THE PRODUCTION OF PIG-IRON AND FERRO-ALLOYS IN PENNSYLVANIA COMPARED WITH THAT IN THE UNITED STATES

Pennsylvania has extensive areas of limestone rock suitable for making cement, and in Northampton and Lehigh counties enormous quantities of it are used in this industry. In Lehigh county the first successful Portland cement plant in the United States was erected in 1870 and since then Pennsylvania has continued to lead all States in its annual output of cement. Portland cement production in the State increased from 825,054 bbl. in 1896 to 41,458,000 bbl. (valued at $70,470,000) in 1925 when it was nearly 25% of that of the United States. Limestone and dolomites suitable for building purposes are obtained chiefly in Montgomery, Chester and Lancaster counties. Until increased facilities of transport brought more desirable stones into competition they were used extensively in Philadelphia. There are limestone quarries in nearly two-thirds of the counties and great quantities of the stone are used for flux in the iron furnaces, for making quicklime, for railway ballast and for road making. Northampton, Lehigh and York counties contain the most productive slate quarries in the country, and in 1925 the value of their output was $5,885,179; the Northampton and Lehigh slate is the only kind in the United States used for school blackboards. There is an extensive area in the south-eastern part of the State containing shale clay of a superior quality for making common brick. Kaolin abounds in Chester and Delaware counties, and fire-clay in several of the western counties. In 1925 the State led all others in the value of its clay output ($2,218,658). Glass-sand abounds both in the eastern and in the western regions, and for many years Pennsylvania has ranked among the leading States in the manufacture of glass. In Chester county, also, is one of the most productive deposits of felspar, second only to those of Maine.

Manufactures.—Pennsylvania ranks second to New York in the value of its manufactures, which increased from $2,832,349,437 in 1914 to $7,381,687,533 in 1923, but declined to $6,901,762,000 in 1925. The value actually added by the manufacturing processes amounted in 1925 to $3,011,249,459. Despite the remarkable increase in value between 1914 and 1925, the number of workmen increased only from 924,478 to 999,460, while the number of establishments steadily decreased from 27,521 to 17,298. The general growth in manufacturing has been promoted by an abundance of fuel, by a good port on the Atlantic seaboard, by the frontage on Lake Erie which makes the ores of the Lake Superior region easily accessible, and by a great railway system which has been built to meet the demands arising from the natural resources. By far the most important industry is the production of iron and steel, in which the State has always held the lead. So long as charcoal only was used in the furnaces (until about 1840) and during the brief period in which this was replaced largely by anthracite, the industry was of chief importance in the eastern region, but with the gradual increase in the use of bituminous coal, or of coke made from it, the industry moved westward, where, especially in the Pittsburgh district, it received a new impetus by the introduction of iron-ore from the Lake Superior region. In the manufacture of pig-iron Pennsylvania is easily first among the States; the output in 1925 from the State's 100 blast furnaces was 12,450,103 long tons, with a value of $268,864,529 or 36·1%, by value of the output of the entire United States. The output of the 171 steel and rolling mills amounted in value to $1,086,935,222 in 1925, or 37·2%, by value, of the nation's output. The manufacture of great quantities of coke has resulted from the demand for this product in the iron and steel industry and from the abundance of coking coal. The manufacture of glass has been promoted by the supply of glass-sand and natural gas in the western part of the State; the manufacture of pottery, terra-cotta and fire-clay products by the abundance of suitable raw clay; the manufacture of silk and silk goods by the large number of women and girls in the miners' families. In each of these industries also the State has for many years produced a large portion of the country's product.

In 1925 the leading manufactures, with the value of each, were: iron and steel, $1,086,935,000; silk manufactures, $329,121,498; foundry and machine shop products, $307,693,000; pig-iron, $268,864,000; electrical machinery and apparatus, $236,843,492; printing and publishing, $234,166,000; knit goods, $230,069,000; steam railway and repair shops, $213,806,000. Others with products between $200,000,000 and $80,000,000 in value were; petroleum refining, bread and bakery products, meat and packing products, cigars and cigarettes, refining of cane sugar, men's outer clothing, motor vehicles, leather, glass, steam railway cars not built in railway repair shops, worsted goods and paper and wood pulp.

Philadelphia is the great manufacturing centre in the State. Within its limits there were, in 1925, 5,636 factories, employing 246,680 persons, which produced 28% ($1,937,414,000) of the State's manufactured articles. Of the total State output, the city produced in 1923 all the cane sugar refined, 82% of the woollen carpets, more than 75% of the clothing, more than 63% of the cotton goods and more than 60% of the printing and publishing. The relative importance of Pittsburgh as a manufacturing centre has declined because of the growth of numerous other steel centres. In 1925 it produced only 10·6% of the State's output of steel and iron. Cities in the western part of the State, such as New Castle, are nearer to the supply of iron-ore from the Great Lakes; while cities in the eastern part of the State, such as Bethlehem, are importing iron-ore from South America. After Philadelphia and Pittsburgh the more important manufacturing cities are Reading, Allentown, Johnstown, Erie, Chester, New Castle, York, Scranton, Altoona and Williamsport.

Forests.—Except on some portions of the Pocono plateau, Pennsylvania was originally well forested, and although most of the merchantable timber has been cut, about one-half of the State is still woodland. On the higher elevations the trees are mostly white pine, yellow pine and hemlock, but in the valleys and lower levels are oaks, hickories, maples, elms, birches, etc. There is an efficient State department of forestry, and State forest reserves in 26 counties amounted to 1,134,444 ac. in 1927.

Transportation and Commerce.—The mountain topography of the State made the building of roads and railways expensive and difficult, but at the same time made them more necessary. Since 1911, when the modern period of State highway construction began, the State has built a system unequalled by any other Appalachian State. The State highways, totalling 10,033 m., form a primary or trunk system connecting the county seats and all the important centres of population. Of this primary system 8,440 m. are surfaced, approximately half being paved with concrete or asphalt. Besides the State system there are rural roads totalling 91,173 m., of which 23,505 m. are surfaced. Licensed motor vehicles increased from 160,137 in 1915 to 570,164 in 1920, and to 1,554,917 in 1925.

The efficient network of railways covering the State is an important factor in the great industrial importance of Pennsylvania. The steam railway mileage increased from 8,453 in 1890 to 11,693 in 1915, after which it declined slightly to 11,337 in 1926. There were 96 electric railway companies operating 4,440 m. of track.

The State has one port of entry on the Atlantic coast, one on the Ohio river, and one on the Great Lakes. Philadelphia, the Atlantic port, exports chiefly petroleum, coal, grain and flour, and imports chiefly iron-ore, sugar, drugs and chemicals, manufactured iron, hemp, jute and flax. In 1927 it ranked third among the Atlantic ports in the tonnage of its foreign commerce, exports 1,909,461, and imports 2,541,099. Pittsburgh ranks high among the interior ports of the country. Erie on Lake Erie has a large domestic trade in iron-ore, copper, wheat and flour.

HISTORY

Swedish and Dutch Periods.—The whole country along the Delaware river before its settlement was disputed between the English, Dutch and Swedes. Both the English and Dutch had traded along the river and had established temporary posts in what is now Pennsylvania, but the Swedes were the first to effect a permanent settlement, their settlements being a continuation of those in Delaware. In 1643, John Printz, governor of New Sweden, built a fort on Tinicum island (near Chester) which he called New Gottenberg, and soon a considerable community was established at Upland (renamed Chester by Penn). In 1655 the Swedish settlements passed under the control of the Dutch who had captured Ft. Christina, the chief Swedish stronghold, in Delaware. The Dutch were in turn dispossessed by the English who took over their colonies after the fall of New Amsterdam in 1664. Gov. Nicolls, the first English governor, put the "Dukes Law" into operation along the Delaware and established a court at Upland. The Swedish settlers remained and later formed a sturdy element in William Penn's colony.

The Quaker Colony.—William Penn (*q.v.*) as early as 1666 became interested in a colony in America for Quakers suffering persecution under the "Clarenden Code." In 1680 he petitioned Charles II. for a grant of land for the purpose, and the Crown, having become indebted to Penn's father, found it easier to pay with land in America than with money. Penn named his grant Pennsylvania (Penn's Woods) in his father's honour. The charter gave him almost unlimited power. He wrote his *Frame of Government* for the Colony and sent commissioners to lay out a "great town" in systematic manner, a city which he named Philadelphia (City of Brotherly Love). Having faith in the people he delegated to them more privileges and powers than the colonists possessed in any other Colony. Absolute religious freedom was the most important and, for the times, the most remarkable concession. All Christians holding certain amounts of property were to be eligible voters and officeholders. The death penalty, in contrast to a long list of offences in other Colonies, was inflicted in Penn's Colony only for murder and treason. Philadelphia was laid out in an advantageous position fronting on both the Delaware and Schuylkill rivers and growth and prosperity began immediately. Soon after Penn's arrival in the Colony in 1682 an assembly, held at Upland, formally adopted Penn's plan of government. In 1683 Penn made his "Great Treaty" with the Indians, according to Voltaire "the only treaty not sworn to and never broken." Penn's fair methods of dealing with Indians and scrupulous care always to pay them well for their land preserved Pennsylvania from Indian hostilities during his lifetime.

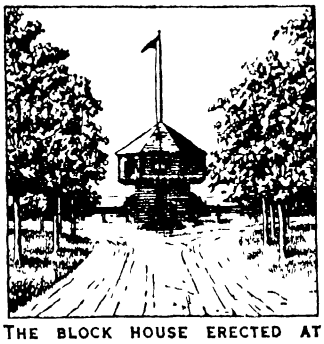
Immigration of Other Nationalities.—To this Colony, thus founded, the oppressed and persecuted of many lands came for refuge. The Quakers soon surpassed all others and were the dominant element to the time of the Revolutionary War. Some of the Quakers were of Welsh stock, a large colony settling in the "Welsh barony" in Montgomery and Delaware counties. The Mennonites came in great numbers in 1682–83 under their remarkable leader, Pastorious, and settled in Germantown, which was long the leading German community in America and the home of many early industries in Pennsylvania. Other large colonies of Germans from the Palatine countries, and belonging to the Lutheran or Reformed churches, settled on fertile lands running from Easton, through Allentown, Reading and Lebanon to the Cumberland valley. The Moravians founded important centres at Nazareth and Bethlehem. Finally the Scotch-Irish, Presbyterian in religion, an active, restless pioneer element arrived and took up the back country positions on the frontier. Because of their difference from the Quakers and Germans in temperament, and because of the peculiar frontier problems which they faced, they formed an element of opposition to the ruling element all through the 18th century. After 1770 large colonies of Connecticut "Yankees" settled in the beautiful northern Wyoming and Muncy valleys, which were claimed by Connecticut.

Pennsylvania was early involved in serious boundary disputes with Maryland, Virginia, Connecticut, New York and Delaware, the first three involving considerable bloodshed between the settlers before they were decided. A decree of Lord Chancellor Hardwicke, in 1750, settled the Maryland-Delaware dispute and led to the survey, 1763–67, of the boundary between Pennsylvania and Maryland by Mason and Dixon, a line which acquired considerable importance later as separating the free and the slave States. In 1784 Virginia agreed to the extension of the line and to the establishment of the western boundary of Pennsylvania at a meridian drawn from a point on the Mason and Dixon line five degrees of longitude west of the Delaware river. The 42nd parallel was finally selected as the northern boundary in 1789, the dispute with Connecticut over northern Pennsylvania having been decided in favour of the latter State by a court of arbitration of the Continental Congress in 1782. In 1792 the Federal Government sold to Pennsylvania the small triangular strip of territory north of the 42nd parallel and bordering on Lake Erie in order that the State might have a good port on the Great Lakes.

Upon William Penn's death in 1718 his widow became proprietary, and after her death in 1733, the proprietorship fell to John, Thomas and Richard Penn. Except for differences between

the governors appointed by the proprietors and the popular assembly over the matter of taxing the proprietors the assembly had little to contest for, and the degree of civil liberty attained in the province was very high. On the whole the Colony was happy and prosperous, trade being good in Philadelphia and the Germans having established some of the most thrifty farming communities in the Colonies.

French and Indian Wars.—The French and Indian War broke rudely in upon this peaceful expansion No longer was it possible to keep the numerous settlers from trespassing upon the Indian's lands or otherwise provoking him, nor were the Scotch-Irish of the frontier temperamentally as pacific and considerate as the Quakers and Germans had been. Furthermore, the heirs of William Penn were guilty of several sharp land deals which made the Pennsylvania tribes resentful. It was fertile soil for French propaganda In 1750 the French began building a line of forts in the Ohio valley to back up their claims to the territory, among them a fort at Presque Isle (on the present site of Erie), Ft. Le Boeuf (at Waterford in Erie county), and Ft. Venango (within the limits of the city of Franklin). Virginia, claiming western Pennsylvania at this time, sent George Washington to build a fort at the confluence of the Monongahela and Allegheny rivers, but his workmen were driven away by the French who finished the fort and named it Ft. Duquesne Washington met and defeated a force of French and Indians at Mountain Meadows, but was later besieged in a hastily thrown up breastwork (Ft. Necessity) by a larger force and forced to surrender The English upon being informed of the French movements sent an expedition under Gen. Braddock against Ft Duquesne, but on July 9, 1755, when but a few miles from the fort, Braddock's column was set upon by the French and Indians and cut to pieces, only 459 out of 1,386 men escaping During this year the frontiers of Pennsylvania suffered greatly, scarcely a lone and exposed household escaping attack Most of the settlers fled to a line of 17 forts which had been established under Franklin's direction in the mountain gaps In 1758 a second expedition against Ft. Duquesne, under Gen. Forbes, was successful. The fort was rebuilt, and named Ft Pitt after the English prime minister, and the log settlement was named Pittsburgh. With the fall of Montreal in 1760 all Pennsylvania came definitely into English hands


THE BLOCK HOUSE ERECTED AT ERIE DURING FRONTIER DAYS

Indian wars were not past, however, for when Pontiac's rebellion broke out in 1763 every fort on the frontier was besieged, and Presque Isle and Venango were easily taken by the Indians The settlers again fled back over the mountains Col. Henry Bouquet, after defeating the Indians in a desperate engagement at Bushy Run, reached Pittsburgh in time to relieve the fort, and marched on into Ohio, where he inflicted heavy defeats upon the Indians

Pennsylvania in the Revolution.—As the central Colony, Pennsylvania's attitude in the struggle with the mother country was of vast importance The British party was strong because of the loyalty of the large Church of England element, the neutrality of many Quakers, Dunkers and Mennonites, and a general satisfaction with the liberal and free government of the province, which had not suffered such catastrophic reverses as had embittered the people of Massachusetts, for instance. But the Whig party under the lead of John Dickinson, Thomas Mifflin and Joseph Reed was successful in the State, and Pennsylvania contributed greatly to the success of the Revolutionary War by the important services rendered by her statesmen, by providing troops and by the financial aid given by Robert Morris (*q v*). The two Continental Congresses (1774 and 1775–81) met in Philadelphia, except for the months when Philadelphia was occupied by the British army and Congress met in Lancaster and York, Pa, and then in Princeton, N. J. In Philadelphia the second Congress adopted the Declaration of Independence, which the Pennsylvania delegation, excepting Franklin, thought premature at the time, but which was well supported by Pennsylvania afterwards. During the Revolutionary War battles were fought at Brandywine (1777), Paoli (1777), Ft. Mifflin (1777) and Germantown (1777), and Washington's army spent the winter of 1777–78 at Valley Forge Philadelphia was occupied by the British from Sept. 26, 1777 to June 18, 1778. Soon after the signing of the Declaration of Independence, a convention of representatives of the counties met in Philadelphia, and drew up a new State Constitution which went into effect in Sept 1776, without being submitted to a vote of the people It provided for a unicameral legislative system, abolished the office of governor and substituted an executive council of 12, presided over by a president to be chosen by the legislature. With the institution of this new Government the proprietorship went out of existence and the Penn heirs were compensated by a grant of £120,000 and the guarantee of titles to certain private estates With the passing of the old Government Quaker dominance also passed out of existence.

Pennsylvania ratified the Federal Constitution in spite of powerful opposition on Dec 22, 1787, and in 1790 revised its own Constitution to conform with that instrument, the executive council being abolished, the office of governor restored and a bicameral legislative system adopted From 1790 to 1800 Philadelphia, then the largest and wealthiest city in the United States, was the seat of the Federal Government. The State capital was moved from Philadelphia to Lancaster in 1799 and from Lancaster to Harrisburg in 1812.

Progress of Settlement and Industry.—In 1800 the population of the State was 602,000. The years just previous to the Revolution and those after the Revolution were years of rapid settlement beyond the mountains. Settlement in the Upper Susquehanna valley was also rapid in this period. Bridges and roads were being built in every direction and stage-coach routes established The Philadelphia-Lancaster turnpike (1790) was the first important turnpike in America In 1806 a bill passed Congress providing for the national road from Cumberland, Md, to the Ohio, which passed through south-western Pennsylvania and had great influence in the development of that section After 1790 anthracite coal began to be mined near Mauch Chunk and transported down the rivers to Philadelphia. About 1800 iron began to be manufactured in Lancaster, Coatesville, Phoenixville and the Juanita valley. Upon the opening of the mines thousands of Irish began to settle in the mining regions

Canals and railways came into use in Pennsylvania about the same time and both played an important part in the State's development. Many of the early railways were short lines to carry coal from mines to river banks In 1834 the Columbia railroad and the Allegheny Portage railroad were begun by the State and connected with the Pennsylvania canal to form a rail-water route from Philadelphia to Pittsburgh Most of the important rivers were canalized so that they became available carriers By 1840 the burden of debt upon the State from the extensive system of internal improvements led to wide-spread popular discontent and such projects were abandoned The success of railways was by that time assured and the State began selling its enterprises to private corporations

Pennsylvania was usually Democratic before the Civil War owing to the democratic nature of its western and immigrant citizens The growth of the protectionist movement and the development of anti-slavery sentiment drew it toward the newly organized Republican party, however, and it voted the Lincoln ticket in 1860 During the Civil War the State was subject to raids along its southern border, Chambersburg being burned in 1862. The battle of Gettysburg (July 1863), a defeat of Lee's attempt to invade the North, was a turning point in the war

After the Civil War.—On the political side the chief feature of the State's history after the Civil War was the growth of the Cameron-Quay-Penrose political machine, founded by Simon Cameron, strengthened by his son James Donald Cameron, and continued under Matthew Stanley Quay and Boies Penrose, down to

the time of the latter's death in 1921. It was based upon the control of patronage, the distribution of State funds, the support of the Pennsylvania railway and other powerful corporations, and upon the ability to persuade the electors that it was necessary to vote the strict Republican ticket to save the protective system. This machine was not only all-powerful in State politics but influenced national elections. During Governor Pennypacker's administration, 1903–07, a number of new departments, among them those of forestry, health and highways, were created. Also under his administration the Pennsylvania State police were established as a more efficient body than the State militia in dealing with strikes and lawlessness. In 1913 the department of labour and industry was created and a workmen's compensation board set up. Gifford Pinchot was nominated by a close vote in 1922 and afterward elected. Under his direction the "Administrative Code" of 1923 centralizing control and consolidating departments was passed, giving the governor much more power than he had hitherto possessed. In 1927 John S. Fisher (Republican) was elected to succeed Pinchot.

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PENNSYLVANIA, UNIVERSITY OF, an American institution of higher learning, in Philadelphia. Its campus stretches from the west bank of the Schuylkill river to 39th street, and from 34th and Chestnut streets on the north to the Philadelphia General hospital and the Philadelphia Commercial museum.

The library contains (1928) 635,070 bound and 55,000 unbound volumes and pamphlets. Among the important collections are the Penniman (education), Biddle (law), Lippincott (social sciences), Lea (history), Macauley (romance, and an excellent Dante collection), the Franklin papers, the Curtis collection of Franklin imprints and the Hale collection of autographs of signers of the Declaration of Independence.

The museum has important archaeological and ethnological collections. The exhibitions largely represent the results of the museum's own expeditions to Central and South America, Alaska, various parts of the United States, Egypt, Palestine and Babylonia.

The university consists of the college, Towne Scientific school, Moore School of Electrical Engineering, Wharton School of Finance and Commerce and Schools of Education and Fine Arts. The university also includes the graduate school, schools of medicine (the first medical school in America, 1765), law, dentistry, veterinary medicine, hygiene and public health, the evening school of accounts and finance, extension schools, departments of physical education and military science and tactics, the Carter foundation (child helping), and the Graduate School of Medicine. Among affiliated divisions are the Henry Phipps Institute, devoted especially to research in tuberculosis, the Wistar Institute of Anatomy and the University of Pennsylvania Press.

Admission to the undergraduate schools requires the equivalent of graduation from a four-year high school. The graduate and law schools require a bachelor's degree for admission, the school of medicine three years of college study, and the school of dentistry, two years. About 800 scholarships are granted annually. Several large groups are for students from the public schools of Philadelphia; others are in the gift of the governor and members of the State legislature. In the graduate school there are available 15 fellowships ($1,000 annually) in addition to free tuition, for men and for women, besides 37 scholarships, varying in value from $250 and free tuition to free tuition only. There are two travelling scholarships ($2,000 each) in diplomacy and international law, one in modern languages and one in architecture ($1,000).

The corporation from 1791 to 1927 was composed of 24 trustees, with the governor of Pennsylvania as ex officio president. An amendment to the charter fixes the number of trustees at 40, 10 of these being elected by the alumni. The directing head of the university and the head of the university faculty and of the faculty of each department is the provost, a title rarely so used in American universities. The provost also presides over meetings of the trustees, the governor of Pennsylvania taking no active part in the management of the university. In 1927–28 the instructors totalled 1,341; the students, 16,382.

The year ended June 30, 1927 showed excess of assets over liabilities amounting to approximately $39,783,162, invested in part as follows: plant funds, $25,175,288; endowment funds, $12,204,109; general funds, $1,334,365. Land, buildings and contents increased by more than $4,000,000 during 1927. Private benefactions in 1926–27 totalled $1,594,335.35; fees, receipts, rentals, etc., amounted to $4,235,032.40. Tuition fees ranged from $225 to $400. Income from invested funds, gifts and other receipts for designated purposes and the State appropriation aggregated $1,286,281.58. The payment on account of instructional salaries totalled $2,343,167.67. Payments on account of other salaries and wages totalled $1,304,396.94. Current expenses and purchases of equipment brought the total to $5,350,250.08.

The university publishes: the *Astronomical Series; Contributions from the Botanical Laboratory; Contributions from the Zoological Laboratory; Series in History; Translations and Reprints from the Original Sources of European History; Series in Romanic Languages and Literature; The American Law Register; Museum Journal; Scientific Reports from the Museum; Contributions from the William Pepper Laboratory of Clinical Medicine; The Psychological Clinic; Publications of the Wistar Institute,* including *Journal of Morphology; The Journal of Comparative Neurology; The American Journal of Anatomy; the Anatomical Record* and *The Journal of Experimental Zoology.* The University of Pennsylvania Press (1920) publishes annually a number of books and monographs.

Benjamin Franklin in 1749 published a pamphlet entitled *Proposals Relating to the Education of Youth in Pensilvania,* which led to the formation of a board of 24 trustees, 19 of whom, on Nov. 13, 1749, met to promote "the Publick Academy in the City of Philadelphia," and elected Franklin president of the board, an office which he held until 1756. In 1750 there was conveyed to this board of trustees the "New Building," erected in 1740 for a meeting house and charity school; the original trustees (including Franklin) of the "New Building" date from 1740, and therefore the university attaches to its seal the words "founded 1740." The academy was opened in Jan. 1751, the city having voted £200 for the completion of the building. On Sept. 16, 1751 a charitable school "for the instruction of poor Children gratis in Reading, Writing, and Arithmetick" was opened in the "New Building." The proprietaries, Thomas and Richard Penn, incorporated "The Trustees of the Academy and Charitable School in the Province of Pennsylvania" in 1753; and in 1755 issued a confirmatory charter, changing the corporate name to "The Trustees of the College, Academy and Charitable School," etc., whereupon William Smith (1727–1803) of the University of

Aberdeen, who had become rector of the academy in 1752 and had taken orders in the Church of England in 1753, became provost of the college. In 1756 Dr. Smith established a complete and liberal curriculum. In 1757 the first college class graduated.

In 1779, after fears had been repeatedly expressed that Smith planned to make the institution sectarian, the State legislature confiscated the rights and property of the college and chartered a new corporation "the Trustees of the University of the State of Pennsylvania"; in 1789 the college was restored to its rights and property and Smith again became its provost; in 1791 the college and the University of the State of Pennsylvania were united under the title, "the University of Pennsylvania," whose trustees were elected from their own members by the board of trustees of the college and that of the university. In 1802 the university purchased new grounds on 9th street, between Market and Chestnut, where, until 1829, it occupied the administrative mansion built for the president of the United States; there new buildings were erected after 1829; and from these the university removed to its present site in 1872.

See T. H. Montgomery, *A History of the University of Pennsylvania from its Foundation to A.D. 1770* (1900); G. B. Wood, *Early History of the University of Pennsylvania* (1896); J. B. McMaster, *The University of Pennsylvania* (1897); G. E. Nitzsche, *Official Guide to the University of Pennsylvania* (1906); and E. P. Cheyney, "University of Pennsylvania," in vol. i. of *Universities and Their Sons* (1901).

PENNSYLVANIA RAILROAD COMPANY, a corporation of the Commonwealth of Pennsylvania, U.S.A., is the parent company of a group of 116 corporations known as the Pennsylvania Railroad System, united in one management through ownership of the majority of the stock, or long term leases or both. The company directly owns the principal lines of the system in Pennsylvania, and under its corporate organization directly operates about 90% of the mileage. The Pennsylvania traverses practically the entire eastern middle belt of the United States, lying between the Atlantic ocean on the east and the Mississippi river on the west, and stretching from the Great Lakes to the southern States. This is the most densely populated region in the United States, and contains the largest cities.

By the Act of Incorporation, approved on April 13, 1846, the Pennsylvania Railroad Company was incorporated for the purpose of constructing and operating a railroad from Harrisburg to Pittsburgh. On Feb. 15, 1854, the company opened for service its own through line between these cities, and on Aug. 1, 1857, through purchase or lease gained complete control of the entire Philadelphia-Pittsburgh route.

Iron, steel and coal and other raw materials provide the backbone of the Pennsylvania's traffic. The company is also a very important carrier of miscellaneous manufactured articles, fresh fruits, vegetables and general produce, packing-house products and lumber from the South and West. Serving as it does the four leading eastern seaports—New York, Philadelphia, Baltimore and Norfolk—it handles a large proportion of the nation's import and export trade. In 1927 the Pennsylvania System carried the equivalent of one ton of freight 45,538,219,469 m., and one passenger 6,386,154,279 miles. On Dec. 31, 1927, the system embraced 11,689 m. of line and 28,127 m. of track. On the entire system 4,369·21 m. were double-tracked, 917·52 m. had three tracks and 697·81 m. had four tracks. At the end of 1927 the rolling stock consisted of 7,018 locomotives, 7,921 passenger cars, 271,952 freight cars and 4,178 work cars.

The Pennsylvania Railroad System represented at the end of 1927 an investment in road and equipment of $2,440,333,861. Against this sum there were outstanding in the hands of the public securities (stocks and bonds of various companies) amounting to $1,554,832,019. The Pennsylvania Railroad Company, the parent company, had outstanding $561,765,700 of capital stock divided into shares of $50 each, on Dec. 31, 1927. Under action of the board of directors in March 1928, an allotment of $62,500,000 of additional stock was authorized to be issued to the stockholders. At the close of April 1928, the stock was in the hands of 142,602 stockholders whose average holdings were approximately 70 shares each. The total operating revenues of the system in 1927 were $721,280,031. The operating expenses, including taxes, were $611,111,782. Net railway operating income was $110,168,249. The average number of employees on the system in 1927 was 201,583. The total payroll for the year was $367,022,000. Following the close of the World War numerous problems of a serious character arose with reference to relations between employees and management. In an endeavour to solve this problem, the Pennsylvania management instituted a plan of employee representation. Under this plan differences between the employees affected and the management are referred to joint reviewing committees.

A recent development of far-reaching importance was the railroad's announcement of its entry into the air transport field. On May 16, 1928, the Pennsylvania railroad, the Curtiss Aeroplane and Motor Company, the Wright Aeronautical Company and a group of banking interests formed a new company, the Transcontinental Air Transport, Inc., for the purpose of operating a joint rail-air service between New York and the Pacific Coast. The new service contemplates an evening departure from New York on the Pennsylvania railroad, passengers using a sleeping car for the night journey and an airplane for the day.

Another step of importance was the company's announcement on Oct. 31, 1928, that work would be inaugurated soon on the complete electrification of its freight and passenger train service between New York city and Wilmington, Del., including the main line between Philadelphia and Atglen, Pa., and the low grade freight lines which join at Columbia, Pa., and connect the cities of New York, Philadelphia and Wilmington with the West. The cost of the work will be approximately $100,000,000, and it is expected it will reach completion in 1935. (W. W. A.)

PENNY, an English coin, equal in value to one-twelfth of a shilling. It is one of the oldest of English coins, superseding the sceatta or sceat. It was introduced into England by Offa, king of Mercia, who took as a model a coin first struck by Pippin, father of Charlemagne, about 735, which was known in Europe as *novus denarius*. Offa's penny was made of silver and weighed 22½ grains, 240 pennies weighing one Saxon pound (or Tower pound, as it was afterwards called), hence the term pennyweight (dwt.). In 1527 the Tower pound of 5,400 grains was abolished, and the pound of 5,760 grains adopted instead. The penny remained, with some few exceptions, the only coin issued in England until the introduction of the gold florin by Edward III. in 1343. It was not until the reign of Edward I. that halfpence and farthings became a regular part of the coinage, it having been usual to subdivide the penny for trade purposes by cutting it into halves and quarters, a practice said to have originated in the reign of Aethelred II. In 1257, in the reign of Henry III., a gold penny, of the value of 20 silver pence, was struck. The weight and value of the silver penny steadily declined from 1300 onwards, as will be seen from the following table:—

Reign	Weight	Value in silver 925 fine, at 5s. 6d. per oz.
	Grains	Penny
William I., 1066	22½	3·00
Edward I., 1300	22	3·02
„ III., 1344	20¼	2·78
„ III., 1346	20	2·75
„ III., 1351	18	2·47
Henry IV., 1412	15	2·06
Edward IV., 1464	12	1·65
Henry VIII., 1527	10½	1·44
„ VIII., 1543	10	1·37
Edward VI., 1552	8	1·10
Elizabeth, 1601	7¾	1·06

The last coinage of silver pence for general circulation was in the reign of Charles II. (1661–62), since which time they have only been coined for issue as royal alms on Maundy Thursday. Copper halfpence were first issued in Charles II.'s reign, but it was not until 1797, in the reign of George III., that copper pence were struck. This copper penny weighed 1 oz. avoirdupois. In the same year copper twopences were issued weighing 2 oz., but they were found too cumbersome and were discontinued. In 1860 bronze was substituted for the copper coinage, the alloy containing 95 parts of copper, four of tin and one of zinc. The weight was

also reduced, 1 lb. of bronze being coined into 48 pennies, as against 24 pennies into which 1 lb. of copper was coined.

The figure of Britannia first appeared on the issue of copper coins made in the reign of Charles II. The original of Britannia is said to have been Frances Stewart, afterwards duchess of Richmond (Pepys, *Diary*, Feb. 25, 1667) and Charles' mistress.

PENN YAN, a village of New York, U.S.A., the county seat of Yates county; at the foot of Lake Keuka, 45 m. S.E. of Rochester. It is served by the New York Central and the Pennsylvania railways. Pop. (1925) 5,326 (State census). Keuka is one of the most beautiful of the "finger lakes" of central New York. There are many summer cottages around it, and on the west shore is Keuka college for women (Baptist; 1921). The region is famous for its grapes, apples and grain. Among the numerous manufactures of the village are buckwheat products, grape-juice, vinegar, fruit baskets, flour, paper, boats, store fixtures, clothing and canned fruits and vegetables. The first settlers of Penn Yan were chiefly followers of Jemima Wilkinson (1753–1819), a religious enthusiast from Rhode Island, who in 1788 founded the village of Hopeton near Lake Seneca. Her followers began to desert her before 1800, and gradually the community broke up. The first dwelling on the site of Penn Yan was built in 1799. The village was made the county seat when Yates county was created in 1823, and in 1833 it was incorporated. Its name was devised from the first syllables of Pennsylvania and Yankee, to commemorate the origin of most of the early settlers.

PENNYROYAL, in botany, a herb formerly much used in medicine, the name being a corruption of the old herbalist's name "Pulioll-royall," *Pulegium regium*. It is a member of the mint genus, and has been known to botanists since the time of Linnaeus as *Mentha pulegium*. It is a perennial herb with a slender branched stem, square in section, up to a foot in length and rooting at the lower nodes, small opposite stalked oval leaves about half-inch long, and dense clusters of small reddish-purple flowers in the leaf axils, forming almost globular whorls. It grows in damp gravelly places, especially near pools, on heaths and commons. It has a strong smell somewhat like that of spearmint, due to a volatile oil which is readily obtained by distillation with water, and is known in pharmacy as *Oleum pulegii*. The specific name recalls its supposed property of driving away fleas (*pulices*). Like the other mints it has carminative and stimulant properties.

The similar American pennyroyal (*Hedeoma pulegioides*), but belonging to a different genus of the mint family (Labiatae), occurs in dry fields from Cape Breton island to Ontario and Minnesota southward to Florida and Arkansas.

PENOLOGY, penal science, that part or division of criminology which concerns itself with the philosophy and practice of society in its efforts to repress criminal activities. As the term signifies (Lat. *poena*, pain, suffering), penology has stood in the past and, for the most part, still stands for the policy of inflicting punishment on the offender as a consequence of his wrong-doing, but it may reasonably be extended to cover other policies, not punitive in character, such as probation, medical treatment and education, aimed at the cure or rehabilitation of the offender; and this is, in fact, the accepted present sense of the term.

The principal aims of penal science are: to bring to light the ethical bases of punishment, along with the motives and purposes of society in inflicting it; to make a comparative study of penal laws and procedures throughout human history and particularly at the present time; and, finally, to evaluate the social consequences of the policies in force at a given time. Thus conceived, penology represents a grouping of studies, some of which, dealing with the aims and the moral or social justifications of punishment, date from a remote past, while others, having to do with the wider social implications of the system, have scarcely yet made a beginning. As a modern and, therefore, a critical science, penology may properly be regarded as a serious effort to effect a revaluation of the concepts, theories and assumptions regarding punishment for crime which have for 2,000 years found expression in legal and philosophical literature, as well as in the penal law.

The exploration of the animating forces of the system of punishment carries the penologist far back into human nature as well as into human history. Back of any scheme of punishment is a policy and that policy is, in its turn, the fruit of a living sentiment or the result of a struggle between competing sentiments. The policy that has most persistently dominated and which is still a powerful if not controlling factor in penal legislation and practice is that of retribution, offspring of the sentiment of vengeance. Whether the offence to be compensated for is confined to an individual victim or is conceived of as an injury to the social group to which he belongs, the immediate reaction is resentment and this can be appeased only by expiation or retribution. This, with primitive literalness, gave to early society at a comparatively advanced stage the rule: life for life, eye for eye, tooth for tooth, limb for limb. It still survives in the death penalty for murder and in the drastic penalties imposed for rape and other crimes which are peculiarly offensive to the moral sentiments or to the sense of security of the community. Nearly everywhere, in the more recent stages of social development, this motive has been supplemented, but never wholly supplanted, by an unquestioning faith in the deterrent effect on potential offenders of exemplary, *i.e.*, drastic, punishments inflicted on actual offenders, which, in practice if not in theory, comes to much the same thing.

This policy of retribution is justified and sustained by an ethical philosophy which regards punishment as an integral and inviolable element in wrong-doing, as a moral necessity, "the other half of crime." This doctrine has been consistently maintained by the intuitive or idealistic philosophers from Plato to Thomas Aquinas and from Kant to T. H. Green and his disciples. The deterrent effect of punishment has also been claimed by adherents of this school but its widespread adoption as a policy has probably been due more to the influence of the utilitarian philosophy of Bentham, Paley, John Stuart Mill and Herbert Spencer, which makes the welfare of society, "the greatest good of the greatest number," the aim of all moral activity. It is this utilitarian philosophy which is now in the ascendant in penal legislation and which governs the view of most modern penologists.

Modern penology dates from the publication of Beccaria's pamphlet on "Crimes and Punishments" in 1764. This represented a school of doctrine, born of the new humanitarian impulse of the 18th century, with which Rousseau, Voltaire and Montesquieu in France and Bentham in England were associated. This, which came afterwards to be known as the classical school, assumed every criminal act to be a deliberate choice determined by a calculation of the prospective pleasures and pains of the act contemplated. All that was needed to overcome the criminal purpose was to provide for each and every crime a penalty adequate to overbalance its assumed advantages. Excessive penalties, such as death, were unnecessary and therefore unjust. This was followed, a generation later, by the neo-classical school of the revolutionary period in France, which modified Beccaria's rigorous doctrine by insisting on the recognition of varying degrees of moral, and therefore of legal responsibility, as in the case of children and the insane, as well as of mitigating circumstances in general. The doctrine of the "individualization of punishment," that is to say of the punishment of the individual rather than of the crime committed by him, which is of commanding importance in present day penology, is only a development of this fundamental principle of the neo-classical school.

This normal historical development of penology was interrupted during the last quarter of the last century by the widespread acceptance of the theory of crime and its treatment promulgated by the Italian, Lombroso, and his disciples. This, at first known as the Italian, later, as the continental, school of criminology, now claims the title of the positive school, so-called because it pursues the positive methods of modern science. Its fundamental doctrine is that the criminal is doomed by his inherited traits to a criminal career and is therefore a wholly irresponsible actor. Society must, of course, protect itself against him, but to punish him as if he were a free moral agent is as irrational as it is unethical.

While the enthusiasm for the doctrines of the positive school has waned and the alleged facts on which they were based have been largely discredited, it has, nevertheless, left a valuable legacy of influence. To it must be given much of the credit for the pres-

ent active tendency to make the mental study of the criminal an essential part of his diagnosis, a fact which has, in the last quarter-century, given the psychologist and, particularly, the psychiatrist a leading place in the development of modern penological theory. From studies such as these the present school of criminologists have discovered that there is no single formula that accounts for all violators of the penal code, while the policy of the individualization of punishment has taken on the form of individualization of treatment. Indeed, the note of the day is research—research into the factors, whether individual or social, which determine criminal activities and research into the resources of the community for making such disposition of the offender as will effectually protect the former without destroying the latter.

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PENRITH, market town, urban district, Penrith and Cockermouth parliamentary division, Cumberland, England, 281 m. from London on the L.M.S. railway. Pop. (1921) 8,336. It is also served by the L.N.E. railway. A 14th century grammar school was refounded by Queen Elizabeth; and there are two mansions dating from the same reign, which have been converted into inns. Though there are breweries, tanneries and saw-mills, the town depends mainly on agriculture. There are some ruins of a castle. Near Penrith on the south, above the precipitous bank of the Eamont, stands a small but beautiful old castellated house, Yanwath Hall. To the N.E. of the town Eden Hall, rebuilt 1824, contains the celebrated enamelled goblet, the "Luck of Eden Hall."

Penrith, otherwise Penreth, Perith, Perath, was founded by the Cambro-Celts. In 1222 Henry III. granted a yearly fair extending from the eve of Whitsun to the Monday after Trinity and a weekly market on Wednesday, but before 1787 the market day was changed to Tuesday. The manor in 1242 was handed over to the Scottish king who held it till 1295, when Edward I. seized it. In 1397 Richard II. granted it to the first earl of Westmorland; it then passed to Warwick the king-maker and on his death to the crown. In 1694 William III. granted it to the earl of Portland, by whose descendant it was sold in 1787 to the duke of Devonshire. In the 18th and early part of the 19th century Penrith manufactured checks, linen cloth and ginghams. Clock and watch-making seems to have been an important trade here in the 18th century. The town suffered much from the incursions of the Scots, and Ralph, earl of Westmorland, who died 1426, built the castle; but a tower called the Bishop's Tower had been previously erected on the same site. In 1597–98, 2,260 persons perished by plague in the Penrith rural deanery. During the Civil War the castle was dismantled by the Royalist commandant. The church of St. Andrew is of unknown foundation, but the list of vicars is complete from 1223.

PENRY, JOHN (1559–1593), Welsh Puritan, was born in Brecknockshire in 1559; tradition points to Cefn Brith, a farm near Llangammarch, as his birthplace. He was educated at Peterhouse, Cambridge, and St. Alban's Hall, Oxford. He did not seek episcopal ordination, but was licensed as University Preacher. The tradition of his preaching tours in Wales is slenderly supported; they could only have been made during a few months of 1586 or the autumn of 1587. At this time ignorance and immorality abounded in Wales. In 1562 an act of parliament had made provision for translating the Bible into Welsh, and the New Testament was issued in 1567; but the number printed would barely supply a copy for each parish church.

Indignant at this negligence, Penry published, early in 1587, *The Aequity of an Humble Supplication—in the behalf of the country of Wales, that some order may be taken for the preaching of the Gospel among those people.* Archbishop Whitgift thereupon caused him to be brought before the High Commission and imprisoned for about a month. On his release Penry married at Northampton, where he lived for some years, and set up a printing press. It was successively located at East Molesey (Surrey), Fawsley (Northampton), Coventry and other places in Warwickshire, and finally at Manchester, where it was seized in August 1589. On it were printed Penry's *Exhortation to the governours and people of Wales,* and *View of . . . such publike wants and disorders as are in the service of God . . . in Wales;* as well as the celebrated *Martin Marprelate* tracts. In January 1590 his house at Northampton was searched and his papers seized, but he succeeded in escaping to Scotland. There he published several tracts, as well as a translation of a learned theological work known as *Theses Genevenses.*

Returning to England in September 1592, he joined the Separatist Church in London, in which he declined to take office, though after the arrest of the ministers, Francis Johnson and John Greenwood, he seems to have been the regular preacher. He was arrested in March 1593, and efforts were made to find some pretext for a capital charge. Failing this a charge of sedition was based on the rough draft of a petition to the queen that had been found among his private papers; the language of which was indeed harsh and offensive, but had been neither presented nor published. He was convicted by the Queen's Bench on May 21, 1593, and hanged on the 29th.

See the Life, by John Waddington (1854).

PENRYN, a market town and port, and municipal borough of Cornwall, England, 2 m. N.W. of Falmouth, on a branch of the G.W. railway. Pop. (1921) 3,149. Penryn owed its development to the fostering care of the bishops of Exeter within whose demesne lands it stood. These lands appear in Domesday Book under the name of Trelivel. In 1230 Bishop Briwere granted to his burgesses of Penryn that they should hold their burgages freely at a yearly rent of 12d. by the acre for all service. Bishop Walter de Stapeldon secured a market on Thursdays and a fair at the Feast of St. Thomas. The return to the bishop in 1307 was £7, 13s. 2½d. from the borough and £26, 7s. 5d. from the forum. In 1311 Bishop Stapeldon procured a three days' fair at the Feast of St. Vitalis. Philip and Mary gave the parliamentary franchise to the burgesses in 1553. James I. granted and renewed the charter of incorporation, providing a mayor, 11 aldermen and 12 councillors, markets on Wednesdays and Saturdays, and fairs on May 1, July 7 and Dec. 21. The charter having been surrendered, James II. by a new charter *inter alia* confined the parliamentary franchise to members of the corporation. This proviso however was soon disregarded, the franchise being freely exercised by all the inhabitants paying scot and lot. An attempt to deprive the borough of its members, owing to corrupt practices, was defeated by the House of Lords in 1827. The act of 1832 extended the franchise to Falmouth in spite of the rivalry existing between the two boroughs. In 1885 the united borough was deprived of one of its members. Penryn and Falmouth are now in one of the county parliamentary divisions of Cornwall. The corporation of Penryn was remodelled in 1835, the aldermen being reduced to four.

Its foreign trade, dating from the 14th century, is considerable. The extra-parochial collegiate church of Glasney, founded by Bishop Bronescombe in 1265, had a revenue at the time of its suppression under the act of 1545 of £221, 18s. 4d. The town lies at the head of the estuary of the Penryn river, which opens from the main estuary of the Fal at Falmouth. Granite, which is extensively quarried in the neighbourhood, is dressed and polished at Penryn, and there are also chemical and bone manure works, engineering, iron and gunpowder works, timber-yards, brewing, tanning and paper-making. The harbour dries at low tide, but at high tide has 13 ft. of water.

PENSACOLA, a city of Florida, U.S.A., on Pensacola bay (an arm of the Gulf of Mexico), 50 m. S.E. of Mobile; a port of entry

and the county seat of Escambia county. It is on Federal highways 90 and 131, and is served by the Frisco system and the Louisville and Nashville railroad, as well as by transoceanic and coastwise steamship lines. Pop. 31,035 in 1920 (34% negroes); estimated locally at nearly 45,000 in 1928 The large land-locked harbour has a controlling depth of 32 feet. Its narrow entrance (between the island of Santa Rosa on the east and a narrow peninsula on the west) is guarded by Ft Pickens and (on the mainland) Ft. Barrancas, headquarters of the IV Corps area coast defence Between Ft. Barrancas and the city is the principal air-training station of the U S navy. The city (9·75 sq m in area) is bordered on three sides with water. From the bay it rises gently to heights commanding wide views, and on its eastern and western boundaries are Bayou Texar and Bayou Chico There are 27 public parks, and near by are many beaches and other pleasure resorts The traffic of the port in 1925 amounted to 757,009 tons (45% foreign commerce) valued at $29,130,467 The city has a large wholesale trade, extensive fisheries, dry-docks, and over 70 manufacturing plants, with an annual payroll of $8,000 000 Lumber, naval stores, marble, mattresses, excelsior, sails, tents, awnings, ships, small boats, dredges, fertilizer, brick, tile and cotton-seed oil are leading products Since 1913 a commission form of government has been in operation

Pensacola bay may have been visited by Ponce de León in 1513 It was reached in 1528 by Pánfilo de Narváez, with 240 followers, and in 1540 De Soto established his base of supplies here A settlement which lasted two years was made in 1559 by Tristan de Luna, and another (on land now occupied by the naval air station) in 1696 by Don Andreas d'Arriola, who built Ft San Carlos (still standing) In 1718 Pensacola was captured for France (then at war with Spain) by Sieur de Bienville, and recaptured by a Spanish force from Havana; and in 1719 was again taken by de Bienville, who burned the town and destroyed the fort. When it was restored to Spain, in 1723, a new town was built, at the west end of Santa Rosa island, but after a destructive hurricane in 1754 the survivors went back to the mainland, building on the present site of the city In 1763, when the Floridas were ceded to Great Britain, Pensacola was made the capital of West Florida, and most of the Spanish population went to Mexico and Cuba

During the Revolutionary War it was a refuge for many Loyalists from the North On May 9, 1781, it was captured by Don Bernardo de Gálvez, the Spanish governor at New Orleans, whereupon most of the English left, though trade remained in the hands of the English merchants During the War of 1812 the British made it a centre of operations, and in 1814 entered the harbour to take formal possession, but were repulsed by Gen Andrew Jackson In 1818 Gen Jackson captured the city from the Spanish, on the ground that they were encouraging the Seminole Indians, and in 1821 Florida as a whole was finally transferred to the United States, the ratification ceremony and transfer of flags taking place in the public square (now City Hall park) of Pensacola. In 1824 Pensacola was chartered as a city and was selected as the site of a Federal navy yard On Jan. 12, 1861, the navy yard was seized by the State Government, but Ft. Pickens remained under Federal control, and on May 8, 1862, the Confederates evacuated the city.

PENSHURST, a village in Kent, England, at the confluence of the Eden and Medway, 4½ m S W of Tonbridge. Pop (1921) 1,531. The village has some old houses, including a timbered house of the 15th century It has also a factory of cricket implements. The church is chiefly late Perpendicular. Penshurst Place is celebrated as the home of the Sidney family The mansion is quadrangular, and has a court, chapel and hall (*c.* 1341) with open timber roof and a minstrels' gallery

PENSIONARY, a name given to the leading functionary and legal adviser of the principal town corporations of Holland, because they received a salary, or pension. At first this official was known by the name of "clerk" or "advocate" The office originated in Flanders The earliest "pensionaries" in Holland were those of Dort (1468) and of Haarlem (1478). The pensionary conducted the legal business of the town, and was the secretary of the town council and its representative and spokesman at the meetings of the provincial states. The post of pensionary was permanent and his influence was great.

In the States of the province of Holland the pensionary of the order of nobles (*Ridderschap*) was the foremost official of that assembly and he was named (until the death of Oldenbarneveldt in 1619) the land's advocate, or more shortly, the advocate. The importance of the advocate was much increased after the outbreak of the revolt in 1572, and still more so during the long period 1586–1619 when John van Oldenbarneveldt held the office The advocate drew up and introduced all resolutions, concluded debates and counted the votes in the provincial assembly When it was not in session he was a permanent member of the college of deputed councillors who carried on the administration. He was minister of justice and of finance All correspondence passed through his hands, and he was the head and the spokesman of the deputation, who represented the province in the states-general. The conduct of foreign affairs in particular was entrusted almost entirely to him.

After the downfall of Oldenbarneveldt the office of lands'-advocate was abolished, and a new post, tenable for five years only, was erected in its place with the title of *Raad-Pensionaris,* or pensionary of the council, usually called by English writers grand pensionary In the stadtholderless régime 1650–72 the grand pensionary became even more influential than Oldenbarneveldt himself, since there was no prince of Orange filling the offices of stadtholder, and of admiral and captain-general of the Union. From 1653–72 John de Witt, re-elected twice, made the name of grand pensionary of Holland for ever famous during the time of the wars with England The office was abolished after the conquest of Holland by the French in 1795

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PENSIONS: CIVIL SERVICE, MUNICIPAL, ETC. The pension scheme for British civil servants is laid down in the Superannuation Acts 1834 to 1919. (*See* SUPERANNUATION) The whole cost of the pensions is borne by the state Pensions are awarded by the Treasury and are payable only to those state paid permanent civil servants who are admitted into the civil service with a certificate from the Civil Service Commissioners or who hold their appointments directly from the Crown The latter is a very small class Broadly speaking the permanent members of the administrative, technical, clerical and manipulative grades are pensionable and the members of the industrial grades are non-pensionable, although a certain number of industrials, especially in the dockyards, are pensionable.

Under the Acts in force prior to 1909, a civil servant retiring at or over the age of 60, and after not less than 10 years' service, was eligible for a pension calculated at $\frac{1}{60}$ of his salary (meaning salary at the date of retirement or, in certain cases, average salary for the last 3 years) for each completed year of his service, with a maximum of $\frac{40}{60}$ On retirement for permanent ill-health he was eligible for a pension similarly calculated if he had served for 10 years or more, and for a short service gratuity of one month's salary for each year of his service if he had served for less than 10 years. If retired owing to the abolition of his office or a reorganization of staff effecting greater efficiency and economy he could be granted an annual compensation allowance, which, in practice, was calculated at $\frac{1}{60}$ of his salary for each completed year of his service, whether more or less than 10 years. This pension scheme applied to women as well as to men.

Following the recommendations of the Royal Commission on Superannuation in the Civil Service, the benefits were altered by the Superannuation Act, 1909, for all future *male* entrants and for those existing pensionable *males* who wished to come under the new scheme and were allowed to do so on proof of good health The old scheme continued to apply to females Under the new scheme pension is calculated in eightieths, instead of sixtieths, with a maximum of $\frac{40}{80}$; but in addition to the reduced pension and the short service gratuity there is, after two years' service, a lump sum allowance calculated at $\frac{1}{30}$ of salary for each completed year of service, with a maximum of $\frac{45}{30}$. And, if the civil servant dies in the service after serving for 5 years or more

his legal personal representatives may be granted a death gratuity of one year's salary or, if greater, $\frac{1}{30}$ of a year's salary for each completed year of service: if he dies after retirement on pension his legal personal representatives may be granted a sum equal to the excess, if any, of a year's salary over the total amount received in pension and lump sum. For male civil servants as a whole the new benefits were estimated to be equal in value to the old. The Act of 1909 also altered the compensation allowance, but only for future entrants whether male or female, to whatever could be granted (whether pension or gratuity) if the retirement had been for ill-health. If a person in receipt of pension or compensation allowance is re-employed in government service the pension or allowance is suspended or abated so that the pay and pension or allowance together do not exceed the pay at the date of retirement. It is customary to grant to women, who, under departmental regulations, resign on marriage a gratuity of one month's pay for each completed year of pensionable service, with a maximum of 12 months' pay, provided they have rendered not less than 6 years' service, including non-pensionable service. By the Pensions (Increase) Acts 1920 and 1924, small pensions and compensation allowances granted before Aug. 4, 1914, or, with certain limitations, between that date and Aug. 20, 1920, may in certain circumstances be increased by from 30% to 70%, provided that the increase does not raise the total income of the pensioner (or the joint income of husband and wife) above £200 (if married) or £150 (if unmarried). Those Acts apply also to police and certain municipal pensioners. There are special scales of pension under special Acts for Diplomatic Officers, Colonial Governors and certain officials in the Supreme Court. The total expenditure on these pensions, etc., in the financial year 1926–7 was approximately £6,335,078, of which £3,055,197 was in respect of the Post Office. The Digest of Pension Law and Regulations for the Civil Service, published by H.M. Stationery Office, gives the law and the regulations arranged under the headings of their subject matter.

Judicial Pensions.—The Lord Chancellor of Great Britain receives a pension of £5,000 however short a time he may have held office, but he usually continues to act as a Law Lord in the House of Lords without salary. Judges receive pensions—in England, ranging from £3,500 to £4,000, and in Scotland, of $\frac{2}{3}$ of salary—after 15 years' service or on retirement through permanent ill health. County Court Judges, Metropolitan Police Magistrates and Scottish Sheriffs and their substitutes receive pensions under special Acts.

Municipal, etc., Pensions.—A considerable number of British local authorities have obtained special parliamentary powers for giving pensions to their staff. The Local Government, etc., Officers' Superannuation Act, 1922, laid down a pension scheme which local authorities, other than Poor Law authorities in England and Asylum authorities, may under certain conditions adopt if they wish. Under that scheme, officials and servants who occupy pensionable posts are eligible for pensions, towards which they have to contribute 5% of their pay. Pension is payable, after not less than 10 years of local authority service, on retirement for permanent ill-health or at age 65 (or age 60 after 40 years' service), and amounts to $\frac{1}{60}$ of salary (on the average of the last 5 years) for each year of service, with a maximum of $\frac{40}{60}$. Service before contributions commenced normally reckons in one-hundred-and-twentieths, instead of sixtieths. Contributions, less any pension received, are returnable at death or on termination of employment before becoming eligible for a pension, in some cases with, and in others without, interest. The pension scheme for English Poor Law officers and servants, laid down in the Poor Law Officers' Superannuation Acts 1896 and 1897, gives benefits generally similar to those under the Local Government, etc., Officers' Superannuation Act, 1922. The employee, however, contributes only 2% of his pay, and service before contributions commenced reckons in full in all cases, but the contribution required is $2\frac{1}{2}$% if the non-contributing service was more than 5 but less than 15 years and 3% if it exceeded 15 years. Asylum officers, other than officers of the Metropolitan Asylums Board who elected to remain under the Poor Law Officers' Superannuation Acts, are pensionable under the Asylum Officers' Superannuation Act, 1909.

School Teachers' Pensions.—By the School Teachers (Superannuation) Act, 1918, which applies to England and Wales, full time teachers in schools aided by state grants and in a few other schools, became eligible for superannuation benefits generally similar to those applicable to male civil servants who entered after 1909 (*see* under CIVIL SERVICE), except that pensions are calculated on average salary for the last 5 years of service. The whole cost of these benefits was to be borne by the state. From June 1, 1922, however, the teachers were required to contribute 5% of their salaries towards the cost of the benefits. In 1925, following the Report of the Departmental Committee on the Superannuation of School Teachers (Cmd. 1962), which gives a brief history of teachers' superannuation in England and Scotland prior to April 1, 1919, the Teachers (Superannuation) Act, 1925, was passed amplifying the scheme and imposing a contribution of 5% of salaries also on the teachers' employers, to commence from April 1, 1928. The 10% total contributions are on the basis of covering the cost of the benefits in respect of future service: the cost in respect of service prior to April 1, 1928, reduced by the teachers' contributions since 1922, remains a charge on the Exchequer. As regards Scotland, the position since April 1, 1919, has been generally similar except that the employers' contributions commenced from April 1, 1926. The benefits are paid from, and the contributions to, the Education (Scotland) Fund, to which the Exchequer contributes each year $\frac{11}{80}$ of the net expenditure (benefits paid less contributions received) during the year on teachers' superannuation in England and Wales.

Police Pensions.—Pensions for members of police forces in Great Britain are granted under the Police Pensions Act 1921. The members contribute 5% of their pay towards the cost of the pensions. The pension amounts to half of pay after 25 years' service and two-thirds of pay after 30 years' service. After not less than 10 years' service smaller pensions may be given on retirement for ill-health. Service before age 20 does not reckon. There are higher scales of pension for retirements caused by injuries received in the execution of duty. If a member has served for 5 years or more his widow receives a pension of from £30 to £50 a year according to his rank, but if his death resulted from injury sustained in the execution of his duty the widow's pension may in certain circumstances be one-third of his pay. Allowances may in certain circumstances be granted to children until they reach age 16. Members serving on July 1, 1919, were allowed, if they wished, to remain under the previous pension scheme under which a pension of two-thirds of pay could be earned after 26 years' service, but 15 years' service was necessary to earn pension on retirement for ill-health. The Report of the Committee on the Police Service (Cmd. 253) gives some account of police pensions prior to 1921.

Ecclesiastical Pensions.—The pensions of clergy of the established Church in England are regulated by contributory schemes under the Episcopal Pensions Measure, 1926, for diocesan bishops including the two archbishops, and under the Clergy Pensions Measure, 1926, for all other clergy holding ecclesiastical preferments and offices who were under age 55 on Dec. 31, 1926. Before the passing of these measures there were systems of pensions for deans and canons and incumbents, charged upon the incomes of their successors, and these remain in force for those members of the clergy who had attained the age of 55 on Dec. 31, 1926.

Civil List Pensions.—These are pensions granted by the sovereign upon the recommendation of the First Lord of the Treasury and paid (since 1837) from the Consolidated Fund. By 1 and 2 Vict. c. 2 they are to be granted to "such persons only as have just claims on the royal beneficence, or who by their personal services to the Crown, or by their performance of duties to the public, or by their useful discoveries in science and attainments in literature and the arts have merited the gracious consideration of their sovereign and the gratitude of their country." A sum of £1,200 is allotted each year in addition to the pensions already in force, and a list of the pensions granted each

year is presented to Parliament. The pensions paid in 1926–7 amounted to £22,686. (*See* PENSIONS: THE UNITED STATES.)

(F. SK.)

PENSIONS, MINISTRY OF: *see* GOVERNMENT DEPARTMENTS.

PENSIONS: NAVY, ARMY AND AIR FORCE. In Great Britain, the retired pay and pensions of members of the fighting forces of the Crown and the pensions payable after their death to their dependent relatives are regulated by Orders in Council as regards the Royal Navy and Royal Marines, Royal Warrants as regards the Army and King's Orders as regards the Royal Air Force. The regulations are administered by the Admiralty, the War Office and the Air Ministry, respectively, except those relating to retired pay or pension granted on account of disablement or death due to service in the World War or in former wars, which are administered by the Ministry of Pensions. Retired pay is granted to officers on retirement, usually for age, ill-health or at their own request, at rates which depend mainly upon length of service and rank held on retirement. Officers with insufficient service to qualify them for retired pay may in certain circumstances be granted gratuities.

New scales of retired pay, subject to review triennially in the light of changes in the cost of living, were introduced in 1919. Although the regulations differ in the several forces, the following figures indicate fairly closely the annual pensions that may be earned at the rates in force in 1928 by officers of equivalent rank. Admirals of the Fleet, £1,692: Field Marshals and Marshals of the Royal Air Force never retire, but, when not employed, receive half pay of the same amount: Other Flag Officers, General Officers and Air Officers, up to £1,339.10.0.: Captains, R.N., Colonels and Group Captains R.A.F., up to £846: Commanders R.N., Lieutenant Colonels and Wing Commanders R.A.F., up to £564: Lieutenant Commanders and Lieutenants R.N., Majors and Squadron Leaders R.A.F., up to £423. Long service pensions are granted to Seamen, Marines, Soldiers and Airmen on discharge after 22 years' service in the Royal Navy, 21 in the Royal Marines and the Army and 24 in the Royal Air Force. Special pensions are also granted in exceptional cases.

The basic pension in each service is, in 1929, at the rate of 1½d. a day for each year of service while additions are granted for service in ranks or ratings above Able Seaman, Marine, Private or Aircraftman and on attainment of age 55. The average rate of pension is about £65 per annum. Pensions may also be awarded to men invalided after at least 14 years' service, and gratuities to men invalided after shorter periods of service. Disability retired pay and disability pensions, either in the form of additions to the rates for service or otherwise, may be granted to officers and men who on retirement or discharge are found to be disabled above a certain degree from causes attributable to the service. Pensions are granted to the widows of officers dying from wounds, injuries or disease attributable to the service at annual rates varying from £90 (widow of a Sub-Lieutenant, Royal Navy, Second Lieutenant in the Army or Royal Marines or Pilot Officer in the Royal Air Force) to £600 (widow of an Admiral of the Fleet, Field Marshal or Marshal of the Royal Air Force) and "compassionate allowances" of £24 annually to each child within the prescribed age limits.

In cases of death not attributable to the service, widows' pensions, varying from £45 to £300 annually (maximum rates) according to the husband's rank, may be granted to widows and "compassionate allowances" up to a maximum of £16 annually to each child. These pensions and allowances cannot be claimed as a right and are not granted to widows without regard to their other means. Pensions are granted to the widows and children of men only in cases of death attributable to the service. The rates of widows' pension vary from 10/6d. to 27/6d. weekly according to the rank of the husband and the age of the widow, while the children's pensions are at the rate of 5s. a week. Widows' pensions may be refused or withdrawn at the discretion of the administering authority on account of unworthiness.

The cost for 1926 of the pensions described was approximately as follows:—

	R.N.& R.M.	Army	R.A.F.
	£	£	£
Officers' retired pay	2,553,000	3,881,000	155,000
Men's pensions	4,320,000	4,511,000	36,000
Widows' pensions, etc.	174 000	205,000	13,000
	7,047,000	8,597,000	204,000

The cost during the same year of the pensions granted by the Ministry of Pensions in respect of disablement or death attributable to the World War and former wars was £56,617,000, of which £3,134,000 was paid to disabled officers, £26,648,000 to disabled men and £26,835,000 to the dependants of deceased officers and men. (*See* PENSIONS IN THE UNITED STATES.)

(C. M. B.)

PENSIONS, OLD AGE: *see* OLD AGE PENSIONS; PENSIONS: THE UNITED STATES.

PENSIONS: PERPETUAL OR HEREDITARY. Perpetual or hereditary pensions in Great Britain were freely granted either to court favourites or as a reward for political services from the time of Charles II. onwards. Such pensions were very frequently attached as "salaries" to places which were sinecures, or posts which were really necessary were grossly overpaid, while the duties were discharged by a deputy at a small salary. On the accession of George III. and his surrender of the hereditary revenues in return for a fixed civil list, this civil list became the source from which the pensions were paid. (*See* CIVIL LIST.) The three pension lists of England, Scotland and Ireland were consolidated in 1830, and the civil pension list reduced to £75,000, the remainder of the pensions being charged on the consolidated fund.

The Bradlaugh Agitation.—In 1887, Charles Bradlaugh, M.P., protested strongly against the payment of perpetual pensions, and as a result a committee of the House of Commons enquired into the subject (*Report of Select Committee on Perpetual Pensions*, 248, 1887). An appendix to the report contains a detailed list of all hereditary pensions, payments and allowances in existence in 1881, with an explanation of the origin in each case and the ground of the original grant; there are also shown the pensions, etc., redeemed from time to time, and the terms upon which the redemption took place. The nature of some of these pensions may be gathered from the following examples: To the duke of Marlborough and his heirs in perpetuity, £4,000 per annum; this annuity was redeemed in August 1884 for a sum of £107,780, by the creation of a ten years' annuity of £12,796 17s. per annum. By an act of 1806 an annuity of £5,000 per annum was conferred on Lord Nelson and his heirs in perpetuity. In 1793 an annuity of £2,000 was conferred on Lord Rodney and his heirs All these pensions were for services rendered, and although justifiable from that point of view a preferable policy was pursued in the 20th century by parliament voting a lump sum, as in the cases of Lord Kitchener in 1902 (£50,000) and Lord Haig and other distinguished commanders at the end of the World War.

Charles II. granted the office of receiver-general and controller of the seals of the court of king's bench and common pleas to the duke of Grafton. This was purchased in 1825 from the duke for an annuity of £843, which in turn was commuted in 1883 for a sum of £22,714 12s. 8d. To the same duke was given the office of the pipe or remembrancer of first-fruits and tenths of the clergy. This office was sold by the duke in 1765, and after passing through various hands was purchased by one R. Harrison in 1798. In 1835 on the loss of certain fees the holder was compensated by a perpetual pension of £62 9s. 8d. The duke of Grafton also possessed an annuity of £6,870 in respect of the commutation of the dues of butlerage and prisage. To the duke of St. Albans was granted in 1684 the office of master of the hawks. The sums granted by the original patent were: master of hawks, salary, £391 1s. 5d.; four falconers at £50 per annum each, £200; provision of hawks, £600; provision of pigeons, hens and other meats, £182 10s.; total £1,373 11s. 5d. This amount was reduced by office fees and other deductions to £965, at which amount it stood until commuted in 1891 for £18,335. To the duke of Richmond and his heirs was granted in 1676 a duty of one shilling per ton on all coals exported from the Tyne for consumption in England.

This was redeemed in 1799 for an annuity of £19,000, which was afterwards redeemed for £633,333.

The conclusions of the committee were adverse to the continuance of such pensions, and after its report recommendations were adopted by the Government and outstanding hereditary pensions were gradually commuted.

PENSIONS: POLITICAL. In Great Britain, by the Political Offices Pensions Act, 1869, pensions were instituted for those who had held political office. For the purposes of the act political offices were divided into three classes: (1) those with a yearly salary of not less than £5,000; (2) those with a salary of less than £5,000 and not less than £2,000; (3) those with a salary of less than £2,000 and more than £1,000. For service in these offices there may be awarded pensions for life in the following scale: (1) a first class pension not exceeding £2,000 a year, in respect of not less than four years' service or its equivalent, in an office of the first class; (2) a second class pension not exceeding £1,200, in respect of service of not less than six years or its equivalent, in an office of the second class; (3) a third class pension not exceeding £800 a year, in respect of service of not less than ten years in an office of the third class.

The service need not be continuous, and the act makes provision for counting service in lower classes as a qualification for pension in a higher class. These pensions are limited in number to twelve, but a holder must not receive any other pension out of the public revenue; if so, he must inform the Treasury and surrender it if it exceeds his political pension, or if under he must deduct the amount. He may, however, hold office while a pensioner, but the pension is not payable during the time he holds office. To obtain a political pension, the applicant must file a declaration stating the grounds upon which he claims it and that his income from other sources is not sufficient to maintain his station in life. The act states that not more than one pension can be granted in the same year.

It should be added that the act has fallen into abeyance, and in 1928 no such pensions were being paid. The last recipient was Lord Chaplin, who died in 1923. Lord George Hamilton relinquished his pension in the same year.

PENSIONS: THE UNITED STATES. The soundness of a pension system depends principally on whether the system contains within itself the power of self-perpetuation and not on the nature of the organization nor the scale of the pension benefits. If financial provisions, scientifically calculated, will provide the pension payments as they fall due, the system is self-perpetuating, assuming an administration that adheres to its rules. This condition rarely exists except on a reserve basis, where enough is accumulated before the pension is granted to pay it during its entire existence. If a pension system is dependent upon casual collections or on a periodic vote of funds out of a corporation treasury, it does not contain within itself the element of perpetuity and is practically always on a cash disbursement basis where the resources are provided as the pension payments are actually made. When there is no question of the financial adequacy or the good faith of the organization, as in the case of governments, such a system is reliable.

The problem of the accrued liabilities must be recognized; it is the fact that during the past service of all members of a pension system, there has been no financial provision for that part of their pension represented by this past service. Either there must be a large sum paid down, or a proportionate loading of future financial provisions or a partial or total repudiation of such past service, if the pension system is not to start bankrupt. A rigid adherence to the rules on which the actuarial calculations were made is as essential as the calculations themselves. (M. SA.)

Military Pensions.—On Aug. 26, 1776, Congress offered pensions equal to half-pay to officers and men disabled in the Revolutionary War, with proportionate pensions in case of partial disability. For all following wars and the various Indian disturbances, pension laws of constantly expanding liberality for the soldiers, their widows and other relatives, have been passed. For each war, generally, first pensions on account of disability alone were passed, then pensions in case of dependence, and finally pensions based solely on service however short. Politics unavoidably figured largely in this pension legislation. Since 1861, outside of the liberal general acts, 69,254 cases were dealt with by special acts of Congress. In 1905 the pensioners exceeded 1,000,000. On June 30, 1927, there were 489,942 names on the pension rolls, of which 302,692 were the result of the Civil War. The total expenditure for the fiscal year ending June 30, 1927, was $230,152,712, of which $166,493,209 was for the Civil War, $57,232,828 for the War with Spain and the rest for a few survivors of earlier wars and for the regular establishment. The total expenditure for pensions, 1866–1927, was $7,397,053,627.09. From 1776 the total is $7,491,499,071.32.

War Risk Insurance Act.—This act became a law on Oct. 6, 1917, and provided allowances for the immediate dependents of those in the service, compensation for the soldier in the event of disability or for his dependents in case of death and war risk insurance providing benefits to the veteran during his permanent and total disability and to his relatives in the event of his death. No general pension laws were enacted. Insurance protection at a peace time rate was provided for every soldier, the hazard of war being borne by the United States. Upon application and without medical examination, insurance was granted against death or total permanent disability in any multiple of $500, and not less than $1,000 or more than $10,000. The beneficiaries were limited to a spouse, child, grandchild, parent, brother or sister or to any or all of them and during total permanent disability to the injured person. The benefits were payable in 240 equal monthly installments of $5.75 for each $1,000 of insurance. Benefits for total permanent disability were payable during total permanent disability without limitation as to the number of installments. This insurance was authorized at the net premium according to the American Experience Table of Mortality and interest at 3½% per annum, on the yearly renewable term basis, computed for payment monthly. Provision was made for the conversion of this term insurance into other forms of level premium insurance within five years after the date of the termination of the war, and for the termination of such insurance, unless converted, at the end of such period. This limitation date was later extended by law to include July 2, 1927. Within 15 months after the passage of the amendment, insurance had been granted to more than 4,500,000 applicants amounting to approximately $40,000,000,000. The liability incurred by the United States for losses under war risk insurance is approximately $1,500,000,000, while the total amount of premium received is less than $500,000,000. The monthly benefits payable will extend over a period of more than 20 years after the date of the termination of the war.

Converted insurance was provided on the net premium basis, the Government bearing the cost of administration and the extra losses resulting from the hazards of military and naval service. Converted insurance is participating, and benefits are made payable in one sum or other optional settlements elected by the insured. A recent amendment to this act removed all restrictions as to who may be designated as beneficiary under converted insurance. A large percentage of those in service never paid a premium on their insurance after discharge. At the present time (1929) approximately 650,000 veterans are insured under legal reserve policies in an aggregate amount of more than $3,000,000,000. This converted insurance is self-sustaining and dividends have been paid regularly to all policy holders. All the forms of relief, insurance and the care of veterans have been consolidated in the Veterans' Bureau. For the fiscal year ending June 30, 1927, the cost of this bureau was $405,348,447.70. Since April 6, 1917, the total cost of all such operations concerned with the World War has been $3,904,592,602.56. (G. E. I.)

Civil Service.—On May 22, 1920, Congress adopted a civil service pension plan. Retirement is permissible, after 15 years of service, at ages from 62 to 70, according to certain classifications of service. The amount of pension, depending upon length of service, ranges from 30% to 60% of the average basic salary of the employee during the last 10 years of service. There is a minimum, in any case, of $180 a year, and a maximum of $1,020 a year. The plan is financed by a deduction of 3½% from the

salaries of all Government employees, the Government being responsible for all that may otherwise be needed, including the accrued liabilities. There has been some demand for more liberal provisions by associations of civil service employees. A more adequate system exists in the Department of State for the permanent officers of the foreign service. The deduction from pay is 5% and the pensions are higher, a maximum pension of $5,400 being possible. The treasury will eventually have to pay the cost in excess of the contributions, and the accrued liabilities.

State and Municipal Pensions.—State and municipal pensions began with enabling acts of State legislatures permitting municipalities to establish pension plans for hazardous services, such as the police and fire departments, and later for the public school teachers. The public school teachers' plans have gradually become to a large extent State-wide and in a few instances comprehensive plans for all State employees have been adopted.

The earlier plans did not establish a balance between the revenue of the system and the pensions promised, covering the entire period of the plan's existence. Outside sources of income, which could bear no relation to the amount of the pensions and the longevity of pensioners, were important items of revenue, such as licences for carrying fire-arms, deductions for teachers' absences, etc. The New York City Police Pension Fund was the earliest one in force. In 1893 a contribution of 2% of salary was required. It bore no relation to the cost of the plan. It was, however, copied literally by cities over the entire country. Sometimes the contributions, such as an equal amount from each individual, were entirely unrelated to the pension. There was the common error of regarding a balance in the treasury, almost inevitable in the early years of even the worst constructed system, as a real surplus and therefore an evidence of solvency. (M. SA)

Teachers' Pensions.—Beginning with Chicago in 1893 and a State organization in New Jersey in 1896, half of the States now have comprehensive systems of teachers' pensions and in the others there are many city or county provisions that are developing toward State-wide systems. Where the teacher is wholly an officer of the Government, pensions are likely to be paid entirely by the State and to be closely related to rigid governmental control of training, certification, tenure and salary. Free pensions are considered, and properly, as partial compensation, but as such are generally valued too highly and this keeps salaries unduly low. Political pressure upon free pension systems has frequently resulted in arbitrary changes in regulations that have frustrated many hopes. Even more frequently friendly legislation has increased the privileges of free pension systems until their cost, which is rarely reckoned in advance, has become intolerable, promised privileges have been reduced, and entire pension systems have been modified or abandoned. Teachers' pensions, therefore, are now most generally provided in part by contributions from the teachers,—an arrangement that is ethically, socially and economically sound. As yet, however, the teacher's contribution rarely bears any precise relation to the benefits that are expected, it being still quite customary to decide that certain benefits are desirable, to require teachers to make modest contributions, and then to hope that the employing State or city or institution will provide the remainder of the cost, whatever it may be. The disappointment of such extravagant hopes, however, is developing an increasing agreement that the cost of pensions should be borne by equal contributions from the employing organization and the teacher, that pension provisions must be carefully related to the funds that are available, and that the carrying out of the plans shall be guaranteed by contracts between the system and each member. Less agreement exists that the contributions of the employer and the teacher should be made jointly, year by year, so as to accumulate throughout the teacher's service. There is, however, no other way of making certain that the prospective pension will be adequate and that the funds necessary to provide the pension will be available at the time of retirement.

Experience and enquiry agree that retiring allowances of approximately half of the active pay preceding retirement, together with pensions for widows of approximately half of the retiring allowances, provide reasonable comfort at a cost that is not too great for the teacher and the employer. The principle of half-pay, however, has been the occasion of many difficulties, on account of the necessity of estimating the pay over a period of many years, and adequately preparing for payment. The only safe application of the principle of half-pay is to estimate its cost from as many instances of completed and prospective service as are available, to fix deposits and contributions on this basis; usually as a percentage of salary, and then to promise pensions that are not a proportion of any series of future salaries but annuities than can be definitely provided for by contracts based on the deposits and contributions that are made, on a guaranteed rate of interest, and upon specified tables of mortality. Tables can then be provided by means of which any teacher can ascertain the amount accumulated by any deposit over any number of years, and the annuity that any accumulation will provide for a man or woman, beginning at any age, according to various options.

Retirement on the basis of age is ordinarily optional at 60 to 65 and compulsory at 70. A contractual contributory plan allows of greater adjustment to individual needs, the annuities being whatever the sums accumulated will provide at any age chosen for retirement. Contractual annuities also make possible choice of provisions for a member alone, for both himself and his widow, or for a return to his estate, should he die before receiving in annuity payment, the full accumulation to his credit at the time of retirement. When annuity accumulations are used for benefits other than those of retirement on the basis of age, about 50% is usually devoted to such age retirement, 30% to death benefits and 10% each for benefits in case of withdrawal or disability. Disability, withdrawal and death benefits reduce the benefits at retirement, but teachers appear to prefer the return of their accumulations in these cases, even though they must, in consequence, look forward to smaller allowances on retirement. Pensions for retirement on the ground of twenty, thirty or forty years of service, irrespective of age or disability are still common but rapidly disappearing. Such provisions injure the service by causing able people to retire early: they may extend retirement to a third or a half of a beneficiary's adult life, and they are so expensive that their cost has been known to approximate one-third of the entire salary budget.

Allowances in case of disability before the normal age of retirement are desirable, because of their relief of individual distress and the comfort produced by the removal of apprehension as to possible distress in case of disability. Statistics concerning the incidence and continuance of disability among teachers are, however, as yet so fragmentary and untrustworthy, that it is difficult to provide contractual protection against disability. Most pension systems, therefore, provide this protection wholly or largely at the cost of the employer, who is more able than the teacher to bear the variations of this load.

Teachers who withdraw from service before the normal age of retirement should, theoretically, continue to retain the benefit not only of their own deposits but also of the employer's contributions, and the interest accumulations of both. This is economically sound and facilitates desirable changes in teaching positions. In practice, however, the employer's contribution is rarely credited to the teacher who withdraws and his own deposits are sometimes returned without interest. Also for teachers who die in service before the normal age of retirement, only their deposits with interest are usually paid, sometimes with the proceeds of group life insurance provided by the employer.

For the administration of any pension plan it is customary to have a small board or committee, including the superintendent, principal or other educational head of the organization, together with two, four or six other persons, equally representing the employing organization and the teachers. It is desirable to specify that any factors in a pension plan can be modified as experience may suggest, by agreement between the teachers and the employing organization.

For university and college teachers the local pension plans of particular institutions and free pension plans, like that of the Carnegie Foundation, are being gradually superseded by comprehensive contributory contractual plans such as the Federated

Superannuation System of the English universities and, in the United States, the Teachers' Insurance and Annuity Association, which provide contractual annuities for the officers and teachers of some 200 universities, colleges and research institutions. (C. Fu.)

Industrial Pensions.—Among the earliest plans were those of the American Express Company (about 1875) and the Baltimore and Ohio Railroad (about 1884). The United States Steel Corporation was also among the first to establish a pension system.

Pensions for employees are now allowed by most railways, many large banks and some industrial organizations because of age or illness after service ranging upward of 15 years. There are probably not fewer than 500 industrial pension programmes. Very few of these were in operation before 1900, and probably less than 100 before 1910. Almost all began informally as older employees became incapacitated. Beginning as a sort of charity, pensions in industry are coming to be considered as the economical way to clear the rolls of the less efficient workers, and therefore as constituting a legitimate charge against production. This change of attitude has resulted in a change of business practice—an increasing number of industries now setting up annually during the active life of the workers a reserve out of which to provide pensions payable in the future. There is an increasing tendency to permit or require the payment of a part of the cost by the employees through contribution generally made by deduction from pay. The usual contribution is from 2 to 5%, depending on the amount and nature of the benefits granted. In most places the employee's contribution is returned on leaving the service.

The customary pension age is from 60 to 70, usually 5 years lower for women than for men. The amount of pension is generally based on a percentage of the average salary received over a given period of service; sometimes the period over which the average is calculated is as short as three years, but the tendency is to lengthen the period and in the most modern plans, to cover the entire period of service. In view of the fact that pensions when paid constitute life annuities, there is also a tendency to employ the service of life insurance companies in the administration of pension schemes. (I. K.)

Church Pensions.—The Protestant Episcopal Church was the first organization in America, according to the *Journal of the International Congress of Actuaries*, to establish a pension system after actuarial calculations. It was planned in 1912, and incorporated in 1914, being placed under State insurance supervision. This was an innovation in English-speaking countries. In 1916, the church under the leadership of William Lawrence, bishop of Massachusetts, raised $8,750,000 to carry the accrued liabilities up to the extent of a $600 a year pension for every clergyman in service when its pension system became operative on March 1, 1917. Thereafter the pension system is carried by every Protestant Episcopal Church paying an equivalent of 7½% of the salary paid to the clergy. The assets of the Church Pension Fund in 1928 were approximately $25,000,000. The Presbyterian Church in the U.S.A. (North) raised in 1928 the sum of $15,000,000 for the accrued liabilities of their pension system and requires each congregation to pay 7½% on salaries and the ministers to pay 2½%. Its system is working successfully. The Congregational Churches have a "Pilgrim Memorial Fund" of $5,000,000, the interest of which helps to pay the 6% contributions on the salaries of those ministers who join; the church is supposed to pay one-half. Other churches, such as the Disciples of Christ and the Methodist Episcopal Church, are at work on similar enterprises. There are still denominations which have not advanced beyond the plan of "ministerial relief" or are still depending on endowed pensions.

Old Age Pensions.—Old age pensions are in operation in Alaska (at 65, after 10 years' residence); in Montana (at 70, after 15 years' residence for those with incomes below $300 a year); and in Wisconsin (at 70, after 15 years' residence, with property below $3,000). Colorado, Kentucky, Maryland and Nevada have passed similar acts, but the counties, which alone have authority to put such legislation in force, have not done so. The State courts declared unconstitutional such old age pension laws in Arizona and Pennsylvania. (M. Sa.)

Mothers' Pensions.—The term "mothers' pensions" is popularly applied to the plan by which mothers of dependent children receive financial assistance from public authority to enable them to keep their children with them in their own homes, avoiding the necessity for institutional care. Laws providing such assistance or "pensions" are to be found on the statute books of more than 40 States in the Union and such legislation seems likely to become universal throughout the country. Missouri and Illinois were the first States to pass legislation of this character, both States enacting statutes in the year 1911. The Missouri law at first applied only to one community within the State—Kansas City—while the Illinois statute was of State-wide application. In the beginning, assistance to mothers was generally limited to widows and a few States still adhere to that limitation, notably Connecticut, Maryland, New Jersey, Texas and Utah. The tendency has been, however, to include mothers, whether widows or not, whose children were dependent for a variety of reasons: where the mother is deserted or divorced, or where the husband and father is physically or mentally incapacitated or imprisoned. In Michigan, Nebraska and Tennessee the mother of an illegitimate child may be eligible for assistance, but this is not the general rule.

In order to establish the dependency of the children it must appear that the mother, as well as the father, is incapable of caring for them without assistance. The usual provision is that a mother is ineligible if she has personal or real property of a value in excess of a prescribed amount. Also the mother must be of good moral character, capable of giving good care and her home must be a suitable one for the child. The aid may be granted until the child reaches the age of 16 years, although a few States have a slightly higher or lower age limit. There is considerable variety in the provisions of the laws of the various States regarding the amounts of money which may be granted to the mother for her children. The maximum which could be granted to a family with three children varies from $30 a month in certain jurisdictions to $70 in others.

The administration of mothers' pensions is carried on under different methods in different States. The juvenile court is the administering agency in 20 jurisdictions. In other States the public board of the county, town or city which administers poor relief in general also administers mothers' pensions. This has not usually been as successful, because mothers are not to be regarded as supplicants for public relief but as co-operating with the public authorities in the rearing of future citizens. A third form of administration is through specially created county boards. These boards are usually made up of citizens of the county who serve without compensation. Such boards may or may not have paid assistants and usually there is some form of State supervision. Such is the law in Pennsylvania, Delaware and New York.

It has been estimated that while there are approximately 400,000 children in the United States who would be eligible for assistance under these laws if they were fully applied, in all probability not more than 130,000 are actually receiving public aid at any given time. It is evident that much remains to be done in the United States to improve administrative methods and to establish the high purpose of this beneficent legislation. (W. Ho.)

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PENSIONS, WAR: *see* War Pensions.

PENTAMETER, a line consisting of the first colon of a hexameter (*q.v.*) with penthemimeral masculine caesura (*see* Caesura) twice repeated, thus:—

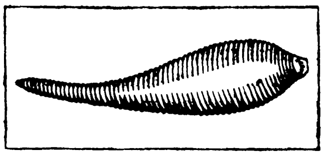
— ⏑⏑ — ⏑⏑ — || — ⏑ ⏑ — ⏑ ⏑ —
No—but a |most bur|lesque| barbarous| experi|ment

Its name (Gr., "five-measure") seems to be derived from the fact that it can be scanned, very artificially, as five feet,

– ⏑ ⏑ | – ⏑ ⏑ | – – | ⏑ ⏑ – | ⏑ ⏑ –.

The second half must always consist of dactyls, but spondees are allowed in the first half, as shown above. Diaeresis must occur at the end of the first half (*see* CAESURA). In Latin, Ovid and his followers, and to a less extent Tibullus and Propertius, introduce numerous minute refinements, unknown in Greek. The pentameter is seldom found without the hexameter, following which it makes an elegiac couplet. This is used for all manner of subjects, but somehow got the reputation (*see* OVID, *Amores* III. 9, 4) of being a melancholy metre, and its name was absurdly derived from Gr. *e e lege*, "Say, alas, alas," *see* Suidas, *s.v. elegos*. Hence the modern sense of *elegy* (*q.v.*).

PENTASTOMIDA, also called Linguatulida, a group of parasitic animals of uncertain systematic position but sometimes regarded as degenerate Arachnida (*q.v.*) of the order Acari. The body is worm-like, unsegmented, but superficially annulated, the alimentary canal traverses it from end to end, and close to the mouth, which is encircled by a horny ring, are two pairs of horny hooks. There are no special organs of respiration or circulation and the nervous system consists of a collar round the oesophagus and a pair of ventral strands. The sexes are distinct, the females are oviparous and the generative orifice in the males of all species and in the females of one genus, *Reighardia,* opens upon the ventral surface of the fore part of the body, whereas in the females of the others it is close to the anus.



WORM-LIKE PENTASTOMID (LINGUATULA SERRATA), A NOSE PARASITE OF DOGS

There are three well marked types:—*Reighardia,* which has the genital orifice of both sexes opening anteriorly and the hooks behind the mouth, is regarded as the representative of a special family, Reighardiidae. Only one species is known, namely, *R. sternae,* a parasite of terns and sea-gulls. Much better known are *Linguatula* (*Pentastomum*) and *Porocephalus* (*Armillifer*) assigned to the family Linguatulidae or Porocephalidae, which is characterised by the posterior position of the genital orifice in the females and the situation of the hooks nearly level with the mouth.

Both these forms are of pathogenic importance to man. *Linguatula serrata* (*Pentastomum taenioides*) is comparatively broad and flat and finely annulated. The male is less than an inch long, the female considerably larger. When mature they live in the nasal cavities of dogs, wolves or foxes, and the ova, discharged in mucous secretion upon vegetation, may be swallowed by hares, rabbits, domesticated animals or man. The larvae, upon hatching in the stomachs of these intermediate hosts, make their way to the liver, kidneys, lungs or other visceral organs, there to remain encysted until the host is devoured by the canine carnivore into whose nasal chambers they pass to become adult and breed. The parasitic cycle is thus very like that of tape-worms.

Porocephalus (*Armillifer*) *armillatus,* larger than *Linguatula,* has the body cylindrical and marked by a series of upstanding, thick, rick-like ridges. The parasitic cycle is similar to that of *Linguatula,* but the hosts are different. The adults infest the lungs of African snakes, pythons (*P. regius* and *P. sebae*) and Puff adders (*Bitis nasicornis*). The eggs, disseminated by these reptiles, are taken up in water or vegetable food by a great variety of animals, by negroes, monkeys, ungulates, hedgehogs and even lions and leopards, in whose viscera the immature forms have been found encysted. Infection of the lungs or other important internal organs in man by this parasite may be followed by serious pathological results. (R. I. P.)

PENTATEUCH, the Greek name corresponding to the Jewish חמשה חומשי תורה (the five-fifths of the Torah, or Law), and applied to the first five books of the Old Testament (Genesis, Exodus, Leviticus, Numbers, Deuteronomy). The Pentateuch, together with Joshua, Judges and Ruth, with which it is usually united in Greek mss., makes up the Octateuch; the Pentateuch and Joshua together have recently been named the Hexateuch. *See* BIBLE and the articles on the several books.

PENTECOST, a feast of the Jews, is celebrated on the 50th day after the Passover (hence its name "Pentecost," a Greek word meaning "fiftieth"), and now on the following day also, *i.e.,* Sivan 6 and 7. In the Bible, where a festival of one day only is referred to, it is described as "the feast of Harvest" (Ex. xxiii. 16), and "the day of the First-Fruits" (Num. xxviii. 26). It really marked the close of the grain-harvest which in Palestine lasted seven weeks (from Passover to Pentecost). Hence the name Feast of Weeks.

The agricultural character of this feast clearly reveals its Canaanite origin (*see* HEBREW RELIGION). It does not, however, rank equal in importance with the other two agricultural festivals of pre-exilian Israel, viz., the *Maṣṣōth* or feast of unleavened cakes (which marked the beginning of the corn harvest), and the *Asiph* ("ingathering" later called *succōth,* "booths") which marked the close of all the year's ingathering of vegetable products. This is clear in the ideal scheme of Ezekiel (xlv. 21 *seq.*) in which, according to the original text, Pentecost is omitted (*see* Cornill's revised text and his note *ad loc.*). It is a later hand that has inscribed a reference to the "feast of weeks" which is found in our Massoretic Hebrew text. Nevertheless occasional allusions to this feast, though secondary, are to be found in Hebrew literature, *e.g.,* Isa. ix. 3 and Ps. iv. 7. In the earliest codes, viz., Ex. xxiii. 16 (Elohist) and in Ex. xxxiv. 22 (Yahwist), no explicit statement about the time of celebration is given; but in Deut. xvi. 9 the time is defined as an interval of seven weeks from the beginning of the corn-harvest at the end of which the feast was celebrated. For the later elaboration of sacrifices and ritual, *see* Lev. xxiii. 10–21, Num. xxviii. 26 *seq.*

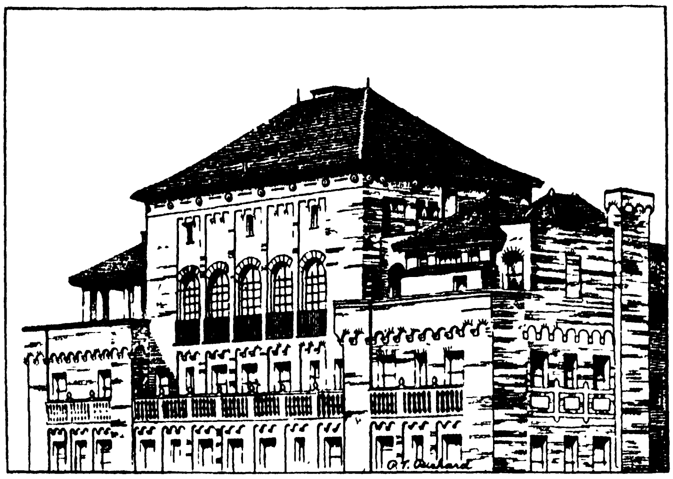
See further SADDUCEES and compare generally the article "Pentecost" in D. B. Hastings, *Ency. Bib.* and *Jew. Enc.* (G. H. B.)

PENTELICUS (Βριλησσός, or Πεντελικὸν ὄρος from the deme Πεντέλη; mod. Mendeli), a mountain north-east of the Athenian plain, height 3,640 ft. Its white marble was not regularly worked until after the Persian wars; later all the chief buildings and sculptures of Athens were constructed of it. The ancient quarries are mostly on the south side; the modern quarries on the north side. There was a statue of Athena on the mountain.

PENTHEUS, son of Agāvē, daughter of Cadmus. For his legend, *see* DIONYSUS.

PENTHIÈVRE, COUNTS OF. In the 11th and 12th centuries the countship of Penthièvre in Brittany (dep. of Côtes-du-Nord) belonged to a branch of the sovereign house of Brittany. Henry d'Avaugour, heir of this dynasty, was dispossessed of the countship in 1235 by the duke of Brittany, Pierre Mauclerc, who gave it as dowry to his daughter, Yolande, on her marriage in 1238 to Hugh of Lusignan, count of La Marche. Duke John I. of Brittany, Yolande's brother, seized the countship on her death in 1272. In 1337 Joan of Brittany brought Penthièvre to her husband, Charles de Châtillon-Blois. In 1437 Nicole de Blois, a descendant of this family, married Jean de Brosse, and was deprived of Penthièvre by the duke of Brittany, Francis II., in 1465. The countship, which was restored to Sebastian of Luxemburg, heir of the Brosses through his mother, was erected for him into a duchy in the peerage of France (*duché-pairie*) in 1569, and was afterwards held by the duchess of Mercoeur, daughter of the first duke of Penthièvre, and then by her daughter, the duchess of Vendôme. The duchess of Vendôme's grandson, Louis Joseph, inherited Penthièvre in 1669, but it was taken from him by decree in 1687 and adjudged to Anne Marie de Bourbon, princess of Conti. In 1696 it was sold to the count of Toulouse, whose son was called duke of Penthièvre. This title finally passed to the house of Orleans.

PENTHOUSE, originally any subsidiary or added structure attached to a larger building and covered by a roof sloping down in one slope away from the main wall of the building; also any bracketed, sloping roof projecting from the wall of a building to give shelter to a door, window or outside stair. In modern usage the term is applied especially to any subsidiary roof construction,



BY COURTESY OF THE "ARCHITECTURAL FORUM"

UPPER PART OF THE ALLERTON HOUSE, NEW YORK CITY, ILLUSTRATING ONE OF THE TYPES OF PENTHOUSE (ARTHUR LOOMIS HARMON, ARCHITECT)

and in particular to structures built above the main roof line and recessed behind the exterior wall line, to house water tanks, elevator machinery and occasionally living quarters.

PENTLANDITE. This mineral, whose composition is usually given as (Fe,Ni)S, is probably a solid solution of pyrrhotite and millerite, although it is said to crystallize in the cubic system. It has a bronzy-yellow metallic lustre and is not magnetic like pyrrhotite. It is found intimately associated with nickeliferous pyrrhotite at Sudbury, Ontario, and may contain as much as 20% of nickel.

PENTSTEMON, in botany, a genus of plants (family Scrophulariaceae), comprising about 150 species, chiefly natives of North America, with showy open-tubular flowers. Noteworthy species are *P. laevigatus* (smooth beard-tongue), *P. Digitalis* (foxglove beard-tongue), and *P. hirsutus* (hairy beard-tongue), of the eastern and southern States; *P. alpina* (alpine beard-tongue), *P. cyananthus* (blue beard-tongue), and *P. barbatus* (bearded pentstemon), of the Rocky Mountain region, and *P. antirrhinoides* (snapdragon beard-tongue), *P. diffusus* (spreading beard-tongue), and *P. centranthifolius* (scarlet bugler), of the Pacific States; these and various others are more or less cultivated. The pentstemon of the florist has, however, sprung from *P. Hartwegii,* of Mexico, and *P. Cobaea,* of the south-western United States, and possibly some others. The plants endure English winters unharmed in favoured situations. They are freely multiplied by cuttings, selected from the young side shoots, planted early in September, and kept in a close cold frame till rooted. They winter safely in cold frames, protected by mats or litter during frost. They produce seed freely, new kinds being obtained by that means.

PENUMBRA (Lat. *paene,* almost, *umbra,* a shadow), in astronomy, the partial shadow of a heavenly body as cast by the sun. It is defined by the region in which the light of the sun is partially but not wholly cut off through the interception of a dark body. *See* ECLIPSE.

PENUTIAN, a North American Indian language family, constituted by Dixon and Kroeber (*Univ. Calif. Publ. Am. Arch. Ethn.,* vol. xvi., 1919) by the union of five stocks previously considered distinct. These five are Maidu (*q.v.*), east of Sacramento river, California; Wintun, including Patwin, to the west; Costano, San Francisco and Monterey bays; Miwok, central Sierra Nevada; Yokuts, San Joaquin valley. The area occupied approximates closely to the drainage of the great interior valley of California. The population, estimated at above 50,000 in 1770, had shrunk to 3,500 in 1910. The name Penutian is artificial, being a composite of the stems for the numeral word "two" in two branches of the family: *pen,* in Maidu, Wintun, Yokuts, and *uti* in Costano and Miwok. The unity of the family has not been considered proved by all authorities, but according to E. Sapir various native languages north of California, such as Kus, Takelma, Kalapuya, Chinook (*q.v.*), Tsimshian (*q.v.*), would be genetically related.

PENZA, a province of the Russian S.F.S.R., surrounded by those of Saratov, Tambov, Ryazan, Nizhegorod and Ulianovsk. Area 45,903 sq.km. Pop. (1926) 2,207,668. The province forms part of the Central Russian plateau, here reaching a height of 900 ft. It is deeply dissected by rivers, the chief being the Moksha, flowing north to the Oka, the Sura to the Volga, and the Khoper flowing south to the Don. The Moksha and Sura are navigable and other streams are available for floating timber. Patches of forest occur in the west, and also to the east of the Sura river, but are insufficient for local timber needs, most of which are supplied by timber floated down the rivers from the north. Of the land favourable for cultivation, 82·2% is used and agriculture is the main occupation. Marshes exist in the Krasnoslobodsk district, and sandy stretches along the rivers, but there is much fertile black earth.

The climate is severe, with five months of frost, a brief and hot summer, and a rainfall averaging 16–18 inches. The traditional three field system and primitive implements are obstacles to agriculture, and the low literacy rate, 24·4%, makes progress difficult. Winter rye and oats are the chief crops, lentils are produced for export, and peas, sunflower seed, potatoes, beetroot, fruit and vegetables are successfully grown. Efforts are being made to introduce maize cultivation and to discourage the sowing of buckwheat, because of its variable yield. Sheep, dairy and working cattle, pigs and horses are bred, the sheep providing wool for the felt and woollen industry and fat for tallow. Factory industries include saw-milling, paper and match manufactures, and woollen cloth, felt, glass, leather, tobacco and oil pressing works. There is a comparatively good railway net, but the only town with a population of over 16,000 is Penza (*q.v.*). There are Great Russians, Tatars, Mordvinians and Mescheryaks among its mixed population, and the north was mainly settled by refugee Raskolniks (Dissenters).

PENZA, the chief town of the above province, situated at the confluence of the Penza with the navigable Sura, in 53° 12′ N., 44° 59′ E. Pop. (1926) 91,151. The town has saw-mills and paper and match factories, and its position at the intersection of north to south and east to west railways, and on a navigable river has made it an important trading centre for corn, timber and the products of sheep and cattle raising. It dates from the 17th century and was captured by Pugachev in 1776. It has several times been destroyed by fire.

PENZANCE, town and seaport, in St. Ives parliamentary division, Cornwall, England, the terminus of the G.W.R., 325½ m. W.S.W. of London. Pop. (1921) 12,087. It is on Mount's Bay, opposite St. Michael's Mount, being the westernmost port in England. The site of the old town slopes upward from the harbour, to the west of which there extends an esplanade and modern residential quarter. The harbour has an area of 24 ac., with 17 to 21 ft. depth, and floating and graving docks. There is a large export trade in fish. Other exports are tin and copper, granite, serpentine, vegetables and china clay. Imports are principally coal, iron and timber. Great quantities of early potatoes and vegetables, together with flowers and fish, are sent to London and elsewhere. Nearly two miles inland to the north-west is Madron (pop. 3,277). The church of St. Maddern is principally Perpendicular, with earlier portions and a Norman front. There is also a "wishing well" and the ruins of a baptistry both of extreme antiquity. Megaliths are not uncommon. Three miles north-east is Ludgvan (pop. 2,052), and to the south Paul (5,398), which includes the village of Newlyn.

Penzance (Pensans) was recognized as a port in 1512 by Henry VII., but its importance as a fishing village dates from the 14th century. During the war with Spain the town was devastated in 1595. The charter of incorporation was granted in 1614, after the town had been rebuilt and a pier erected. In 1663 Penzance was constituted a coinage town for tin.

The public buildings include a library, museum, mining and science schools, the West Cornwall infirmary and a meteorological station.

PEONAGE, a form of involuntary servitude which developed in Mexico. It prevailed extensively in Yucatán and especially in

the Valle Nacional, where cheap labour was required in the cultivation of tobacco. The beginning of peonage, however, has been traced as far back as the conquest of Mexico by the Spaniards. Early in the history of Mexico the conquerors worked out a scheme by which the poor, especially the Indians, could be forced to do the work of the planters and mine operators. The word *peon* became synonymous with the English word labourer, but it later was restricted in its meaning to those labourers who were compelled to serve their creditors to pay debts which by contract they had pledged themselves to pay in labour. Although the 13th amendment and legislation of the U S. Government prohibited any such involuntary servitude in that country, the former slave-holding States devised certain legislation, following emancipation, which might make labour compulsory. Under these State laws employers deceived ignorant men by inducing them to sign contracts for labour in payment of debts, and those who might pay fines imposed by the courts to sign other similar contracts.

For a number of years peonage continued in the United States without any one directing much attention to it because it was practised in those sequestered parts where negroes were not enlightened and where the majority of the planters raised no objection. Such practices were authorized by special laws in certain Southern States, and public opinion permitted the practice when there were no laws specifically providing for it. The laws penalized failure to comply with contracts for employment, enticement of labourers from their employers, violation of a contract with a surety who had paid the fine of a misdemeanour, acts of vagrancy, and the operations of emigrant agents. The laws of few States contained similar clauses binding those who rented land on shares.

In rural districts far removed from the populous centres the chain gang system of forced labour under the pretence of farming out the services of misdemeanants or penal offenders developed into great injustices. A number of cases were brought to light in 1902 and 1903, and the offenders were tried. The jury, however, failed to convict The practice of leasing short-term prisoners, both blacks and whites, to managers of labour camps has continued in a few of the Southern States.

Bibliography.—*The Outlook*, lxiv, p. 391, 687, lxxxvii., p. 319; *Cosmopolitan*, xxxix., 423, xlii., 481; *The Independent*, lvi., 409; *Colliers*, xliii., 26; *Nineteenth Century Magazine*, lxii., 306; *American Magazine*, lxviii., 526, lxix., 250; *The Nation*, lxxxii., 379, lxxxv., 557; U.S. Labor Bur. *Bull* vii., 27; L. M. Hershaw, *Peonage* (1915), *Bailey* v. *Alabama*, 219 U.S. 210; *United States* v. *Reynolds* and *United States* v. *Broughton*, 235 U.S. 133. (C. G. W.)

PEORIA, a city of north-central Illinois, U S A , on the Illinois river where it widens to form Lake Peoria, midway between Chicago and Saint Louis; a port of entry and the county seat of Peoria county. It has a municipal airport and is a station on the Chicago-to-Gulf airway; is on Federal highways 24 and 124; and is served by the Big Four, the Burlington Route, the Chicago and Alton, the Chicago and Illinois Midland, the Chicago and North Western, the Illinois Central, the Illinois Traction (electric), the Minneapolis and St. Louis, the Pennsylvania, the Nickel Plate, the Peoria and Pekin Union, the Peoria Terminal, the Rock Island, and the Toledo, Peoria and Western railways; and by river steamboats and motor-bus and truck lines. Pop. (1920) 76,121, 87% native white; estimated by the Census Bureau at 84,500 in 1928. The local estimate for 1928, including contiguous suburbs, was 108,500. The city extends for 8 m. along the river (6,000 ft. across at its widest point) and has an area of 11·5 square miles. The commercial and industrial districts lie on a plain running back 200–5,000 ft. from the river to bluffs 200–400 ft. high, occupied by the residential sections. Peoria lake, the adjacent reaches of the river, its tributary brooks, the wooded bluffs, canyons and waterfalls, provide beautiful scenery in and about the city. The public parks cover 1,450 acres. At the western edge of the city is the 25 ac. campus of Bradley Polytechnic Institute, a co-educational college of arts and sciences (including a school of Horology), founded in 1896 by Mrs. Lydia Bradley, and endowed by her with $2,000,000. There are 3 high and 30 elementary public schools, and 8 parochial schools.

In the heart of the corn belt and of a vast coal-field, with deposits of sand, gravel and gypsum in the immediate vicinity, the centre of a network of railroads and highways, and on the waterway from the Great Lakes to the Gulf, Peoria is a great shipping and distributing point, has a large wholesale and retail trade, and has developed important manufacturing industries. The wholesale and jobbing business is estimated at $30,000,000 annually. The output of the 350 plants in and near the city in 1927 was valued at $212,000,000. Among the principal products are commercial solvents, washing machines, tractors, agricultural implements, furnaces, oil burners, stock feeds and corn products. In the village of East Peoria (pop. 1920, 2,214) is the plant which produced the "caterpillar" tanks used in the World War (now used for farm tractors). The first successful gasolene motor-boat was launched on Lake Peoria; and in the experiment shop of Charles E. Duryea was built the first practicable gasolene engine in the United States. Before the adoption of national prohibition the manufacture of distilled liquors was the city's principal industry. Peoria is the headquarters of the National Swine Show and ships large quantities of fish. The city's assessed valuation of property for 1927 was $88,722,802.

Peoria was named after one of the five tribes of the Illinois Indians. In 1680 La Salle built Ft. Crèvecoeur on the bluffs opposite the present city, but it was destroyed and deserted within the year. A French mission was probably established in the vicinity as early as 1711; and by 1725 there was a settlement of French and half-breeds known by the name of Peoria on the west shore of the lake. This village was abandoned during the Revolution, but another had been founded about 1778, on the present site, by Jean Baptiste Maillet, and was called by his name. In Nov. 1812, about half the town was burned by a company of Illinois militia, sent to build a fort, who alleged that the villagers had fired on their boats. In 1813 Ft. Clark was erected on the site of the old village. It was evacuated in 1818 and soon afterwards was destroyed by the Indians. Peoria was incorporated as a town in 1835 and chartered as a city in 1845. In 1850 it had a population of 5,095. In 1880, and at each succeeding Federal census, it has ranked first among the cities of the State after Chicago.

PEPE, GUGLIELMO (1783–1855), Neapolitan general, born at Squillace in Calabria, took part in 1799 in the republican movement at Naples inspired by the French Revolution; he fought against the Bourbon troops under Cardinal Ruffo, was captured and exiled to France. He entered Napoleon's army and served first under Joseph Bonaparte and later under Joachim Murat. After commanding a Neapolitan brigade in the Peninsular campaign, Pepe returned to Italy in 1813, with the rank of general, to help to reorganize the Neapolitan army. When the news of the fall of Napoleon (1814) reached Italy Pepe and other generals demanded from Murat a constitution. On Napoleon's escape from Elba (1815) Pepe served on Murat's staff in the campaign of 1815. The Neapolitan officers retained their rank under Ferdinand IV. (*q.v.*) who now regained the throne of Naples. While engaged in suppressing brigandage in the Capitanata, Pepe organized the carbonari (*q.v.*) into a national militia, and was preparing to use them for political purposes. He had hoped that the king would grant a constitution, but when that hope failed he meditated seizing Ferdinand, the emperor of Austria, and Metternich, who were expected at Avellino, and thus compelling them to liberate Italy (1819). The scheme broke down, but in 1820 a military revolt broke out. Pepe was sent against the rebels, but while he was hesitating as to what course he should follow Ferdinand promised a constitution (July 1820). A revolt in Sicily having been repressed, Pepe was appointed inspector-general of the army. In the meanwhile the king, who had no intention of respecting the constitution, obtained the loan of an Austrian army with which to restore absolute power. Pepe now took command of the army and marched against the Austrians. He attacked them at Rieti (March 7, 1821), but his raw levies were repulsed. The army was gradually disbanded, and Pepe went into exile, keeping up his connection with the carbonari. In 1848 Pepe returned to Naples, where a constitution had again been proclaimed. He was given

command of the Neapolitan army which was to co-operate with Piedmont against the Austrians, but when he reached Bologna the king recalled him and his troops. Pepe resigned his commission in the Neapolitan service, and crossed the Po with 2,000 volunteers to take part in the campaign. He joined Manin in Venice and took command of the defending army. On the fall of Venice, Pepe and Manin were among those excluded from the amnesty; he again went into exile and died in Turin in 1855.

The story of Pepe's life down to 1846 is told in his own interesting *Memorie* (Lugano, 1847), and his *Narrative of the Events . . . at Naples in 1820 and 1821* (London, 1821); for the later period of his life *see* the general histories of the Risorgimento, and the biographical sketch in vol. ii. of L. Carpi's *Risorgimento* (Milan, 1886)

PEPERINO, an Italian name applied to a brown or grey volcanic tuff, containing fragments of basalt and limestone, with disseminated crystals of augite, mica, magnetite, leucite, etc The typical peperino occurs in the Alban Hills, near Rome, and was used by the ancients, under the name of lapis albanus, as a building stone and for the basins of fountains Other tuffs and conglomerates in Auvergne and elsewhere are also called peperino The name originally referred to the dark coloured inclusions, suggestive of pepper-corns In English the word has sometimes been written peperine

PEPO, the typical fruit of the plants of the gourd family (Cucurbitaceae) consisting of a large, fleshy, berry-like structure with a tough rind and a spongy seedy interior, as in the pumpkin, squash, melon and cucumber (*See* CUCURBITACEAE)

PEPPER, WILLIAM (1843–1898), American physician, was born in Philadelphia on Aug 21, 1843 He was educated at the University of Pennsylvania, graduating from the academic department in 1862 and from the medical department in 1864 In 1868 he became lecturer on morbid anatomy in the same institution and in 1870 lecturer on clinical medicine From 1876 to 1887

FROM BAILLON HISTOIRE DES PLANTES' (H BONNAIRE)

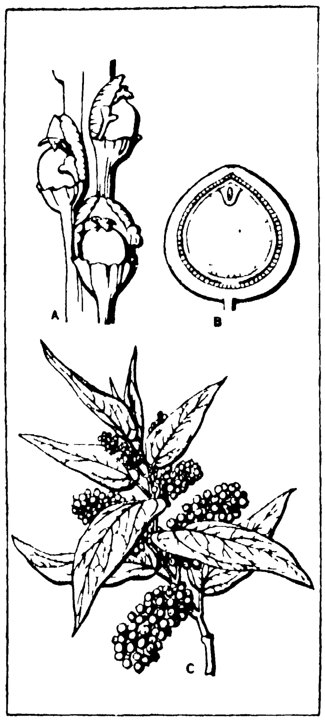
FRUITING BRANCH OF BLACK PEPPER (PIPER NIGRUM)

For black pepper-corns, the berries are gathered before ripe and dried; for white pepper, the outside layer of fruit is removed by maceration

he was professor of clinical medicine, and in 1887 succeeded Dr. Alfred Stillé as professor of theory and practice of medicine. He was elected provost of the university in 1881, resigning in 1894 He is best known for his *System of Medicine* (1885–86). He died on July 28, 1898, at Pleasanton (Calif).

PEPPER, a name applied to several pungent spices known respectively as black, white, long, red or cayenne, Ashanti, Jamaica and melegueta pepper, but derived from at least three different natural orders of plants

Black pepper is the dried fruit of *Piper nigrum* (family Piperaceae), a perennial climbing shrub indigenous to the forests of Travancore and Malabar, from whence it has been introduced into Java, Sumatra, Borneo, the Malay peninsula, Siam, the Philippines and the West Indies It climbs on tree-trunks by roots in the same way as ivy, and from its climbing habit is known as the pepper vine It is one of the earliest spices known to mankind, and for many ages formed a staple article of commerce between India and Europe. Tribute has been levied in pepper; one of the articles demanded in 408 by Alaric as part of the ransom of Rome was 3,000 lb of pepper, and its exorbitant price during the middle ages was one of the inducements which led the Portuguese to seek a sea-route to India. The discovery of the passage round the Cape of Good Hope led (1498) to a considerable fall in the price Pepper remained a monopoly of the Portuguese crown as late as the 18th century. In Great Britain it was formerly taxed very heavily, the impost in 1623 amounting to 5s , and as late as 1823 to 2s 6d per pound.



FROM BAILLON, "HISTOIRE DES PLANTES" (H BONNAIRE)

A HERMAPHRODITE FLOWERS OF BLACK PEPPER (PIPER NIGRUM) B LONGITUDINAL SECTION THROUGH FRUIT OF BLACK PEPPER C FRUITING BRANCH OF THE CUBEBS PEPPER (PIPER CUBEBA)

The largest quantities of pepper are produced in Penang, the island of Riouw and Johore near Singapore. Singapore is the great emporium for this spice in the East, the largest proportion being shipped thence to Great Britain. The varieties of black pepper met with in commerce are known as Malabar, Aleppy or Tellicherry, Cochin, Penang, Singapore and Siam

Pepper owes its pungency to a resin, and its flavour to a volatile oil, of which it yields from 1 6 to 2 2%, it also contains a yellow crystalline alkaloid, called piperine, to the extent of 2 to 8%, which has the same empirical formula as morphine, $C_{17}H_{19}NO_3$, but differs in constitution and properties The only use of black pepper is as a condiment

White pepper differs from black only in being prepared from the ripe fruits These, after collection, are kept in the house three days and then bruised and washed in a basket with the hand until the stalks and pulpy matter are removed, after which the seeds are dried It is, however, sometimes prepared from the dried black pepper by removing the dark outer layer It is less pungent than the black but possesses a finer flavour.

Long pepper is the fruit-spike of *Piper officinarum* and *P longum,* gathered shortly before it reaches maturity, and dried The former is a native of the Indian archipelago; the latter is indigenous in the hotter provinces of India, Ceylon, Malacca and the Malay islands

Ashanti or *West African pepper* is the dried fruit of *Piper Clusii*, a plant widely distributed in tropical Africa, occurring most abundantly in the country of the Niam-niam It differs from black pepper in being rather smaller, less wrinkled, and in being attenuated into a stalk, like cubebs (the dried unripe fruits of *P Cubeba*), to which it bears considerable resemblance externally The taste, however, is pungent, exactly like that of pepper, and the fruit contains piperine It was imported from the Grain Coast by the merchants of Rouen and Dieppe as early as 1364 and was exported from Benin by the Portuguese in 1485 In tropical Africa it is extensively used as a condiment.

Melegueta pepper, known also as "Guinea grains," "grains of paradise" (*q v*) or "alligator pepper," is the seed of *Amomum Melegueta,* a plant of the ginger family (*See* also CAYENNE PEPPER.)

PEPPER-CORN, the fruit or seed of the pepper plant, hence anything very small or insignificant. Pepper-corn rent is a merely nominal rent, reserved for the purpose of having the tenancy acknowledged by the tenant. Building leases frequently reserve a pepper-corn as rent for the first few years. (*See* RENT.)

PEPPER-GRASS, a name given, especially in the United States, to certain species of *Lepidium* (family Cruciferae), which are widely spread as weeds. They are erect, annual herbs with freely branching stems, about ½ to 1½ ft. high, small, toothed or deeply cut leaves, minute white flowers, followed by elongated, cylindrical clusters of small, short-stalked, flattened, nearly round, slightly notched pods. Examples are the wild pepper-grass (*L. virginianum*), with mostly undivided leaves, found in fields from Quebec to Minnesota and southward to Mexico and the West Indies, and also naturalized in southern Europe, and the roadside pepper-grass (*L. ruderale*), with narrowly divided leaves, native to Europe but now naturalized from Nova Scotia to Texas, and occurring also in Australia.

PEPPERMINT, an indigenous perennial herb of the family Labiatae, and genus *Mentha* (*see* MINT), the specific name being *Mentha piperita,* is distinguished from other species of the genus by its stalked leaves and oblong-obtuse spike-like heads of flowers. It is met with, near streams and in wet places, in several parts of England and on the European continent, where—as also in the United States—it is cultivated for the sake of its essential oil. It was, however, only recognized as a distinct species late in the 17th century, when Dr. Eales discovered it in Hertfordshire and pointed it out to Ray, who published it in the second edition of his *Synopsis stirpium britannicarum* (1696). The medicinal properties of the plant were speedily recognized and it was admitted into the *London Pharmacopoeia* in 1721, under the name of *Mentha piperitis sapore.*

Two varieties are recognized by growers, the white and the black mint. The former has purplish and the latter green stems; the leaves are more coarsely serrated in the white. The black is more generally cultivated, probably because it is found to yield more oil, but that of the white variety is considered to have a more delicate odour, and obtains a higher price. The white is the kind chiefly dried for herbalists. When pure the oil is nearly colourless and has an agreeable odour and powerful aromatic taste, followed by a sensation of cold when air is drawn into the mouth. When oil of peppermint is cooled to 4° C it sometimes deposits colourless hexagonal prisms of menthol, $C_{10}H_{20}O$, which are soluble in alcohol and ether, almost insoluble in water, and fusible at 92° F; the oil consists chiefly of menthol and a terpene called menthene, $C_{10}H_{18}$. Oil of peppermint is often adulterated with a third part of rectified spirit, which may be detected by the milkiness produced when it is agitated with water. Oil of rosemary and rectified oil of turpentine are sometimes used for the same purpose.

FROM BAILLON, "HISTOIRE DES PLANTES" (H. BONNAIRE)

PEPPERMINT (MENTHA PIPERITA), SHOWING (A) SINGLE FLOWER, (B) LONGITUDINAL SECTION THROUGH FLOWER (A AND B ENLARGED)

Peppermint oil is largely distilled at Canton, a considerable quantity being sent to Bombay, also a large quantity of menthol. The species cultivated in the neighbourhood of Canton, is *Mentha arvensis,* var. *glabrata.* In Japan also the distillation of oil of peppermint forms a considerable industry, the plant cultivated being *M. arvensis,* var. *piperascens.* The oil, under the name of *hakka no abura,* is exported from Hiogo and Ozaka, but is said to be frequently adulterated. The menthol is obtained by subjecting the oil to a low temperature, when it crystallizes out and is separated. The two varieties of *M. arvensis* just named yield much more menthol than *M. piperita.*

Since about 1900 the United States has been an important producer of peppermint oil. Production on a large commercial scale was first attained in southern Michigan. Shortly after the World War peppermint culture was extended to northern Indiana, the two States producing in 1925 more than three-fourths of the world's supply of true peppermint oil.

The volatile oil of *Mentha piperita* is a valuable and widely used drug. Its chief constituents are menthol and menthene, which is a liquid terpene. The British Pharmacopoeia contains two preparations of this oil, the *Aqua menthae piperitae* and the *Spiritus menthae piperitae.* The oil has the characters of its class, with certain special features. Its local anaesthetic action is exceptionally strong, and is also powerfully antiseptic. These properties make it valuable in the relief of toothache and also in certain forms of dyspepsia and in colic generally, "soda-mint lozenges" being a familiar form. The characteristic anti-spasmodic action of the volatile oils is perhaps more marked in this than in any other oil, and greatly adds to its power of relieving pains arising in the alimentary canal.

PEPPERRELL, SIR WILLIAM (1696–1759), American soldier, was born in Kittery, Me., then a part of Massachusetts, on June 27, 1696. He studied surveying and navigation, and joined his father in his ship-building, fishing and general trading business, quickly becoming one of the wealthiest and most influential men in the province. He was commissioned captain (1717), major, lieutenant-colonel, and in 1726 colonel of militia. Pepperrell served in the Massachusetts general court (1726–27), and in the governor's council (1727–59), of which for 18 years he was president. Although not a trained lawyer, he was chief justice of the court of common pleas from 1730 until his death. In 1745 he was commander-in-chief of the New England force of about 4,000, which, with the assistance of a British squadron under Commodore Peter Warren, besieged and captured the French fortress of Louisburg, the garrison of which surrendered on June 16, Pepperrell and Warren taking possession on the following day. For his services Pepperrell, in Nov. 1746, was created a baronet —the only New Englander so honoured. He was active in raising troops during the "French and Indian War," and received the rank of lieutenant general in Feb. 1759. He died in Kittery, Me., on July 6, 1759.

See Usher Parsons, *Life of Sir William Pepperrell, Bart.* (Cambridge, Mass., 1855), based on the family papers; L. Dame, "Life and Character of Sir William Pepperrell," *Essex Inst. Hist. Coll.,* vol. xxi., pp. 161–176 (1884); "The Pepperrell Papers," *Mass. Hist. Soc. Coll.,* ser. 6, vol. x. (1899); Charles Henry Lincoln (Ed.), *The Journal of Sir William Pepperrell Kept During the Expedition Against Louisbourg* (1910); and John Francis Sprague, sketch in *Three Men from Maine* (1924).

PEPPER TREE, a tree which has no proper connection with the true pepper (*Piper*), and is really a member of the family Anacardiaceae, being known botanically as *Schinus Molle,* from the Peruvian name *Mulli.* It is a native of tropical South America and is grown in the open air in the south of Europe. Introduced into California, it became widely popular as an ornamental tree, but

later it was found to be a host plant for scale insects very destructive to orange orchards, with the result that in citrus districts the trees were cut down and further plantings discouraged. It is a small tree with unequally pinnate leaves, filled with volatile oil stored in large cells or cysts, which are visible to the naked eye and appear like holes when the leaf is held up to the light. When the leaves are thrown upon the surface of water the resinous or oily fluid escapes with such force as violently to agitate them. The flowers are small, whitish, arranged in terminal clusters and polygamous or unisexual, with five sepals, as many petals, ten stamens (as large as the petals in the case of the male flower, very small in the female flower, but in both springing from a cushion-like disk surrounding the base of the three-celled ovary).

The fruit is a small, globose, pea-like drupe with a bony kernel enclosing a single seed; its fleshy portion has a hot aromatic flavour from the abundance of the resin it contains. The resin is used for medicinal purposes by the Peruvians, and has properties similar to mastic. The very similar Christmas-berry-tree (*S. terebinthifolius*), native to Brazil, with stiffer, less pendulous branches, more densely clustered flowers and smaller, bright red fruit, is sparingly planted for ornament. The Japan pepper tree is *Zanthoxylum piperitum* the fruits of which have also a hot taste. Along the Riviera the tree known as *Melia Azedarach* or the "Pride of India," is sometimes also incorrectly called the pepper tree.

PEPSIN, an enzyme or ferment obtained by drying the mucous lining of the fresh and healthy stomach of a pig, sheep or calf. As used it is a light yellow-brown or white powder, or pale yellow, translucent grains or scales. It is only slightly soluble in water and alcohol. Pepsin digests proteins and is used to help gastric digestion in old people and those in whom there is a deficient secretion of the gastric juice. It is useful in chronic catarrhal conditions of the stomach, the dyspepsia of alcoholism, and in gastric ulcer and cancer of the stomach. Many varieties of proprietary peptonizing tablets are on the market and are convenient for the preparation of peptonized milk. Predigested foods should not be used over a long period or the digestive functions of the stomach may atrophy from disuse.

Pancreatic solution, derived from the pig's pancreas digested in alcohol, has the power of converting starch into sugar from the presence of the enzyme amylopsin, and albumen and fibrin into peptones from the presence of trypsin. It only acts in an alkaline medium and at a temperature under 140° F. If used to peptonize milk sodium bicarbonate should be added. Many commercial preparations are on the market.

PEPUSCH, JOHN CHRISTOPHER (1667–1752), English musician, of German parentage, was born in Berlin. He was for many years musical director at Lincoln's Inn Fields theatre, and arranged the tunes and composed the overture for Gay's *Beggar's Opera,* doing the like later for its sequel, *Polly.* In 1737 he became organist of the Charterhouse. His later years were spent in study, in the composition of chamber music and some admirable motets, and in teaching some favoured pupils, among these being Boyce. Pepusch died on July 20, 1752. His *Treatise on Harmony* (anonymous 1st ed. 1730) is believed to have been an embodiment of his rules drafted by his pupil, Viscount Paisley, afterwards earl of Abercorn.

PEPYS, SAMUEL (1633–1703), English diarist, was born on Feb. 23, 1633, in a house in Salisbury Court, close to St. Bride's Churchyard, where his father, John Pepys, carried on the business of a tailor. The family can be traced in Cambridgeshire as far back as the reign of Edward I. They rose by slow degrees from the class of small copyholders and yeoman farmers to the position of gentry. In 1563 they had a recognized right to use a coat of arms. The name was pronounced in the 17th century, and has always been pronounced by the family, "Peeps." John Pepys was a younger son, who, like other gentlemen in his position in that age, went into trade. He married Margaret Kight, "washmaid to my Lady Veere," whose brother William was a butcher in Whitechapel. This was regarded as a *mésalliance,* for Samuel refers to his mother's relations with a certain disrespect. In 1661 John Pepys inherited a small estate at Brampton near Huntingdon, where he died in 1680, his wife having predeceased him in 1667.

Samuel was fifth child and second son of a large family, all of whom he survived. His first school was in Huntingdon, but he was afterwards sent to St. Paul's in London, where he remained till 1650. On June 21 in that year he was entered at Trinity Hall, Cambridge, but migrated to Magdalene as a sizar on Oct. 1. On March 5, 1651, he went into residence, obtaining a Spendluffe scholarship a month after entering, and one on Dr. John Smith's foundation on Oct. 4, 1653. In March, 1654, he proceeded to the B.A. degree, and in 1660 to that of M.A. Nothing is known of his university career except that on Oct. 21, 1653, he was publicly admonished with another undergraduate for having been "scandalously overseene in drink." At Cambridge he wrote a romance, *Love is a Cheat,* which he afterwards destroyed.

On Dec. 1, 1655, he was married at St. Margaret's Church, Westminster, to Elizabeth, daughter of Alexander Marchant, Sieur de St. Michel, a French Huguenot exile from Anjou who had married an English lady named Kingsmill. Pepys had at this time no independent means, and probably relied on his relatives, the Mountagus, to provide for him. On March 26, 1658, he was cut for the stone, an event which he always kept in memory by a solemn anniversary. In 1659 he went as secretary with his kinsman, Edward Mountagu, afterwards Earl of Sandwich, on a voyage to the Sound. On his return he was engaged as a clerk under Mr. (afterwards Sir Edward) Downing, one of the four Tellers of the Exchequer. In 1660 he accompanied Mountagu when he commanded the fleet which brought King Charles II. back from exile. In that year, by the interest of his kinsman, he was appointed clerk of the acts in the Navy Office, but was compelled to buy off a competitor, one Barlow, with an annuity of £100. Though he was so ignorant of business that he did not even know the multiplication table when he first took office, he soon mastered the needful mechanical details by working early and late. He had other posts and honours, which came to him either as consequential on his Clerkship, or because he was a useful official.

The Official.—On July 23, 1660, he was appointed a clerk of the privy seal, but he resigned the office on Aug. 17, 1662. On Sept. 24, 1660, he was made a justice of the peace. In 1662 he was appointed a Younger Brother, and in 1672 an Elder Brother of the Trinity House. In 1662 also he was named a commissioner for managing the affairs of Tangier, then occupied by an English garrison. In 1664 he became a member of the corporation of the Royal Fishery, and in 1665 was appointed treasurer for Tangier. In that year also he was elected a Fellow of the Royal Society.

During the naval war with Holland (1665–67) he proved himself an indefatigable worker. As surveyor of victualling, the whole burden of a most important department was thrown on him in addition to his regular duties. While the plague was raging in London in 1666 he remained at his post when many of his colleagues ran away, and he manfully avowed his readiness to take the risk of disease, as others of the King's servants faced the dangers of war. He had now gained the full confidence of the lord high admiral, the Duke of York, afterwards King James II. When, on the termination of the war, the navy office was violently attacked in Parliament, he was entrusted with its defence. The speech which he delivered at the bar of the House of Commons on March 5, 1668, passed for a complete vindication. The charges of mismanagement were well founded, but the fault was not in the officials of the navy office only, and Pepys, who was master of the details, had no difficulty in making out a defence.

Nobody indeed was better acquainted with the defects of the Office, for in 1668 he drew up for the Duke of York two papers of inquiry and rebuke, "The Duke's Reflections on the several Members of the Navy Board's Duty" and "The Duke's answer to their several excuses." (*See* Pepysian mss. at Magdalene, No. 2242 and Harleian mss. 8003.) In 1668 he went for a fortnight's tour in the west of England, and in 1669 he and his wife travelled in Holland and France. His success in addressing Parliament gave him the ambition to become a member of the House of Commons. He stood for Aldeburgh, but the death of his wife,

on Nov. 10, 1669, prevented him from conducting his canvass in person, and he was not elected. In 1673 he was, however, returned for Castle Rising. The validity of his election was questioned by his opponent, Mr. Offley, and the committee of privileges decided against him, but the prorogation of the House prevented further action.

The no-popery agitation was now growing in strength. The Duke of York was driven from office by the Test Act, and Pepys was accused of "popery," partly on the ground that he was said to keep a crucifix and altar in his house, partly because he was accused of having converted his wife to Roman Catholicism, but the charges broke down on examination. In 1673 Pepys was transferred by the King from the navy office to the secretaryship of the admiralty. In 1679 he was member for Harwich, and in the height of the Popish Plot mania he was accused, manifestly because he was a trusted servant to the Duke of York, of betraying naval secrets to the French. He resigned office on May 21, 1679, and on the following day he was committed to the Tower, but he was released on bail on July 9, and in the following February the charges against him were finally dropped.

In October 1680 he was with the king at Newmarket, and took down the narrative of his escape after the battle of Worcester. In 1676 Pepys had been appointed a governor of Christ's Hospital and was elected Master of the Trinity House, and in 1677 he became Master of the Clothworkers Company. A proposal to make him Provost of King's College, Cambridge, in 1681, came to nothing. In 1682 he accompanied the Duke of York to Scotland, and in 1683–84 he was engaged in arranging for the evacuation of Tangier. He visited the place and kept a diary of his voyage, and of a subsequent tour in Spain. In 1684 he was elected president of the Royal Society.

When the Admiralty Commission of 1679 was dissolved in 1684, Pepys was restored to the secretaryship of the admiralty, and he retained the office when James II. ascended the throne. His chief work during this period was the establishment of the Special Commission of 1686 "for the recovery of the navy," by which its impaired efficiency was entirely restored. In 1685 he again sat in Parliament as member for Harwich, and in the same year he was for a second time Master of the Trinity House. The Revolution of 1688 ended his official career. He was dismissed on March 9, 1689, and spent the rest of his life in retirement, and, except for two brief imprisonments in 1689 and in 1690 "on suspicion of being affected to King James," in peace. He died at his friend William Hewer's house in Clapham on May 26, 1703, in the 71st year of his age.

His last years were passed in correspondence with his friends, who included Evelyn and Dryden, or in arranging his valuable library. This was left on his death to his nephew, John Jackson, son of his sister Paulina, and in 1724, by the terms of his will, was transferred to Magdalene College, Cambridge, where it is still preserved.

The Diary.—Such was the outward and visible life of Samuel Pepys, public servant, whose diligence was rewarded by success. The other Pepys, whom Sir Walter Scott called "that curious fellow," was revealed in 1825, when his secret diary was partly published. The first entry was made on Jan. 1, 1660, the last on May 31, 1669, when the increasing weakness of his eyes, which had given him trouble since 1663, compelled him to cease writing in the conditions he imposed upon himself. If there is in all the literature of the world a book which can be called "unique" with strict propriety, it is this. Confessions, diaries, journals, autobiographies abound, but such a revelation of a man's self has not been discovered. The diary is a thing apart by virtue of three qualities which are rarely found in perfection when separate and nowhere else in combination. It was secret; it was full; and it was honest. That Pepys meant it for his own eye alone is clear. He wrote it in Shelton's system of tachygraphy, published in 1641, which he complicated by using foreign languages or by varieties of his own invention whenever he had to record the passages least fit to be seen by his servants, or by "all the world." Relying on this cypher, he put down whatever he saw, heard, felt or imagined, every motion of his mind, every action of his body, and he noted all this, not as he desired it to appear to others, but as it was to his seeing.

The result is "a human document" of amazing vitality. The style is as peculiar as the matter—colloquial, garrulous, racy from simplicity of language, and full of the unconscious humour which is never absent from a truthful account of the workings of nature in the average man. To his credit must be put the facts that he knew the animalism and the vice of the Restoration period to be what they were; that he had a real love of music, and gave help to musicians, Cesare Morelli, for instance; that though he made money out of his places he never allowed bad work to be done for the navy if he could help it; that he was a hard worker; and that he had a capacity for acts of kindness and generosity.

The diary, written in shorthand in 6 volumes, was included among his books at Magdalene. On the publication of Evelyn's diary in 1818, the then master of Magdalene, the Hon. and Rev. George Neville, decided to publish Pepys's. The library contained both the short and the longhand copy of Pepys's account of King Charles's adventures, but its contents were so little known by the curators that this key was overlooked. The ms. was deciphered between 1819 and 1822, by John Smith, afterwards rector of Baldock in Hertfordshire. The first and partial edition, edited by Richard Griffin Neville, third Lord Braybrooke, appeared in 1825. It attracted great attention, and was reviewed by Sir Walter Scott in the *Quarterly* for January 1826. A second edition followed in 1828. A third and enlarged edition appeared in 1848–49, and a fourth in 1854. A still fuller edition was published in 1875–79 by Dr. Mynors Bright. Finally, in 1893–99 Dr. H. B. Wheatley printed the whole of the diary with the exception of a few unprintable passages. Pepys's only known publication in his life was the *Memoires of the Royal Navy* (1690).

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PER-ACIDS, that is, acids which have oxidising powers in virtue probably of an oxygen atom linked to a hydroxyl group thus: $-O-OH$, are described under the corresponding element, *e.g.*, persulphuric acid under SULPHUR.

PERCEVAL, the hero of a comparatively small but highly important group of romances, now forming part of the Arthurian cycle. Originally the story of Perceval was of the character of a folktale, and that one of considerable importance and worldwide diffusion. He is represented as the son of a widow, *"la dame veuve,"* his father having been slain, in battle or tourney, either immediately before or shortly after his birth. The mother, fearful lest her son should share his father's fate, flies to the woods, either with one attendant or with a small group of faithful retainers, and there brings up her son in ignorance of his name and parentage, and all knightly accomplishments. The youth grows up strong, swift-footed, and of great personal beauty, but, naturally, of very limited intelligence. He spends his days chasing the beasts of the forest.

As the result of a chance meeting with a party of knights he determines to set forth into the world in search of knighthood. He comes to Arthur's court, where he creates a sensation by his personal beauty and uncouth behaviour. He succeeds, by a cast of his javelin, in slaying the Red Knight, a foe of Arthur's who

has vainly challenged the knights of the Round Table, and clothing himself in his armour, sets out on a series of adventures which differ in the various versions, but the outcome of which is that he becomes a skilful knight, and regains the heritage of his father.

This, the *Perceval* story proper, has been recognized by scholars as the variant of a widespread folk-tale theme, designated by J. G. von Hahn as *the Aryan Expulsion and Return Formula*, which counts among its representatives such heroes as Perseus, Cyrus and Romulus and Remus. This particular variant appears to be of British-Celtic origin, and the most faithful representative of the original tale is now very generally held to be the English *Syr Percyvelle of Galles,* a poem preserved in the Thornton ms. of Lincoln cathedral library. Here the hero is nephew to Arthur on the mother's side, and his father, of the same name, is a valiant knight of the court. A noticeable feature of the story is the uncertainty as to the hero's parentage; the mother is always a lady of rank, a queen in her own right, or a sister of kings, but the father's rank varies, he is never a king, more often simply a valiant knight, and never of equal rank with his wife.

The connection of the story with Arthur and his court brought about an important development, the precise steps of which are not yet clear. Perceval became the hero of the Grail Quest, ousting Gawain, to whom the adventure originally belonged, and the *Perceval* became merged in the *Grail* tradition. Of the *Perceval-Grail* romances the oldest, from the point of view of ms. preservation, is the *Perceval* or *Conte del Graal* of Chrétien de Troyes, but as Chrétien had already, in a previous poem (*Cligés*), referred to Perceval as *"un vassal de grant renon,"* and states at the commencement of the *Conte del Graal* that he is about to "rimoier" the best tale told in a royal court, it is quite clear that, contrary to the theory of Foerster and Golther, Perceval is no invention of Chrétien's, but was already a popular hero. Unfortunately the *Perceval* was left unfinished, so we are without a guide (which the conclusion might have afforded) to the precise character of Chrétien's source, and the three writers, Wauchier de Denain, Gerbert and Manessier, who eventually carried the story to a conclusion, differ widely from each other, and were clearly familiar with divergent traditions. An interesting problem is that of the relation between Chrétien's poem and the *Parzival* of Wolfram von Eschenbach, which was long held to be a translation from the French poem, in spite of the fact that Wolfram himself asserts that his source was the work of a certain Kiot, and that Chrétien has told the story wrong. A fragment attached to two of the Chrétien mss. relates the birth and parentage of the hero, the death of his father, and flight of the mother (details only alluded to by Chrétien) in a manner which corresponds curiously with the German poem, and which, taken in connection with the knowledge, on the part of other writers, of features peculiar to the *Parzival,* would indicate that Wolfram was right, and that the two works are independent derivations from a common source.

We have also two prose versions of the *Perceval* story, the older, contained in two mss. only, is attributed to Robert de Borron, and forms the final section of his trilogy, concluding with a version of the death of Arthur, manifestly derived from a rhyming chronicle, akin to but not identical with that of Wace. The second romance, the *Perlesvaus,* obviously knew, and used, this text, but it is a much longer and more complicated romance, relating the adventures of Gawain, Lancelot and Perceval (Perlesvaus) in quest of the Grail. It probably formed at one time the *Quest* section of the prose *Lancelot,* and was later displaced in favour of the Galahad version. In fact two Paris mss. retain its opening adventure as introductory to the Galahad *Queste,* and in the early printed editions the two are found together. It was in all probability composed towards the close of the 12th century by a Welsh monk of Glastonbury, and was apparently designed to exploit the discovery of the tombs of Arthur and Guenevere in that abbey.

The exact position of the Welsh *Mabinogi, Peredur, son of Evrawc,* is still a matter of debate. It certainly contains incidents which are found in Chrétien, but there is also much which is obviously of Welsh and folk-lore origin. The theory that it is a mere translation of the French poem must be rejected, but its exact relation, with that of other *Mabinogion* to the parallel French versions is uncertain. (*See* also GRAIL, THE HOLY; WAGNER, RICHARD.)

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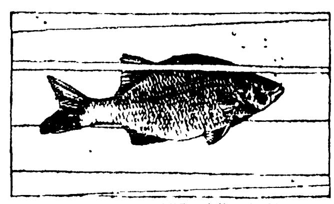
(J. L. W.)

PERCEVAL, SPENCER (1762–1812), prime minister of England from 1809 to 1812, second son of John, 2nd earl of Egmont, was born in Audley Square, London, on Nov. 1, 1762. He was educated at Harrow and at Trinity College, Cambridge, and was called to the bar at Lincoln's Inn in 1786, becoming K.C. in 1796. Entering parliament for Northampton in 1796, he supported the administration of Pitt. In 1801, on the formation of the Addington administration, he was appointed solicitor-general, and in 1802 he became attorney-general. An ardent opponent of Catholic Emancipation, he delivered in 1807 a speech on the subject which helped to destroy the Grenville administration; he then became chancellor of the exchequer under the duke of Portland, whom in 1809 he succeeded in the premiership. Perceval retained office till he was shot by a madman named Bellingham, a bankrupt with a grievance, who had vainly applied to him for redress, in the lobby of the House of Commons on May 11, 1812. Bellingham was certainly insane, nevertheless he was hanged.

See Spencer Walpole, *Life of Spencer Perceval* (1874), and P. Treherne, *Spencer Perceval* (1909).

PERCH, a fresh-water fish (*Perca fluviatilis*), generally distributed over Europe, northern Asia and North America, and a type of the *Percidae,* a family of spiny-rayed fishes. It inhabits rivers and lakes, but thrives best in waters with a depth of over 3ft.; in large lakes it frequently descends to 50 fathoms and more. It occurs in Scandinavia as far north as the 69th parallel.



BY COURTESY OF THE N Y. ZOOLOGICAL SOCIETY

THE WHITE PERCH (MARONE AMERICANA), ONE OF 125 SPECIES

The species exhibits many variations in shape, some specimens being high-backed, others low and long-bodied. A rich greenish-brown with golden reflections covers the back and sides, which are ornamented with five or seven dark cross-bands. A large black spot occupies the membrane between the last spines of the dorsal fin; and the ventral, anal and lower part of the caudal are bright vermilion. The perch is carnivorous and most voracious.

Perch are good, wholesome food, and highly esteemed in inland countries. The perch is exceedingly prolific; it begins to spawn when three years old, in April or in the first half of May, depositing the ova, which are united by a viscid matter in lengthened or net-shaped bands, on water plants. Other members of the *Percidae* are the pope (*q.v.*) and the pike-perch (*q.v.*).

See C. Tate Regan, *British Fresh Water Fishes.*

PERCHE, a region of France extending over the departments of Orne, Eure, Eure-et-Loir and Sarthe. Its boundaries are Normandy north and west, Maine south-west, Vendômois and Dunois south, Beauce east, and Thimerais on the north-east. The greater part of the district is occupied by a semicircle of heights (from 650 to 1,000 ft) stretching from Moulins-la-Marche to Montmirail; within the basin formed thereby lie the chief towns—Mortagne, Nogent-le-Rotrou and Bellême. Stock-raising and dairy-farming flourish in the Perche, which is famous for the production of a breed of large horses. Cider-apples and pears are grown. In the middle ages the Perche constituted a countship of which Corbon, Mortagne and Nogent-le-Rotrou were successively the capitals. Under the *ancien régime* it formed, together with Maine, a *gouvernement* of which Mortagne was the capital

PERCIVAL, JAMES GATES (1795–1856), American poet, philologist, and geologist, was born in Berlin (Conn.), on Sept. 15, 1795. Few Americans have been so versatile or so eager in the acquisition of learning. He was a graduate of Yale, a practising physician, an editor, a linguist who knew ten languages and who did important work on *Webster's Dictionary*, a prolific poet,

assistant surgeon and lecturer on chemistry at West Point, a botanist, State geologist of Connecticut (1833–42) and of Wisconsin from 1854 until his death at Hazel Green, May 2, 1856.

See his *Poetical Works* (1859) with a biographical sketch by L. W. Fitch; J. H. Ward, *Life and Letters of James Gates Percival* (1866).

PERCY (Family). This family, whose deeds are so prominent in English history, was founded by William de Perci (*c.* 1030–1096), a follower of the Conqueror, who bestowed on him a great fief in Yorkshire and Lincolnshire. The register of Whitby Abbey, which he founded anew, and in later days the heralds, were responsible for the fabulous origin and pedigree of the family. By Emma, daughter of Hugh de Port, a great Hampshire baron, William was father of several sons, of whom Alan the eldest succeeded him. His grandson William was the last of the house in the direct line, and left two sisters and coheiresses, Maud countess of Warwick, who died childless, and Agnes. Agnes de Perci had married Josceline, styled "brother of the queen" (*i.e.*, Adeliza of Louvain, second wife of Henry I.), whose legitimacy has been questioned, and from this marriage descended the second house of Percy (which name it assumed), till its own extinction in the male line five centuries later (1670). By it was brought into the family the great Petworth estate in Sussex, which Josceline had obtained from his sister, who was holding Arundel and its fief. His son Richard (*c.* 1170–1244) and Richard's nephew William (*c.* 1183–1245) were among the barons who rose in arms against John, but the latter made his peace with Henry III., and had his lands restored to him. Richard de Percy was one of the twenty-five barons appointed to enforce the observance of Magna Carta.

Henry de Percy (*c.* 1272–1315), William's grandson, was one of Edward I.'s most active agents in the subjugation of Scotland till the success of Robert Bruce drove him out of Turnberry Castle, and made him withdraw into England. Percy strengthened his position in the north of England by purchasing lands from Anthony Bek, bishop of Durham, among which was the honour of Alnwick, the principal seat of the family ever since.

Henry's son, another Henry (*c.* 1299–1352), did splendid service to his sovereign by defeating and taking prisoner David II., king of Scotland, at the battle of Neville's Cross (1346).

To him succeeded another Henry Percy (1322–1368), a feudal baron like his predecessors, who fought at Crécy during his father's lifetime and whose brother Thomas Percy (1333–1369) was bishop of Norwich from 1356 to 1369. Henry Percy, 1st earl of Northumberland, father of the famous Hotspur, Sir Henry Percy (*q.v.*), was killed at Bramham Moor in 1408, while in arms against the king, and his title and estates were forfeited. But, by an act no less gracious than politic, Henry V. restored them in 1414 to this earl's grandson, Henry (1394–1455), then a prisoner with the Scots, whose liberation he procured from the duke of Albany during the time of James I.'s captivity. From that day the loyalty of the family to the house of Lancaster was steadfast and undeviating. The 2nd earl died fighting for Henry VI. at the first battle of St. Albans in 1455; the 3rd, Henry (1421–1461), was slain on the bloody field of Towton; the 4th, Henry (1446–1489), was killed in quelling an insurrection in the time of Henry VII. So strong was the Lancastrian feeling of the family that even Sir Ralph Percy (1425–1464), a brother of the earl who fell at Towton, though he had actually submitted once to Edward IV., turned again, and when he fell at Hedgley Moor in April 1464 consoled himself with the thought that he had, as he phrased it, "saved the bird in his bosom."

No wonder, then, that in Edward IV.'s days the title and estates of the family were for a time taken away and given to John Neville Lord Montagu, brother of Warwick the king-maker. But the north of England was so accustomed to the rule of the Percys that in a few years Edward saw the necessity of restoring them, and did so even at the cost of alienating still further the powerful family of the Nevilles, who were then already on the point of rebellion.

A crisis occurred in the fortunes of the family in the reign of Henry VIII. on the death of Henry, the 6th earl (*c.* 1502–1537), whose brothers Sir Thomas and Sir Ingelram Percy, much against his will, had taken part in the great insurrection called the Pilgrimage of Grace. The title was forfeited on his death, and was granted by Edward VI. to the ambitious John Dudley, earl of Warwick, who was attainted in the succeeding reign.

It was restored under Queen Mary to Thomas Percy (1528–1572), a nephew of the 6th earl, who was one of the three earls who took the lead in the celebrated rising of 1572, and was beheaded at York. His brother Henry (*c.* 1532–1585), who succeeded him, was no less unhappy. Involved in Throgmorton's conspiracy, he was committed to the Tower of London, and was found shot in bed there. His son, Henry (1567–1632), the next earl, suffered like his two predecessors for his Catholicism. The Crown lawyers sought in vain to implicate him in the Gunpowder Plot, but he was imprisoned for fifteen years in the Tower and compelled to pay a fine of £30,000. Algernon (1602–1668), the son who next succeeded, was a parliamentary general in the Civil War. The male line of this illustrious family became extinct, at least in the direct line, in 1670 about five hundred years after the marriage of Agnes de Perci with Josceline of Louvain.

The last earl's daughter Elizabeth, a great heiress, was mother by Charles Seymour, 6th duke of Somerset, of Algernon, 7th duke, who was summoned (in error) as Lord Percy in 1722 and created earl of Northumberland in 1749. On the duke's death in 1750 his earldom of Northumberland passed under a special remainder, with the main inheritance of the Percys, to Sir Hugh Smithson, bart. (1715–1786), who had married his daughter and eventual heiress in 1740, and was created duke of Northumberland and Earl Percy in 1766. From this marriage descends the present ducal house, which bears the name of Percy in lieu of Smithson.

See E. B. De Fonblanque, *Annals of the House of Percy* (1887), and G. Brenan, *History of the House of Percy* (edited by W. A. Lindsay, 1902), both somewhat adulatory and needing critical revision; Tate, *History of Alnwick* (1866); Hartshorne's paper on the Percys and their Castles in the Newcastle volume of the *Archaeological Institute* (1852); E. A. Freeman, "The Percy Castles" (1875) in *English Towns and Districts;* G. T. Clark, *Medieval Military Architecture* (1884); G. E. C(okayne), *Complete Peerage* (1895), vol. vi.; Bishop Percy, *Northumberland Household Book*. *See* also the article *Northumberland, Earls and Dukes of.*

PERCY, SIR HENRY, called Hotspur (1364–1403), eldest son of Henry, 1st earl of Northumberland, was born on March 20, 1364. He saw active service when he was fourteen at the siege of Berwick. His zeal in border warfare won the name of Hotspur for him from his opponents. In 1386 he was sent to Calais, and raided French territory, but was shortly afterwards recalled to defend England against a naval attack by France. In popular story and ballad he is known as one of the heroes of Otterburn or Chevy Chase. In the summer of 1388 the Scots invaded England by way of Carlisle, sending a small body under the earls of Douglas, Mar and Moray to invade Northumberland. The earl of Northumberland remained at Alnwick, but sent his sons Sir Henry and Sir Ralph against the enemy. In hand-to-hand fighting before the walls of Newcastle, Douglas is said to have won Sir Henry's pennon, which he swore to fix upon the walls of Dalkeith. The Scots then retreated to Otterburn, where Percy, who was bent on recovering his pennon, attacked them on a fine August evening in 1388. Douglas was slain in the battle, though not, as is stated by Walsingham, by Percy's hand: Henry Percy was captured by Sir John Montgomery, and his brother Ralph by Sir John Maxwell. Hotspur was released on the payment of a heavy ransom, to which Richard II. contributed £3,000, and in the autumn his term as warden of Carlisle and the West March was extended to five years. In 1399 together with his father he joined Henry of Lancaster. Henry IV. gave the charge of the West March to Northumberland, while Henry Percy received the castles of Bamburgh, Roxburgh and Berwick, and the wardenship of the East March, with a salary of £3,000 in peace time and £12,000 in war. During the first year of Henry's reign Hotspur was appointed justiciar of North Wales and constable of the castles of Chester, Flint, Conway, Denbigh and Carnarvon. Henry also gave him a grant of the island of Anglesey, with the castle of Beaumaris. William and Rees ap Tudor captured Conway Castle on April 1, 1401, and Percy in company with the prince of Wales set out to recover the place, Percy pro-

viding the funds. In May he reported to the king the pacification of Merioneth and Carnarvon, and before the end of the month Conway was surrendered to him. His demands for arrears of pay were, however, refused, and he had the same difficulty in obtaining money for his northern charge that he had experienced in Wales. Anglesey was taken from him, and he was deprived of Roxburgh Castle in favour of his rival, the earl of Westmorland The Scots again invaded England in the autumn of 1402, headed by the earl of Douglas and Murdoch Stewart, son of the duke of Albany, but were heavily defeated by Northumberland and Hotspur at Humbledon, or Homildon Hill, on Sept 14 Disputes with the king arose over the disposal of the Scottish prisoners, Percy insisting on his right to hold Douglas as his personal prisoner, and he was summoned to court to explain It is related that when he arrived Henry asked for Douglas, and Hotspur demanded in return that his brother-in-law, Edmund Mortimer, should be allowed to ransom himself from Owen Glendower, with whom he was a prisoner High words followed, in the course of which Henry called Percy a traitor, struck him on the face, and drew his sword on him. Percy is said to have answered this defiance with the words, "Not here, but on the field." This was late in 1402, and in 1403 Hotspur issued a proclamation in Cheshire stating that Richard II was alive, and summoning the inhabitants to his standard He was joined by Douglas, Glendower, and Thomas, Earl of Worcester, who together proclaimed the young earl of March king When he arrived at the Castle Foregate, Shrewsbury, early July 21, and demanded provisions, he found the king's forces had arrived before him He retired in the direction of Whitchurch, and awaited the enemy about 3½ m from Shrewsbury After a long parley, the Scottish earl of March, fighting on the royal side, forced on the battle in the afternoon, the royal right being commanded by the prince of Wales Hotspur was killed, the earls of Douglas and Worcester, Sir Richard Venables of Kinderton, and Sir Richard Vernon were captured, and the rebel army dispersed Worcester, Venables and Vernon were executed the next day Percy's body was buried at Whitchurch, but was disinterred two days later to be exhibited in Shrewsbury The head was cut off, and fixed on one of the gates of York

See NORTHUMBERLAND, EARLS AND DUKES OF, and PERCY (FAMILY). Also *Chronique de la traison et mort de Richard II*, ed B Williams (Eng Hist Soc, 1846); J Creton, *Histoire du roy Richard II*, ed John Webb, in *Archaeologia* (xx, 1824), and Adam of Usk's *Chronicon*, 1377–1404, ed E M Thompson (1876), the authorities are cited in detail in J H Wylie's *England under Henry IV* (1884–98), and Sir J H Ramsay's *Lancaster and York* (Oxford, 1892) Holinshed's *Chronicle* was the chief source of Shakespeare's account of Hotspur in *Henry IV*.

PERCY, THOMAS (1729–1811), bishop of Dromore, editor of the *Percy Reliques*, was born at Bridgnorth on April 13, 1729 He studied at Christ Church, Oxford, and in 1753 became vicar of Easton Maudit, Northamptonshire, and in 1756 rector of Wilby in the same county, benefices which he retained until 1782 At Easton Maudit most of the literary work for which he is now remembered—including the *Reliques*—was completed When his name became famous he was made domestic chaplain to the duke and duchess of Northumberland, and was tempted into the belief that he belonged to the illustrious house of Percy Through his patron's influence he became dean of Carlisle in 1778 and bishop of Dromore in Ireland in 1782 He died on Sept 30, 1811 He and his wife (Anne Gutteridge) lie buried in the transept which Percy added to Dromore Cathedral The *Reliques of Ancient English Poetry* (1765) was based on an old manuscript collection of poetry, rescued by Percy in Humphrey Pitt's house at Shifnal, Shropshire, from the hands of the housemaid who was about to light the fire with it. The manuscript was edited in incomplete form by J W Hales and F J Furnivall in 1867–1868 His influence on Scott and the Romantics was very great

Percy's other works include editions of the poems of the Earl of Surrey (1763) and of the *Household Book* of the duke of Northumberland in 1514, a translation of Mallet's *Northern Antiquities* (1770). *See* his *Life* by Miss Gaussen (1908) *See* A C C Gaussen, *Percy: Prelate and Poet* (1908) The *Reliques* has been edited by various hands, notably by H B. Wheatley (1876).

PERDICCAS, the name of three kings of Macedonia, who reigned respectively *c.* 700 B.C., *c.* 454–413 B.C., and 364–359 B.C., and of one of Alexander the Great's generals, son of Orontes, a descendant of the independent princes of the province of Orestis At Alexander's death Perdiccas was probably acting chiliarch (vizier), and supported the claim of the unborn child of Roxana to the throne. Meleager's revolt forced a compromise, under which Philip Arrhidaeus and the unborn child (if a son) were to be joint kings, with Craterus as regent for Arrhidaeus and, perhaps, Perdiccas for the infant, who was duly born a son (Alexander IV) The Lamian war called Craterus to Europe and left Perdiccas in control; it was he who divided up the satrapies In the ensuing confusion Perdiccas may be classed among those who wished to keep the Empire a unity, though personal friendship and circumstances first grouped him with Ptolemy, a convinced separatist, against Antipater and Antigonus Perdiccas had to abandon Alexander's Arabian schemes, but set himself to complete the conquest of Asia Minor When Antigonus refused to help, he invaded Cappadocia in 322, established his most reliable subordinate, Eumenes, there, and made progress in Pisidia and Armenia. Then he called Antigonus to account; Antigonus fled to Antipater and Craterus and convinced them that Perdiccas was aiming at the throne; Ptolemy joined them. Perdiccas marched to meet the allies, failed to force the Nile at Pelusium, and his soldiers mutinied and murdered him (*See* MACEDONIAN EMPIRE) (E R B)

PEREDA, JOSÉ MARÍA DE (1833–1906), Spanish novelist, was born at Polanco near Santander, and began his literary career by contributing articles to a local journal, *La Abeja montañesa*, in 1858 In 1864–71 appeared his powerful realistic sketches of local life and manners under the title of *Escenas montañesas*, and a second series was published under the title of *Tipos y paisajes* (1871). These were followed by *Bocetos al temple* (1876), *Tipos trashumantes* (1877), and *El Buey suelto* (1877), which was intended as a reply to the thesis of Balzac's work, *Les Petites misères de la vie conjugale* More and more pessimistic as to the political future of his country, Pereda took occasion in *Don Gonzalo González de la Gonzalera* (1879), to ridicule the revolution as he had seen it at work, and to pour scorn upon the *nouveaux riches* who exploited liberalism for their personal ends Two novels by his friend Pérez Galdós, *Doña Perfecta* and *Gloria*, drew from Pereda a reply, *De Tal palo tal astilla* (1880), in which he endeavours to show that tolerance in religious matters is disastrous alike to nations and to individuals The *Esbozos y rasguños* (1881) is of lighter material, and is less attractive than *El Sabor de la Tierruca* (1882), a striking piece of landscape which won immediate appreciation. In *Pedro Sánchez* (1883) Pereda leaves his native province to portray the disillusion of a sincere enthusiast who has plunged into the political life of the capital Pereda's masterpiece is *Sotileza* (1884), a vigorous rendering of marine life by an artist who perceives and admires the daily heroisms of his fisher-folk It has often been alleged against the author that he confines himself to provincial life, to lowly personages and to unrefined subjects, and no doubt an anxiety to clear himself from this absurd reproach led him to attempt a description of society at the capital in *La Montálvez* (1888), which is certainly the least interesting of his performances In *La Puchera* (1889) he returned to the marine subjects which he knew and loved best Again in *Peñas arriba* (1895), his love of country life is manifested in the masterly contrast between the healthy labour of the fields and the squalid life of cities

Pereda belongs to the native realistic school of Spain, which, founded by the unknown author of *Lazarillo de Tormes*, was continued by Mateo Alemán, Cervantes, Quevedo, Castillo Solórzano and many others. With the single exception of Cervantes, however, the picaresque writers are almost entirely wanting in the spirit of generous sympathy and tenderness which constitutes a great part of Pereda's charm His realism is purely Spanish, as remote from Zola's moroseness as from the graceful sentimentality of Pierre Loti Few 19th-century writers possessed the virile temperament of Pereda, and, with the single exception of Tolstoy, none kept a moral end more steadily in

view. This didactic tendency unquestionably injures his effects. Moreover, his grim satire occasionally degenerates into somewhat truculent caricature, and the excessive use of dialect and technical terms which caused him to supply *Sotileza* with a brief vocabulary is a grave artistic blemish. But he saw, knew, understood character; he created not only types, but living personages, such as Andrés, Cleto and Muergo in *Sotileza,* Pedro Juan and Pilara in *La Puchera;* and he personified the tumult and calm of the sea with more power than Victor Hugo displayed in *Les Travailleurs de la mer.* His descriptive powers were of the highest order, and his style, pure of all affectations and embellishments, is of singular force and suppleness. With all his limitations, he was as original a genius as Spain produced during the 19th century. (J. F.-K.)

PÈRE DAVID'S DEER, an aberrant mule-like deer (*q.v.*), the first evidence of whose existence was made known in Europe by the Abbé (then Père) David, who in 1865 obtained the skin of a specimen from the herd in the imperial park at Pekin. The front prong of the main fork of each of the large antlers, which lack brow-tines, curves forward and divides at least once; while the hind prong is of great length, undivided, and directed backwards in a manner found in no other deer. The tail reaches the hocks, and is donkey-like in form. The head is long and narrow, with a prominent ridge for the support of the antlers, moderate-sized ears, and a narrow and pointed muzzle. A gland and tuft are present on the skin of the outer side of the upper part of the hind cannon-bone; but there is no gland on the inner side of the hock. Although new-born fawns are spotted, the adults are uniformly coloured; the general tint of the coat at all seasons being reddish tawny with a tendency to grey. The antlers are shed and replaced twice a year, a unique feature. The true home of this deer has never been ascertained, all now living being kept in confinement.

BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

PÈRE DAVID'S DEER, THE MI-LOU OF CHINA: TRUE HOME UNKNOWN

PEREGRINE FALCON: *see* FALCON.

PEREGRINUS PROTEUS (2nd cent. A.D.), Cynic philosopher, of Parium, Mysia. At an early age he was suspected of parricide, and was obliged to leave his native place. During his wanderings he reached Palestine, where he became the virtual head of the Christian community. His fanatical zeal and craving for notoriety led to his imprisonment, but the governor of Syria freed him. He resumed his wandering life, at first assisted by the Christians, but having been detected profaning the rites of the Church, he was excommunicated. During a visit to Egypt he made the acquaintance of the famous Cynic Agathobulus and joined the sect. Meeting with little encouragement, he journeyed to Rome, whence he was expelled for insulting the emperor Antoninus Pius. Crossing to Greece, he finally took up his abode at Athens. Here he obtained many pupils, including Aulus Gellius But, having given offence by his attacks on Herodes Atticus and finding his popularity diminishing, he announced his intention of immolating himself on a funeral pyre at the celebration of the Olympian games in 165, and actually carried it out. Lucian, who was present, has given a full description of the event.

See C. M. Wieland's *Geheime Geschichte des Philosophen Peregrinus Proteus* (Eng. trans., 1796); this is an attempt to rehabilitate his character. *See* also Lucian, *De morte Peregrini;* Aulus Gellius xii. II.; Ammianus Marcellinus xxix.; Philostratus, *Vit. Soph.* ii. I., 33; J. Bernays, *Lucian und die Kyniker* (1875); E. Zeller, "Alexander und Peregrinus," in his *Vorträge und Abhandlungen,* ii. (1877); and Überweg, *Grundriss der Gesch. der Philosophie,* Bd. I. (1926).

PEREIRE (Pereira), **GIACOBBO RODRIGUEZ** (1715–1780), one of the inventors of deaf-mute language, was born at Estremadura, Spain, on April 11, 1715. He fell in love with a young girl who had been dumb from birth, and devoted himself to discovering a method of imparting speech to deaf-mutes. He devised a sign alphabet for the use of one hand. Pereire was made a member of the Royal Society of London in 1759. He died at Paris on Sept. 15, 1780.

PEREKOP, a village of the Crimean A.S.S.R., on the isthmus which connects the Crimea with the Continent. It was formerly a salt trading town, but declined rapidly after the opening of the Kharkov to Sevastopol railway. It was re-graded as a village in 1925. In ancient times the isthmus was crossed by a ditch which gave the name of Taphros to a Greek settlement. This line of defence having fallen into decay, a fort was erected and a new ditch and dike constructed in the 15th century by the Tatar khan of the Crimea, Mengli Ghirai, and by his son and successor Sahib Ghirai. The fort, known as Kapu or Or-Kapu, became the nucleus of the town. In the middle ages Perekop was known as Tuzla. In 1736 it was captured by the Russians and again in 1738 under Lascy (Lacy), who blew up the fort and destroyed a great part of the dike. In 1754 the fort was rebuilt by Krim Ghirai; but the Greek and Armenian inhabitants of Perekop formed a new settlement at Armyanskiy Bazar (Armenian Market), 3 m. south. Captured in 1771, the town passed into Russian possession with the rest of the Crimea in 1783.

PERENNIALS, the name given to those plants whose natural term of life or life cycle continues for more than two growing periods or years in contradistinction to annuals (*q.v.*), which exist for a single growing period, and biennials (*q.v.*) whose life term embraces only two growing periods. Perennials may be woody (*e.g.,* trees and shrubs) or herbaceous (*e.g.,* iris).

PEREYASLAVL, a town of the Ukrainian S.S.R., in 50° 4′ N., 31° 30′ E., at the confluence of the Trubezh and the Alta, which reach the Dnieper 5 m. lower down at the town's port, the village of Andrushi. Pop. (1926) 14,975. Though founded in 993 by Vladimir the Great of Moscow in memory of his success over the Turkish Pechenegs, Pereyaslavl has now few remains of antiquity. From 1054 Pereyaslavl was the chief town of a separate principality. As a southern outpost it often figures in the 11th, 12th and 13th centuries, and was plundered by the Mongols in 1239. In later times it was a centre of the Cossack movement; and in 1628 the neighbourhood was the scene of the extermination of the Polish forces known as "Tara's Night." By the Treaty of Pereyaslavl in 1654 the Cossack chieftain Bogdan Chmielnicki acknowledged the supremacy of Tsar Alexis of Russia. The town is the centre of an agricultural district and has a flour-milling industry, but no railway.

PÉREZ, ANTONIO (*c.* 1540–1611), for some years the favourite minister of Philip II. of Spain and afterwards the object of his unrelenting hostility, was the natural son of Gonzalo Pérez, secretary both to Charles V. and to Philip II. Legitimated by an imperial diploma issued (1542) at Valladolid, Pérez became secretary of State in 1567, protonotary of Sicily, and at the death of Ruy Gomez de Silva, prince of Eboli, in 1573, head of the "despacho universal," or private bureau, from which Philip governed by correspondence the affairs of his dominions. Juan de Escovedo, another of the king's secretaries, attached after 1574 to Don John of Austria to check the latter's ambitious schemes, was sent by John to Rome to obtain the pope's consent to his plan for making himself master of England by marrying Mary Queen of Scots. Pérez was shown the pope's letter by his nuncio in Spain; he informed Philip who authorized him to arrange for the murder of Escovedo. After several unsuccessful attempts to poison Escovedo, Pérez had him assassinated in a street of Madrid on March 31, 1578. A prosecution was set on foot by the representatives of the murdered man. Philip appeared at first willing to protect his accomplice; ultimately he was the secret instigator of those who sought his ruin. Pérez was arrested on July 28, 1579. The process dragged on until 1589 when, on the eve of being condemned, Perez escaped to Aragon. An Aragonese by birth, by the ancient "fueros" of that kingdom, he could claim a public trial and so bring into requisition documentary evidence of the king's complicity in the deed.

To avoid this, Philip ordered Pérez to be transferred from the civil prison in Saragossa to that of the Inquisition, on a charge

of heresy arising from certain blasphemous expressions used by Perez. A popular tumult broke out, Perez escaped across the Pyrenees, and Aragon was punished by losing its ancient "fueros" altogether (1591) after a crushing defeat from Philip's armies. Perez was well received at Pau by Catherine de Bourbon, passed on to the court of Henry IV. of France, and both there and in England, his talents and diplomatic experience, as well as his well-grounded enmity to Philip, secured him at first much popularity. In England he became intimate with Francis Bacon, and was also much in the society of the earl of Essex. After the Peace of Vervins (1598) he lost all political importance; his efforts to obtain pardon from Philip III. proved vain and he died in poverty and obscurity in Paris on Nov. 3, 1611.

See A. Perez, *Pedazos de Historia* (*c.* 1594); *Relaciones* (Paris, 1598); *Cartas* (Bib. de Autores Esp., xiii.); F. Mignet, *Antonio Perez et Philippe II.* (Paris, 1845); J. A. Froude, *An Unsolved Historical Mystery* in *The History of the Spanish Armada* (London, 1892); M. Hume, *Españoles e ingleses* (1903); J. Fitzmaurice-Kelly, *Antonio Perez* (Oxford, 1922).

PÉREZ DE AGALA, RAMÓN (1880–), Spanish novelist and poet, was born at Oviedo. Beginning with a volume of verse, *La Paz del Sendero* (1904), he first attracted notice as a novelist by *La Pata de la Raposa* (1912). *Luna de Miel, Luna de Hiel* (1923) and its sequel, *Los Trabajos de Urbano y Simona* (1923), contain excellent descriptive passages, while in *El Ombligo del Mundo,* the author writes of his native Asturias.

PÉREZ DE HITA, GINÉS (1544?–1619), Spanish novelist and poet, served in the campaign of 1569–71 against the Moriscos. He relates his experiences in the second part of the *Guerras civiles de Granada* (1595–1604?), which purports to be a chronicle based on an Arab original. It is in reality a historical novel. The events which led to the downfall of Granada are related with uncommon brilliancy, and the sympathetic transcription of life at the Emir's court undoubtedly influenced the Hispano-Mauresque novels of Mlle. de Scudéry and others.

PÉREZ GALDÓS, BENITO (1845–1920), Spanish novelist, was at first engaged in political journalism, but the reception given to his early novels, *La Fontana de oro* (1870) and *El Audaz* (1871), encouraged him to adopt novel-writing as a profession. He had already determined upon the scheme of his *Episodios nacionales,* a series which might compare with the *Comédie humaine.* Old charters, old letters, old newspapers were collected by him with the minuteness of a German archivist; no novelist was ever more thoroughly equipped as regards the details of his period. *Trafalgar,* the first volume of the *Episodios nacionales,* appeared in 1873, and long before the first series ended in 1879 Pérez Galdós took rank among the foremost novelists of his time. A monument of industry and exact knowledge, of realism and romantic conception, the *Episodios nacionales* were carried on into a fifth series, raising the total of volumes to forty-six. Parallel with his immense achievement in historical fiction, Pérez Galdós published a collection of romances dealing with contemporary life, its social problems and religious difficulties. Of these the best known, and perhaps the best, are *Doña Perfecta* (1876); *Gloria* (1877); *La Familia de León Roch* (1878); *Marianela* (1878); *Fortunata y Jacinta* (1887); and *Angel Guerra* (1891). Nor does this exhaust his prodigious activity. Besides adapting several of his novels for stage purposes, he wrote original dramas such as *La Loca de la Casa* (1893), *San Quintín* (1894), *Electra* (1900) and *Mariucha* (1903); but his diffuse, exuberant genius was scarcely accommodated to the convention of theatrical form.

PERFUMES, substances, generally of complex composition, which by reason of their fragrance gratify the sense of smell. The history of perfumes is closely associated with that of cosmetics (*q.v.*), and many of the earliest forms were made by digesting odorous vegetable substances with sesame, almond or olive oil. The principle underlying this process is still made use of although in an improved form and will be referred to later under *Maceration.*

Natural Perfumes.—These are the product of plant metabolism and their highest form is found in the scent of fresh flowers. This fragrance is due to the occurrence in the petals of minute traces of essential oil which in rose and lavendar is in the free state, whereas in jasmin and tuberose it is in the form of a glucoside. Under favourable conditions this complex substance is progressively decomposed in the presence of an enzyme or ferment with the formation of a volatile oil. The occurrence of natural perfume is, however, by no means confined to the inflorescence but frequently exists in other parts of the vegetable organism. Briefly it is found in the

flowers of cassia, carnation, clove, hyacinth, heliotrope, mimosa, jasmin, jonquille, orange blossom, rose, reseda, violet and ylang ylang;
flowers and leaves of lavender, rosemary, peppermint and violet;
leaves and stems of geranium, cinnamon and patchouli;
barks of cinnamon and cassia;
woods of cedar, linaloe and santal;
roots of angelica, sassafras and vetivert;
rhizomes of calamus, ginger and orris;
fruits of bergamot, lemon, lime and orange;
seeds of bitter almonds, anise and nutmeg;
gums or *oleo-resinous exudations* from myrrh, peru balsam, storax and tolu.

As mentioned above, the odoriferous constituents of the plant generally occur as a volatile oil which, after separation as described below, is a highly aromatic, mobile liquid. This usually contains several individual bodies, differing chemically, and to one or more of these the typical odour of the oil is due. Chemistry has been able in many cases to establish definitely these principal constituents, as, for instance, the odour of almond oil is attributed principally to *benzaldehyde,* of clove oil to *eugenol* and of lemon oil to *citral.* Where the oil is of complex composition, the typical odour is believed to be due to several perfectly blended constituents. For instance, in rose otto the *higher aliphatic aldehydes* in minute traces, together with the esters of the alcohols *geraniol* and *citronellol,* undoubtedly determine the distinctive rose fragrance. The separation of these natural odoriferous materials from the plant is no easy matter since a process that is suitable for one is of no use for another because the delicate perfume substance may be destroyed or decomposed or, furthermore, may be incompletely extracted. It will be best to describe briefly each process of the plant material under treatment.

Distillation.—This is effected by either boiling the vegetable organism with water in a closed apparatus when the source of heat may be an open fire or a steam-heated coil or jacket in the bottom; or by blowing live steam through the material. In each case the still is connected at the top with a condenser, through which the steam passes, carrying with it in suspension the fine particles of essential oil, the condensed steam and oil emerging from the lower orifice. On standing aside the oil floats to the top and is separated. Distillation with an open fire is the oldest process and in places far distant from modern factories this is resorted to by the peasants. It is, however, not free from danger, for if the water in the apparatus gets low the material is burnt, then the odour of the resulting oil is impaired. In some parts of Bulgaria this method is used for preparing rose otto and in some parts of India for distilling palmerosa oil. When steam is used for distillation a separate boiler is erected near by and the question of damaging the oil by burning is therefore eliminated Generally the raw material does not touch the bottom of the apparatus but is supported upon a false bottom or perforated sheet of metal and sometimes placed in an open wire basket suspended inside. In some cases the water used for distillation dissolves part of the oil or its constituents. It is sold separately, as, for instance, rose water or orange-flower water. Modern apparatus as used in Europe and America is often required to take one ton of material, such as lavender or peppermint, the capacity of the still being about 1,200 gallons. This process is applicable to the majority of the vegetable organisms mentioned above, the principal exceptions being some of the *flowers* and most of the *fruits.*

Expression.—The general name of the processes used to extract the essential oil occurring in the peels of bergamot, lemon, lime and orange fruits. The *sponge process* is used mainly for lemons and oranges cultivated in Sicily and the Calabrian belt. Girls cut the fruits either transversely or longitudinally and remove the pulp. The peel is then steeped in water to make the

cells more turgid. Men then press this drained peel on sponges which absorb the oil. The sponges are squeezed and the oil runs out into a shallow earthenware bowl placed in front of each operator. As each bowl is filled it is emptied into jars and allowed to stand until any juice has separated at the bottom. Subsequently it is filtered and packed in copper cans for export. The *Ecuelle method* consists of rolling the whole fruits about in hollow vessels covered with spikes inside. The oil cells are broken and the liquid flows into a receptacle in the handle. It is then clarified as above. *Machines* are now largely used to extract the oil from bergamots and lemons. In some cases the peel is broken and the oil collected, while in others the whole fruit is subjected to pressure, when the oil and juice run out together. The oil is separated in a machine something like a milk separator and comes out at the top (cream orifice). Limes are sometimes pressed by the sponge process, but the greater part of the oil is a by-product in the preparation of lime-juice.

Extraction.—The general name given to the processes used for extracting the essence from those flowers to which distillation would not be suitable because (1) the high temperature of steam would damage some of the unstable aromatic constituents and (2) the yield would be inadequate. *Enfleurage* has been employed in the south of France for many years and until comparatively recently was the process used for extracting all flowers. To-day it is used mainly for jasmin and tuberose and depends upon the absorption of perfume by fats. Wooden frames, called "chassis," each support a glass plate, on both sides of which is painted a specially prepared and purified mixture of beef and pork fats. The petals are spread lightly on the layers of grease and the chassis piled one upon the other. These are left for some hours until the grease has absorbed all the perfume. Fresh flowers replace the exhausted ones and the process is repeated until the fats are fully charged with perfume. These fats are known as *pomades. Maceration* differs from enfleurage in that the flowers are immersed in hot fats or oils at about 65°C. The heat ruptures the cells and the perfume is absorbed by the fat. Roses and all other flowers excepting jasmin and tuberose are treated this way. *Volatile solvents* are now largely used for extracting the essence from all flowers and many leaves and mosses. The vegetable organism is placed in a series of hermetically sealed cylinders and petroleum ether of great purity is allowed to run through them slowly. The last container is connected with a vacuum still and the solvent is distilled off and returned to the tank for use again. The perfume remains behind in the retort and is called a *concrete.* It contains the highly odorous essence together with natural and insoluble plant waxes. The concretes are shaken with strong and pure alcohol for 24 hours in machines called "batteuse." The perfume and some wax is dissolved and the insoluble waxes filtered out. The alcoholic extract is then placed in a freezing mixture, when the soluble waxes are separated. The solution of the pure flower essence is distilled *in vacuo,* which removes the alcohol and leaves behind the so-called *absolute flower oil.* This is the most expensive type of perfumery raw material and in the case of jasmin is worth from £3 to £6 an ounce according to the flower crop. The quantity of this flower used per annum for oil or other of these processes has for many years exceeded 1,300 tons while in the case of orange blossom it is even 2,000 tons.

Animal Perfumes.—These are of great importance in preparing finished perfumes and impart to them "life" and diffusiveness. The principal animal perfume is musk. This is a dried secretion from the preputial follicles of the male musk deer, which inhabits the mountainous districts of the Atlas and Himalayan ranges. The most important commercial variety is known as *Tonquin musk,* coming from Tibet and the plains of Kokonor, where the animal is found at altitudes of about 8,000 feet. The Chinese hunters capture the deer by various means and after killing it remove the gland completely. This is dried to develop the odour when it is known as a musk *pod.* After treatment and frequent adulteration with blood, earth, shot and hide the pods find their way to Tatsienlu in the province of Szechven. This is the principal centre for the trade and pods are then sent to dealers in Shanghai, whence they are exported. A quantity of musk is retained by the Chinese for medicinal purposes. *Ambergris* is a calculus formed in the intestines of the sperm whale. It is sometimes found there when the animal is killed but at others is picked up in the sea after being expelled. The calculus is the product of an intestinal disease caused probably by the insufficient digestion of cuttlefish, a food much appreciated by the sperm whale. To find a large piece of ambergris is a rare stroke of luck for sailors and one of the largest pieces ever found was stated to weigh 248 lb. and was valued at £13,200. *Civet* is a soft fatty substance of foetid odour imported principally from Abyssinia and packed in horns. It is a glandular secretion of both male and female civet cats. *Castor* is another perfume of animal origin, being the dried preputial follicles and their secretion from the Canadian and Russian beaver.

Balsams, Gums and Oleo-resins.—These are very important raw materials for perfumes because they generally have a soft and tenacious odour. Commercial samples consist of the natural exudation from the plant together with extraneous matter which is present owing to the crude methods of collection in different parts of the world. The valuable portion of the material contains a small percentage of highly odorous essential oil and a large proportion of soluble resin. The extraneous matter is eliminated by treating the crude substance with alcohol or other solvent, filtering out the insoluble matter and concentrating the filtrate by suitable methods. Some of the more important substances coming under this head are as follows:—*Benzoin* is obtained from trees native to Siam, Sumatra and Java. Incisions are made in the trunk and when the bark is removed the resin flows out as a milky sap and dries in the sun. *Labdanum* is a secretion from the leaves of several species of a genus of the rock rose family. The modern method is to collect the leaves and extract them, as described above, by means of volatile solvents. *Storax* is a balsam obtained from trees occurring in vast forests in the south-west of Asia Minor. It is collected by the Yaruks who beat the outer bark of the tree in midsummer and this causes the balsam to exude into the inner bark. The outer bark is then removed and the inner bark stripped off with knives. It is boiled with water, when the balsam separates and floats to the top.

Synthetics and Isolates are substances of standard quality prepared by chemical means. An isolate exists in a natural product and is separated from it in a nearly pure state. Examples of this are geraniol, an alcohol from palmerosa oil; carvone, a ketone from caraway oil; eugenol, a phenol from clove oil; safrol, a phenolic ether from camphor oil. A synthetic is "built up" from other substances, but this does not mean that it cannot exist in nature. There are many instances where a perfumery material occurs as one of the constituents of an essential oil, but it would never pay to separate it because it can be synthesised chemically much cheaper. Examples are phenyl ethyl alcohol, occurring in rose otto but synthesised from phenyl acetic esters; benzyl acetate, occurring in jasmin oil but synthesised from benzyl alcohol; linalyl acetate, occurring in lavender and bergamot oils but synthesised from acetic anhydride and linalol. Many synthetics, however, do not, so far as is known, exist in nature but are the result of chemical research. Examples are ionone, having the odour of violets and synthesised from citral and acetone; hydroxy-citronellal, having the odour of lilies and lilac and synthesised by hydrating citronellal; phenyl acetic aldehyde, having the odour of hyacinths and synthesised from cinnamic acid; musk ketone, having an odour recalling that of animal musk and synthesised by nitrating butyl-meta-xylene; d-cresyl phenylacetate, having an odour resembling that of narcissus and synthesised from coal tar liquors. Other important synthetic aromatic chemicals are amyl salicylate—(odour of clover); anisic aldehyde—(odour of may-blossom); benzylidene acetone—(odour of sweet pea); beta naphthol ethers—(odour of orange blossom); coumarin—(odour of tonka-beans); iso-eugenol—(odour of carnation); heliotropin—(odour of heliotrope); ethyl protocatechuic aldehyde—(odour of vanilla); gamma undecalactone—(odour of peaches); methyl phenyl acetate—(odour of gardenia); terpineol—(odour of lilac).

Artificial Flower Oils.—These are very widely used in the

as a basis for finished perfumes, but more particularly for scenting cosmetics. The misconception which exists concerning the crudeness of odour of these oils is altogether unfounded, especially when they have been prepared by an expert. It is quite true to say that no perfume offered to the public is entirely made from natural flower extracts. It is the *absolutes* skilfully blended with the synthetics, balsams and animal extracts that impart the delicious softness of odour so much appreciated The question of price generally decides how much of the natural substance shall enter the artificial compound For instance, a good jasmin oil made without any absolute would cost about two shillings an ounce. If about 2% of real Jasmin were added (and this proportion is necessary for the best oils) then the price would be doubled In many cases the perfume of flowers has been analysed, not completely because so far the reactions are not known for detecting many of the mere traces of aromatics present in a flower When a flower perfume has been analysed by present methods, however, it is a relatively simple matter to prepare an imitation from the known constituents, but there is always something lacking in the artificial odour. In order to compensate for this missing link a small quantity of the natural extract is used. In those cases where the composition of the flower perfume is not known the chemist must employ the nearest natural substance having an odour akin to that being imitated For instance, the composition of the perfume of violets is not known, so a small percentage of cassia absolute is used to give a natural finish to the ionone employed as its base

Finished Perfumes.—These are prepared from the artificial flower oils by solution in alcohol of about 80% strength They are toned or blended with balsams, gums and oleo-resins, which retard the rate of evaporation, and small quantities of extracts of animal origin are added to give greater persistence and diffusiveness of odour In many cases further quantities of flower extracts are added to improve the delicacy of the perfume and the whole is allowed to stand for several weeks or months in glass-lined tanks to allow it to mature The tenacity of a scent is of the utmost importance, and the longer a perfume will remain fragrant after application to the handkerchief or garment the more popular it becomes This is known as *fixation* and must be controlled during the whole of the process of manufacture Examples of fixators are (1) oils—patchouli, clary sage, santalwood, vetivert; (2) balsams, gums and oleo-resins—benzoin, labdanum, myrrh, oakmoss, storax; (3) synthetics—benzyl cinnamate, ethyl phthalate, coumarin, musk ambrette, heliotropin, vanillin. Many perfumes are so-called bouquets of flowery odour, yet representing no particular flower In these cases the typical odour is generally a combination of synthetics, one of which is used in sufficient quantity to create a new perfume note

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PERGA (mod *Murtana*), an ancient city of Pamphylia, situated about 8 m. inland, at the junction of a small stream (Sari Su) with the Cestrus. It was a centre of native influences as contrasted with the Greek, which were predominant in Attalia, and it was a great seat of the worship of "Queen" Artemis, here represented as a human-headed cone and a purely Anatolian nature goddess. There Paul and Barnabas began their first mission in Asia Minor (Acts ix. 13). A much frequented route into Phrygia and the Maeander valley began at Perga, and Alexander made it the starting-point of his invasion of inner Asia Minor Long the metropolis of Pamphylia Secunda, it was superseded in Byzantine times by its port, Attalia, which became a metropolis in 1084. The extensive ruins all lie in the plain south of the Acropolis. The walls are well preserved, but of late Roman or Byzantine reconstruction. The most notable monument is the theatre outside the walls on the S.W. Modern Murtana is only a large village.

PERGAMUM or PERGAMUS (mod. *Bergama*), an ancient city of Teuthrania, a district in Mysia It is usually named Πέργαμον by Greek writers, but Ptolemy has the form Πέργαμος.

Little but mythology is known of the city till the time of Xenophon, but it had been striking coins since 420 B.C. at latest. Its importance began under Lysimachus. In 283 B C. Philetaerus, governor of the fortress, rebelled, and Pergamum became the capital of a little principality. Philetaerus contrived to keep on good terms with his neighbours on all sides (283–263 B.C.). His nephew Eumenes (263–241) succeeded him, increased his power, and even defeated Antiochus II. of Syria near Sardis His successor Attalus I. (241–197) won a battle over the Gauls, and assumed the title of king Other Greek kings in Asia Minor reduced Pergamenian power to a very low ebb about 222 On the other hand, the influence of the Romans was beginning to make itself felt in the East. Attalus prudently connected himself with them and shared in their continuous success. Pergamum thus became the political and cultural capital of a considerable territory. The splendour of Pergamum was at its height under Eumenes II. (197–159) He continued true to the Romans during their wars with Antiochus and Perseus, and his kingdom spread over the greater part of western Asia Minor, including Mysia, Lydia, and a great part of Phrygia, Ionia and Caria He left an infant son, Attalus (III), and a brother, Attalus II. (Philadelphus), who ruled 159–138, and was succeeded by his nephew, Attalus III. (Philometor) The latter died in 133, and bequeathed his kingdom to the Romans, who erected part of it (excluding Great Phrygia, which they gave to Mithradates of Pontus) into a province under the name of Asia Pergamum continued to rank for two centuries as the capital, and subsequently, with Ephesus and Smyrna, as one of the three great cities of the province; and the devotion of its former kings to the Roman cause was continued by its citizens, who erected on the Acropolis a temple to Augustus It was the seat of a *conventus*, including the cities of the Caicus valley and some of those in the northern part of the Hermus valley Under the Roman Empire Pergamum was one of the chief seats of the worship of Asclepius "the Saviour" Pergamum was the chief centre of the imperial cult under the early empire, and in Rev. ii 13 is referred to as the place of "Satan's throne" It was also an early seat of Christianity, and one of the Seven Churches The place, re-fortified by the Byzantines, and still retaining its name as Bergama, passed into Muslim hands early in the 14th century The lower town was rebuilt, and in the 17th and 18th centuries became a chief seat of the great Dere Bey family of Kara Osman Oglu, which did not resign it to direct Ottoman control until about 1825 It is still an administrative and commercial centre of importance Excavations in the late 19th century at the south end of the Acropolis led to the discovery of the Altar of Zeus erected by Eumenes II in 180 B C. to celebrate his victory over the Gauls In very high relief and representing furious action, these altar sculptures are the finest which survive from the Pergamene school, which replaced the repose and breadth of earlier schools by excess of emphasis and detail The summit of the Acropolis is crowded with public buildings, between the market place, which lies at the southern point, and the Royal Gardens on the north. In the interval are the Zeus altar; the great hexastyle Doric temple of Athena flanked by the palace on the east, by the theatre and its long terrace on the west, and by a library on the north; and a large Corinthian temple of Trajan The residential part of the Greek, and practically all the Roman city lay below the Acropolis on ground now mostly occupied by modern Bergama; but west of the river Selinus, on rising ground facing the Acropolis, are the remains of a Roman theatre, an amphitheatre and a circus.

See, beside general authorities for Asia Minor, J Dallaway, *Constan-*

tinople, etc. (1797); W. M. Ramsay, *Letters to the Seven Churches* (1904); and especially the publication by the Royal Museum of Berlin, *Alterthümer von Pergamon* (1885 *sqq.*); "Operations at Pergamon 1906–1907," in *Athenische Mitteil.* (1908), xxxiii. 4; G. Leroux, "La Prétendue basilique de Pergame" in *Bull. Cor. Hell.* (1909), pp. 238 *sqq.*

PERGOLESI (or PERGOLESE), **GIOVANNI BATTISTA** (1710–1736), Italian musical composer, was born at Jesi near Ancona on Jan. 3, 1710. He was sent by a noble patron to complete his education at Naples, where he became a pupil of Greco, Durante and Feo for composition and of Domenico de Matteis for the violin. His earliest known composition was a sacred drama, *La Conversione di S. Guglielmo d'Aquitania*, between the acts of which was given the comic intermezzo *Il Maestro di musica*. These works were performed in 1731, probably by fellow pupils, at the monastery of St. Agnello Maggiore. Pergolesi was then commissioned to write an opera for the court theatre, and in the winter of 1731 successfully produced *La Sallustia*, followed in 1732 by *Ricimero*, which was a failure. Both operas had comic intermezzi, but in neither case were they successful. After this he abandoned the theatre for a time and wrote thirty sonatas for two violins and bass for the prince of Stigliano. In September 1732 he returned to the stage with a comic opera in Neapolitan dialect, *Lo Fratè inammorato*, which was well received; and in 1733 he produced a serious opera, *Il Prigionier*, to which the celebrated *Serva padrona* furnished the intermezzi. About this time (1733–1734) Pergolesi accompanied the duke of Maddaloni to Rome. The failure of *L'Olimpiade* at Rome in January 1735 was followed by a conspicuous success with his comic opera *Il Flaminio* at Naples in September of the same year. In 1736 he was sent by the duke of Maddaloni to the Capuchin monastery at Pozzuoli, the air of the place being considered beneficial to cases of consumption. Here he is supposed to have written the celebrated *Stabat Mater;* Paisiello, however, stated that this work was written soon after he left the *Conservatorio dei poveri di Gesù Cristo* in 1729. Of quite a different nature was the humorous, not to say improper, *Scherzo fatto ai Cappuccini di Pozzuoli.* Pergolesi died prematurely on March 17, 1736, and was buried in the cathedral of Pozzuoli.

BIBLIOGRAPHY.—The most complete life of Pergolesi is that by E. Faustini Fasini (Ricordi, 1900); G. Annibaldi's *Il Pergolesi in Pozzuoli, vita intima* (Jesi, 1890) gives some interesting additional details derived from documents at Jesi, but is cast in the form of a romantic novel. H. M. Schletterer's lecture in the *Sammlung musikalischer Vorträge*, edited by Count P. von Waldersee, is generally inaccurate and uncritical, but gives a good account of later performances of Pergolesi's works in Italy and elsewhere. Complete lists of his compositions are given in Eitner's *Quellen-Lexicon* and in Grove's *Dictionary* (1927).

PERGOLESI, MICHAEL ANGELO, an 18th-century Italian decorative artist, who worked chiefly in England to which he came about 1770. Like Cipriani he was brought, or attracted, to England by Robert Adam. He worked extensively for the Adams, and his designs are typical of much upon which their reputation rests. He designed furniture, mantelpieces, ceilings, chandeliers, doors and mural ornament with equal felicity. The centre panels of his walls and ceilings were often occupied by classical and pastoral subjects painted by Cipriani, Angelica Kauffmann, Antonio Zucchi, her husband, and sometimes by himself. Pergolesi was in large measure responsible for the designs for the painted satinwood furniture; some of this painted work was, apparently, executed by his own hand.

The chief source of information upon his works is his own publication, *Designs for Various Ornaments on Seventy Plates*, a series of folio sheets, without text, published between 1777 and 1801.

PERI, JACOPO (1561–1633), Italian composer, was born at Florence on Aug. 20, 1561, of a noble family. After studying under Cristoforo Malvezzi of Lucca, he became maestro di cappella, first to Ferdinand, duke of Tuscany, and later to Cosmo II. He was a member of the literary and artistic circle which frequented the house of Giovanni Bardi, conte de Vernio, where the revival of Greek tragedy with its appropriate musical declamation was a favourite subject of discussion. The poet Ottavio Rinuccini supplied a drama with the title of *Dafne*, to which Peri composed music, and this first attempt at opera was performed privately in 1597 in the Palazzo Corsi at Florence. In 1600 Rinuccini and Peri were commissioned to produce an opera on the occasion of the marriage of Henry IV. of France with Maria de' Medici. This work (*L'Euridice*) attracted a great deal of attention, and the type once publicly established, the musical drama was set on the road to success by the efforts of other composers and the patronage of other courts. Peri afterward wrote recitatives to Rinuccini's *Arianna* (1608), an opera *Adone* for Mantua (1620), and *La precedenza delle dame* for the court of Florence (1625). He died in Florence on Aug. 12, 1633.

Peri's *Dafne* (which has entirely disappeared) and *L'Euridice* (printed at Florence 1600; reprinted Venice 1608 and Florence 1863) are of the greatest importance not only as being the earliest attempts at opera, but as representing the new monodic and declamatory style which is the basis of modern music as opposed to the contrapuntal methods of Palestrina and his contemporaries. Of his work only *L'Euridice* and the *Varie musiche a una, due a tre voci* (Florence, 1609) survive.

See R. Rolland, *Histoire de l'opéra en Europe avant Lulli et Scarlatti* (1895).

PERIANDER (625–585 B.C.), the second tyrant of Corinth. In contrast with his father Cypselus, the founder of the dynasty, he is generally represented as a cruel despot. The Greek tradition, however, is probably derived from a prejudiced source. There is no doubt that he was ruthless with the remains of the nobility. A careful sifting of the available evidence would rather tend to represent Periander as a ruler of probity and insight, and the firmness and activity of his government is beyond dispute. His home administration was so successful that he was able to dispense with direct taxation, and, combined with the far-seeing colonizing activities, laid the foundations of Corinth's commercial and industrial prosperity. Periander further appears as a patron of literature, for it was by his invitation that the poet Arion came to Corinth to organize the dithyramb. To promote and protect Corinthian commerce he established colonies at Potidaea and Apollonia in Macedonia, at Anactorium and Leucas in northwestern Greece, and he is said to have projected a canal through the isthmus. In Greece proper he conquered Epidaurus and annexed Corcyra. He cultivated friendly relations with the tyrants of Miletus and Mytilene, and maintained a connection with the kings of Lydia, of Egypt and, possibly, of Phrygia.

Periander was reckoned one of the seven sages of Greece, and was the reputed author of a collection of maxims (Ὑποθῆκαι) in 2,000 verses. The letters ascribed to him are spurious.

See Herodotus iii. 48–53, v. 92; Aristotle, *Politics*, v. 6, 10–12; Heracleides Ponticus in C. Müller's *Frag. hist. graec.* ii. 212; Nicolaus Damascenus, *ibid.*, iii. 393; Diogenes Laertius, *De vitis clarorum philosophorum*, i. ch. 7; *Cambridge Ancient History* (vol. iii. 1925).

PERIANTH, the term used in botany to denote the outer covering of the flower, composed of more or less modified but non-reproductive leaves and divided usually into an outer, often greenish whorl, the calyx of sepals; and an inner, often brightly-coloured whorl, the corolla of petals. (*See* FLOWER.)

PERIBOLOS or **PERIBOLUS,** in architecture, a sacred enclosed space, usually containing a temple, altar or shrine, especially used of such enclosures in ancient Greece, but occasionally of the enclosed, consecrated ground around an early mediaeval church, which was the limit to which its rights of sanctuary extended.

PERICARDIUM, DISEASES OF THE. (For anatomy, *see* COELOM AND SEROUS MEMBRANES.) The serous sac in which the heart is contained may be the seat of inflammation (pericarditis) along with the cardiac valves and heart muscle in the course of acute rheumatism or other acute diseases. The normal shiny appearance is then lost, the membrane becomes congested and inflammatory serum exudes into the cavity. In this stage the visceral and parietal layers grate upon one another with the heart's beat and give rise to a "friction rub" over the front of the chest which can be heard with the stethoscope and may be perceptible to the hand. As more inflammatory exudation is poured out the surfaces are separated and friction disappears. From this point the course of the disease varies according as the inflam-

mation advances or recedes. If it advances fluid may accumulate in the sac to an extent that seriously impedes cardiac action, while if the pericarditis accompanies or follows pneumonia the fluid may become purulent. In either event exit must be given to the fluid surgically. If the disease recedes the roughened pericardial surfaces again come into contact through absorption of the exuded fluid, and friction reappears. Later, fibrous adhesions are formed between the two layers of pericardium over a greater or smaller area; sometimes they become universally adherent and the cavity is obliterated. Exudation of fluid into the pericardial cavity, apart from inflammation, occurs in certain diseases of the kidney and is then often unaccompanied by symptoms though it is a very grave omen. In rupture of the heart or of certain varieties of aneurism the pericardial sac is suddenly filled with blood. Distress is extreme and death occurs after a few seconds from mechanical interference with the action of the heart. Other conditions affecting the pericardium either act by inducing inflammation or are so rare that they cannot be considered here.

(W. S. L.-B.)

PERICLES (*c.* 490–429 B.C.), Athenian statesman, was born about 490 B.C., the son of Xanthippus and Agariste. His father took a prominent part in Athenian politics, and in 470 held high command in the Greek squadron which annihilated the remnants of Xerxes' fleet at Mycale; through his mother, the niece of Cleisthenes, he was connected with the former tyrants of Sicyon and the family of the Alcmaeonidae. His early training was committed to the ablest and most advanced teachers of the day; Damon instructed him in music, Zeno the Eleatic revealed to him the powers of dialectic; the philosopher Anaxagoras, who lived in close friendship with Pericles, had great influence on his cast of thought and was commonly held responsible for that calm and undaunted attitude of mind which he preserved in the midst of the severest trials.

The first important recorded act of Pericles falls in 463, when he helped to prosecute Cimon on a charge of bribery, after the latter's Thasian campaign; but as the accusation could hardly have been meant seriously Pericles was perhaps put forward only as a lay-figure. Undue prominence has commonly been assigned to him in the attack upon the Areopagus in 462 or 461 (*see* AREOPAGUS; CIMON), which was mainly the work of his senior colleague Ephialtes. To Ephialtes likewise we must ascribe the renunciation of the Spartan alliance and the new league with Argos and Thessaly (461).

Not long after, however, when Ephialtes fell by the dagger, Pericles undoubtedly assumed the leading position in the State. On several later occasions, and throughout the period 443–429 B.C., he held the office of strategus (general-in-command), and to the end of his life he remained the most influential speaker in the ecclesia (popular assembly). The beginning of his ascendancy is marked by an unprecedented outward expansion of Athenian power. In continuance of Cimon's policy, 200 ships were sent to support the Egyptian insurgents against Persia (*c.* 459 B.C.), while detachments operated against Cyprus and Phoenicia. At the same time Athens embarked on several wars in Greece proper. An alliance with the Megarians, who were being hard pressed by their neighbours of Corinth, led to enmity with this latter power, and before long Epidaurus and Aegina were drawn into the struggle. On sea the Athenians, after two minor engagements, gained a decisive victory which enabled them to blockade Aegina. On land their general Myronides beat off two Corinthian attacks on Megara, which had been further secured by long walls drawn between the capital and its port Nisaea, nearly a mile distant. In 457 the Athenians and their allies ventured to intercept a Spartan force which was returning home from central Greece. At Tanagra in Boeotia a pitched battle was fought, in which both Pericles and the partisans of Cimon distinguished themselves. The Spartans were successful but did not pursue their advantage, and soon afterwards the Athenians, seizing their opportunity, sallied forth again and obtained the submission of all Boeotia, save Thebes, and of Phocis and Locris. In 455 Tolmides secured Naupactus on the Corinthian gulf; in 454 Pericles himself made a descent upon Oeniadae at the mouth of the gulf. These years mark the zenith of Athenian greatness. Yet the drain on the country's strength was severe, and when news arrived in 453 that the Egyptian armament had been destroyed by the Persians a reaction set in, and Cimon was empowered to make peace with Sparta on the basis of the *status quo*. For a while the old anti-Persian policy again found favour in Athens, and Cimon led a great expedition against Cyprus; but on his death hostilities were suspended, and a lasting arrangement with Persia was brought about. It was probably in order to mark the definite conclusion of the Persian War and to obtain recognition for Athens' work in punishing the Mede that Pericles now proposed a pan-Hellenic congress at Athens to consult about the rebuilding of the ruined temples and the policing of the seas; but owing to the refusal of Sparta the project fell through.

Pericles may now have hoped to resume his aggressive policy in Greece proper, but the events of the following years completely disillusioned him. In 447 an Athenian army, which had marched into Boeotia to quell an insurrection, had to surrender in a body at Coroneia, and the price of their ransom was the evacuation of Boeotia. Upon news of this disaster Phocis, Locris, and Euboea revolted, and the Megarians massacred their Athenian garrison, while a Spartan army penetrated into Attica as far as Eleusis. In this crisis Pericles induced the Spartan leaders to retreat, apparently by means of a bribe, and hastened to reconquer Euboea; but the other land possessions could not be recovered, and in a thirty years' truce which was arranged in 445 Athens definitely renounced her predominance in Greece proper. Pericles' foreign policy henceforward underwent a profound change—to consolidate the naval supremacy, or to extend it by a cautious advance, remained his only ambition. While scouting projects for interference in distant countries, he occasionally made a display of Athenian power abroad, as in his expedition to the Black sea (after 445 B.C.) and in the colonization of Thurii (445–443 B.C.), which marks the resumption of a western policy. The peaceful development of Athenian power was interrupted by the revolt of Samos in 440. Pericles himself led out a fleet against the seceders; he won a first engagement, but unwisely divided his armament and allowed one squadron to be routed. In a subsequent battle he reduced the town itself.

Turning to Pericles' policy towards the members of the Delian League, we find that he frankly endeavoured to turn the allies into subjects (*see* DELIAN LEAGUE). A special feature of his rule was the sending out of numerous cleruchies (*q.v.*), which served the double purpose of securing strategic points to Athens and converting the needy proletariat of the capital into owners of real property. The land was acquired either by confiscation from disaffected states or in exchange for a lowering of tribute. The chief cleruchies of Pericles are: Thracian Chersonese (*c.* 450 B.C.), Lemnos and Imbros, Andros, Naxos and Eretria (before 447); Brea in Thrace (446); Oreus (445); Amisus and Astacus in the Black sea (after 445); Aegina (431).

In his home policy Pericles carried out more fully Ephialtes' project of making the Athenian people truly self-governing. His chief innovation was the introduction of payment from the public treasury for State service. He provided a remuneration of one to two obols a day for the jurymen, and he created a "theorikon" fund which enabled poor citizens to attend the dramatic representations of the Dionysia. In connection with this system of salaries should be mentioned a somewhat reactionary law carried by Pericles in 451, by which an Athenian parentage on both sides was made an express condition of retaining the franchise and with it the right of sitting on paid juries. The measure by which the archonship was opened to the poorer citizens (457 B.C.) may also be due to Pericles (*see* ARCHON).

The last years of his life were troubled by a new period of storm and stress. A conflict between Corcyra and Corinth, the second and third naval powers of Greece, led to the simultaneous appearance in Athens of an embassy from either combatant (433). Pericles had, as it seems, resumed of late a plan of western expansion by renewing alliances with Rhegium and Leontini, and the favourable position of Corcyra, on the trade-route to Sicily and Italy, as well as its powerful fleet, no doubt helped to

induce him to secure an alliance with that island, and so to commit an unfriendly act towards a leading representative of the Peloponnesian League. Pericles now seemed to have made up his mind that war with Sparta, the head of that League, had become inevitable. In the following spring he fastened a quarrel upon Potidaea, a town in Chalcidice, which was attached by ancient bonds to Corinth, and in the campaign which followed Athenian and Corinthian troops came to blows. A further *casus belli* was provided by a decree forbidding the importation of Megarian goods into the Athenian empire, presumably in order to punish Megara for her alliance with Corinth (spring 432). The combined complaints of the injured parties led Sparta to summon a Peloponnesian congress which decided on war against Athens, failing a concession to Megara and Corinth (autumn 432). In this crisis Pericles persuaded the wavering assembly that compromise was useless, because Sparta was resolved to precipitate a war in any case. An embassy calling upon the Athenians to expel the accursed family of the Alcmaeonidae, clearly aimed at Pericles himself as its chief representative, was left unheeded, and early in 431 hostilities began between Athens and Sparta and their respective allies (*see* PELOPONNESIAN WAR).

At the same time Pericles was being sorely hampered by his adversaries at home. The orthodox Conservatives and some democrats who were jealous of his influence, while afraid to beard the great statesman himself, combined to assail his nearest friends. The sculptor Pheidias (*q.v.*) was prosecuted on two vexatious charges (probably in 433), and before he could disprove the second he died under arrest. Anaxagoras was threatened with a law against atheists, and felt compelled to leave Athens. A scandalous charge against his mistress Aspasia, which he defeated by his personal intercession before the court, was taken very much to heart by Pericles. His position at home scarcely improved during the war. His policy of abandoning the countryside was unpopular with the land-owning section of the people, who from the walls of Athens could see their own property destroyed by the invaders. At the end of the first year of war (early in 430) Pericles made a great appeal to the pride of his countrymen in his well-known funeral speech. But in the ensuing summer, after a terrible outbreak of plague had ravaged the crowded city, the people became thoroughly demoralized. Pericles led a large squadron to harry the coasts of the Peloponnese, but met with little success. On his return the Athenians sued for peace, though without success, and a speech by Pericles had little effect on their spirits. Late in 430 they deposed him from his magistracy. In addition to this they prosecuted him on a charge of embezzlement and imposed a fine of 50 talents. A revulsion of feeling soon led to his reinstatement, apparently with extraordinary powers. But the plague, which had carried off two of his sons and a sister, had left its mark also on Pericles himself. In the autumn of 429 he died and was buried near the Academia, where Pausanias (150 A.D.) saw his tomb. A slightly idealized portrait of Pericles as *strategus* is preserved to us in the British Museum bust, No. 549, which is a good copy of the well-known bronze original by Cresilas.

If we now endeavour to give a general estimate of Pericles' character and achievements, it will be well to consider the many departments of his activity one by one. In his foreign policy his standpoint was at all times purely Athenian. We may clearly distinguish two periods in his administration of foreign affairs. At first, joining to Cimon's anti-Persian ambitions and Themistocles' schemes of western expansion a new policy of aggression on the mainland, he endeavoured to push forward Athenian power in every direction, and engaged himself alike in Greece proper, in the Levant and in Sicily. After Cimon's death he renounced the war against Persia, and the collapse of 447–445 had the effect of completing his change of attitude. Henceforward he repressed all schemes of adventure and confined himself to the gradual expansion and consolidation of the empire. It is not quite easy to see why he abandoned this successful policy in order to hasten on a war with Sparta, and neither the Corcyrean alliance nor the Megarian decree seems justified by the facts as known to us, though commercial motives may have played a part which we cannot now gauge. In his adoption of a purely defensive policy at the beginning of the Peloponnesian War he severely tried the temper of the Athenians, but in the main his policy was sound, and the disasters of the war cannot fairly be laid to his charge. In his attitude towards the members of the Delian League Pericles likewise maintained a purely Athenian point of view, and his appropriation of federal funds for Athenian purposes is difficult to justify. But he could hardly be said seriously to have oppressed the subject cities. Under Pericles Athens also attained her greatest measure of commercial prosperity, and the activity of her traders all over the Levant, the Black sea and the West, is attested not only by literary authority, but also by many Attic coins and vases.

Pericles' home policy has been much debated since ancient times. His chief enactments relate to the payment of citizens for State service. These measures have been interpreted as an appeal to the baser instincts of the mob, but this assumption is entirely out of keeping with all we know of Pericles' general attitude towards the people, over whom Thucydides says he practically ruled as a king. We must, then, admit that Pericles sincerely contemplated the good of his fellow-countrymen, and we may believe that he endeavoured to realize that ideal Athens which Thucydides sketches in the funeral speech—an Athens where free and intelligent obedience is rendered to an equitable code of laws, where merit finds its way to the front, where military efficiency is found along with a free development in other directions and strangles neither commerce nor art. In accordance with this scheme Pericles sought to educate the whole community to political wisdom by giving to all an active share in the government, and to train their aesthetic tastes by making accessible the best drama and music. It was most unfortunate that the Peloponnesian War ruined this project by diverting the large supplies of money which were essential to it.

Pericles also incurred unpopularity because of his rationalism in religious matters; yet Athens in his time was becoming ripe for the new culture, and would have done better to receive it from men of his circle—Anaxagoras, Zeno, Protagoras and Meton—than from the more irresponsible sophists. The influence of Aspasia on Athenian life, though denounced unsparingly by most critics, may indeed have been beneficial, inasmuch as it tended towards the emancipation of the Attic woman from the over-strict tutelage in which she was kept. As a patron of art and literature Pericles was a still greater force. He counted Sophocles and probably also Herodotus among his personal friends, and he left a profound impression on the mind of Thucydides. He is largely responsible for the splendour of Attic art in his time, for had he not so fully appreciated and given such free scope to the genius of Pheidias, Callicrates and Ictinus, Athens would hardly have witnessed the raising of the Parthenon and other famous structures.

Of Pericles' personal characteristics we have a peculiarly full and interesting record. He was commonly compared to Olympian Zeus, partly because of his serene and dignified bearing, partly by reason of the eloquence with which he held friend and foe spellbound. The same dignity appeared in the grave beauty of his features, though the abnormal height of his cranium afforded an opportunity for ridicule of which the comedians made full use.

ANCIENT AUTHORITIES.—Our chief source must always remain Thucydides (i. and ii. 1–65), whose insight into the character and ideals of Pericles places him far above all other authorities. The speeches which he puts into his mouth are of special value in disclosing to us Pericles' inmost thoughts and aspirations (i. 140–144; ii. 35–46; ii. 60–64). Thucydides alone shows sympathy with Pericles, but he was by no means a blind admirer. Of other 5th-century sources, Aristophanes is obviously a caricaturist, pseudo-Xenophon (*de republica Atheniensium*) a mere party pamphleteer. Plato, while admiring Pericles' intellect, accuses him of pandering to the mob; Aristotle in his *Politics* and especially in the *Constitution of Athens*, which is valuable in that it gives the dates of Pericles' enactments as derived from an official document, accepts the same view. Plutarch (*Pericles*) gives many interesting details as to Pericles' personal bearing, home life, and patronage of art, literature and philosophy; but he reproduces scandalous anecdotes in a quite uncritical spirit.

For Pericles' politics, *see* E. Abbott, *Pericles and the Golden Age of Athens* (1898); Ad. Schmidt, *Das Perikleische Zeitalter;* and the relevant parts of the general histories of Greece. For Pericles' buildings,

see E. A. Gardner, *Ancient Athens* (1902) and M. L. d'Ooge, *The Acropolis of Athens* (1908). *See* ATHENS: *History;* GREECE: *Ancient History;* and GREEK ART. (M. C.)

PERIDOTITE, a plutonic holo-crystalline rock composed in large part of olivine, and almost or entirely free from felspar. The rocks are the most basic, or least siliceous plutonic rocks, and contain much iron oxide and magnesia. Hence they have dark colours and a high specific gravity (3·0 and over). In some peridotites, such as the *dunites,* olivine greatly preponderates over all other minerals. It is always in small, rather rounded crystals without good crystalline form, and pale green in colour. Most of the rocks of this group, however, contain other silicates such as augite, hornblende, biotite or rhombic pyroxene, and often two or three of these are present. By the various mineral combinations different species are produced, *e.g.,* mica-peridotite, hornblende-peridotite, enstatite-peridotite. Of the accessory minerals the commonest are iron oxides and chromite or picotite. In some peridotites these form segregations or irregular masses which are of importance as sources of the ores of chromium. Platinum and the nickel-iron compound awaruite are found in rocks of this class in New Zealand. Red garnet (pyrope) characterizes the peridotites of Bohemia. The diamond mines of South Africa are situated in pipes or volcanic necks occupied by a peridotite breccia which has been called *kimberlite.* In this rock in addition to diamond the following minerals are found; hypersthene, garnet, biotite, pyroxene (chrome-diopside), ilmenite, zircon, etc.

Some peridotites have a granular structure, *e.g.,* the dunites, all the crystal grains being rounded and of nearly equal size; a few are porphyritic with large individuals of diallage, augite or hypersthene. Some are banded with parallel bands of dissimilar composition, the result probably of fluxion in a magma which was not quite homogeneous. The great majority of the rocks of this group are poikilitic, that is to say, they contain olivine in small rounded crystals embedded in large irregular masses of pyroxene or hornblende. The structure is not unlike that known as ophitic in the dolerites, and arises from the olivine having first separated out of the liquid magma while the pyroxene or amphibole succeeded it and caught up its crystals. In hand specimens of the rocks the smooth and shining cleavage surfaces of hornblende and augite are dotted over with dull blackish green spots of olivine; to this appearance the name "lustre-mottling" has been given. Although many peridotites are known in which the constituent minerals are excellently preserved, the majority have undergone much mineralogical alteration. The olivine is specially unstable and is altered to serpentine while the pyroxene and amphibole are in large measure fresh. In some cases the whole rock is changed to an aggregate of secondary products. Most serpentines (*q.v.*) arise in this way. *See* also PICRITE. (J. S. F.)

PÉRIER, CASIMIR PIERRE (1777–1832), French statesman, was born at Grenoble on Oct. 11, 1777, the son of a rich banker and manufacturer, Claude Périer (1742–1801), who was one of the first directors of the Bank of France; of his eight sons, Augustin (1773–1833), Antoine Scipion (1776–1821), Casimir Pierre and Camille (1781–1844), all distinguished themselves in industry and in politics. Casimir joined the army of Italy in 1798. On his father's death he left the army and with his brother Scipion founded a bank in Paris. He opposed the ruinous methods by which the duc de Richelieu sought to raise the war indemnity demanded by the Allies, in a pamphlet *Réflexions sur le projet d'emprunt* (1817), followed in the same year by *Dernières réflexions . . .* in answer to an inspired article in the *Moniteur.* In the same year he entered the chamber of deputies for Paris, taking his seat in the Left Centre and making his first speech in defence of the freedom of the press. Re-elected for Paris in 1822 and 1824, and in 1827 for Paris and for Troyes, he sat for Troyes until his death. Under Louis Philippe Périer became president of the chamber of deputies, and sat for a few months in the cabinet without a portfolio.

On the fall of the ministry of Laffitte, Casimir Périer, who had drifted more and more to the Right, was summoned to power (March 13, 1831), and in a year he restored civic order in France and re-established her credit in Europe. Paris was only held in check by the premier's determination; revolts at Lyons and Grenoble were also put down. The minister refused to be dragged into armed intervention in favour of the revolutionary Government of Warsaw, but he constituted France the protector of Belgium by the prompt expedition of the army of the north against the Dutch in Aug. 1831; French influence in Italy was asserted by the audacious occupation of Ancona (Feb. 23, 1832); and the refusal of compensation for injuries to French residents by the Portuguese Government was followed by a naval demonstration at Lisbon. In the spring of 1832 during the cholera outbreak in Paris, Périer visited the hospitals with the duke of Orleans. He fell ill the next day and died on May 16, 1832.

His *Opinions et discours* were edited by A. Lesieur (2 vols., 1838); C. Nicoullaud published in 1894 the first part (*Casimir-Périer, député de l'opposition, 1817–1830*) of a study of his life and policy; and his ministry is exhaustively treated by Thureau-Dangin in vols. i. and ii. (1884) of his *Histoire de la monarchie de juillet.*

For the family in general *see* E. Choulet, *La Famille Casimir-Périer* (Grenoble, 1894).

PERIGEE, in astronomy that point of the moon's orbit or of the sun's apparent orbit at which the moon or sun approaches nearest to the earth (Gr. περί, near, γῆ, the earth). The sun's perigee and the earth's perihelion (*q.v.*) are so related that they differ 180° in longitude, the first being on the line from the earth toward the sun, and the second from the sun toward the earth. The longitude of the solar perigee is now 101°, that of the earth's perihelion 281°.

PÉRIGORD, as a French province, formed part of the military government of Guienne and Gascony, and was bounded on the north by Angoumois, on the east by Limousin and Quercy, on the south by Agenais and Bazadais, and on the west by Bordelais and Saintonge. It is now represented by the departments of Dordogne and part of Lot-et-Garonne. Périgord was in two divisions: Périgord blanc (cap. Périgueux) and Périgord noir (cap. Sarlat). Under the Roman empire it was included in *Aquitania secunda,* and it afterwards formed the diocese of Périgueux. From the 8th century it had its own counts, who were feudatories at first of the dukes of Aquitaine and afterwards of the kings of England. In the 15th century the county passed to the dukes of Orleans, and in the 16th came to the family of d'Albret, becoming Crown land again on the accession of Henry IV.

See the *Dictionnaire topographique du département de la Dordogne* by the Vicomte de Gourgues (1873); the Bulletin of the *Société historique et archéologique du Périgord* (1874 *seq.*); *l'Inventaire sommaire de la "Collection de Périgord"* in the Bibliothèque nationale (1874); J. L. Dessalles, *Histoire du Périgord,* 3 vols. (Libourne, 1883–86).

PÉRIGUEUX, a town of south-western France, formerly capital of the old province of Périgord, now chief town of the department of Dordogne, 79 m. E N E. of Bordeaux, on the railway between that city and Limoges. Pop. (1926), 30,482. Vesunna was the capital of the Petrocorii, allies of Vercingetorix when Caesar invaded Gaul. The country was afterwards occupied by the Romans, who built a second city of Vesunna on the right bank of the Isle opposite the site of the Gallic town. The barbarian invasion brought this prosperity to a close. St. Front preached Christianity here in the 4th century and over his tomb there was raised a monastery, which became the centre of the new town called Le Puy St. Front. The *cité* was pillaged by the Saracens about 731, and in 844 the Normans devastated both quarters. The new town soon began to rival the old city in importance, and it was not until 1240 that the attempts of the counts of Périgord and the bishops to infringe on their municipal privileges brought about a treaty of union. During the Hundred Years' War, Périgueux was twice attacked by the English, who took the *cité* in 1356; and the whole town was ceded to them by the Treaty of Brétigny, but returned to the French Crown in the reign of Charles V. The county passed by marriage into the hands of Anthony of Bourbon, father of Henry IV., and was converted by the latter into royal domain. During the Huguenot wars Périgueux was frequently a stronghold of the Calvinists, who in 1575 did great destruction there, and it also suffered during the troubles of the Fronde.

The town, standing on a height on the right bank of the Isle,

is divided into three parts. On the slope of the hill is the mediaeval town; to the west is the modern town; to the south of the modern town is the old Roman town or *cité*. Three bridges connect Périgueux with the left bank of the Isle, where stood Vesunna, the capital of the Petrocorii. Hardly a trace of this old Gallic town remains, but not far off, on the Plateau de la Boissière, the rampart of the old Roman camp can still be traced. On the right bank of the Isle, in the Roman city, there have been discovered some baths of the first or second century, supplied by an aqueduct 4 m. long, which spanned the Isle. A circular building, called the "Tower of Vesunna," stands at what was formerly the centre of the city. It is believed to have been originally the cella or main part of a temple, probably dedicated to the tutelary deities of Vesunna. The amphitheatre, now in ruins, had a diameter of 1,312 ft., that of the arena being 870 ft.; and dates from the 3rd or even the 2nd century. The counts of Périgueux used it for their château, and lived in it from the 12th to the end of the 14th century. In 1644 it was given over by the town to the Order of the Visitation, and the sisters built their nunnery with stones from it. Of the ruins of the *cité*, the Château Barrière is an example of the fortified houses formerly common there. Two of its towers (third or fourth century) formed part of the fortified enceinte; the highest tower is of the tenth century; and the part now inhabited is of the 11th or 12th century, and was formerly used as a burial chapel. The bulk of the château is of the 12th, and some of the windows of the 16th century.

The chief mediaeval building in the *cité* is the (11th and 12th centuries) church of St. Etienne, once the cathedral; it has a fine carved wooden reredos of the 17th century and a tomb of a bishop of the 12th century. In the mediaeval town, known as Le Puy-St.-Front, is the cathedral of St.-Front which, till its restoration in the 19th century, was of unique architectural value. Nearby are the remains of an old basilica of the 6th century, above which rises the unique Byzantine 11th century belfry. It is composed of two massive cubes, placed the one above the other in retreat, with a circular colonnade surmounted by a dome. To the south-west of St. Front, the buildings of an old abbey (11th to 16th century) surround a 13th century cloister. Of the fortifications of Le Puy-St.-Front, the chief relic is the Tour Mataguerre (14th century).

Périgueux is the seat of a bishop, prefect and court of assizes, and has tribunals of first instance and of commerce and a board of trade-arbitrators. The trade of the town is in pigs, truffles, vegetables, brandy, poultry, pies known as *pâtés de Périgord,* and all kinds of preserved foods. There are quarries in the adjacent vicinity.

PERIHELION, in astronomy, the point of nearest approach of a body to the sun (Gr. *περί,* near, *ἥλιος,* sun). The earth is at perihelion about Jan. 3.

PERIM, a British island in the Strait of Bab-el-Mandeb and 96 m. W. of Aden. Pop. about 200. Formed of volcanic rocks, it stands on the shallow threshold of the Red sea, 2 m. from the Arabian shore, and is about 3½ m. long with an area of 7 square miles. It is horse-shoe shape and a good harbour (depth of water 30 ft.) occupies the concavity on the south side. It is a coaling and revictualling station for vessels. Perim, the Diodoros island of the *Periplus,* was garrisoned from 1799–1801 by a British force and in 1857, in view of the cutting of the Suez canal, annexed to Great Britain, becoming a fortified charge of the Aden residency. It is a cable station and has a lighthouse on the eastern end of the island.

PERINO DEL VAGA (1500–1547), a painter of the Roman school, whose true name was PERINO (or PIERO) BUONACCORSI. He was born near Florence on June 28, 1500. Perino was first apprenticed to a druggist, but soon passed into the hands of a mediocre painter, Andrea da Ceri, and, when eleven years of age, of Ridolfo Ghirlandajo. The painter, Vaga from Toscanella, undertook to settle the boy in Rome, but first set him to work in Toscanella. Perino, when he at last reached Rome, was poor, and with no clear prospect beyond journey-work for trading decorators. He was eventually entrusted with some of the subordinate work undertaken by Raphael in the Vatican. He assisted Giovanni da Udine in the stucco and arabesque decorations of the loggie of the Vatican, and executed some of those small scriptural subjects which go by the name of "Raphael's Bible"—Raphael himself furnishing the designs. Perino's examples are: "Abraham about to sacrifice Isaac," "Jacob wrestling with the Angel," "Joseph and his Brethren," the "Hebrews crossing the Jordan," the "Fall and Capture of Jericho," "Joshua commanding the Sun to stand still," the "Birth of Christ," "His Baptism" and the "Last Supper." He also painted, after Raphael's drawings, the figures of the planets on the ceiling of the great hall of the Appartamenti Borgia. He executed many other works about Rome.

After Raphael's death in 1520 he executed several works independently in Rome, in the churches of S. Marcello and Trinità de Monti. He then returned to Florence, where his work was much appreciated. On his return to Rome in 1523 he associated himself with Giulio Romano, and Penni, whose sister he married. After Le Sacco di Roma in 1527 he settled in Genoa, where he was employed in decorating the Doria Palace. He ornamented the palace and frescoed historical and mythological subjects in the apartments, fanciful and graceful arabesque work, sculptural and architectural details. Among the principal works are: the "War between the Gods and Giants," "Horatius Cocles defending the Bridge," and the "Fortitude of Mutius Scaevola." He also did some work in Pisa in the Duomo and elsewhere. Finally he returned to Rome, where Paul III. allowed him a regular salary. He worked in the Sala della Segnatura (Vatican) on the monochrome decoration of the basement, to replace Fra Giovanni's woodwork decoration which had been destroyed in the Sacco of 1527; he was engaged in the decoration of the Sala Reale, begun by Paul III., when his health gave way, and he died on Oct. 19, 1547. He is buried in the Pantheon. (W. M. R.)

PERINTHUS (Turk. *Eski Eregli,* Old Heraclea), an ancient town of Thrace, on the Propontis, 22 m. W. of Selymbria, strongly situated on a small peninsula. It was a Samian colony, founded about 599 B.C. for trade with Thrace and beyond. Its original name was Mygdonia; later it was called Heraclea Thraciae or Heraclea Perinthus. In 340 B.C. it successfully resisted Philip II. of Macedon and rivalled Byzantium in importance.

PERIODICAL. The term "periodical" refers to reviews and magazines appearing monthly or at longer intervals; it has also been applied to weekly and other newspapers but these are for the most part excluded here. The date in parentheses is the date when the periodical was first published.

The general output of literature reflects changes in the constitution of society (in the large sense) and of the political outlook, but whereas in books we find an index to the life and thought of a generation, the periodical is, or should be, a mental chart recording from day to day the level of average educated intelligence of its readers.

It may be said, generally, that there have been five definite epochs in periodical literature: its birth in the seventeenth century; its jubilee in the eighteenth century, when Addison and Steele did their brilliant work; its rapid expansion in the first half of the nineteenth century; the revolt of the specialists in the latter half; and the vast output of the present, with popular approbation as its objective.

The Early Periodicals.—The beginning of the periodical was in the 17th century, when catalogues of books (1646) were first issued. The bare titles of books, however, did not seem sufficiently attractive, catalogues being, in the opinion of many, "dry things scarce able to raise in men that gust and appetite to learning." Short notices were added by the bookseller or by his hack. The amalgamation of the titles and the commentaries brought the "notices" into greater prominence until they became the leading features. A further strong impetus was given to this new departure by the *Journal des Sçavans,* which began to be printed in France in 1665, and by Britain's *Acta Philosophica* (1665), from both of which editors drew material. A little later they also made abstracts from the *Acta Eruditorum,* issued in Germany in 1682. The French *Journal* was entirely devoted to giving its readers summaries of books. Its publication has continued up to the present time, with only one short break at the end of the eighteenth century. The *Philosophical Transactions* of the Royal

Society (1665) followed in imitation of, and with a similar scope to, the French *Journal*. The aim was stated to be "to give some account of the present undertakings, studies and labours of the Ingenious in many considerable parts of the world." These two journals were, in reality, the parents of the periodical. In the *Weekly Memorials for the Ingenious* (1682) a further development may be registered, when an original contribution made its appearance for the first time. A few years after it was followed by the *Universal Historical Bibliothèque* (1686), which announced its intention of printing reviews of the most important books and the "quality of the author if known." This seems to be the first attempt at periodical criticism, and the first time that it is recorded that an editor asked for contributions from the learned. The innovation was welcome. Periodicals began at once to increase. An interesting attempt, on account of its novelty and originality, was the *Athenian Gazette* (1690), the forerunner of *Notes and Queries* and *Answers,* in which undertaking Samuel Wesley was partner with John Dunton, the editor. Defoe appears as one of the contributors to this magazine when it was issued under the name of the *Athenian Mercury.* In 1692 Dunton issued supplements in which natural history and natural phenomena were dealt with, thus still further widening the scope of the periodical. The *Compleat Library* (1691–92, also printed for John Dunton) came next in order of time and importance with a definite plan allotting a given space to original contributors and to the reviews of books. This magazine contained the elements of criticism as understood to-day. The *Works of the Learned,* 1691, by J. de la Crose deserves mention because it has been said to be the first literary periodical. Side by side with these attempts at giving the public serious reading were periodicals which, though vulgar and obscene, reflect the manners of the day. The best known was Edward Ward's *London Spy,* which is full of well-drawn sketches of London life.

Essay Periodicals.—A new phase in periodical literature began with the eighteenth century. The chief representatives are the *Tatler* (1709), which established the essay periodical as a type, the *Spectator* (1711), the *Guardian* (1712), and the *Examiner* (1710). Politics now became blended with literature. All the great writers then were politicians. Swift and Bolingbroke wrote diatribes for the *Examiner* and filled its pages with personal attacks against the leading men and women of the day; Addison and Steele used their pens in the *Spectator* and *Guardian* to defend Whig principles. The former attained such popularity for its outspoken articles that its sale rose to 4,000. These journals were the only medium then existing of telling men what was happening in politics, and the only guide available for those who desired a lead. Addison and Steele owed their position as public men to the brilliant essays they wrote. The pen was their only weapon, for neither was an orator. The success they achieved, however, was checked by the Stamp Act, passed to curb the licence of the Press and to restrain frank criticism. Owing to its restriction, several periodicals were compelled to cease printing. They had gone a step further than their predecessors in giving current news, social and legal, and in criticising books on literature, history and travel. Perhaps the two most interesting of the century are the *North Briton* (1762) and *Gentleman's Magazine* (1731). The former was edited by John Wilkes (*q.v.* for its history).

The latter, the *Gentleman's Magazine,* though not then the leading monthly, is better known to us than any other of the older periodicals. It contained summaries of events at home and abroad, scraps of art and antiquity, and short and accurate obituary notices now so often consulted by the genealogist.

THE MODERN BRITISH PERIODICAL

The modern periodical burst upon the world with a singular glory at the very beginning of the nineteenth century. The three outstanding periodicals were the *Edinburgh* (1802), the *Quarterly* (1809), and *Blackwood* (1817).

The story of the founding of the *Edinburgh* is recorded in full in Cockburn's *Life of Lord Jeffrey,* 1852. A group of young men, among whom were Sydney Smith, Henry Brougham and Francis Jeffrey, resolved, after some consultation together, to start a new magazine to be called the *Edinburgh Review.* The credit of mooting the idea is generally accorded to Sydney Smith. The aim of the *Edinburgh* was "to erect a higher standard of merit, and secure a bolder and a purer taste in literature, and to apply philosophical principles and the maxims of truth and humanity to politics." But the promoters were not sanguine; it seemed an almost unjustifiable experiment. Undaunted, however, the venture took shape and the first number appeared in October 1802. "The effect," says Cockburn, "was electrical. It was an entire and instant change of everything that the public had been accustomed to in that sort of composition The learning of the new journal, its talent, its spirit, its writing, its independence, were all new. Its literature, its political economy and its pure science were generally admired. It was hailed as the dawn of a brighter day."

The Tory spirit was roused to action by the *Edinburgh.* To maintain their principles the *Quarterly* and *Blackwood* came out as rivals. These three journals together have maintained the political and literary note of the founders up to the present day, the political element always predominating.

The Popular Magazine.—In the next fifty years the crowd of magazines hurtle against each other on the bookstall and in reading-rooms. No sooner has one outstripped the other in popularity than another starts in the race seeking to surpass its rival in excellence and dignity. Their names seem legion and the heterogeneity bewildering. Four—*All the Year Round* (1859), the *Cornhill* (1860), *Macmillan's Magazine* (1860), and *Temple Bar* (1861)—are typical of the period.

The beginnings of these magazines have resolved round the question of supply and demand. Competition between publishers was now alive and active. The series started with *All the Year Round,* with Charles Dickens as editor, and was succeeded after a short lapse of time by the other three under the respective editorships of Thackeray, David Masson, and George Augustus Sala. Since their object was to beguile the leisure hours of the public, fiction was preferred to politics. The tables were turned. The political article was either non-existent or was relegated to the background. The classical and literary essay had proved failures.

The *Cornhill,* the most characteristic example of the spirit of modernity that was creeping in, was launched by Mr. George Smith in 1860 with the idea of making the popular serial the chief attraction. Though the plan cannot be claimed as original, the enterprise necessary to carry it out belongs to Mr. Smith. His scheme was the first definite move in this direction. The novelty of it "lay in uniting the popular lure of the serial with the literary work of the more serious reviews" A pleasant record of the founding of this magazine is given in the *History of the House of Smith, Elder.*

Children's Magazines.—An outstanding feature of the late 19th century is the development of literature for the young, principally due to the spread of education. In a world bent on introducing new methods and making experiments in the upbringing of children, with encyclopaedias and dictionaries expressly written that they may be comprehended by them, it is not surprising that the serial for boys and girls should also fill an important niche. The best magazines contain a mixture of fiction, science and practical suggestions to young people in a variety of crafts which might appeal when grammar becomes tedious. The credit for originating this special kind of literature seems to belong to the New World *The Young Misses' Magazine* (1806) of Brooklyn apparently led the way, and was then followed by many others until in the seventies of the nineteenth century the avalanche of printed matter began to move forward and has never ceased to advance The first to appear were *Little Folks* (1871), *The Boys' Own Paper* (1879) and *The Girls' Own Paper* (1880). Among the most popular monthlies in England are *My Magazine* (1914), formerly the *Children's Magazine* (1911), ably edited by Arthur Mee, and *Child Education* (1924). In the United States *St. Nicholas* (1873) and *Youth's Companion* (1827) call for mention.

Historical and Scientific Magazines.—The revolt of the

'eighties and 'nineties, as we have termed this next period, though not quite accurate when one comes to examine details, is significant of this period when historian, antiquarian and scientist first became aware that the ordinary periodical did not meet their requirements. A glance at the dates when the principal historical and other scientific magazines were founded will bring conviction to those who would be inclined to question this contention. A few samples are sufficient to show the tendency.

The *English Historical Review* began in 1886, the *Classical Review* in 1887, the *Church Quarterly Review* in 1875, the *Asiatic Quarterly* in 1886 (since 1914 called the *Asiatic Review*), the *Law Quarterly* in 1885, the *Magazine of Art* in 1878, and the *Western Antiquary* in 1883.

The Coming of Illustrations.—The general periodical had not, however, come to a standstill. On the contrary, new magazines were keeping the printer busy. It is only necessary to mention *The Nineteenth Century* in 1877, which immediately took the foremost place in the political and literary field, and *Longman's Magazine* or *Murray's Magazine;* but these were merely developing on the lines of their predecessors, and forced their way into notice by dint of the great ability displayed by their editors. This period is also notable for the first magazine that made illustrations a distinct feature. Many had already inserted full-page illustrations and woodcuts in the 'sixties, but none of these approached to what we now accept as an illustrated magazine. The *English Illustrated Magazine* (1884) may perhaps be considered the parent of illustrated periodicals, though no doubt the bibliographer would name an earlier one. The continually changing attitude of the public is clearly shown by George Augustus Sala, who had stated in *Temple Bar* (1861) that, with due regard to the interests of his readers, he preferred to give them sixteen extra pages of print rather than an illustration or two.

The journalism of our own day was quick to take the suggestion thus received. Popularisation is its keynote. Innumerable publishers adopted the view of Sir George Newnes that a magazine should give "wholesome and harmless entertainment to crowds of hard-working people craving for a little fun and amusement," and should provide the public with light literature and a large supply of illustration to please the senses. The failure of Mr. W. T. Stead to see eye to eye with Sir George Newnes when the *Review of Reviews* was brought out resulted in the issue of the *Strand Magazine* in 1891. The design of that magazine was that it should "contain stories and articles by the best British writers and special translations of the chief foreign authors." Its policy was "to change individual features as soon as there were signs that the public were tired of them." No limit was to be put to illustration. It was a bold move, and even the publishers felt that they were embarking "upon the wildest extravagance in furnishing no fewer than a hundred and ten illustrations in a single number." It must be remembered that this was before the general adoption of process engraving, and that woodcuts were still in use. The success which followed was phenomenal. Though fiction predominated, many articles of a scientific nature, comprehensible to the lay mind, were printed. One notable example deserves mention, namely, the contribution of Professor Langley on his own aeroplane with a picture of its flight, which may be said to be the first representation of the working of an aerial machine. The periodical market is now crowded with magazines of this kind of varying merit and popularity.

Canada.—Canada naturally did not show the same literary activity in the 18th century as the mother country, but the standard to which it has attained gives it precedence among British self-governing dominions. The first monthly in Eastern Canada, or Nova Scotia as it was called, was *The Nova Scotia Magazine* (1789–92), and in Canada proper *The Canadian Magazine* (Quebec, 1823–25). In addition to these there were the bi-lingual *Quebec Magazine* (1791–93), a quarterly; and several others entirely in French, *L'Abeille canadienne* (1818); *La Bibliothèque canadienne* (1825–30), continued as *L'Observateur* (1830–31); and the *Magasin du Bas-Canada* (1832). *The Literary Garland* had a longer life (1838–50) than most of those that preceded and was for some time the only English magazine published in Canada. A series of interesting French-Canadian reviews followed; the foremost *La Revue canadienne* (1864) contained the best writing of contemporary French-Canadian men of letters. A short-lived serial *The Bystander* (1880–83) was edited by Goldwin Smith. The quite modern publications are *The Queen's Quarterly* (1893), the organ of the Queen's University, Kingston, Ont.; *The Canadian Forum* (1920); *The Dalhousie Review* (1921). Mention should also be made of the *University Magazine*, the organ of McGill University, now no longer issued; and *Le Canada Français* (1888), published by the Université Laval de Quebec.

Australia and New Zealand.—There has not been any lack of literary venture in the great Southern colonies, but among the many magazines issued in the 19th century only one or two can lay claim to any real merit. But it must be remembered that the learned societies print Journals or Transactions which in a small community supply the need. *The Sydney University Magazine* (1855 and 1878–79), continued as *The Sydney University Review*, was of some importance and of literary value. The best magazine now is probably *The Bulletin*, in which many noted Australian writers have first made their mark. Apart from *The Bulletin* there are two monthlies, *Life* and *Stead's Review*. The former is popular and illustrated, while the latter is a copy of the well-known *Review of Reviews*. *The Lone Hand* (1907) and the *New Triad*, New South Wales, take the lead among popular serials. A journal of outstanding merit, *The Economic Record*, the organ of the Economic Society of Australia and New Zealand, cannot be included among literary reviews.

UNITED STATES

The periodical made its appearance in America later than in England. After the struggle with Great Britain was over, the Americans with the enthusiasm of a young nation exerted themselves to the utmost to lay the foundation of a national literature. One of the items in their programme was the periodical, which they took special care to encourage. From the very beginning it seemed to them an essential vehicle of culture. The postal authorities with a generosity uncommon in modern days, stimulated its circulation by the grant of liberal terms for postage.

In imitation of *The Gentleman's Magazine*, Benjamin Franklin founded *The General Magazine* (1741) at Philadelphia, but its life was short. Several attempts to bring out new periodicals were made during the next thirty years, but none seemed to grasp what the public wanted. *The Pennsylvania Magazine* (1775–76), perhaps the most notable, was the joint work of Robert Aitken and Thomas Paine.

The most important magazines of the 18th century were *The American Museum* (1787); *The Universal Asylum and Columbian Magazine* (1790); *The Monthly Anthology* (1803), an interesting Bostonian experiment, in which the study of Belles Lettres predominated; established by Phineas Adams, it was taken over a few months later by the Anthology Club of which Ticknor, Everett, William Tudor and Bigelow were members; *The Salmagundi* (1807) for which Washington Irving wrote; *The Literary Magazine* (1803–07), whose editor was Charles Brockden Brown, and the *Port Folio* (1809) issued in 1801 as a weekly newspaper, and then in 1809 transformed into a monthly. This last named exercised a considerable influence over the literary life of the period by its disinterested devotion to pure literature. Its editor, Joseph Dennie, received the nickname of "The American Addison."

A peculiar feature of the 18th and early 19th centuries in America was the desire of every town of any size to have its own magazine run by its own small literary coterie. Each group wished to express its own opinion and to direct the literary taste of its fellow townsmen. An interesting and creditable example of these provincial attempts was *The Medley* (1803) issued in Lexington, Kentucky. The premier place in periodical literature belongs to *The North American Review* (1815). It is the only one that survived through the troublous days that followed its inception. Its list of contributors contained among others the names of Edward T. Channing, Richard Henry Dana, John Adams, George Ticknor, Daniel Webster and George Bancroft. Its

first editor, William Tudor, gave as the reason for establishing it "a desire to emancipate America from undue subservience to England in literary matters." After a period of comparative dullness and prosy writing, it emerged to new life in 1864 under the joint editorship of Lowell and Charles Eliot Norton.

Holmes, Lowell and Emerson.—A few years later the *North American Review* was followed by *The United States Literary Gazette* (1825–27) to which Longfellow made many contributions; by the *New England Magazine* (1831–35), famous as the medium selected by Oliver Wendell Holmes for the chapters of his *Autocrat of the Breakfast Table;* by Lowell's *Pioneer* (1843), a short-lived publication not without interest, since it contained tales by Poe and Hawthorne, and by *The Dial* (1840–44) published quarterly by a group of New England transcendentalists with Emerson as its second and unwilling editor. "I wish it to live," he wrote in his diary, "but I do not wish to be its life. Neither do I like to put it into the hands of the Humanity and Reform men, because they trample on letters and poetry; nor in the hands of scholars, for they are dead and dry." It was not a financial success and ended with an existence of four years.

Among other periodicals of high standing were the *Knickerbocker Magazine* (1833), an early and successful popular magazine published in New York (after a succession of well known editors, Lewis Gaylord Clark assumed control of the magazine until it ceased to appear in 1859); the *Boston Quarterly Review* (1838), merged five years afterwards with the *Democratic Review,* and the *Southern Literary Messenger* (1834).

Not unworthy of mention are two successful magazines of the lighter kind, *Godey's Lady's Book* (1830) and *Graham's* (1841). Poe, Longfellow and Holmes wrote for the former, while Lowell, Hawthorne and Simms contributed to the latter. When the middle of the century was reached, and more especially after the Civil War, competition between publishing houses began in earnest. The position of the *North American Review,* the sole survivor of the early 19th century, was assailed on every side. Its most serious rivals were *Harper's Magazine* (1850), *The Atlantic Monthly* (1857), and some years later *Scribner's Magazine* (1870), *The Century* (1881) and *The Forum* (1885).

The financial difficulties of the preceding generation were gradually overcome by the new processes in printing, by the great advance in the art of illustration, and by the increased facilities of transport, while the rapid development of advertising has also done a great deal to secure the commercial success of the periodical, unfortunately often to its detriment.

The outstanding feature of the 20th century is the decline in popularity of the quarterlies with their long and heavy reviews, and the rise of the magazine with short well written essays, charming stories, and illustrations of artistic excellence. Among the many reviews devoted to literature it is difficult to select the best, but attention must be called to the *American Mercury* (1924), and to *The Bookman* (1895) a purely literary monthly of some years' standing.

FRANCE

The *Journal des Sçavans* in France, the first number of which appeared in January, 1665, is acknowledged to be the parent of modern periodical literature. The credit of having mooted the idea is due to Denys de Sallo, who at the time was regarded as a genius and inventor for having framed the scheme. Its intention and scope is given in the *Encylopédie méthodique* "il a été inventé pour le soulagement de ceux qui sont ou trop occupés ou trop paresseux pour lire les livres entiers."

One of its principal successors, the *Nouvelles de la République des lettres* (1684), though published at Amsterdam, was edited by Bayle who had retired to Holland, where, in spite of the comparative liberty of the press, nothing had as yet been issued resembling the *Journal.* A very few years after, the *Mémoires pour servir à l'histoire des sciences et des arts,* known by the name of *Journal de Trévoux* (1701–67), was brought out under the auspices of the Jesuits, who announced that it would contain extracts and criticisms from books of science printed in France and elsewhere. Their primary object, however, was to defend religion from attack, and it was probably for this reason that it incurred the displeasure of Voltaire. Its course ran so smoothly that for thirty years the printers of the little town of Trévoux were kept busy, until it became more convenient to transfer the headquarters of the Journal to Paris. Simultaneously the *Spectator* and *Tatler* were appearing in England, giving a new impulse to periodical literature. The French, characteristically averse from imitation, hesitated, and refused to follow the lines laid down by Addison and his companions. It was not till 1722 that Marivaux made his unsuccessful attempt to rival the Englishmen by issuing his *Spectateur français* (1722). The *Spectateur suisse* (1723), *Le nouveau Spectateur* (1758) and others came after but were of little value. *Le Pour et le Contre* (1723–40) edited by the Abbé Prévost, and full of anecdote and miscellaneous information, had also some traits in common with the English reviews. Another periodical of high rank of the 18th century—Voltaire proclaimed it the chief journal—was the *Journal encyclopédique* (1756–73) founded by P. Rousseau, who carried on his work for many years under the protection of the Count of Horion, minister of the prince bishop of Liége. When the latter died, Rousseau was compelled to transfer the Journal from Liége to Bouillon on account of the philosophical articles it contained, but permission was given him to establish his presses there.

Development of the periodical in France has not been quite so rapid as in England and elsewhere, though it has proceeded on similar lines. The cheapness of books has probably had a considerable influence. What the French term "Journaux de lecture" or "de récréation," like the *Gentleman's Magazine,* made their appearance late in France, and have not met with the same remarkable success as in England and America. The first genuine example may be said to be *Le Journal pour tous* (1855) an illustrated literary magazine which was much sought after. The periodicals of the specialist seem to have started a little earlier than in England; the first law journal (*Journal du Palais*), appeared in 1672, the first medical journal (*Nouvelles découvertes dans toutes les parties de la médecine* par Blégny) in 1679.

The leading reviews to-day are:—*Revue des deux Mondes* (1829), *Nouvelle Revue* (1879), *Revue bleue* (1863), *Revue de Paris* (1894), *Le Mercure de France* (1890), *Revue de France* (1871), *Revue Hebdomadaire* (1892) and *Chronique des Lettres françaises* (1922).

GERMANY

The *Acta Eruditorum* (1682), the earliest of German periodicals, as has been mentioned above, was not only limited in the choice of subjects to mathematics, physics and botany, but was also handicapped by the use of the Latin language. Nevertheless, German men of science, like Leibnitz, the botanist Ettmüller, and the mathematician Pfautz combined to make the *Acta* a central meeting ground where the results of their researches might be read. The plan turned out so successful that others decided to try the same experiment. In consequence, a large number of similar journals issued from the press. Christian Thomasius, professor in the University of Halle and the founder of journalism in Germany, led the way with the first learned periodical in the German language. *Schertz- und Ernsthaffter Vernünftiger und Einfältiger Gedanken über allerhand lustige und nützliche Bücher und Fragen* (1688). Twenty years later, soon after the English periodicals of Addison and Steele had reached Hamburg, the Germans taking these, especially the *Spectator* and the *Guardian,* as models brought out *Der Vernunftler* (1713), *Die Lustige Fama* (1718), *Discoursen der Maler* (1721). But the culminating point was reached when F. Nicolai introduced his *Briefe die neueste Literatur betreffend* (1759) to the world, and enlisted as collaborators Lessing and Mendelssohn. Nicolai offered a yearly prize of 50 thalers for the best tragedy, an early example of rewards offered by a periodical. This move had a considerable influence on the dramatic literature in Germany in those days. The *Frankfurter Gelehrten Anzeigen* (1772) formerly *Frankfurter Gelehrte Zeitung* (1736) followed a few years later and is chiefy interesting because Goethe wrote for it as a young man, and similarly the *Jenaische Litteratur-Zeitung* (1804) of which Goethe may be said to have

acted as editor in chief. But *Der Teutsche Mercur* (1773–89) stands out more prominently than most of the preceding, and its appearance marks a further stage in the history of this branch of literature.

Germany, split up as she was into a variety of states, was just beginning to show signs of an awakening to a new political consciousness, while editors and writers were forced to note events in the world beyond their boundaries and to discuss politics. The happenings in America and France drove them into new currents of thought. When at last the century was drawing to a close, politics were displacing literary matter in the pages of the periodical so completely that the editor of *Minerva* (1792) wrote "the best poems are unread; men are craving for the journals to satisfy their political appetite."

Fifty years later, after the Revolution of 1848, the periodical in Germany as everywhere else underwent another phase. Editors with a view to increasing their circulation appealed to a wider public of intelligent readers for support. The magazines became more attractive and their matter lighter. Among these may be cited *Westermanns Monatshefte* (1856), *Unsere Zeit* (1857), *Gartenlaube* (1853). The number of monthly publications has gone on increasing ever since, until at the present moment they may be reckoned in thousands. The trend of development does not differ much from that in other countries, while the reading public of Germany is less given to this form of literature than in England.

The best known are the *Preussische Jahrbücher* (1838), the *Deutsche Rundschau* (1874), *Historische Zeitschrift* (1859), *Neue Rundschau* (1889), *Die Literatur* (1898), and *Deutsche Vierteljahrsschrift* (1923).

OTHER EUROPEAN COUNTRIES

Holland.—The oldest periodicals in Holland are the *Examinator* (1719) and *Den Amsterdamschen Hermes* (1722–23). In 1837 *De Gids* was founded as the organ of Liberalism and at the same time of a new movement in literature. It is still the most important of Dutch reviews although it lost its literary leadership when *De Nieuwe Gids* started in 1885 and has never quite regained it. Of twentieth century literary periodicals *Het Haagsch Maandblad* (1921) and *De Stem* (1920) are important.

Italy.—The conditions under which literary men worked in Italy were different from those in other countries. Here the church interfered to a greater degree in the production of books, while the fact that Italy was broken up into a number of petty states militated against the circulation of literature. It was unwise for writers to touch on politics, and religious matters for the most part were barred; sanction of the church being always necessary when anything new was conceived. Nevertheless, the *Journal des Scavans* had its imitator in Rome when Cardinal Ricci began to print *Il Giornale de' Litterati* (1668–79), and Venice, always in the forefront in literary activities, issued the *Galleria di Minerva* (1696). The rivalry, however, of the various academies and princes acted as a continual curb, and the outlook of editors and writers remained circumscribed for a long period. Even in the 18th century when Baretti undertook to publish *La Frusta letteraria* (1763), liberty of the press was still unheard of. Baretti so mercilessly attacked the writers of Italy and even the ruling princes, that after a few years of precarious existence the *Frusta* was suppressed. He had also incurred displeasure by his disapproval of the opinions of a coterie of young men in Milan whose organ *Il Caffè* was greatly influenced by French thought. The best modern periodicals are *Nuova Antologia* (1866) a bi-monthly, *La Critica* (1903) edited by B. Croce, *La Revista d'Italia* (1897), *La Rassegna italiana* (1918), *Revista di cultura* (1920), *La Cultura* (1922), *Il Convegno* (1919) and *Le opere e i Giorni* (1922).

Poland.—The position in Poland has always been difficult owing to political turmoil, to the partition of Poland and subsequent Draconian measures of both Russian and Prussian governments. The first monthly seems to have been the *Pamiętnik* of Sartkowski (1782–92). When Russia became more liberal in 1905 the press began to revive, but the modern period does not start till 1918. The present reviews in French and German are chiefly intended to give information to the foreigner.

Portugal.—In Portugal the *Jornal Enciclopedico* (1779) and subsequently *O Panorama* (1837–68) were the chief serials. The latter was concerned with history and letters, and Herculano published his historical tales in it. The nearest approach to the English *Nineteenth Century* were the *Revista universal* (1841–59) the *Revista Peninsular* (1855–56) and the *Revista de Portugal*. *O Instituto* which began in 1853 still continues, and is a scientific and literary review, and the *Lusitania* (1924), which is literary, artistic and historical.

Russia.—In Russia the Academy of Sciences led the way by the issue of a monthly (1755), and four years later the first private undertaking, the *Trudolyubivaya Pchela* (1759), came out. Shortly after, Novikov, a distinguished man of letters in the reign of Catherine II., brought out two or three serials (1777–82) simultaneously, but throughout the whole of the 18th century the public in Russia does not seem to have fancied this kind of publication; subscribers were few and entirely confined to readers in Moscow and St. Petersburg (Leningrad). In the 19th century the most representative magazines were the *Vestnik Evropy* (1802–30) edited by the historian Karamsin; the *Biblioteki dlya Chteniya* (1834), the first to obtain any commercial success; the *Sovremmenik* (1836), founded by Pushkin; the *Russkaya Starina* (1852), limited to archaeology and history, but of considerable value; the *Russky Vestnik* (1856), edited by the well-known publicist Katkov; the *Vestnik Evropy* (1866), a continuation of the earlier *Vestnik*, to which the novelist Turgenev contributed; the *Russkoe Bogatstvo* (1878); *Russkaya Misl* (1881); *Letopis* (1913), edited by Maxim Gorki. The latest comer, the *Novy Mir* (New World), is the chief journal in present day Russia.

Scandinavian Countries.—The northern countries of Europe, Sweden, Norway and Denmark, have never lagged behind in the production of literature. The earliest periodical in Sweden was *Svenska Argus* (1733) moulded on Addison's and Steele's *Spectator*. Of modern reviews the following are worth mentioning: *Ord och Bild* (1892), *Nordisk Tidskrift* (1878) which prints historical and philosophical essays and studies but excludes articles on political and religious topics, and *Det nya Sverige* (1907), a very conservative organ. For special information on the early history of periodicals in Sweden Sylwan's *Svenska pressens historia intill 1772* (1896) should be consulted. In Norway *Ugentlige Korte Afhandlinger* (1760) claims priority. *Samtiden* (1890), started by Gerhard Gran in Bergen, and transferred about 1900 to Oslo, is now the leading Norwegian journal. It is edited by Prof. J. S. Wörm-Müller. In Denmark *Nye Tidender om laerde Sager* (1720) is the oldest critical periodical. The leading monthlies are: *Tilskueren* (1884), *Gads danske Magasin* (1906) and the latest, *Dansk Udsyn* (1921).

Spain.—In Spain the periodical came much later than in France, and it was in the beginning dependent on its French prototype. The earliest examples date from the middle of the 18th century, the two best known being *Efemérides Barometricomedicas matritenses* (1743–47) edited by Fernández Navarrete, and the *Diario de los Literatos de España* (1737–42). A third, *Memorial literario* (1784) might be added.

During the reign of Ferdinand VII. (1784–1833) and of his predecessor, literary men worked under great disadvantages. The censorship of the press was active, and the church viewed printed matter with suspicion. The numbers who subscribed to periodicals were few, while their distribution in the provinces was difficult. The life of a new periodical was therefore often short, both the editor and the author receiving but a poor reward for their labour. In spite of these restrictions, however, there are two or three worth noting—*Misceldnea de Comercio, Artes y Literatura* (1819–21) and *El Censor* (1820–22).

When Cristina became regent in 1833 those antagonistic to the press lost much of their power and many new periodicals began to come out. To a great extent they also began to free themselves from foreign influence.

The publication of reviews is one of the most characteristic features of present day Spain; they are generally literary. Every town or province has its own organ. The most important general

eview of the 20th century was *La Lectura*, but it has now ceased to appear. At present there is *La Revista de Occidente* (1923) edited by Ortega y Gasset; *Residencia* published by the Residencia de Estudiantes, Madrid, is also good and of greater nterest than its title would imply. Mention may also be made of he *Gaceta literaria; La Pluma* (1919); and *La Revista hispanoamericana de ciencias, letras y artes* (1921).

Switzerland.—The *Nova litteraria helvetica* (1703–15) of Zurich is the earliest literary periodical which Switzerland can show. This was followed by the *Bibliothèque italique* (1728–36) and the *Bibliothèque britannique* (1796–1815) both published at Geneva. The leading Swiss periodicals now are *La revue mensuelle* (Geneva, 1897); *La Revue de Genève* (1919); *Bibliothèque universelle* (1816), and *Revue Suisse* (1838) amalgamated n 1838 as the *Bibliothèque universelle et revue suisse. La Suisse romande* (1885) only lasted twelve months. *Théologie et philosophie* (1868–1872), an account of foreign literature on those subjects, was continued as *Revue de théologie et de philosophie* (1873) at Lausanne. Among later periodicals may be mentioned *Archives de psychologie de la Suisse romande* (1901) edited by Flournoy and Claparède; *Jahresverzeichnis der schweizerischen Universitätsschriften* (1897–1898); *Untersuchungen zur neueren Sprach- und Literaturgeschichte* (1903); *Zwingliana: Mitteilungen zur Geschichte Zwingli und der Reformation* (1897).

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(C. T. H. W.)

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PERIODIC CURRENT, as applied to radio, is alternating current in which the frequency is determined by the electrical constants of the circuits in which it flows.

PERIODIC LAW, THE. The classification of the elements, in the strict chemical sense, is a comparatively recent problem, for it was not until about the beginning of the 19th century that the two kinds of chemical substances, elements and compounds, were clearly differentiated. The early years of the century witnessed a rapid development in analytical chemistry, the art of distinguishing different chemical substances, and the consequent building up of a vast body of knowledge of the chemical and physical properties of both elements and compounds. This rapid expansion of chemical knowledge soon necessitated classification, for on the classification of chemical knowledge are based not only the systematized literature of chemistry but also the laboratory arts by which chemistry is passed on as a living science from one generation of chemists to another. The elementary substances are few in number, rather less than a hundred, with distinctive properties, whereas compound substances are extremely numerous, in the order of a million, with properties correspondingly diversified and often overlapping. The fact that many compounds contain elements in common renders classification easy, whereas elements, having no chemical components, are not readily amenable to classification. It thus occurred that the classification of elements lagged many years behind that of compounds, and, in fact, no general agreement had been reached among chemists as to the classification of elements for nearly half a century after the systems of classification of compounds had become established in general use.

Probably the earliest steps towards the classification of the elements were taken by J. W. Döbereiner between 1817 and 1829, when he showed that certain triads of elements possessed close relationships between their members, the alkaline-earth metals, calcium, strontium, and barium, for example, having many properties in common, those of strontium being a mean between those of calcium and barium. Similarly in the halogen triad, the properties of bromine are a mean between those of chlorine and iodine, while in the alkali metal triad the properties of sodium are a mean between those of lithium and potassium. J. B. A. Dumas, L. Gmelin, E. Lenssen, Max von Pettenkofer, and J. P. Cooke, between 1828 and 1854, expanded Dobereiner's suggestions by showing that similar relationships were more extensive than between triads of elements, fluorine being added to the halogens, and magnesium to the alkaline-earth metals, while oxygen, sulphur, selenium, and tellurium were classed as one family, and nitrogen, phosphorus, arsenic, antimony and bismuth as another family of elements.

Many attempts were subsequently made to prove that the atomic weights of the elements were expressible by an arithmetical function, and in 1862 A. E. B. de Chancourtois proposed a classification of the elements based on the new values of atomic weights (*q.v.*) consequent on Stanislao Cannizzaro's system of 1858. De Chancourtois plotted the atomic weights on a helical curve such that corresponding points differed by 16, the atomic weight of oxygen. This curve brought closely related elements on to corresponding points, and he suggested in consequence that "the properties of the elements are the properties of numbers," a remarkable prediction in the light of the modern view that the elements are characterized by the natural numbers from unity onwards which express the numbers of electrons in atoms (*See* ATOMIC NUMBERS.) In the following year, 1863, J. A. R. Newlands proposed a system of classification of the elements in the order of atomic weights, the elements being assigned ordinal numbers from unity upwards and divided into seven groups having properties closely related to the first seven elements, hydrogen, lithium, beryllium, boron, carbon, nitrogen and oxygen. This septenary relationship was termed the *law of octaves*, by analogy with the seven intervals of the musical scale. A somewhat similar classification was put forward by William Odling a year later, and in 1869 Dmitri I. Mendeléev, as a result of an extensive correlation of the properties and atomic weights of the elements, proposed the periodic law by which "the elements arranged according to the magnitude of atomic weights show a periodic change of properties."

The Periodic Classification of the Elements as proposed

by Mendeléev in 1869 had few advantages over the classifications of Newlands and Odling, the families of elements in all three classifications being arranged in horizontal rows. The principal virtue of Mendeléev's classification lay in the fact that he clearly recognized that the outstanding periodic property of the elements is valency (*q.v.*). Valency is a number that expresses how many times the equivalent weight of an element is contained in its atomic weight. As the equivalent weight of an element is the weight of it which combines with, displaces from combination, or is otherwise chemically equivalent to unit weight of hydrogen, the valency of an element is simply the number of atoms of hydrogen that are equivalent to an atom of the element in chemical combining capacity. Mendeléev's classification was essentially a classification by valency, the elements falling into seven families with valency from one to seven respectively. This classification by valency was further emphasized by Mendeléev in 1871, when he put forward an improved form of the periodic table, in which the families of elements were arranged in eight vertical groups having valency from one to eight. This form of the table has continued unchanged to the present day, and on it is based practically the whole modern system of arrangement and classification of chemical knowledge. Moreover, on this periodic arrangement is ultimately based the bulk of scientific knowledge of the electronic structure of atoms.

After the formulation of the periodic law and classification by Mendeléev, numerous attempts were made to express the law in rigid terms and the classification in a completely unambiguous form. Most of these, which have no longer even historical importance, served merely to demonstrate that the octet arrangement by valency is indispensable to the classification of the elements. The discovery of the inert gases, argon, etc., by Lord Rayleigh and Sir William Ramsay from 1894 onwards, introduced a new complication into the periodic classification. The properties of argon indicated that it should be placed between the highly electronegative element, chlorine, and the highly electro-positive element, potassium, that is, between a halogen element and an alkali metal. As the inert gases have no valency, Mendeléev proposed to create a new "zero" group to accommodate them, thus increasing the number of groups or families from eight to nine, despite the fact that several places in group VIII. were unoccupied. For example, neon is the sole element having atomic weight between that of fluorine in group VII. and that of sodium in group I., and could thus have been accommodated in one of the vacant spaces of group VIII. of Mendeléev's table. The other inert gases could also be fitted into the remaining vacancies of group VIII.

This classification of the elements into eight families or groups, having valency from one to eight respectively, presents certain anomalies. For example, only one element, hydrogen, precedes the inert gas helium of group VIII., though there are seven other groups. The inert gas argon has atomic weight greater than potassium in group I., though it should have smaller atomic weight according to its position in the group VIII. preceding; the properties of cobalt indicate that it should precede nickel in the classification, though its atomic weight is slightly greater; the atomic weight of iodine in group VII. is less instead of greater than that of tellurium in group VI.; the triad of elements, iron, cobalt and nickel, require to be placed in group VIII., in order that univalent copper shall fall into group I., and similarly with the triads ruthenium, rhodium, palladium, and osmium, iridium, platinum. The anomalies relating to the position of hydrogen and that of these triads are inherent in the periodic classification. The anomalies relating to atomic weight are, however, only apparent.

Mendeléev assumed that the periodicity of properties was a function which depended primarily on the magnitude of the atomic weights. It is certain that this is not strictly true, and that the order of the elements follows another function, the numbers of electrons in atoms, known as the atomic numbers (*q.v.*). These numbers are based on the theories of Sir Ernest Rutherford and Niels Bohr as to the structure of atoms. In Rutherford's theory an atom consists of a central massive nucleus surrounded by nearly massless negatively charged electrons, sufficient in number to neutralize the positive nuclear charge. Bohr's theory involved a quantitative explanation of the lines in the spectra of atoms in terms of the nuclear charges, and was utilized by H. G. J. Moseley to determine the nuclear charges from X-ray spectra. Moseley's work showed that atoms, adjacent in the periodic classification, differ by unity in nuclear charge and therefore by one electron. Assuming that iron had 26 electrons as the 26th element in the chemical order, Moseley showed that cobalt had 27 and nickel 28 electrons, despite the fact that nickel has a smaller atomic weight than cobalt. The method was successfully applied to the other periodic anomalies, and it was proved that the true order of the elements in the classification is that of atomic number, not atomic weight. The periodic law consequently states that the properties of the elements are periodic functions of their atomic numbers.

The Abridged or Typical Classification.—Examination of the properties of the elements in the order of atomic number shows that the elements fall into series or periods of eight families having valency from one to eight respectively. The first series, consisting of hydrogen and helium, may be regarded as a rudimentary or primitive period, hydrogen being the prototype of all the valent elements and helium the prototype of all the non-valent or inert elements. The eight elements succeeding helium, lithium to neon, form a period of eight groups from I. to VIII. The next eight elements, from sodium to argon, form a similar period of eight groups. These two octet periods may be regarded as generalized types for the classification of the remaining elements. Instead of eight, however, there are 18 elements up to the next inert gas, krypton. Of these 18 only eight exhibit close resemblance to the preceding elements of the two short typical periods. These eight elements are potassium, calcium, gallium, germanium, arsenic, selenium, bromine and krypton—exactly sufficient to fill the eight groups of this 4th period. This arrangement leaves a gap of ten in atomic number between calcium (20) and gallium (31), by excluding the ten elements from scandium to zinc. These ten elements exhibit a gradual transition in properties from close resemblance to calcium on the part of scandium to close resemblance to gallium on the part of zinc. The ten excluded elements may consequently be regarded as a first transition series bridging a gap in atomic number and in properties between more typical elements of the period.

Similar considerations apply to the 18 elements from rubidium to the next inert gas, xenon, ten elements from yttrium to cadmium being excluded and relegated to the second transition series, leaving a typical period of eight elements, rubidium, strontium, indium, tin, antimony, tellurium, iodine and xenon. In the next period, the sixth, 32 elements occur from caesium to the inert gas radon. Nevertheless, as in the two preceding periods, only eight elements are closely related to those of the short typical periods, these eight being caesium, barium, thallium, lead, bismuth, polonium, the unknown halogen element 85, and radon; 24 elements from lanthanum to mercury are consequently excluded and relegated to the third transition series. In the last period, radium alone shows close resemblance to elements in the typical periods, and the remainder, actinium, thorium, protoactinium and uranium, are consequently relegated to the fourth transition series.

The typical classification of the elements, shown in Table I., thus consists of 7 periods each consisting of eight groups, each period, except the rudimentary 1st, and the incomplete 7th, commencing with an alkali metal and ending with an inert gas. This arrangement illustrates the extreme regularity of the periodicity of properties of the elements included in this abridged classification. It further reveals that basic or alkaline character increases steadily in each vertical group from a minimum in period one to a maximum in period seven, and decreases steadily in each horizontal period from a maximum in group I. to a minimum in group VIII. This decrease in basicity in each period, however, is not quite uniform, but occurs by a series of leaps, all the elements yielding alkaline hydroxides being in groups I. and II., those yielding amphoteric hydroxides (soluble in both acids and alkalis) being included in groups III. and IV., while all the acidic and non-basic elements are included in groups V. to VIII. The elements can thus be further classified into an *alkaline* class of two

TABLE I. *Abridged Periodic Classification*

Class		Alkaline		Amphoteric		Non-alkaline and acidic			
Group		I.	II	III.	IV.	V	VI	VII.	VIII.
Valency		+1	+2	+3	+4	+5	+6	+7	zero
					−4	−3	−2	−1	
Period	1	(1 H)						1 H	2 He
	2	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
	3	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 A
	4	19 K	20 Ca*	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
	5	37 Rb	38 Sr†	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
	6	55 Cs	56 Ba**	81 Tl	82 Pb	83 Bi	84 Po	85 —	86 Rn
	7	87 —	88 Ra‡						

*Ten elements, 21 Sc to 30 Zn
†Ten elements, 39 Y to 48 Cd
**Twenty-four elements, 57 La to 80 Hg
‡All elements after 89 Ac
} relegated to Table II.

groups I and II, and *amphoteric* class of two groups III and IV, and a *non-alkaline* or *acidic* class of four groups V to VIII It may further be observed that, where elements exhibit variable valency, this variation occurs by two or four units Elements of group III., for example, exhibit variable valencies of three and one, those of group IV valencies of four and two, those of group V valencies of five, three and one, and so forth. This variation of valency by two or four units is intimately related to the three main classes of elements, the alkaline class of two groups, the amphoteric class of two groups, and the non-alkaline class of four groups, a reduction in valency of two or four units being accompanied by an increase in basic character equivalent to a decrease in group number of two or four units Thallium of group III, for example, on reduction from valency three to one, exhibits the properties of an alkali metal of group I. with valency one

The variations in alkaline character of the elements of Table I., as one proceeds either along the horizontal periods or down the vertical family series, lead, by a sort of cross-hatching, to a manifestation of resemblances between elements otherwise unrelated in the classification For example, these variations explain the close resemblance of beryllium and aluminium, two metals which are not in the same group or period. In a similar way resemblances arise between lithium and magnesium, and between boron and silicon So pronounced is this diagonal resemblance in the periodic table that a line, drawn between beryllium and boron and between aluminium and silicon and continued diagonally across the table, completely separates all the metallic from all the non-metallic elements, and allocates hydrogen and arsenic to the non-metals and antimony to the metals All the known nonmetals are in the abridged classification (Table I) which also includes a space for the missing halogen (eka-iodine)

The Transition Series.—The elements excluded from the abridged classification, as showing considerable divergence in properties from the typical elements of the first two octet periods, are ten in the 4th period, ten in the 5th period, twenty-four in the 6th period, and four of the five known elements of the 7th period Examination of the properties of the ten transition elements of the 4th period, reveals that these elements can be arranged in a period of eight groups, III, IV., V.. VI, VII, VIII., I and II., scandium, the lightest element, being proper to group III, and zinc, the heaviest element, proper to group II, the triad, iron, cobalt and nickel, being included within group VIII A similar arrangement holds good for the ten transition elements of the 5th period, yttrium, the lightest, being proper to group III like scandium, and cadmium, the heaviest, to group II like zinc, the triad, ruthenium, rhodium and palladium, being included within group VIII

In the 6th period, however, there are 24 transition elements The heaviest nine exhibit extremely close resemblance to the heaviest nine of the two preceding transition periods, celtium (hafnium) thus being proper to group IV like zirconium and titanium, while mercury is proper to group II like cadmium and zinc, the triad, osmium, iridium and platinum like its two forerunners being included within group VIII Group III alone remains unoccupied and 15 elements remain in this transition series These 15 elements, the "rare earth" metals from lanthanum to lutecium, all exhibit characteristic trivalency and an extremely close resemblance to yttrium and scandium of the preceding two periods. The 15 elements are consequently all proper to group III Of these 15, however, lanthanum alone is characteristic in yielding a strongly alkaline hydroxide and diamagnetic salts The remaining 14 elements, cerium to lutecium, may, therefore, be relegated to a transition sub-series, lanthanum remaining as the typical group III element of this transition period, thereby reduced to ten elements closely resembling the ten in each of the preceding transition periods The 14 excluded elements (*see* Table III) cannot be arranged to form a period as none of them exhibits valency higher than four or lower than two They thus constitute an anomalous sub-series of this transition period.

In the last period, the 7th, the transition series includes only the radioactive elements, actinium, thorium, protoactinium, and uranium, with valency from three to six respectively These elements may, therefore, be allocated to groups III, IV, V, and VI.

TABLE II *Transition Classification*

Class		High natural valency				Low natural valency					
Group		III	IV	V	VI	VII	VIII			I.	II.
Group Valency		3	4	5	6	7	8			1	2
Minimum Valency		2	2	2	2	2	2	2	2	1	2 (1)
Period	4	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn
	5	39 Y	40 Zr	41 Cb	42 Mo	43 Ma	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd
	6	57 La*	72 Ct	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg
	7	89 Ac	90 Th	91 Pa	92 U						

*Fourteen elements, 58 Ce to 71 Lu, relegated to Table III.

TABLE III. *"Rare Earth" Transition Subseries* (period 6, group III.)

Class		"Cerium earth" elements						"Lutecium earth" elements							
Element		Ce	Pr	Nd	Il	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
Atomic Number		58	59	60	61	62	63	64	65	66	67	68	69	70	71
Valency	Maximum	4	4	4					4			.			
	Normal	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Minimum	2	2	2		2	2	.			2			2	

of the transition period. As there is no gap in atomic number between actinium (89) and thorium (90), similar to the gap of 14 between lanthanum (57) and celtium (72) in the preceding transition period, it may be regarded as certain that the transition elements of period 7 do not include a "rare earth" sub-series similar to that of period 6

The transition classification, shown in Table II consists of four similar periods comprising an octet of groups from III. to II, each period containing a triad of elements in group VIII and a single element in each of the other groups This classification resembles the abridged or typical classification in that basic character decreases in each period from a maximum in the lightest to a minimum in the heaviest element, and increases in each group from a minimum in the lightest to a maximum in the heaviest element The transition classification differs from the abridged classification in that valency differences of one unit in an element can exist, that all the elements are metals, and that nearly all can yield coloured salts at all stages of valency, whereas the valency difference for elements in the abridged classification is invariably two or four units.

The Complete Periodic Classification.—On combining the abridged classification (Table I) with the transition classification (Table II), the full periodic classification including the whole of the known elements is obtained, and is shown in Table IV

Seven main periods suffice to include all the elements, a rudimentary period of two elements, two simple or short periods each of eight elements, and four complex or long periods each consisting of two sub-periods. Each period comprises eight groups commencing with I and ending with VIII, the simple periods and the first sub-periods of the long periods terminating with inert or noble gases, whereas the second sub-periods of the long periods terminate with noble metals To indicate the close resemblance of hydrogen in its univalency to the alkali metals and to the halogens, it is included in both groups I and VII, helium being included in group VIII from its close resemblance to the other noble gases, despite the fact that it differs from them in possessing only two instead of eight potential valency factors or electrons

The transition elements are shown in thin type to distinguish them from the elements most closely allied to the typical elements of the first two octet periods. To preserve the symmetry of the octet classification, the 15 "rare earth" elements of group III, succeeding barium in atomic weight, are represented only by their most typical member, lanthanum, the other 14 being shown in detail in a footnote to the table

Mendeléev stated that a natural law only acquires scientific importance when it yields practical results in elucidating unexplained phenomena, in disclosing unrecognized occurrences, and in evoking verifiable predictions The periodic law has been used in the classification of the elements, in the determination of atomic weights of elements from equivalent weights, in correcting atomic weights, in the prediction of the existence and properties of new elements and in the determination of the electronic structures of atoms It was used by Mendeléev to determine the atomic weights of indium and beryllium, which were then in dispute and could not be settled, as only the equivalent weights were known In the same way Mendeléev was enabled to predict the existence and properties of eka-boron, eka-aluminium, eka-silicon, eka-manganese, dwi-manganese, and eka-tantalum, now identified with the elements scandium, gallium, germanium, masurium, rhenium and polonium respectively. Similarly the discovery of the noble gases, helium and argon (crude) led to the prediction of eka-helium, and eka-, dwi-, and tri-argon, now known as neon, krypton, xenon and radon respectively (*See* ATMOSPHERE)

Interpretation of the Periodic Law.—The recognition of the existence of a definite periodicity in the chemical properties of the elements, particularly with regard to valency, soon led to many hypotheses as to the inner meaning of the periodic law At first, attempts were made to express this periodicity in terms of mathematical relations between atomic weights, but after the periodicity of properties was found to be a function of atomic numbers, instead of atomic weights, investigations were almost solely directed to the relations between electrons in atoms All modern interpretations of the periodic law are based on hypotheses as to the electronic structures of atoms, and all possess the common feature that they postulate, tacitly or explicitly, the existence of a natural law of uniform atomic plan to which all atoms con-

TABLE IV. *Periodic Classification*

Group		I	II	III	IV.	V	VI	VII	VIII
Valency		+1	+2	+3	+4	+5	+6	+7	zero or 8
					−4	−3	−2	−1	
Period	1	(1 H)		.				1 H	2 He
	2	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne
	3	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 A
	4	19 K	20 Ca	*21 Sc*	*22 Ti*	*23 V*	*24 Cr*	*25 Mn*	*26 Fe, 27 Co, 28 Ni*
		29 Cu	*30 Zn*	↘31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
	5	37 Rb	38 Sr	*39 Y*	*40 Zr*	*41 Cb*	*42 Mo*	*43 Ma*	*44 Ru, 45 Rh, 46 Pd*
		47 Ag	*48 Cd*	↘49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
	6	55 Cs	56 Ba	*57 La**	*72 Ct*	*73 Ta*	*74 W*	*75 Re*	*76 Os, 77 Ir, 78 Pt*
		79 Au	*80 Hg*	↘81 Tl	82 Pb	83 Bi	84 Po	85 —	86 Rn
	7	87 —	88 Ra	*89 Ac*	*90 Th*	*91 Pa*	*92 U*		
				↘					

*With *58 Ce, 59 Pr, 60 Nd, 61 Il, 62 Sm, 63 Eu, 64 Gd, 65 Tb, 66 Dy, 67 Ho, 68 Er, 69 Tm, 70 Yb, 71 Lu.*

rm. Essentially this law is that the electronic structural pattern every atom is a recapitulation of the patterns of all atoms ıving fewer electrons.

Examination of the periodic classification at once reveals that .e most basic or alkali-forming atoms have electrons which are ost easily detached, and that, in general, basic character is pro- ›rtional to electron mobility. Take, for example, the thallium om: it possesses a single most feebly attached electron responsi- e for the powerful alkalinity of its hydroxide in which the ılency is unity; it further possesses two more firmly attached ectrons by which it becomes trivalent and yields an oxide of latively feeble basicity. It is evident that the electrons in an om are not all equally firmly bound, but that there is a pro- 'essive increase in firmness of binding as more and more elec- ons are disclosed by increase of valency. If different atoms are ›mpared, this rule of increase of firmness of electron binding with ılency increase is still found to hold true, bivalent magnesium, ›r example, being less basic and having more firmly bound elec- ons than univalent sodium. This general feature is abundantly 'ident in the abridged classification (Table I.) in which basic alkali-forming character decreases steadily in each period from ·oup I. to group VIII.

The maximum firmness of binding of electrons observable in ıe elements of group VIII in each period, leads to curious re- ılts. Helium of atomic number 2 and with 2 electrons is chemi- ılly inert. The next element, lithium, of atomic number 3 and ith 3 electrons, is definitely only univalent and thus possesses electrons which resemble the helium 2 in being unavailable for ıemical combination by valency. From lithium, valency and ·mness of electron binding increase to a new maximum in neon, hich is chemically inert like helium. In each period the same cir- ımstances are observable, leading to the conclusion that the .ert gases represent specially stable arrangements of electrons. his arrangement is obviously one of 2 electrons for helium, and for all the other inert gases.

The fact that each period begins with a univalent alkali metal, ›llowing an inert gas of the previous period, involves that each kali metal contains the stable structures of all the preceding inert ıses, and similarly for every other element in the classification. he bivalent group II. element radium, for example, must contain ıe structures of the inert gases radon, xenon, krypton, argon, ›on and helium, and must, therefore, contain the seven electron ·oupings, 2, 8, 8, 8, 8, 8, 2 in order of decreasing firmness of ectron binding, that is, from the atomic nucleus outwards, ıe last 2 being the valency electrons. The number of elec- on groups is 7, radium being in the 7th period. In Bohr's theory f atomic structure, based on spectral evidence, these groups of ectrons are referred to as quantum groups and are characterized y quantum numbers from 1 to 7, which are identical with the rdinal numbers appropriate to the various chemical periods. his description of electron groups by quantum numbers is con- ›nient to avoid confusion between the facts of periodic classi- cation and those of electronic structure.

Law of Uniform Atomic Plan.—It has been indicated that the ements in each chemical period fall into three classes, an alkaline, ı amphoteric, and a non-alkaline class, consisting of 2, 2 and 4 ele- ıents respectively per period. It has further been indicated that alency variation occurs only by two units, that a bivalent ele- ıent can never be univalent, a quadrivalent element never trival- nt. This involves that 2 valency electrons in an atom are most rmly bound, 2 less firmly bound and any remaining least firmly ound. Sulphur, with 6 electrons, for example, can be bivalent 'ith 2 weakly bound electrons, quadrivalent with a further 2 more rmly bound, and sexavalent with a further 2 still more firmly ound. Hence, the inert gas octet of electrons comprises three ıb-groups, the first with 2 electrons most firmly bound, the ›cond also with 2 but less firmly bound, and the third with 4 lectrons least firmly bound. This 2, 2, 4 sub-grouping is discerni- le throughout all the periods shown in the abridged classification nd is thus present in each quantum group of electrons in all toms.

In the 4th chemical period, ten elements intervene between groups II. and III. and form a transition series, and it can be shown that none of the ten transition elements possesses more than 2 electrons of the 4th quantum group, and that all the 10 more firmly bound electrons are proper to the 3rd quantum. Examination of the transition classification shows that it is divisible into two classes (*see* Table II.), the first consisting of 4 elements with high natural valencies and the second of 6 elements with low natural valencies. This division of the transition period corresponds with a division of the ten electrons into two sub-groups of 4 more firmly and 6 less firmly bound. This sub-grouping is general throughout all the transition series and leads to the conclusion that the 3rd, 4th and 5th quantum groups can be extended from the 2, 2, 4 sub-grouping of the inert gases to 2, 2, 4, 4, 6 discernible onwards from univalent copper, silver and gold, respectively.

In the 6th chemical period, 14 elements intervene between groups III. and IV. of the transition classification and form a transition sub-series. It can be shown that the firmness of binding of the 14 electrons concerned relates them to the 4th quantum group. This sub-series can further be shown on various grounds to be divisible into two classes, the first comprising the six cerium earths and the second the eight lutecium earths (usually referred to as the "yttrium earths"). This division of the sub-series corresponds with a division of the 14 electrons into two sub-groups of 6 electrons more firmly and 8 less firmly bound. The 4th quantum group is thus extended from the sub-grouping 2, 2, 4, 4, 6 to 2, 2, 4, 4, 6, 6, 8.

From the foregoing group and sub-group schemes, the structure of the heaviest atom, uranium with 92 electrons, may be deduced to contain the groups 2, 8, 18, 32, 18, 8, 6, comprising the sub-groups 2; 2, 2, 4; 2, 2, 4, 4, 6; 2, 2, 4, 4, 6, 6, 8; 2, 2, 4, 4, 6; 2, 2, 4; 2, 2, 2. The precise form of the law of uniform atomic plan is now evident. The maximum numbers of electrons in main groups are equal to twice the squares of the natural numbers, $2(1^2, 2^2, 3^2, 4^2) = 2, 8, 18, 32$; the number of sub-groups in a main group is equal to one less than twice the natural number characterizing the group, the 4th group having $2 \times 4 - 1 = 7$ sub-groups; the numbers of electrons in the sub-groups of a main group are equal to twice the natural numbers taken in duplicate, the last sub-group being unduplicated and equal to twice the natural number characterizing the main group, the 4th group having the sub-groups, $2(1, 1, 2, 2, 3, 3, 4) = 2, 2, 4, 4, 6, 6, 8$. This law of uniform atomic plan discloses clearly the inner meaning of the periodic law of chemistry in terms of the arrangement of electrons within atoms.

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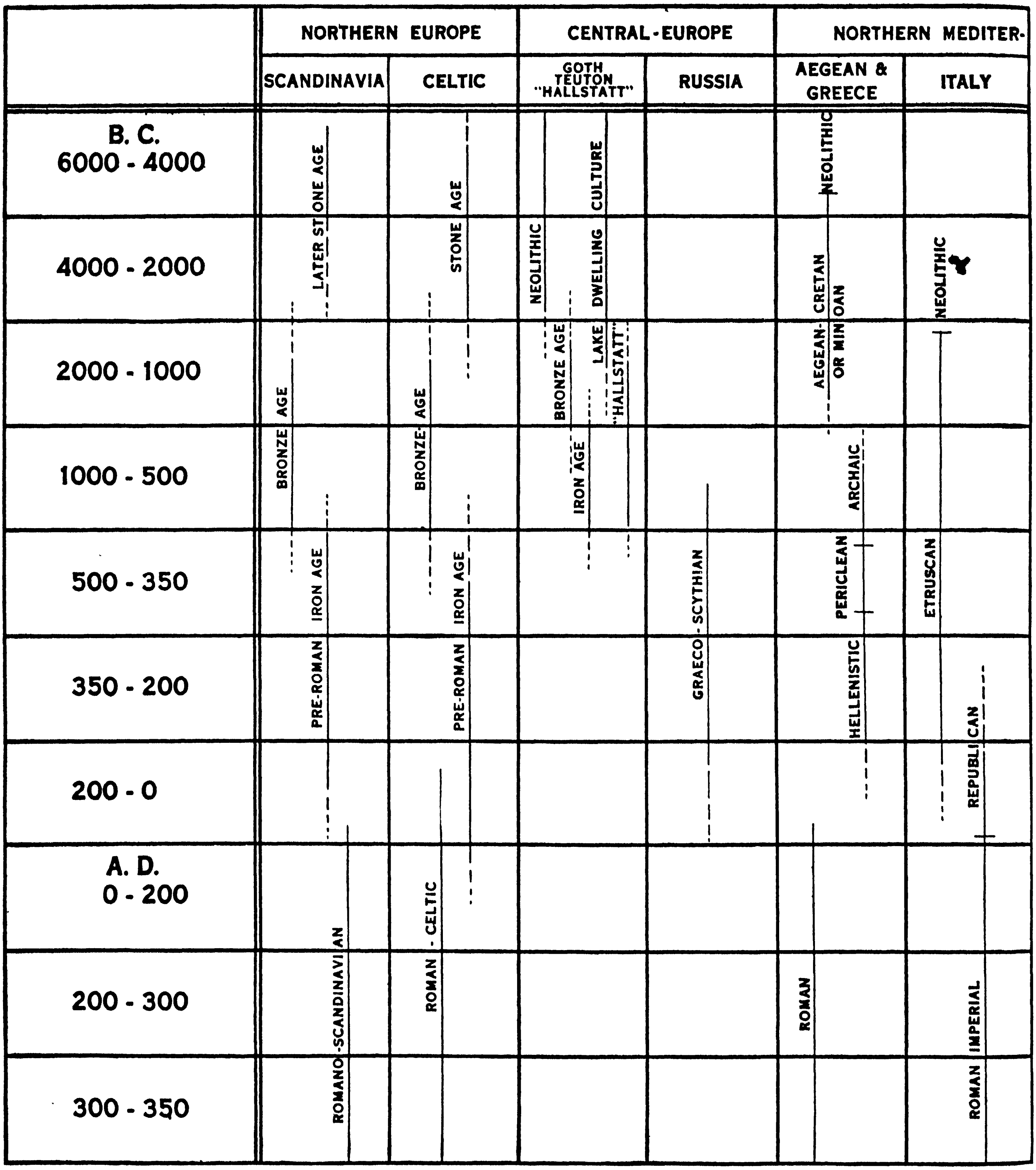
(J. D. M. S.)

PERIODONTOCLASIA or **PYORRHEA ALVEOLARIS:** *see* PYORRHEA.

PERIODS OF ART. An art period is that duration of time within which the main arts, both fine and applied, show a general recognizable trend or group of characteristics. These characteristics which the reader will find described under the various articles listed at the end of this article, like those of the human beings who created them, are usually complex and difficult to describe, often being wholly unrecognizable until the observer has equipped himself with a considerable experience in the identification, comparison and classification of various works of art and, even when he is so equipped, these characteristics are sometimes found to be the basis of irreconcilable discussion so far as details are concerned, by the greatest of experts. That there are, however, specific characteristics upon which the majority of authorities agree and which clearly indicate the time and geographical location on the earth's surface, wherein some certain work of art was conceived and made, cannot be denied. It is on such expert classification quite as much as upon the deductions of archaeological research that the whole fabric of the history of art, as well as our understanding of the extent and characteristics of the various cultural periods, is based.



The chart which extends over the following four pages gives a chronological and geographical outline of the various periods of art throughout the world
location is indicated by the name of the country or general area specified at the tops of the columns of the chart. The years, starting at 6000 B.C., or
years in extent and the later ones being finally reduced on the second part of the chart to 100 years in extent.

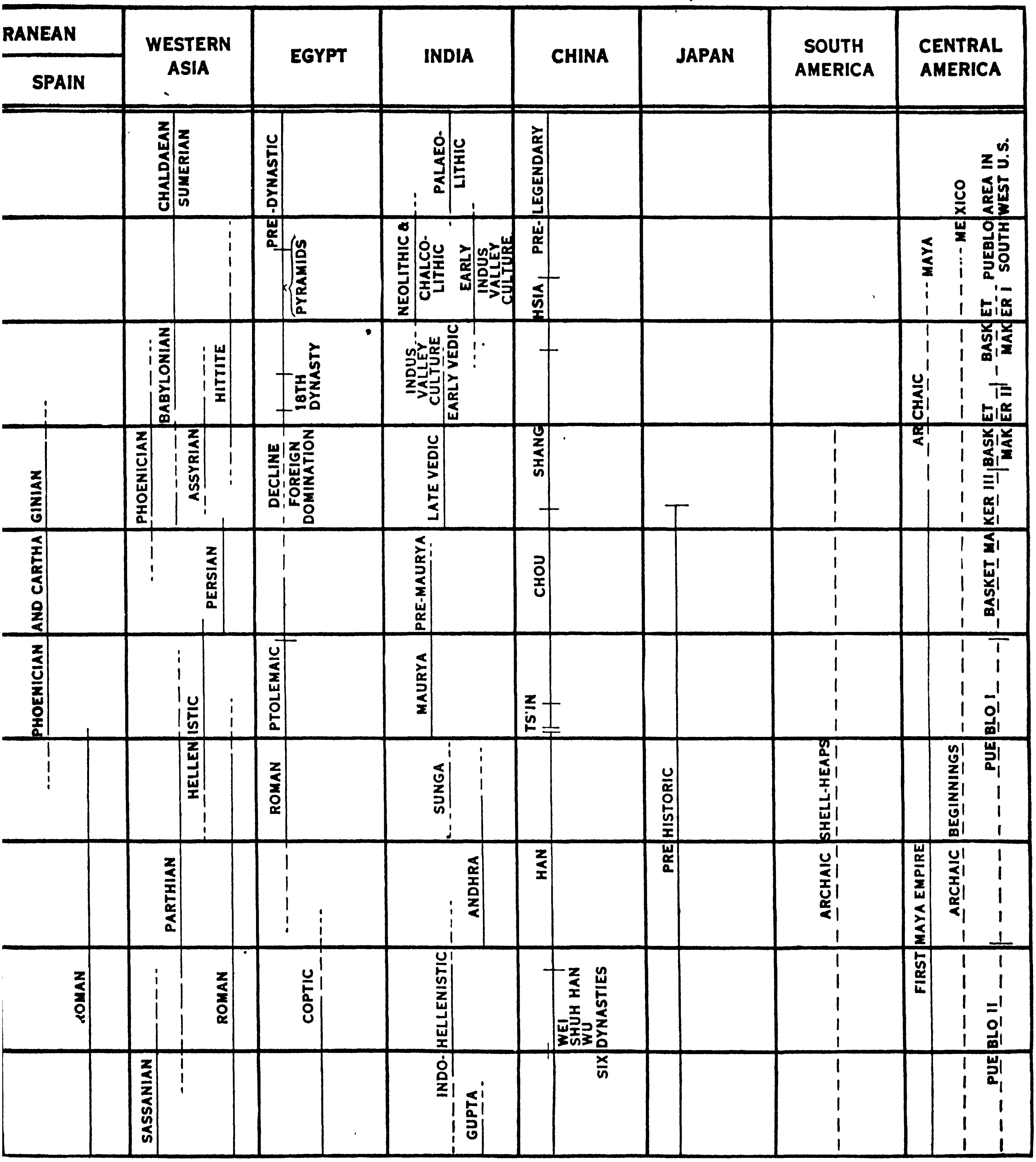
The first part of the chart covers the time from 6000 B.C., or earlier, to A.D. 350, the second, from A.D. 350 to the present time. It should
had been arrived at.

In the indication of a given period a solid line shows the length of time during which its influence was felt. If the beginning or end of the line is
had a definite beginning or end, such as did many of those in China identified by the dynasties in which they occurred.

The datings of the earliest periods are necessarily vague, often being legendary in character and consequently frequently the field of controversy.
latter part of this article, as well as by the authors under whose strict supervision each statement was carefully weighed and checked. Under the heading
of great doubt; the common names for these cultures are therefore given. Similarly the divisions under the headings "Aegean and Greece" and "Italy"

Civilization seems to have developed from barbarism first in Egypt, in the Tigro-Euphrates Valley, in India or in China, though authorities differ as
ture or such racial questions as may arise in a consideration of pre-historic India. In China where the bronze age preceded that of Europe the more or
America" is used in the broad sense to include also the earliest cultures of the Pueblo area in the southwestern United States.

It is interesting to note that the period between 500 B.C. and 350 B.C. coinciding with the beginning of the iron age in northern Europe, witnessed
the Etruscan; in Spain, the Phoenician and Carthaginian; in Western Asia, the early Persian; and finally in China the Chou Dynasty which produced
his studies and keep in mind the relative growth and decline of the arts of various sections of the earth, in a way that would be very difficult otherwise



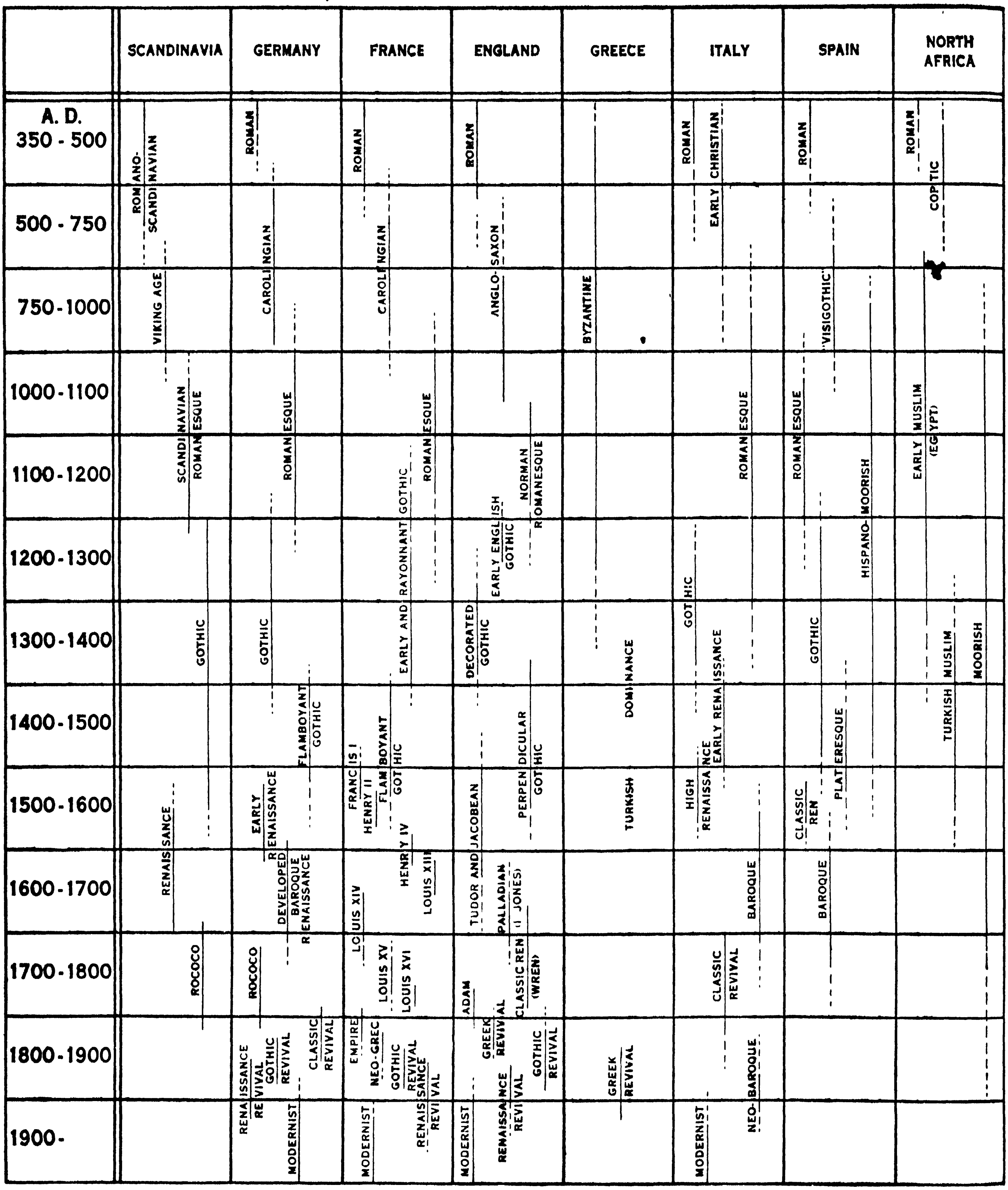
o that a clear understanding of the time of occurrence, the duration and the relationship of these periods can be gained at a glance. The geographical
earlier, are grouped into sections indicated at the left hand side, and it will be noticed that these sections are not constant, the earlier ones being 2000

e noted that the geographical divisions of the second section differ from those of the first, owing to the fact that more definite demarcations politically

lotted it shows a gradual development or decline. If there is an abrupt beginning or end terminated by a small cross-line this shows that the period

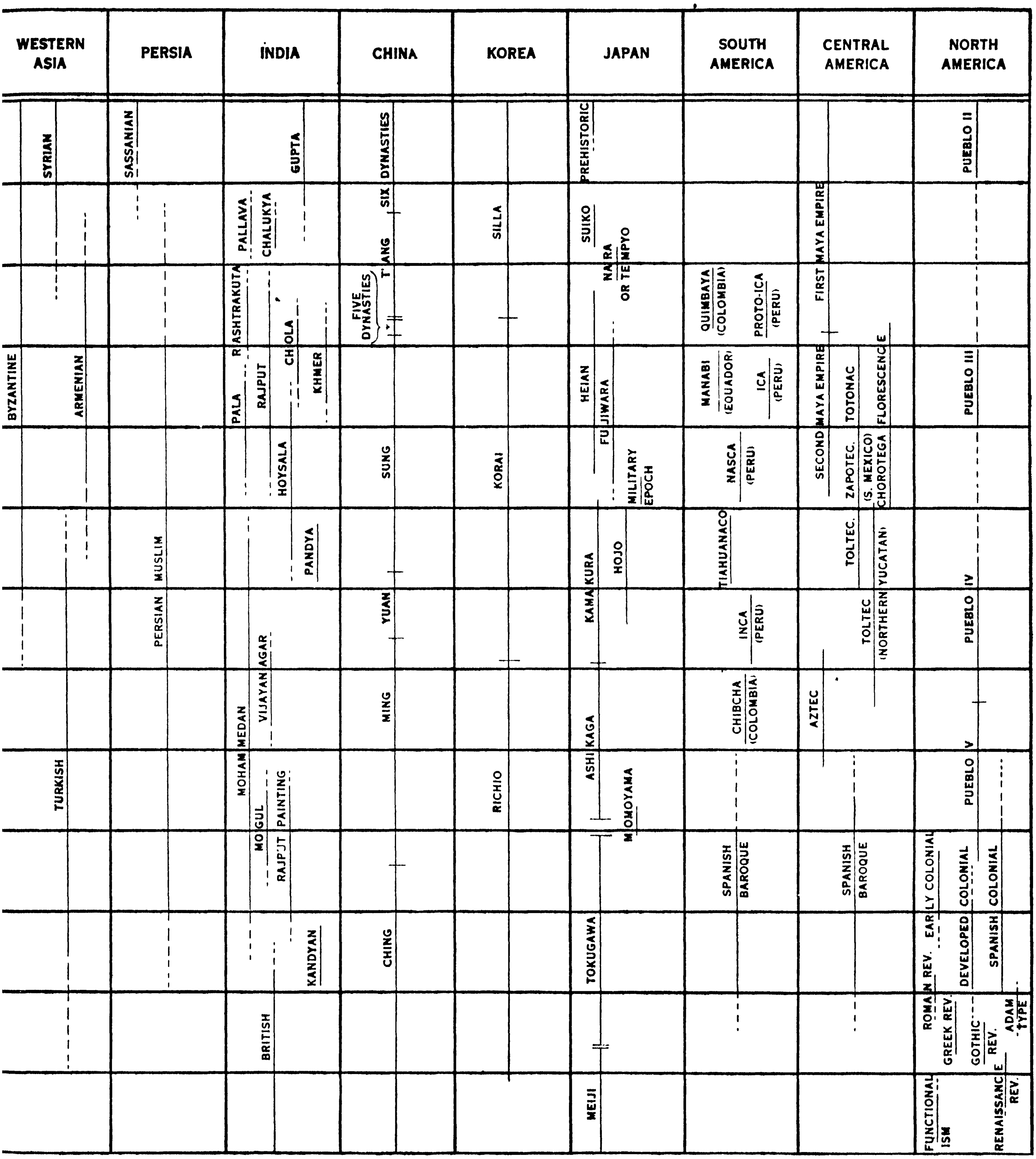
But this compilation represents the concensus of the best founded opinions and has been carefully brought together by the authorities enumerated in the
"Goth, Teuton, Hallstatt" are included a number of European cultural expressions irrespective of their actual racial origins which are still a matter
are called by their cultural names without consideration of any of the existing racial differences or similarities.
o which culture came earlier. It was not thought advisable to attempt to indicate the differing racial elements that created Chaldean and Sumerian cul-
less legendary dynasties of Hsia and Shang have been indicated in accordance with the dating of the Chinese chronicles while the heading "Central

the excellence of the Greco-Scythian period in the territory now known as Russia, while in Greece the Periclean culture was at its height; in Italy,
some of the most beautiful bronzes known to the collectors of to-day. Thus, the reader will find it possible, through the use of this chart, to organize
to bring together from various sources of information.



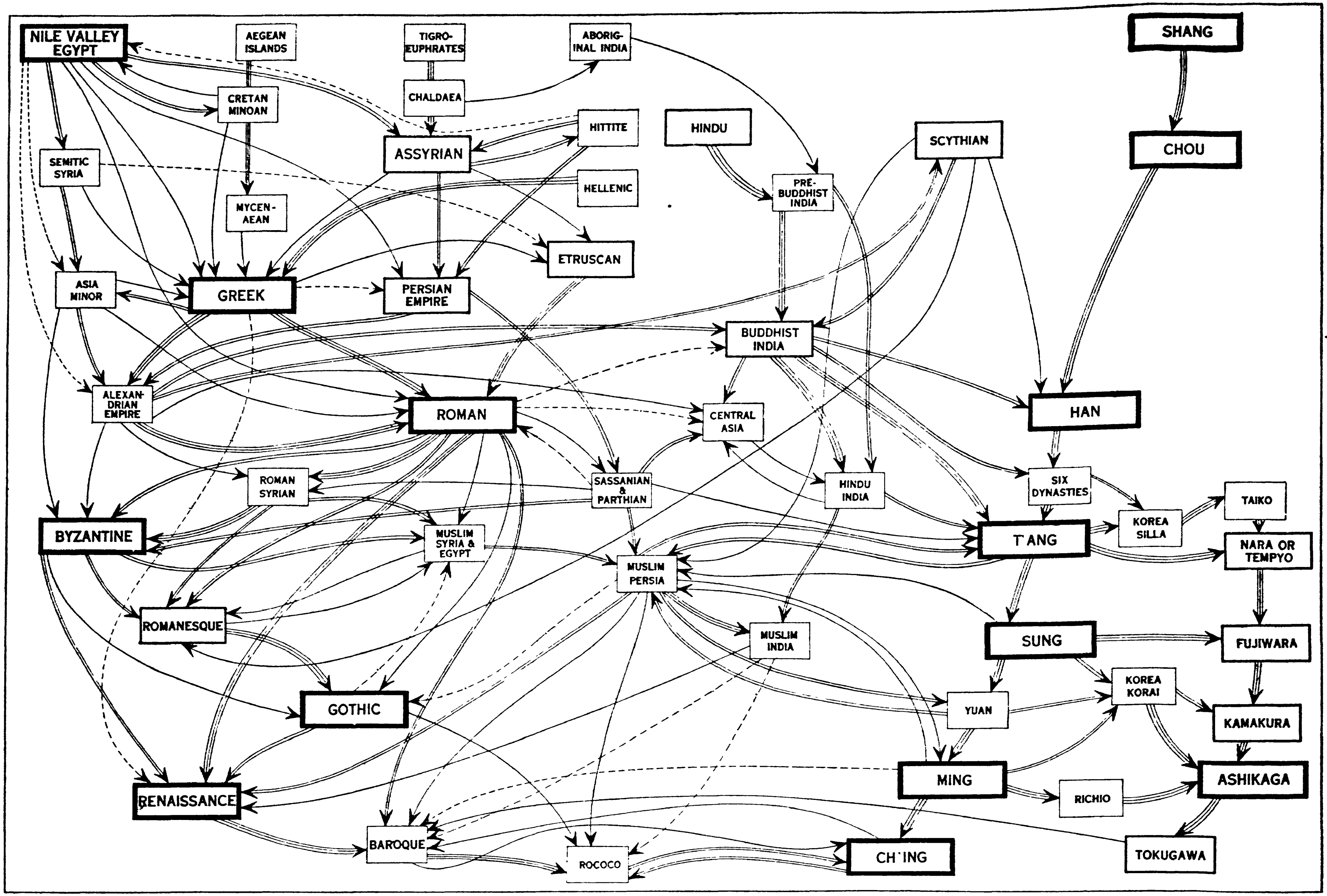
It was found necessary in the above second section of the chart on the periods of art, not only to make smaller subdivisions of time ranging from 250 geographical subdivisions because of the altered, more numerous and more definite national demarcations. The countries of Europe separated, and though partly distinct from, but parallel with, the continent. Korea and Japan, though closely bound to China, found their own expression, and finally North new culture in this area. Many authorities include Carolingian and Romanesque under the general title of Romanesque Art and the line between early Syrian under "Western Asia" are sometimes considered variant forms of the Byzantine; even the widely divergent Armenian style is occasionally called shores of the Adriatic.

A new use for these charts is illustrated in this second one: that of the study of one single period of art, such as the Gothic and its development "Early and Rayonnant" style in France followed almost immediately by its rise in Germany, Spain and England, later in Scandinavia, and still later characteristics that made the Baroque so appealing, at a later date, Gothic art soon became flamboyant as indeed it immediately afterwards became in there was a revival in Gothic art between A.D. 1800 and A.D. 1900 not only in Germany, France, and England, but in America where the original in the various countries and the approximate dates easily fixed in mind.



ears to 100 years owing to the continually increasing speed in the development of art periods throughout the world, but to alter and add to the
here was a strong mutual influence, each began a more or less individual national development. England, starting with the Roman period, developed
merica which had known only Pueblo culture until the 17th Century became inhabited by Europeans who brought to it and developed an entirely
hristian work and certain work of the Italian Romanesque styles is quite impossible to fix definitely. Both the Coptic under "North Africa" and the
yzantine. The word Byzantine as used on the chart is confined to that art produced under the direct influence of Constantinople, in Greece and on both

the various countries which felt its influence. With this section it may be seen that Gothic art started between A.D. 1100 and A.D. 1200 in the
Italy where its influence lasted for only a comparatively short time, giving way to the Renaissance. In Germany perhaps because of the same national
rance while in England it was, after the original introduction, first the "decorated" style and later the "perpendicular" style. It may also be seen that
eriod had never existed. In the same way, the influence of the Roman, the Carolingian and Romanesque, as well as many other periods, can be traced



This chart is not designed to show chronological relationships though the earlier civilizations are near the top and the more recent arranged below (for chronological comparisons the charts on the preceding four pages should be consulted)—neither is there any attempt to arrange the countries in which the periods occurred geographically, the primary intention being simply to show those influences which were brought to bear upon the various most important periods, omitting all question of the original genius of each nation which received, amalgamated and translated these influences as well as added their own contributions. The importance of the period is indicated by the weight of the outline. It will be seen that there are three classifications.

A dotted arrow indicates traces; a single arrow, definite but slight influence; a double arrow strong; and a triple arrow such influence as to be a dominant factor in the period. Arrows running both ways indicate reciprocal influences such as those between Muslim Persia, and T'ang China. In general the terms used are in their broadest interpretations; thus, "Romanesque" covers Carolingian, as well.

As was pointed out in the notes under the first chart in the reference to the period between 500 B.C. and 350 B.C., there seems to occur at times a nearly world-wide stimulus or depression in the field of art. From A.D. 1400 to A.D. 1500 that great movement called the Renaissance prevailed through southern Europe; at the same time the Gothic movement in northern Europe was still productive; western Asia saw perhaps its highest pinnacle in painting, pottery making, rug weaving and the other arts; and in the Far East the great Ming Dynasty (1368 to 1644) was at its height. It seems strangely inexplicable that though the individual causes seem to differ, in some cases being due to religious fervour, in others the pomp resulting from great wealth, the results were nevertheless equally worthy.

Yet when we study that small part of the history of man of which we have records we find that the development of civilization has extended over only a comparatively brief period of time and that it has in the various parts of the earth been parallel and consistent. Thus, though we of the western world may look down upon the civilization of the Far East, perhaps because the East did not produce such efficient battleships, it is evident on closer study that the Chinese are very much like the Westerners. They understood and used bronze at about the same time and, though they have never taken the same interest in iron and steel, it was their invention of the lens and gunpowder which made possible these modern battleships.

Not only were there a number of cultures which originated at about the same time, but it must be kept in mind that from 2,000 years ago (at just the time these cultures began to take on marked individual characteristics) travel, inspired by commerce and war, commenced to bind together the races of man with an ever stronger bond. It is therefore not so surprising that at certain given times man's development in the various parts of the world should be such as to produce simultaneously great artistic achievements.

The tremendous wars which the Mongols waged under Jenghis Khan and which influenced the East and West alike may have dammed the flood of production until it rose to the irresistible pressure which found expression in the courts of the Ming Dynasty as well as in those so similar ones of Renaissance Italy. The religious fervor which made Gothic art possible was not dissimilar to that felt in Western Asia and China and both were probably the result of the oppressions of war and at the same time reactions against a too materialistic wealth

This consideration leads us to question what now seems to be the world trend What can be hoped for the immediate future? To a remarkable degree the improved methods of travel and communication are bringing together the various peoples National characteristics are being so blended as to show signs of a loss of identification The Japanese artist is like the French, influenced by Cézanne, and there are American sky-scrapers in China. Undoubtedly this is going to prove a happy thing for all art as well as for civilization though just now the process is a discouraging one. There is bound, however, to emerge a functional art with a world-wide appeal.

A much more threatening element is that easily perceived interest on man's part in the new toys provided him by a bountiful science. The publics of all countries are becoming so interested in the moving pictures that there is little time to spare for looking at paintings Similarly, the radio, the automobile and a thousand other inventions bid for man's amusement and time, and compete with all artists How long it will take the world to adjust itself to this melting down of various characteristics, and to the building up of wider and more profound characteristics; how long it will take artists to adjust themselves to the new competitive demands and learn to make use of the inventions of science rather than combat them or have them make use of art, is a question that cannot yet be answered, but it is certain that until these two obstacles are overcome there can never be great art such as there has been in the past.

Thus we must get out of the habit of thinking that the last art is the best art. There is more loss than gain to be seen when the earlier arts such as those of Egypt or China or Greece are weighed in the scale against the modern, in spite of (or perhaps because of) all the new means available to artists of to-day which these earlier civilizations did not know

The following articles deal with the various periods of art: ART; ARCHAEOLOGY; Stone age: *Palaeolithic, Mesolithic, Neolithic;* Bronze Age; Iron Age; HALLSTATT; EGYPT: *Art and Archaeology; Architecture*; INDIAN AND SINHALESE ART AND ARCHAEOLOGY; BABYLONIA AND ASSYRIA; PHOENICIA; ETRUSCANS; CARTHAGE; WESTERN ASIATIC ARCHITECTURE; PERSIA: Archaeology; PERSIAN ART, PAINTING AND CALLIGRAPHY; PARTHIA; PUEBLO; GREEK ART; ROMAN ART; BYZANTINE ART; CHINESE ARCHITECTURE; CHINESE PAINTING; CHINESE SCULPTURE; JAPANESE ARCHITECTURE; JAPANESE PAINTING AND PRINTS; JAPANESE SCULPTURE; CAROLINGIAN; ROMANESQUE ART; GOTHIC ART; RENAISSANCE ART; BAROQUE, LOUIS STYLES; ROCOCO; MODERN ART; MODERN ARCHITECTURE.

Thanks must be given for their kind assistance in providing the facts upon which the charts in this article have been constructed to Professor Alfred W. Tozzer, Dr. Herbert J. Spinden, Dr. Ananda K. Coomaraswamy and Alan R Priest.

Bibliographies on the various periods will be found at the end of the above-mentioned articles. (W. E. Cx.)

PERIOECI, in Greek *Perioikoi,* in ancient Laconia the class intermediate between the Spartan citizens and the helots (*q v*). Ephorus says (Strabo viii 364 seq) that they were the original Achaean inhabitants of the country (Gr περίοικοι—"dwellers around") The term, however, came to denote not a nationality but a political status, and afterwards included Arcadians on the northern frontier of Laconia, Dorians, especially in Cythera and in Messenia, and Ionians in Cynuria They inhabited a large number of settlements, varying in size from important towns like Gythium to insignificant hamlets. They possessed personal freedom and some measure of communal independence, but were under the immediate supervision of Spartan harmosts (governors) and subject to the general control of the ephors They were excluded from all Spartan offices of state and from the assembly, and, owing to the absence of any legal right of marriage (ἐπιγαμία) the gulf between the two classes was impassable *See* SPARTA

PERIPATETICS, the name given in antiquity to the followers of Aristotle (*q v*), either from his habit of walking up and down as he lectured to his pupils (Gr. περιπατεῖν, to walk about, or from the περίπατος covered walk) of the Lyceum. (*See* ARISTOTLE.)

PERIPATUS, a genus of remarkable worm-like Arthropoda (*q.v.*) belonging to the class Onychophora (*q v*). The name is often loosely used to denote all members of this class, which is in many respects intermediate between the segmented-worms (Annelida, *q v*) and the Arthropoda (insects, spiders, crabs, etc), though most nearly related to the latter. There are about 40 species of *Peripatus,* found chiefly in tropical America, tropical Africa and the East Indies

PERISCOPE, an optical instrument used in land warfare and in submarine navigation to enable an observer to see his surroundings while remaining under cover or submerged. It invariably includes among its optical elements two mirrors or reflecting prisms to change the direction in which the light travels, the first to divert it down the interior of a tube and the second to guide it into a direction convenient for observation. In addition there is usually a more or less complex telescopic system, and in some types devices are added for taking ranges, for measuring the speeds with which various objects are moving, for searching the whole sky, and for varying the magnifying power of the telescope

The simplest type of periscope, consisting of a tube and two mirrors at its ends placed parallel to one another and at an angle of 45° with the axis of the tube, is not of recent origin, but the great developments which have been made in modern times are due to requirements for submarine navigation. These developments secure a large angular field of view when the tube is of considerable length and yet of restricted diameter and give an enlarged image. As in other military instruments, clear vision through the periscope even under adverse conditions is of great

importance, and the beam of light brought to the observer's eye must therefore be of a diameter large enough to fill his pupil when it is somewhat widely opened. These various conditions tend to be opposed to one another, so that the design of each instrument represents a compromise which may vary over a considerable range as more or less importance is attached to one or the other of these requirements.

A typical submarine periscope consists externally of a tube about 30 ft. long and 6 in. in diameter except for a length of from two to three feet at the top, where the diameter may be reduced to two inches or even less. At the lower end a length of several feet of the full diameter is required for passing through the long stuffing box where the instrument enters the hull of the submarine. A diameter of about six inches is needed to resist the bending moment caused by the resistance of the water as the submarine advances; an increase in the diameter adds to the resistance offered by the periscope to the boat's progress. The narrowing at the top is introduced to make the part which projects above the surface of the water less conspicuous. The optical effects of this constricted portion are so pronounced that the dimensions assigned to this part determine the design of the instrument. It is debatable whether the tendency has not been to attach too much importance to this reduction in the diameter of the tube.

If an observer looks through a series of tubes of the same diameter but of different lengths, placing his eye close to the end of the tube, his field of view will be smaller with a long tube than with a short one. The factor governing the extent of the field of vision is obviously the proximity of his eye to the front end of the tube. Thus in a periscope the only way of increasing the field of view is to locate the eye virtually near the top of the tube by inserting therein a system of lenses which, in addition to satisfying other conditions, will form an image of the observer's eye in the required position. These further conditions ensure the transmission to the real eye of all the light (assuming for the moment that all losses of light on refraction through the lenses of the instrument may be neglected) that reaches the virtual eye position: roughly, they involve the insertion in the tube of a lens at intervals proportional to the distance of the virtual eye from the open end of the tube. Thus if the field of view is to be doubled the number of lenses needed in a tube of given length and diameter must be doubled. Two tubes, the length and diameter of one being twice that of the other will give the same field of view, but the diameters of the light beams transmitted will be in the ratio two to one. Since diameter of beam and angular field are reciprocally proportional, the angular field may be doubled in the large tube for a fixed number of lenses without reducing the illumination below that obtained with the smaller tube. It follows that for a given angular field and a given diameter of emergent beam the number of lenses required is proportional to the length of the tube and inversely proportional to the square of its diameter. As an illustration, the number of lenses required to transmit a given beam down a tube three feet long and two inches in diameter will transmit the same beam down a tube 27 feet long if the diameter is increased to six inches.

The chief objection to an increase in the number of lenses in an instrument is the reduction in the brightness and clearness of the image it involves. The brightness suffers because the amount of light transmitted through the instrument is decreased owing to reflection, absorption and scattering; the clearness is diminished because, of the transmitted light, a decreasing proportion is concerned with the formation of the real image, the rest forming spurious images or appearing as mere fog. When these additional lenses belong to a narrow part of the instrument, their powers, being inversely proportional to the interval between successive lenses—that is, proportional to the inverse square of the diameter of the tube—are high, and their effects in introducing irremovable aberrations, such as chromatic aberration and curvature of field, are correspondingly great. From the optical point of view that narrowness in the tube, even for a short length, is very detrimental to the production of a good instrument.

The optical system in a periscope is intended to give a view roughly similar to that obtained by direct vision. Usually angular magnification of one and a half is preferred. An angular field of about 40° is ordinarily attained, with an emergent beam of diameter 4 or 5 millimeters.

The use of a simple telescope in addition to the top and bottom reflectors would not allow such a field of view to be attained in a periscope of normal length. The typical method of developing more complex telescopes to meet the conditions consists in adding one telescope to another, with their objectives facing one another. The resulting magnifying power is the ratio of the magnifying powers of the component telescopes, and may therefore be kept down to the low value desired, while the leading lenses, which constitute the eyepiece of the first telescope, are of the small diameter needed. A system of this kind will yield satisfactory images near the axis whatever the separation of the two objectives may be; but in the outer parts of the field, owing to the obliquity of the corresponding beams between these lenses, the brightness of the image is reduced as the separation is increased. There is thus a limit to the length attainable by the use of two telescopes, but the addition of more telescopes gives correspondingly greater lengths.

In many periscopes a higher power than one and a half, nearly always six, can be introduced instantly in place of the lower power without any change in the focus or displacement of the centre of the field of view. In order to avoid loss of light or reduction of the field as seen by the observer (the "apparent" field), the change of power must be effected at the top of the instrument, that is, in the narrow portion of the tube. This requirement of course adds to the difficulties inseparable from a narrow tube. Of the many different means of changing the power employed by different makers only one will be illustrated.

When it is required to search the complete sky, the top reflector must consist of a prism, or alternatively of two prisms placed with their reflecting bases close together and parallel to one another. The way in which light from different altitudes is directed down the tube is evident from fig. 1.

Principles of Construction.—The accompanying series of illustrations (figs. 2 to 4) show the general principles of construction, together with the appearance of the two ends, in one of many patterns made by Messrs. Barr and Stroud. Fig. 2 shows diagrammatically the arrangement of the optical parts in a bifocal periscope giving a field of view of 40° with a power of $1\frac{1}{2}$ and a field of 10° with a power of 6. The system will be considered first as a high power instrument. Light enters through the plane parallel plate *a*, which is sealed into the tube, making a watertight joint; immediately afterwards it is reflected downwards by the prism *b*, and is then refracted in turn by the lenses *e*, *f* and *g*, which constitute an inverted astronomical telescope. Of these *e* corresponds to the eye lens, *f* to the field lens of the eyepiece and *g* to the object glass. This telescope is followed by a second, comprising four lenses *h*, *k*, *m* and *n*: *h* is the objective, *k* a collector lens, which may be moved along the axis of the tube for focusing and the remaining pair *m* and *n* together constitute the eyepiece of the periscope. The lower reflector is the prism *l*, to which the lens *m* of the eyepiece is cemented.

The first telescope produces an inverted image of angular magnification measured by the ratio of the focal lengths of *e* and *g*. The second telescope magnifies this image in a ratio depending on the relation of the focal length of the pair of lenses *h* and *k* to that of the eyepiece *m* and *n*. By a proper selection of these focal lengths a power of six can be obtained. The inverted image formed by the first telescope is reinverted by the second, so that objects viewed through the periscope present their natural appearance. To obtain a power of one and a half with a correspondingly augmented field, Messrs. Barr and Stroud introduce a Galilean telescope which gives an upright image in front of the system just described. Since a diminished angular magnification is to be obtained, the negative lens *c* of the Galilean telescope precedes the objective *d*. When the high power is in use the lenses *c* and *d* are swung to one side, as at c_1 and d_1, against the side of the tube. Fig. 2 shows the paths of two beams through the low power system, that along the axis having the full cross section admitted by the lenses *g* and *h*

and the other from a point at the edge of the field showing by its smaller cross section the diminution in illumination which takes place.

Fig. 3 shows the upper end of a Barr and Stroud periscope of the sky-searching type. The lower end is illustrated in fig. 4.

To enable the observer's line of sight to be directed to any part of the horizon, the instrument is rotated about its axis by the

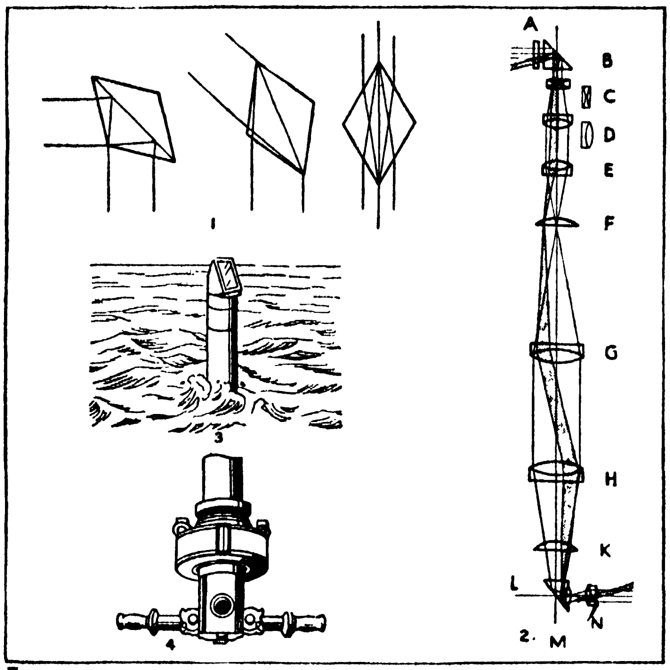


FIG 1—DIAGRAM SHOWING HOW LIGHT FROM DIFFERENT ALTITUDES IS DIRECTED DOWN THE PERISCOPE TUBE

FIG. 2.—GENERAL PRINCIPLE OF TYPE OF PERISCOPE USED IN SUBMARINES

FIGS. 3 & 4.—SKY-SEARCHING TYPE, SHOWING UPPER AND LOWER ENDS

handles shown in fig. 4. When not in use the handles can be folded out of the way. The eyepiece (between the handles in fig. 4) has a rubber cushion which serves as a protective guard. In focus with the image of external objects are seen the graduations of vertical and horizontal scales. These scales enable the observer to make a fair estimate of the apparent sizes of objects and approximate distances. The bearing scale is projected into the field of view by means of a small prismatic telescope. As a result of this projection the bearing scale appears in the top of the field of view so as to be readily seen by the observer without taking the eye from the eyepiece.

In addition to reading the bearing it is important that the observer should be able to bring any object into the centre of the field of view without removing his eye from the eyepiece. This involves control over the angle of elevation of the line of sight and ability to adjust the focus. By rotating one of the handles about its axis the top prism of this periscope may be adjusted for elevation. The two milled heads, which are shown projecting from the bottom of the periscope in fig. 4, control not only the entire focusing adjustment but also regulate the light filters. The change of magnification or power is brought about by rotating the second handle.

In ordinary use the low power telescope is employed, and a change is only made to the high power when it is desired to observe an object more minutely than is possible with the low power. As the low power embraces an angular area sixteen times as great as the high power, large regions can be observed much more rapidly than with the high power.

Special provision has to be made for desiccating the air in the interior of the periscope from time to time. The material of the tubes must be non-magnetic and not liable to be corroded by seawater. Very slight action of this kind is serious, since it causes the tube to work stiffly in its watertight gland.

The principles of construction of periscopes for use on land are the same as those described for naval instruments. The conditions to be satisfied are in general less stringent than in submarine periscopes, and in the absence of important special features it is unnecessary to give illustrations of these instruments. *See* the article "Periscope" in *Dictionary of Applied Physics*, vol. 4. (T. SM.)

PERISSODACTYLA, an order of hoofed, herbivorous mammals, including the tapirs, horses, rhinoceroses and their extinct relatives, in all of which the number of digits (toes) on each hindfoot is either three or one. The name Perissodactyla ("odd toes") was given by Sir Richard Owen, to distinguish the group from the Artiodactyla, or even-toed, ungulate (hoofed) mammals, in which the number of functional digits on each foot is usually either four or two.

The earliest known perissodactyls (Lower Eocene) had four toes on each forefoot and three on each hindfoot. These numbers are still retained in the feet of the existing tapirs, but in the ancestral rhinoceroses the outer digit of the forefoot (corresponding to the fifth of the human hand) gradually became reduced and finally disappeared, leaving three toes on each forefoot and three on each hindfoot, as in existing rhinoceroses. In the horse family the earliest known members started with four functional digits in each hand and three in each foot, the only traces of the first and fifth toes of the ancestral mammals being the inner and outer wrist bones (carpals) that formerly supported these digits. In the course of time the whole foot of the early horses grew very long, the side toes were lifted off the ground, became much reduced in size and were finally eliminated, the chief traces of the second and fourth toes of the original five-toed foot being the "splint" bones, or vestigial metacarpals, on the side of the greatly enlarged middle toe. This symmetrical middle toe of the horse therefore represents the logical extreme of the initial perissodactyl tendency for the axis of symmetry to pass through the middle or third digit rather than between the third and fourth digits as in the artiodactyls.

Both the perissodactyls and the artiodactyls were originally small, swift-footed, herbivorous mammals, in which the wrist and heel were raised far above the ground and the animals ran on the enlarged nails, or hooves, of their principal digits. The numerous resemblances between perissodactyls and artiodactyls are chiefly independently acquired adaptations to similar habits. Even in Lower Eocene times (perhaps 60 million years ago) representatives of the two orders differed so greatly in skeleton and dentition that they must have been derived from widely different families of primitive placental mammals of the Cretaceous epoch. The old concept of the Perissodactyla and the Artiodactyla as being suborders of a single group, the Ungulata Vera or Diplarthra, is erroneous and the two "sub-orders" are in fact wholly distinct.

As noted above, the oldest known perissodactyls are found in the Lower Eocene of North America and Europe. It was formerly believed that these were in turn derived from *Phenacodus* (*q.v.*), but more recent palaeontological research shows that *Phenacodus* was a specialized side-branch of its own order, the Condylarthra, and is definitely excluded from the ancestry of the Perissodactyla by numerous details of specialization. The direct ancestors of the Eocene Perissodactyla remain unknown. However, the comparative morphology of the dentition and of the skeleton indicates that the Perissodactyla, like other orders of placental mammals, were derived eventually from small insectivorous placental mammals of the Cretaceous period The origin and evolution of the numerous families of perissodactyls from the Lower Eocene through many ascending horizons of the Tertiary, has been intensively studied in Europe and North America, and their palaeontological history is more fully known than that of any other mammalian order.

The early Eocene perissodactyls were small animals with four toes on each forefoot and three on each hindfoot. The upper molar teeth bore four principal cusps with two oblique cross-crests running from the two inner cusps forward and outward, toward the outer side. The two main outer cusps were conical, the second set further in toward the middle than the first, so that the outer half of the crown was oblique. Each lower molar crown was more or less W-shaped in top view. The premolars were not yet molariform, although the last upper premolar (p^4) was already

well on the road toward the molar pattern. The front teeth (incisors) were all present, small and not peculiarly specialized.

Horses.—From such a form the line leading to the horses began to lengthen the middle digits and lift the side toes off the ground; in the upper molar teeth the oblique cross-crests became markedly twisted, while the main outer cusps became broadly crescentic; the upper premolars gradually became more molariform until three of them equalled or even surpassed the molars in size and complexity. The subsequent evolution of the horse family is treated elsewhere (*see* EQUIDAE; HORSE).

Tapirs.—In the line leading to the tapirs the number of toes did not change but the animals grew larger, heavier, and their feet broadened. In the cheek teeth the cross-crests became less oblique, more transverse, finally becoming two high, straight, sharp-edged ridges, shearing with similar ridges on the lower molars. The most distinctive feature is the trunk or proboscis, in which the nose and upper lip are combined into a mobile, more or less protrusile organ. The proboscis of the tapir, however, has no finger-like projection of the tip and lacks the mobility and adaptability of that of the elephant. The corresponding alterations in the skull of the tapir are far less than in the case of the elephant, involving only a moderate retreat or retraction of the nasal bones. The middle septum or cartilage of the nose also is far more conspicuous and extended further forward (*see* TAPIR). Thus the skeleton as a whole retains much that was characteristic of the earliest Eocene members of the order. The feet, for instance, have the same number of digits and arrangement of all the elements as in the very earliest Perissodactyla, and the rest of the skeleton is also primitive except for the modifications of the nasal region for the support of the proboscis. Even the cross-crested molars are much like those of the Eocene lophiodonts (family Lophiodontidae), which were, however, intermediate between the tapirs and the rhinoceroses.

Palaeotheres.—The family of the palaeotheres (Palaeotheriidae) was characteristic of the Eocene of Europe and was closely related to the horse family. The typical genus, *Palaeotherium,* resembled a tapir in general proportions but had three instead of four toes on each forefoot; it had at most only the beginning of a proboscis; the upper molar crowns comprised a W-shaped outer wall and two oblique cross-crests united with the two conical inner cusps. The palaeotheres are connected with the horses through such small light-limbed forms as *Palaeoplotherium.*

Titanotheres.—The titanothere family (Titanotheriidae) ranged from the Lower Eocene of Wyoming to the summit of the Lower Oligocene in South Dakota, Nebraska and Saskatchewan. Representatives have also been found in the Eocene of Europe and in the Upper Eocene and Lower Oligocene of Mongolia. The oldest known titanotheres (*Eotitanops*) were about as large as a sheep but shaped more like a tapir except that they had no proboscis, while the nose and lips were possibly somewhat horse-like. The most distinctive character is found in the upper molar teeth, the crowns of which had a W-shaped outer wall, two conical internal cusps and vestigial cross-crests. The lower molar crowns were W-shaped. This general type of molar was retained throughout the history of the family, the chief modification being that in the later forms the W-shaped outer wall of the upper molar crowns became higher and more curved toward the mid-line of the palate, while the internal cusps remained conical and low.

During the Eocene and Lower Oligocene the titanotheres became differentiated into numerous genera and over 100 species. The fossil remains of the Oligocene were formerly abundant in the "Big Badlands" on the White river in South Dakota and Nebraska. The primitive perissodactyl numbers of four toes on the forefeet and three on the hindfeet were retained throughout the family. In the main lines leading to the Lower Oligocene end-forms the size of the body increased until a bulk surpassing that of the largest recent rhinoceros was finally attained. Of the middle-sized genera of the Middle and Upper Eocene the most notable was the genus *Palaeosyops,* comprising animals larger than tapirs, with widespreading feet, broad, rounded skull and low-crowned, circular-cusped molars. At the opposite extreme was the genus *Dolichorhinus,* with an extremely elongated skull and snout, laterally compressed but not long feet, and upper molars with deepened outer wall and flattened outer cusps. The genus *Manteoceras* ("prophet-horn") was more or less intermediate between these extremes, but possessed a small bony swelling above and in front of the eye on each side of the skull. In later forms this swelling became more and more pronounced, until in the Oligocene titanotheres it grew into huge transversely-paired bony outgrowths from the naso-frontal junction, above and in front of the eyes. The shape of these bony protuberances differed in the numerous genera and species. In the more primitive Oligocene forms the "horns" were more or less three-sided, with a pointed tip, but in the more advanced genera they were broad transversely and compressed anteroposteriorly (*Brontotherium*), or erect with cylindrical section (*Megacerops*), or club-shaped (*Brontops robustus*), or three-faced with a rounded, recurved tip (*Menodus*). The skulls of these genera were relatively long (*Brontotherium, Menodus*), or wide (*Brontops robustus, Megacerops*), or of intermediate proportions (*Allops*). The skeleton of the largest titanotheres abounded in adaptations for the support of the huge bodies. Whereas the earliest forms had rather narrow hands and feet, the later giants of the race had very broad four-toed forefeet, parallel to those of the hippopotamus, and broad, short, three-toed hindfeet, parallel to those of the rhinoceros. The angles of the elbows and knees, which were well bent in the earlier running forms, opened out in the larger forms as in other "graviportal" mammals, while the ilium spread widely across the back to support the weight of the viscera. The great monograph on the titanotheres by H. F. Osborn affords one of the clearest and most interesting demonstrations of the facts of evolution yet recorded.

Chalicotheres.—The family of the chalicotheres (Chalicotheriidae) has been described under ANCYLOPODA. Here it will suffice to note that the primitive hoofs grew into long curved claws which seem to have been used for scratching the ground, perhaps in search of water and succulent tubers. The earliest known chalicothere, *Eomoropus* of the Eocene of Wyoming, retained the primitive perissodactyl numbers of four toes in the forefeet and three in the hindfeet, while the upper molars approximated to the Eocene perissodactyl type.

Rhinoceroses.—The family of the rhinoceroses (*see* RHINOCEROS) is connected with that of the lophiodonts by such forms as *Hyrachyus* of the Eocene of North America. *Hyrachyus* has been called "the cursorial rhinoceros" because by comparison with its massive modern relatives it was distinctly light-limbed. Somewhat smaller than a South American tapir, it resembled that animal in the general configuration of its body and limbs. It did not, however, have a proboscis and, unlike a rhinoceros, it had no horn above the nose. All its front teeth of both jaws were unspecialized, not yet like those of later rhinoceroses. Its upper molar teeth, however, had already begun to foreshadow the rhinoceros type in the obliquity and marked flattening of the outer surface of the hinder outer cusp, although the two outer main cusps were not yet submerged in the general outer wall. None of the known species of *Hyrachyus* were directly ancestral to the lines leading to the later rhinoceroses, some of the forerunners of which (named *Prohyracodon* and *Eotrigonias*) were already established during Eocene times. In *Trigonias* of the Lower Oligocene the true rhinoceros characters of the molars and premolars were well defined and the second lower incisors had begun to be enlarged as tusks. On the other hand, *Trigonias* was hornless and retained four toes on each forefoot and the upper canines, though small, were still retained. Most of the later Oligocene rhinoceroses had eliminated the fifth or outer digit of the forefoot and had also lost the upper and lower canines. In *Diceratherium,* a small rhinoceros abundant in the Lower Miocene of Nebraska, a small transversely-placed pair of oval horn-swellings developed near the tip of the nasal bones. This group became extinct during the Miocene. Meanwhile the "aceratheres," or hornless rhinoceroses of Europe, were numerous during the Oligocene and Miocene and some of them probably gave rise to the lines leading to the modern Sumatran and Indian rhinoceroses.

In addition to these central forms there were many peculiar

side lines. In the Miocene and Lower Pliocene of North America and Europe were swarms of extremely short-footed hippopotamus-like rhinoceroses (*Teleoceras,* etc.), with massive heads and very high-crowned molars and a single horn on the tip of the nose. The two existing species of African rhinoceroses and the related woolly rhinoceros of the Pleistocene of Europe are very highly specialized; their exact derivation is unknown. The strangest of all was the fossil *Baluchitherium* from the Upper Oligocene of Turkestan, Baluchistan and Mongolia, a titanic animal with a skull over four feet long and an estimated height at the shoulder of 13 feet.

Besides all these true rhinoceroses, there were two extinct groups to which some authors give the rank of distinct families, namely the hyracodonts and the amynodonts. The hyracodonts were small cursorial forms with rhinoceros-like molar teeth and unspecialized front teeth. Of these, the very small *Triplopus* of the Middle and Upper Eocene had exceedingly long, slender, three-toed feet. The Oligocene *Hyracodon* was much larger,—about the size of a calf,—with stockier feet. Both genera were exclusively North American. The amynodonts were larger forms, the oldest of which appears in the Upper Eocene of Utah. It was followed in the Lower Oligocene of the Big Badlands region of South Dakota by *Metamynodon,* a somewhat hippopotamus-like form with enlarged tusk-like upper and lower canine teeth and very elongated oblique outer walls of the upper molars; the stout forefeet retained four digits, the spreading hindfeet had the usual three toes of the rhinoceroses. Members of the same family have been found in the Lower Oligocene or Uppermost Eocene of Burma, Europe and Mongolia.

Origin of the Order.—The Perissodactyla as an order probably originated in the northern hemisphere, perhaps in basal Eocene times, from some as yet undiscovered relatives of the Eocene condylarths or protoungulates. By Lower Eocene times the group was well represented in western North America and western Europe and was already beginning to diverge into numerous families which have been classified by Osborn in five superfamilies, namely the Hippoidea (containing the lines leading to the palaeotheres and horses), the Chalicotheroidea (or chalicotheres), the Titanotheroidea (or titanotheres), the Tapiroidea (or tapirs and lophiodonts) and the Rhinocerotoidea (or rhinoceroses, hyracodonts and amynodonts). By Upper Eocene times the order was well represented in Burma and Mongolia. It was not until late Miocene or Pliocene times that the horses and tapirs penetrated into South America and the group never reached even the outposts of the Australian region. In Africa, which is now its greatest stronghold, it is conspicuously absent from the Upper Eocene and Lower Oligocene of Egypt and is not known until the Miocene or Pliocene. On the whole the existing Perissodactyla represent a beaten order which has been gradually crowded out by the ruminant artiodactyls. Of its surviving families, the rhinoceroses and tapirs seem doomed to extinction unless preserved by stringent regulation. The zebras, however, seem to have a better chance of survival in certain districts.

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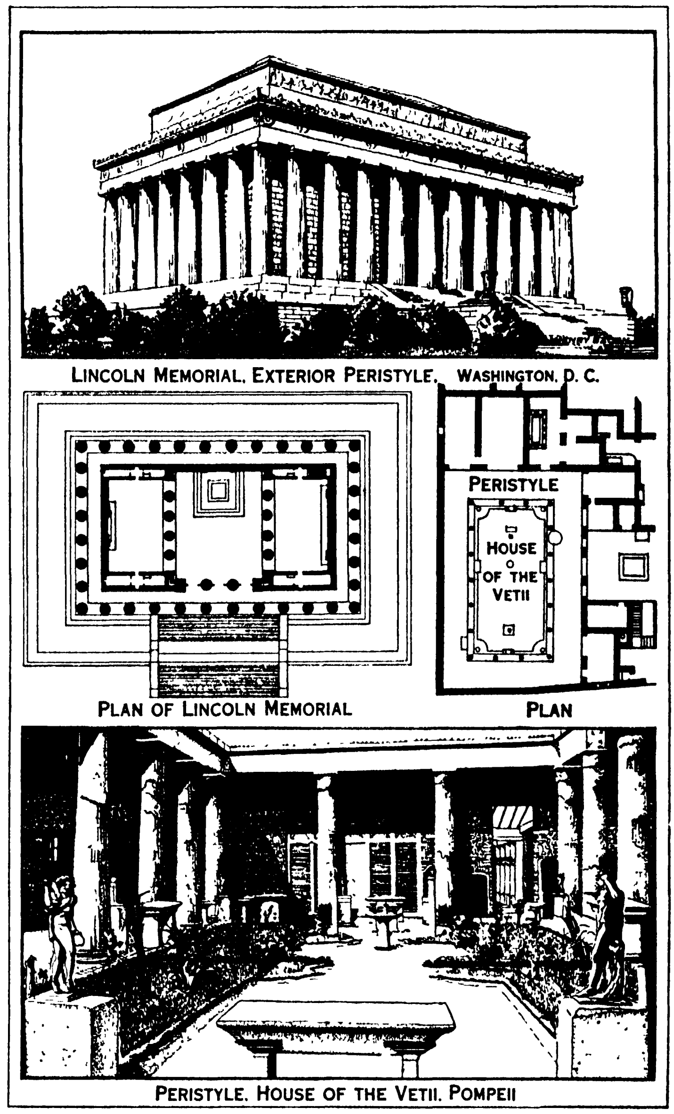
(W. K. G.)

PERISTYLE, in architecture, a range of columns surrounding the outside of a building or an enclosed room and also a range of columns surrounding or enclosing a court. The term is sometimes applied to the inner colonnaded court of a Roman house, reserved for family use, in contradistinction to atrium (*q.v.*), the outer, or more public court.

PERITONITIS, inflammation of the peritoneum. (*See* Coelom and Serous Membranes.) It may be acute or chronic, and either localized or diffused.

Acute peritonitis commonly follows such conditions as hernia and obstruction of the bowels, wounds penetrating the abdomen, perforation of viscera, as in ulcer of the stomach, and of the intestine in typhoid fever, bursting of abscesses or cysts into the abdominal cavity, and extension of inflammation from some abdominal or pelvic organ, such as the appendix, the uterus or bladder. At first localized, it may afterwards become general. The changes in the peritoneum are congestion; exudation of lymph in greater or less abundance, at first greyish and soft, thereafter yellow, becoming tough and causing the folds of the intestine to adhere together; effusion of fluid, either clear, turbid, bloody or purulent.

Acute peritonitis usually begins with a shivering fit, vomiting and pain in the abdomen with extreme tenderness, so that pressure, even of the bed-clothes, cannot be borne. The patient lies on the back with the knees drawn up to relax the abdominal muscles; the breathing becomes rapid and shallow, and is performed by movements of the chest only, the abdominal muscles remaining quiescent—which is not the case in healthy respiration. The abdomen becomes swollen by flatulent distension of the intestines, which increases the distress. There is usually constipation. The skin is hot; the pulse is small, hard and wiry; the face is pinched and anxious. When the peritonitis is due to perforation—as may



PLAN OF HOUSE OF VETII FROM, "POMPEII, ITS LIFE AND ART" (MACMILLAN)

EXAMPLES OF PERISTYLE: (ABOVE) IN MODERN ARCHITECTURE, (BELOW) IN ANCIENT ARCHITECTURE

happen in the case of gastric ulcer or of ulcers of typhoid fever, or in the giving way of a loop of strangulated bowel—the above-mentioned symptoms and fatal collapse may all take place in from twelve to twenty-four hours. The puerperal form of this disease, which comes on within a day or two after childbirth, is often rapidly fatal. The actual cause of death is the absorption of the

poisonous bacterial products formed in the peritoneal cavity.

Chronic peritonitis may follow a localised acute attack, or may be tuberculous. In the former case, the gravest symptoms having subsided, some abdominal pain continues, and there is swelling of the abdomen, due to thickening of the peritoneum, and the presence of fluid. This kind of peritonitis may also develop slowly without any preceding acute attack

Tuberculous peritonitis occurs either alone or in association with tuberculous disease of a joint or of the lungs Often it is associated with tuberculous mesenteric glands, particularly in children. The chief symptoms are abdominal discomfort, or pain, and distension of the bowels The patient may suffer from either constipation or diarrhoea, or each alternately. Along with these local manifestations there may exist high fever, rapid emaciation and loss of strength But some cases of tuberculous peritonitis present few symptoms of any kind In some cases, the neighbouring coils of intestine having been glued together, a collection of serous fluid takes its place in the midst of the mass, and, being walled in by the adhesions, forms a rounded tumour, dull on percussion, but not tender or painful Such cases, when occurring in women, are apt to be mistaken for cystic disease of the ovary.

The sole treatment of acute peritonitis is surgical.

PERIWINKLE, the popular name of a genus of Gastropod molluscs (*Littorina*) of wide distribution in temperate and cold seas. They are all of small size and have spiral, roughly globular shells, which in some species are smooth, in others ornamented with low spiral ribs. Some 80 living species of *Littorina* have been described and there are many fossil forms The common British *Littorina littorea*, about an inch long, has a wide range of colour-variation. This species appeared on the shores of New Brunswick and Nova Scotia between 1850 and 1860 and was found on the coast of Maine in 1868 It has since spread rapidly along the American coast, and is now common as far south as Delaware Bay. Among species native to North American shores are *L rudis*, very abundant from New Jersey to the Arctic ocean and found also on the Pacific coast, and *L palliata*, common from New Jersey to far northern shores Both the last-named species are smaller than *L. littorea*. *L. irrorata*, about equal in size to *L. littorea*, is frequent from Vineyard sound to Florida.

Systematically the periwinkles are placed among the Taenioglossate Pectinibranchs and are allied to the river snails (*Vivipara*) and the cowries (*Cypraea*). The anatomy of certain species has been studied and has been found to exhibit a peculiar modification of the gills, the filaments of which are prolonged across the surface of the mantle-cavity (*see* MOLLUSCA) and are broken up into vascular branches, so as to transform the mantle-cavity into an organ of aerial respiration *Littorina littorea* is sometimes found beyond high-water mark and has been found half a mile from the sea.

According to Blegvad *Littorina littorea* is both herbivorous and carnivorous, feeding on algae, seaweeds and small molluscs and crustacea (Ostracods). The majority of the species seem to be found in the Laminaria and Fucus zones of the sea shore. The eggs of these molluscs are deposited either singly or in masses Some species (*e g., L. rudies* and *neritoides*) are viviparous and the free-swimming larval stages are suppressed

Periwinkles are to be reckoned among the most common edible molluscs. In 1922, 3,245 tons were delivered in Billingsgate fish market.

See M. Caullery and P Pelseneer, *Bull Sci France et Belgique* (1911); W. M Tattersall, "Fisheries, Ireland," *Sci. Invest* (1920).

(G. C. R.)

PERIWINKLE, the name given to various species of the botanical genus *Vinca*, of the dog-bane family (Apocynaceae) The name periwinkle is possibly taken from *pervinka*, the Russian name of the flower, which in turn is derived from *pervi*, "first," as it is one of the first flowers of spring The lesser periwinkle (*V. minor*) with lilac-blue flowers, ¾ in. across, an evergreen, trailing perennial, native to Europe and found in the British Isles, has run wild throughout eastern North America. The similar greater periwinkle (*V major*), with purplish-blue flowers, 1 to 2 in. across, native to continental Europe, has become naturalized in England. The Madagascar periwinkle (*V. rosea*), grown as a garden annual for its rose-purple or white flowers, is of world-wide distribution in the Tropics. (*See* APOCYNACEAE.)

PERJURY. The law now relating to perjury is to be found in the Perjury Act 1911, a statute passed "to consolidate and simplify." That Act in its schedule repeals no fewer than 132 enactments that formerly dealt with the subject By s. 1 of the Perjury Act 1911: "If any person lawfully sworn as a witness or as an interpreter in a judicial proceeding wilfully makes a statement material in that proceeding, which he knows to be false or does not believe to be true, he shall be guilty of perjury, and shall, on conviction thereof or indictment, be liable to penal servitude for a term not exceeding seven years, or to imprisonment with or without hard labour for a term not exceeding two years, or to a fine or to both such penal servitude or imprisonment and fine." The expression "judicial proceeding" includes a proceeding before any court, tribunal or person having by law power to hear, receive and examine evidence on oath. Where a statement made for the purposes of a judicial proceeding is not made before the tribunal itself, but is made on oath before a person authorized by law to administer an oath to the person who makes the statement, and to record or authenticate the statement, it shall, for the purposes of this section, be treated as having been made in a judicial proceeding. A statement made by a person lawfully sworn in England for the purposes of a judicial proceeding—(*a*) in another part of his majesty's dominions; or (*b*) in a British tribunal lawfully constituted in any place by sea or land outside his majesty's dominions; or (*c*) in a tribunal of any foreign State, shall, for the purposes of this section, be treated as a statement made in a judicial proceeding in England Where, for the purposes of a judicial proceeding in England, a person is lawfully sworn under the authority of an Act of parliament—(*a*) in any other part of his majesty's dominions, or (*b*) before a British tribunal or a British officer in a foreign country, or within the jurisdiction of the Admiralty of England, a statement made by such person so sworn as aforesaid (unless the Act of parliament under which it was made otherwise specifically provides) shall be treated for the purposes of this section as having been made in the judicial proceeding in England for the purposes whereof it was made The question whether a statement on which perjury is assigned was material is a question of law the determination of which rests solely upon the court of trial

False statements on oath made otherwise than in a judicial proceeding, false statements with reference to marriage; false statements as to births or deaths; false statutory declarations and other false statements without an oath, and false declarations to attain registration for carrying on a vocation are declared misdemeanours and are punishable on indictment by punishments varying from seven years penal servitude to 12 months hard labour with the alternative or addition of a fine

Offences as to making false declarations as to marriages, births and deaths and false statutory declarations can be dealt with summarily (Criminal Justice Act 1925), but all offences declared to be perjury, punishable as perjury or as subornation of perjury must be tried on indictment at assizes, except those relating to false statutory declarations.

Subornation of Perjury is procuring a person to commit a perjury which he actually commits in consequence of such procurement If the perjury is not actually committed the offence is incitement and now by s 7 of the Perjury Act 1911 every person who aids, abets, counsels, procures, or suborns another person to commit an offence against the Act shall be liable to be proceeded against, indicted, tried and punished as if he were a principal offender, and every person who incites or attempts to procure or suborn another person to commit an offence against the Act is guilty of a misdemeanour, and, on conviction thereof on indictment, is liable to imprisonment, or to a fine, or to both

Before the Act was passed corroboration was required and now by s 13 it is provided that "a person shall not be liable to be convicted of any offence against this Act, or of any offence declared by any other Act to be perjury or subornation of perjury,

or to be punishable as perjury or subornation of perjury solely upon the evidence of one witness as to the falsity of any statement alleged to be false." An "oath" includes an "affirmation," or "declaration," and the expression "swear" likewise includes "affirm" or "declare."

In the United States perjury has been made a felony in most States by statute. These statutes generally embody the common law definition of the crime, though commonly extending the more ancient conception of the judicial proceeding in which the perjury had to be committed to all situations where the administration of an oath is made lawful. Statutes also embrace as a distinct offense that of false swearing. This differs from perjury principally in that it is not an essential ingredient of false swearing that the testimony need be, as to fact, material to the inquiry.

PERKIN, SIR WILLIAM HENRY (1838–1907), English chemist, the discoverer of aniline dyes, was born in London on March 12, 1838. He attended the City of London school and devoted all his spare time to chemistry; in 1853 he entered the Royal college of chemistry and studied under A. W. von Hofmann (*q.v.*) to whom he later became an assistant. He devoted his evenings to private investigations in a rough home-laboratory, and was inspired by some remarks of Hofmann's to undertake the artificial production of quinine. In the course of his experiments (1856) he oxidized impure aniline with potassium bichromate, and obtained a black product from which he was able to extract a bluish substance with excellent dyeing properties; this was the first artificial, or aniline, dye to be prepared, and it subsequently became known as "aniline purple" or "mauve." A patent for the process of manufacturing the dye was taken out in 1856 (Eng. Pat. 1884) and, with the aid of his father and brother, Perkin set up in 1857 works at Greenford Green, near Harrow, for the commercial production of "mauve." In this way the great aniline dye industry, which has assumed such large proportions, was founded. (*See* ANILINE DYES.) Perkin also had an important share in the development of artificial alizarin (*q.v.*), which has now entirely replaced the red dye of the madder root. C. Graebe and C. T. Liebermann in 1868 prepared the substance synthetically from anthracene, but their process was not practicable on a large scale; soon afterwards Perkin patented a commercial process which secured for his Greenford Green works a monopoly of alizarin manufacture for several years. He also carried out investigations on other dyes and on flavouring materials, in the course of which he synthesized coumarin (*q.v.*), the odoriferous principle of woodruff and the tonka bean. About 1874 he abandoned manufacture and devoted himself exclusively to research. In 1878 he discovered the "Perkin reaction," for the preparation of unsaturated acids, *e.g.*, cinnamic acid (*q.v.*) which depends on the condensation of aromatic aldehydes with the salt of a fatty acid. Later he made a comprehensive study of the relation between chemical constitution and the rotation of the plane of polarization of light in a magnetic field (*see* ISOMERISM) and calculated the "magnetic rotatory power" of various elements and radicles. Perkin was awarded the Royal medal of the Royal Society in 1879 and the Davy medal in 1889; he also received many other English and foreign honours. He was knighted in 1906 and died at Harrow on July 14, 1907. *See Jour. Chem. Soc.*, 1908, p. 2,214; L. Meldola, A. G. Green and J. C. Cain, *Jubilee of the Discovery of Mauve and of the Foundation of the Coal Tar Colour Industry by Sir W. H. Perkin* (Perkin Memorial Committee, 1908).

PERLITE or **PEARLSTONE,** a glassy volcanic rock which, when hammered, breaks into small rounded masses often of a pearly lustre, the reason being the many small cracks traversing its glassy substance. These cracks mostly take a circular course, and often occur in groups, one within another; they bound the little spheres into which the rock falls when it is struck, and the concentric fissures reflecting light from enclosed films of air, are the cause of the pearly lustre. Longer straight cracks run across the sections separating areas in which the circular fissures preponderate. By decomposition the fissures may be occupied by secondary minerals; the glass itself often undergoes change along the cracks by becoming finely crystalline or devitrified, dull in appearance and slightly opaque in section. In polarized light the perlitic glass is usually isotropic, but sometimes the interior of some of the spheres has a slight double refraction, apparently due to strain. Many rocks which are cryptocrystalline or felsitic, and not glassy, have perfect perlitic structure, and it seems probable that these were originally vitreous obsidians or pitchstones and have in time been devitrified to a finely crystalline state. Occasionally in olivine and quartz rounded cracks not unlike perlitic structure may be observed.

Many perlitic rocks contain well-developed crystals of quartz, felspar, augite or magnetite, etc., and in the fine glassy base minute crystallites often abound. Some have the resinous lustre and the high percentages of combined water which distinguish the pitchstones; others are bright and fresh obsidians, and nearly all the older examples are dull, cryptocrystalline felsites. According to their chemical compositions they range from very acid rhyolites to trachytes and andesites, and the dark basaltic glasses or tachylytes are sometimes highly perlitic. It is probable that most perlites are of intrusive origin, as indicated by the general absence of steam cavities, but some perlitic Hungarian rhyolites are believed to be lavas. Rocks of this kind are found in Meissen, Saxony, as dikes of greenish and brownish pitchstone. Other examples are furnished by the Tertiary igneous rocks of Hungary (Tokay, etc.), the Euganean Hills (Italy) and Ponza Island (Mediterranean).

In mineralogical collections rounded nodules of brown glass varying from the size of a pea to that of an orange may often be seen labelled *Marekanite.* They are found at Okhotsk, Siberia, in association with a large mass of perlitic obsidian, and are the more coherent portions of a perlite. They are subject to considerable internal strain, and when struck with a hammer or sliced with a lapidary's saw they often burst into fragments—as do "Prince Rupert's drops." In their natural condition the marekanite spheres are doubly refracting, but when they have been heated and very slowly cooled they lose this property and no longer exhibit any tendency to sudden disintegration.

In Great Britain Tertiary vitreous rocks are not common, but the pitchstone which forms the Scuir of Eigg is a dark andesitic porphyry with perlitic structure in its glassy matrix. A better example, however, is provided by a perlitic dacitic pitchstone porphyry that occurs near the Tay Bridge; the tachylytic basalt dikes of Mull are occasionally highly perlitic. (J. S. F.)

PERM, a town of Russia in the Uralsk area, on the left bank of the Kama river in 58° N., 56° 15′ E. Pop. (1926) 84,761. It has an important position on the railway since the products of the Urals converge on the town, partly by rail and partly by river. It is planned to continue the line north of Perm, now terminating at Kotlas, to Sorok on the west of Lake Onega and thus link Perm and the Urals with Murmansk. The town manufactures agricultural machinery, especially separators for the Siberian dairy industry, and has sawmills and timber works, cardboard, match and leather factories. The Perm district was formerly occupied by a Finnish tribe, the Permyaks, speaking a language closely related to that of the Komi (Zirians), and they are still to be found on the upper Kama. In 1568 the Russian merchant princes, the Stroganovs, established a settlement here named Brukhanovo, which received the name Perm in the 17th century. In 1723 copper works were founded near the town, which under the official name of Perm became an administrative centre in 1781. The former government of Perm is now merged in the Uralsk administrative area.

PERMALLOY: *see* ALLOYS and TELEPHONE.

PERMANENT COURT OF INTERNATIONAL JUSTICE. The Permanent Court of International Justice was created by an international agreement concluded at Geneva, Dec. 16, 1920, and consisted of a statute for the establishment of the court and a protocol of signature by which 52 states have declared their acceptance of the statute and of the jurisdiction of the court. At the close of 1927 this protocol had been ratified by 40 of the 52 signatories, including all the principal powers, except Russia and the United States of America. On Jan. 28, 1926, the Senate of the United States, upon the formal initiative

of the President, advised and consented that the United States adhere to the protocol of Dec. 16, 1920, with certain reservations designed to put the United States upon an equal footing in respect of the court with the several members of the League of Nations. Germany signed the protocol on Dec. 10, 1926, and ratified it on March 11, 1927.

I. CONSTITUTION AND JURISDICTION

Judges.—The court consists of 11 judges and four deputy judges, who are elected for terms of nine years and may be re-elected. The seat of the court is at The Hague. It holds regular annual sessions, and, unless otherwise provided by rules of the court, the regular session begins on June 15 of each year and continues as long as may be deemed necessary to finish the cases on the list. It elects its own president and vice-president, appoints its own registrar and makes its own rules regulating procedure The president and registrar are required to reside at the seat of the court. If at any time the full number of 11 judges cannot be present, the deputy judges are called upon to make up the number; nine judges being necessary to make a quorum. The statute requires that the members of the court shall be a body of independent judges elected regardless of their nationality from amongst persons of high moral character who possess the qualifications required in their respective countries for appointment to the highest judicial offices, or are jurisconsults of recognized competence in international law.

Not more than one national of any state at one time may be member of the court. The members receive regular salaries and are not permitted to exercise any political or administrative function, or to act as agent, counsel or advocate in any case of an international nature. Every member is required, before taking up his duties, to make a solemn declaration in open court that he will exercise his powers impartially and conscientiously.

Litigants.—Only states or members of the League of Nations can be parties to cases before the court. The rights of a private person, therefore, can be brought before the court, only by the Government of the state or quasi-state of which he is a citizen The court is open unconditionally to the members of the League of Nations and also to the states mentioned in the annexe to the League Covenant, and it is open to other states upon condition of their accepting the jurisdiction of the court and undertaking to carry out in good faith its decisions and not to resort to war against a state complying therewith. The jurisdiction of the court comprises all cases which the parties refer to it and all matters specially provided for in treaties and conventions in force.

There was much discussion whether this jurisdiction should be made generally compulsory, so that whenever one party to any international controversy wished to bring the case into court, the other party would be bound to submit to the jurisdiction Many states being unwilling to subject themselves to so comprehensive an obligation, the question was disposed of by including in the protocol and statute an optional clause, which the several states were at liberty to sign or refrain from signing, and under which the states signing recognized as compulsory, in relation to each other, the jurisdiction of the court in legal disputes concerning (*a*) the interpretation of a treaty, (*b*) any question of international law, (*c*) the existence of any fact which, if established, would constitute a breach of an international obligation, (*d*) the nature or extent of the reparation to be made for the breach of an international obligation. At the close of the year 1927, this optional clause had been signed by 27 states. France and Germany were the only great powers included in this list. Since the court began its work, its jurisdiction under the head of "matters specially provided for in treaties and conventions" has been enlarged by many new treaties and conventions providing that disputes between the parties shall be submitted to the court

Procedure and Practice.—The statute requires the court to apply in its decisions (1) international conventions, whether general or particular, establishing rules expressly recognized by the contesting states; (2) international custom as evidence of a general practice accepted as law; (3) the general principles of law recognized by civilized nations; (4) judicial decisions and the teaching of the most highly qualified publicists of the various nations, not as binding, but as subsidiary means for the determination of rules of law.

The official languages of the court are French and English. The hearings are public. Every decision is by a majority of the judges present at the hearing. The judgments are required to state the reasons on which the decisions are based. They are delivered in open court, and are printed and published in a regular series of reports. They are final and without appeal, but a judgment is binding only between the parties and in the particular case. Dissenting judges are entitled to deliver separate opinions.

Special chambers of five judges each are appointed by the court for three years to hear and determine labour cases arising under Pt. XIII. of the Treaty of Versailles and cases relating to transit and communications under Pt. XII. of the Treaty of Versailles. In such cases the judges are assisted by technical assessors With a view to the speedy dispatch of business, the court forms annually a chamber of three judges, who, at the request of the contesting parties, may hear and determine cases by summary procedure.

Special pains are taken in the statute to ensure that in each case there shall be in the court some judge familiar with the laws, customs and peculiarities of each country which is a party to the controversy, and if in any case there is no member of the court coming from the country which is a party litigant, that party may name an additional judge to sit in the court in that case. For this purpose several parties in the same interest are reckoned as one party only.

Advisory Opinions.—The court has provided by rules for giving an advisory opinion upon written request from the Assembly or the Council of the League of Nations containing an exact statement of the question accompanied by all documents likely to throw light upon it When such a request is received, the registrar is required to give notice to the members of the court, to the members of the League of Nations, to the states mentioned in the annexe to the Covenant and to any international organizations which are likely to be able to furnish information on the question Opinions are given only after hearing all parties concerned and after deliberation by the full court; and the requests and opinions are printed and published in a special collection of reports

II. ELECTION OF JUDGES

The judges and deputy judges of the court are elected by separate concurrent votes of the Council and the Assembly of the League of Nations, a majority vote of the members of each of those bodies being necessary to an election The voting is confined to a list of eligible candidates nominated by the members of the old Permanent Court of Arbitration at The Hague established by the Hague Conferences of 1899 and 1907. That Court of Arbitration was made up by each power signatory to the Hague Convention for the Pacific Settlement of International Disputes selecting not more than four persons who were required to be "of known competency in questions of international law, of the highest moral reputation and disposed to accept the duties of arbitrators " The persons thus selected were inscribed as members of the Court of Arbitration in a list which was sent to all the contracting powers.

When a controversy was to be brought before the Court of Arbitration, five persons were to be selected from this list by the parties to constitute the tribunal to hear and determine the case. The list of members of the Court of Arbitration accordingly really constitutes a panel from which in each case the arbitral tribunal is selected, and this panel is composed of as many little national groups as there were states signing the Hague Convention and making appointments under it Under the statute of 1920 creating the Permanent Court of International Justice, when a judge of the new court is to be elected, each of these national groups in the old court is called upon to nominate not more than four candidates, not more than two being of their own nationality. All the nominations thus made are entered in a single list to which the votes of the Council and the Assembly for the new judges are

confined.

The experience of many years has shown that the character of the men appointed to the old Court of Arbitration has been such as to withdraw them to a great degree from the most disturbing influences of local politics and to make them specially familiar with the persons who would be fitted for judges of the new court, and the statute conferring the power of nomination upon them contains an express provision that "before making these nominations, each national group is recommended to consult its highest court of justice, its legal faculties and schools of law, and its national academies and national sections of international academies devoted to the study of law." The statute creating the new court also lays down for the guidance of the Assembly and Council in casting their votes the following rule: "At every election the electors shall bear in mind that not only should all the persons appointed as members of the court possess the qualifications required, but the whole body also should represent the main forms of civilization and the principal legal systems of the world."

If after three meetings there remains a vacancy for which no candidate shall have obtained an absolute majority of votes both in the assembly and in the council, then a joint conference committee is provided for, which shall endeavour to agree and report upon a candidate, and the conference committee may, by unanimous agreement, go out of the list of nominations for a candidate. If the conference fails, then the judges of the court already elected may proceed to fill the vacancy by selection from amongst the candidates voted upon in the assembly or in the council.

III. ORGANIZATION AND WORKING

The first election of judges to constitute the court was held at Geneva on Sept. 14–16, 1921. The list of eligible candidates proposed by the members of the old Court of Arbitration included 89 names, and from this list 11 judges and three deputy judges were elected by concurrent ballots of the Council and Assembly, and a fourth deputy judge was chosen upon the report of a conference committee accepted by both bodies. The judges elected were respectively citizens of France, Great Britain, Spain, Denmark, the Netherlands, Switzerland, Italy, Japan, Brazil, Cuba and the United States of America. The deputy judges were citizens of Norway, Rumania, the Serb-Croat-Slovene state and China. The members elected met at The Hague on Jan. 30, 1922, and proceeded to organize the court by electing Judge Loder (Holland) as president and Judge Weiss (France) as vice-president, appointing Mr. Ake Hammarskjold (Norway) as registrar, and adopting rules regulating the constitution and working of the court and procedure before it.

The first session for the transaction of judicial business opened on June 15, 1922. The regular sessions provided for were held thenceforward, and during the years 1922–27 there were six regular and six extraordinary sessions. During the same period the court heard, considered and gave decisions in ten contested international cases and upon 13 requests for advisory opinions. Most of the questions considered were novel, difficult and important, and many of them presented differences of opinion which required an authoritative decision if the establishment of peace and order in Europe on a reasonable working basis was to proceed after the extensive rearrangements caused by the Treaty of Versailles. The 23 judgments and opinions rendered were accepted as final. The existence of the court is manifestly beginning to affect international discussion of disputes and to be recognized as affording a means of escape from those international deadlocks which have seemed insoluble because neither party felt willing to humiliate itself by surrendering its position.

IV. EVOLUTION OF THE COURT

The Permanent Court of International Justice is not a product of any one mind or group or negotiation. It is a growth of many years during which a multitude of men familiar with international affairs have collaborated in an effort to adapt to the conditions of international controversy the idea of justice under which in civilized communities judicial decision has superseded private war. Many projects designed to accomplish this result were devised and published by individuals from the 16th down to the close of the 19th century without much apparent effect. In the meantime, however, provisions for arbitration became more frequent in international treaties and the practice of settling international disputes by arbitration increased. Nineteen international arbitrations are registered during the first half of the 19th century and 117 during the second half. The Hague Conference of 1899 greatly facilitated the practice of international arbitration by providing a general system with well considered forms of procedure, an established secretariat and an available list of suitable arbitrators.

Justiciable and Non-justiciable Questions.—The next step in development was a realization of the distinction between the arbitration of controversies between nations and the judicial decision of justiciable questions. Arbitrators selected *ad hoc* by the parties for the decision of a controversy proved quite likely to negotiate a settlement. Men of the highest character in such a position had a tendency to act under a sense of diplomatic obligation, according to which the legal rights of the parties were merely elements in determining what it would be wise to do. By the time the second Hague Conference of 1907 met, a considerable opinion had arisen that for the decision of international questions of legal right it was necessary to create a permanent tribunal composed of judges who were judicial officers and nothing else, and who would devote their entire time to the trial and decision of international causes by judicial methods and under a sense of judicial responsibility, and who were so selected that the different systems of law and procedure should be fairly represented.

After very full discussion, the conference of 1907 declared itself in favour of this view. It adopted a draft project for such a court which, however, remained incomplete because it proved impossible to reach an agreement on the mode of selecting the permanent judges. The numerous smaller powers were insistent upon their rights of equal and independent sovereignty and upon an equal voice in the selection of judges as a logical incident to that sovereignty. The great powers were unwilling to agree to a court in the constitution of which they would have practically no voice commensurate with their populations and interests, as against the overwhelming majority of smaller states. Throughout the conference and during the seven years that elapsed between 1907 and the outbreak of the World War, there were constant but unavailing negotiations for an agreement upon some mode of electing the judges.

At the close of the War, the 14th article of the Covenant of the League of Nations required the newly created Council of the League to resume this effort and to formulate and submit to the members of the League for adoption plans for the establishment of a Permanent Court of International Justice. In pursuance of that instruction, 12 international lawyers, resident in as many different countries, were invited by the Council to act as a committee to prepare plans for the establishment of the proposed court. Upon this invitation such a committee met at The Hague (June 16, 1920), consisting of members from Great Britain, France, Spain, Belgium, Holland, Norway, Italy, Japan, Brazil and the United States. After long discussion, this committee, on July 24, 1920, reported a plan containing the arrangements for the election of judges above described. With some amendments in the Council and Assembly, particularly regarding jurisdiction, that plan was incorporated in the statute of Dec. 16, 1920.

Many of the provisions embodied in the statute creating this court had their origins during these long years of discussion in the necessity of reconciling the opinions of a great number of nations differing in their circumstances, in their modes of thought and feeling and in their conceptions of what would contribute to international justice. The statute probably does not conform to what would be produced in any single country, but it probably does include substantially all the useful provisions upon which the members of the community of nations were willing to agree in the year 1920.

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Sept. 1920); *The Permanent Court of International Justice* (descriptive booklet, League of Nations Series); A. P. Fachiri, *The Permanent Court of International Justice; its Constitution, Procedure and Work* (1925); M. O. Hudson, *The Permanent Court of International Justice and the Question of American Participation* (Harvard Univ. Press, 1925); Antonio Sanchez de Bustamante, *The World Court* (1925); several pamphlets on the court were issued by the World Peace Foundation between 1920 and 1926. (E. R.)

PERMEABILITY, MAGNETIC. The force between two magnetic poles varies as the product of the strengths of the poles, and inversely as the square of the distance between them. It depends also on the nature of the intervening medium. In the C.G.S. electro-magnetic system of units, unit pole is defined as one which repels an equal pole at a distance of one centimetre in empty space with a force of one dyne. Let F be the force between two poles of strengths m_1, m_2 at a distance r apart. Then, in a vacuum, $F=\frac{m_1m_2}{r^2}$. More generally, $F=\frac{m_1m_2}{\mu r^2}$. The constant μ depends on the medium, and is known as the permeability. The permeability may also be defined as the ratio of the magnetic induction, B, to the magnetizing force, H; the induction being a measure of the magnetic force which would be exerted on unit pole placed in a narrow crevasse in the medium perpendicular to the direction of the magnetic force. Thus $\mu=\frac{B}{H}$. The conception of permeability is due to Faraday, who spoke of it as "conducting power for magnetism," and the term was introduced by Kelvin in 1872.

Substances are divided into two main magnetic classes—diamagnetics, with the permeability, μ, less than 1, and paramagnetics with μ greater than 1. In diamagnetics the directions of the magnetization and the magnetizing force are opposite, in paramagnetics the same. For most substances the permeability differs very little from 1, and does not vary with the magnetizing field. A few paramagnetic substances, below certain critical temperatures, are ferromagnetic, having magnetic properties resembling those of iron. The permeability of ferromagnetics (which include iron, nickel and cobalt and some of their alloys) is a function of the magnetic force, and generally depends on the previous history of the specimen. The permeability may be very large; the maximum for some dynamo steels, and iron-nickel alloys being greater than 10,000. A knowledge of the permeability characteristics of iron and iron alloys, in particular, is of great technological importance. Material having a high permeability for definite ranges of magnetic force is generally required in the construction of electrical machinery. (*See* MAGNETISM.)

PERMEAMETER, an instrument for measuring the permeability of a sample of iron or steel, and more generally for examining the magnetic characteristics. The name was first applied by S. P. Thomson to an apparatus devised by himself in 1890. In this the sample, in the form of a rod, is surrounded by a magnetizing coil, and the mechanical force required to detach one end from an iron yoke of special form is measured by a spring balance. The force varies as the square of the induction, so that the induction, and hence the permeability for a known magnetizing field can be calculated. The measurement of the tractive force is also the basis of the du Bois magnetic balance permeameter.

In commercial routine magnetic testing measurements of a number of corresponding values of the induction, B, and of the magnetic field, H, are required. The Thomson and du Bois permeameters are rapid, and have been much used, but they are unsatisfactory for accurate work. The most accurate method of magnetic testing is the ballistic method using ring-shaped specimens. It is, however, desirable to carry out tests with ordinary bars, and a number of permeameters have been devised in which the same general method is extended to bar shaped specimens. The induction through a bar can be readily measured in the usual way by surrounding it by a search coil connected to a ballistic galvanometer (or fluxmeter); but the calculation of the magnetizing field is usually a matter of difficulty owing to the demagnetizing effects of the ends of the bar. By clamping the bar in a massive yoke of iron, a condition of approximate endlessness is attained, the bar and yoke together forming a magnetic circuit. This is done in the pioneer bar and yoke method of Hopkinson. In the crude arrangement, the joints (between the bar and yoke) and the yoke itself introduce great uncertainties. In Ewing's double bar and yoke test these errors are eliminated by a method involving a double series of measurements with two lengths of the bars. (*See* MAGNETISM.)

One of the most accurate permeameters is the double bar permeameter of C. W. Burrows. In this, two approximately equal bars are clamped in yokes at their ends. The bars are surrounded by magnetizing coils, and on reversing the magnetizing current, by means of a series of search coils connected to a galvanometer, a test can be made as to whether the induction remains uniform along the bar under test. There will generally be variations along the bar owing to the action of the joints and yokes; but this may be compensated by adjusting the current in subsidiary magnetizing coils. When uniformity of induction along the bar is attained, the magnetic field is that corresponding to the current in the main magnetizing coil, so that the field corresponding to the measured induction is accurately known.

For details of this permeameter, and of others, such as that of F. P. Fahy, which have come into general use, the technical literature should be consulted.

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PERMIAN, a geological term designating the uppermost system of rocks of the Palaeozoic era and suggested by Sir R. Murchison in 1841, from their great development in the Russian Province of Perm.

Towards the close of the Carboniferous period a great diastrophic revolution of the earth's surface resulted in the upheaval of many parts of the crust and rearrangements of large areas of land and sea. In certain regions the movements were simple, either up or down; whilst in others they gave rise to mountain building accompanied and followed by denudation. Thus in some cases Permian rocks are conformable to the Carboniferous whilst in others they are separated from them or still older rocks by an unconformity. In western Europe, for example, mountain ranges known as Armorican (Armorica, Brittany); in central Europe the Variscian Alps; in North America the Appalachians, and in Russia the Urals, were elevated at this time.

On the other hand in parts of eastern and southern Europe, central Asia, Australia and America the Carboniferous seas were persistent and there is a continuous suite of marine sediments bridging the interval between the Carboniferous and Permian of western Europe. Such intervening or transition beds whether of marine or continental type, are termed "Permo-Carboniferous."

Confusion has arisen, and still persists to some extent, by the inclusion in the Permian of deposits which are really Carboniferous or Triassic in age, especially in areas where the continental type of deposit was prevalent. Such areas were characterized by their aridity and resembled the Aralo-Caspian region, the Arizona desert and similar tracts of the present-day, *i.e.*, inland drainage basins embracing in places inland seas, salt-lakes and lagoons. The sandy plains or depressions were bordered by mountains gashed by cañons, usually dry but occasionally flushed by torrential rains.

In Europe the Permian consists of (1) the twofold, or "Dyas" type of Germany and (2) the Russian type. The Dyas occurs in great thickness flanking the Harz mountains and in the Rhine provinces, Thuringia, Saxony, Bavaria and Bohemia (Czechoslovakia). Two major divisions are recognized, of which the upper overlaps the lower and covers a greater area. They are as follows:—

Zechstein (Marine series): *Upper.*—Anhydrite, gypsum, rock salt, dolomite, marl, foetid shale and limestone; *Middle.*—Dolomite (*Stinkschiefer* and Great Dolomite) and gypsum; *Lower.*—Zechstein Limestone, Kupferschiefer and conglomerate.

Rothliegende (Terrestrial Series): *Upper.*—Red sandstones and shales with melaphyre and conglomerate; *Lower.*—Sandstones and conglomerates on black shales, poor coals and clay-ironstones, and sheets of melaphyre (lava). Red and grey sandstones with

impure limestones at base.

The clay-ironstones of the Rothliegende (Lower Lebach beds of the Saar region) have yielded a rich fauna (*Archegosaurus*, etc.) and flora (*Walchia, Callipteris*).

Overlying the Zechstein conglomerate is the Kupferschiefer, a thin black marly shale containing bitumen, copper ore, plant and fish remains. Copper ore amounts to no more than 3%, but has given rise to the chief copper mines in Germany (Mansfeld, etc.)

Of animals' remains in the Zechstein the limestone, 30–33 ft. thick, contains the greater number, although they show signs of poverty; fewer occur in the Great Dolomite.

In Thuringia a Bryozoa reef in the Lower and Middle Zechstein extended for miles along the western and southern margin of the Zechstein sea, and in addition to Bryozoa contains a rich fauna which bears witness to the gradual desiccation of the sea and the dying out of individual species.

Beds of salt occur in the Upper Zechstein north of the Harz and are worked, amongst other places, at Stassfurt, where rock-salt, 1,200 ft. thick, is followed by 150 ft. of potash and magnesia salts.

Eastwards the Zechstein extends into the Baltic provinces and the eastern Alps.

In south-eastern Russia the same types are recognized but there is an alternation of terrestrial and marine beds throughout the whole system. They cover an enormous tract, chiefly in the province of Perm (and extend into Nova Zemlya and Spitsbergen). Following the Carboniferous conformably they consist of sandstones, marls, shales, conglomerates and limestones—the latter containing a fauna similar to that of the Zechstein. Intercalated with these are beds of rock-salt, gypsum and coal. At the base are terrestrial beds with plants chiefly of Permian affinities.

On both sides of the Alps the Permian is represented mainly by thick red sandstones and conglomerates which pass up imperceptibly into the Trias. In the eastern Alps are the Grödner Sandstones (with a Zechstein dolomite), and the Verrucano Conglomerate, also found in the Appenines. Rothliegende plants appear in the Brescian Alps, whilst Kupferschiefer plants occur at Neumarkt (Tirol), in the Venetian Alps and in Hungary.

In England the Permian is represented mainly by the German facies, but to some extent also by that of southern Russia, and is everywhere unconformable to the Carboniferous; whilst in France only the Rothliegende is definitely recognizable, its lower members passing up gradually from the Coal Measures (Autun).

Durham and the south-east corner of Northumberland provide the classic area in England, the sequence being as follows:—

Passage Beds (Permo-Trias)—Red marls with sandstones, gypsum or anhydrite, and, in lower part:
- Marls with salt and thin magnesium limestone—170–500 ft.

Magnesian Limestone Series (Zechstein):
- Upper Magnesian Limestone—up to 250 ft. (Hartlepool Anhydrite Bed).
- Middle Magnesian Limestone with reefs—300 ft.
- Lower Magnesian Limestone—up to 240 ft.
- Marl Slate (=Kupferschiefer).

Yellow Sands, quartzose (?Rothgeliegende).

The yellow quartz sands are unfossiliferous, but the Marl slate contains fish remains of Kupferschiefer type.

The Middle Magnesian Limestone comprises a broad chain of Bryozoa reef knolls, flanked by bedded dolomites. This reef affords an example of a fauna locked in a sea in which the forms were dwarfed and gradually exterminated as the conditions of life became unfavourable. According to Trechmann the reef resembles that of Pössnach and other localities in the Gera district of Thuringia (*see* above) and may be continuous with it beneath cover.

Traced southwards into Nottinghamshire the Magnesian Limestone Series becomes thinner by the successive disappearance of its higher members, and what is left takes on a shore facies. The Zechstein sea shrank by desiccation, its margin in Durham moving south and east, in Nottinghamshire north and east, in Thuringia north and west.

Sherlock has recently argued that the upper part of the Magnesian Limestone Series of Durham is equivalent—by lateral passage to Bunter deposits in Nottinghamshire (*see* TRIAS). There is certainly a frequent upward passage from many British Permian deposits into those which are Triassic. Hence the probability is that certain beds classed as high Permian may be equivalent to others classed as low Bunter.

In central England various deposits—red marls, sandstones, conglomerates and breccias—which succeed the Carboniferous rocks conformably and were previously allotted to the Rothliegende have been relegated to the Carboniferous. Certain overlying unconformable deposits are still considered to be of Lower Permian age, as in places (*e.g.*, Collyhurst Sandstone, south Lancashire) they are succeeded by fossiliferous marls and bands of magnesian limestone representing part of the Zechstein.

A branch of the Zechstein sea penetrated into parts of Lancashire, west Cumberland and the Vale of Eden (Westmorland), and into Ireland near Belfast (Cultra), in Tyrone and the Lagan valley.

The Penrith Sandstone of the Vale of Eden, with its included sheets of limestone breccia ("brockrams") is usually attributed to the Rothliegende. It has its approximate counterpart in the sandstones, conglomerates and breccias of Arran (Ballymichael and Lamlash Sandstones, ? Upper Permian), the Brodick Breccia and Sandstone and the Dumfries and Mauchline Sandstones of south Scotland. In Ayrshire and south Lanarkshire they comprise basic lavas, tuffs and volcanic necks.

The Hilton Plant beds of the Vale of Eden are correlated with the Marl Slates, or the Kupferschiefer of Germany, whilst the Magnesian Limestones of west Cumberland (associated with brockrams and gypsiferous shales of Permo-Triassic age) and Ireland, and possibly the Vale of Eden, point chiefly to a Middle Magnesian Limestone age, although the Upper may also be present in Ireland.

Deposits of supposed Permian age, intimately connected with the Trias, occur in Devonshire.

In southern Europe, central and southern Asia marine sediments of Permian age were deposited in a central ocean, named by E. Suess "Tethys," which from time to time had connection with the Atlantic, and of which the present Mediterranean is a shrunken remnant.

In the Karawanken and Carinthian mountains limestones with swollen *Fusulina* and some species recalling the Permo-Carboniferous of Nebraska, follow directly on, or are in intimate connection with, the marine Carboniferous. A *Bellerophon* limestone with a rich Permo-Carboniferous fauna occurs in southern Tyrol. *Fusulina* limestones with an extraordinary number of Ammonoidea, some similar to those of the Artinsk stage, others of newer genera, occur in Sicily. In Asia a similar rich Permian fauna occurs near Djulfa in the valley of the Araxes and the Artinsk fauna appears again at Bokhara.

The lowest part of the Productus Limestone of the Indian Salt Range represents approximately the Artinsk stage. The higher part is Middle and Upper Permian. At the top (which is succeeded by Triassic formations) is a rich fauna of Ammonoidea, Nautili, Productidae, etc., some of the forms being common to the Zechstein. Marine Permian deposits occur also in the northern zone of the Himalayas, in Burma and at Timor in the Moluccas; whilst in the northern part of the Malay Peninsula the Permo-Carboniferous (and probably Permian) consists of marine limestones which become more shaly towards the east and south (Raub Series).

Beds equivalent to a part of the Permian of Russia occur in North America, but as there is frequently a complete upward transition from Coal Measures there is some disagreement as to where the line between the two should be drawn. The flooding by the sea northward and eastward, of the continent, continued throughout Pennsylvanian (Upper Coal Measure) times; it then began to retreat south-westward and in early Permian times the continent had again nearly emerged. Thus the greater part of the marine development in Kansas and south-west Texas is replaced by continental red beds in Oklahoma, northern Texas, and the southern Great Plains country. In Oklahoma tremendous amounts

of gypsum are incorporated in the red beds.

In Texas the beds classed as Permian (7,000 ft.) in the suite are the Wichita (or Wreford of Kansas) followed by the Clear Fork, Double Mountain and Capitan of Trans-Pecos: in Pennsylvania, the Dunkard: in Prince Edward Island, Nova Scotia and New Brunswick Permo-Carboniferous beds consist of soft-red shales and sandstones.

To the south of the Tethys the dominant feature of the southern hemisphere (and a smaller part of the northern) at this period is a vast pile of shales and coals of a deltaic and terrestrial facies, comprising what is known in India as the "Gondwana System," which ranges in age from Permo-Carboniferous to Jurassic.

In Peninsular India the coal-bearing Damuda series (about 10,000 ft.) contains the peculiar "Glossopteris" flora, with such forms as *Glossopteris, Gangamopteris* and *Sagenopteris.* At the base is the Talchir series, including a fossil boulder-clay or "tillite." A glacial boulder bed occurs also at the base of the speckled sandstones beneath the Productus Limestone of the Salt Range. Similar formations have been found in Afghanistan.

In Africa the thick Dwyka series, at the base of the Permo-Triassic Karroo system, extends from the southern to the central parts of the continent, with a horizontal range of 800 miles. The Dwyka conglomerate at or near its base is a tillite (maximum 1,500 ft.) which forms a sheet encircling the Karroo basin. It is succeeded by the Upper Dwyka shales and these by the coal-bearing Ecca beds, both with the *Glossopteris* flora.

At Bacchus Marsh and other places in Victoria coal-bearing beds with the *Glossopteris* flora are interstratified with the glacial deposits (which occur also as moraines in South Australia and Tasmania); whilst in Western Australia the Lyons Conglomerate analogous to similar deposits in New South Wales—associated with a marine Permo-Carboniferous fauna—can be traced without break from south-south-east to north-north-west through 3° of latitude.

In New Zealand the Permian (said to be 7,000–10,000 ft. thick) contains neither coal nor evidence of ice-action, but includes lava-flows.

Glacial conglomerates, associated with rocks of Permo-Carboniferous age, occur in many parts of South America typically Brazil and Argentina, in both cases with strata containing *Glossopteris.*

In the Falkland Islands Permo-Carboniferous beds with *Glossopteris* overlie a tillite, and with these the coal-bearing Beacon Sandstone of South Victoria Land (Antarctica), which also contains *Glossopteris* is tentatively correlated.

The Gondwana continent, margined by sediments with the *Glossopteris* flora, was probably traversed by alpine chains with valley glaciers spreading out as piedmonts on the shores of inland basins and land-locked seas. The movement of ice in India was apparently northward, in South Africa southward.

Certain tillites occur also in North America about Boston, Mass., but here the movement was from north to south, as in the Pleistocene period.

Glacial moraines are said to occur in the Lower Rothliegende of Westphalia in Germany.

The fauna of the continental types of the Permian generally possesses a terrestrial facies and comprises insects, molluscs, crustaceans, fish, amphibians (Labyrinthodonts) and reptiles (*Palaeohatteria, Proterosaurus,* etc.), the latter now making their first appearance. The richest and most varied fauna of amphibians and reptiles is that of America, especially Texas and Oklahoma, where it had an independent and isolated development.

The fauna of the inland seas shows signs of degeneration, but forms living in the open seas, such as Tethys, flourished and followed a normal course of development and new forms made their appearance. Ammonites (*Medlicottia, Wagenoceras,* etc.), so characteristic of the Mesozoic era, began to appear and are associated with Bryozoa, corals and molluscs. The last representatives of the trilobites occur in the Permian of North America.

Plants are represented by many survivors from the Carboniferous (e.g., *Calamites*); others show that a change of type was in progress. The distinctive Glossopteris flora was that of a cool climate. (B. Sm.)

PERN, a name sometimes given to the honey-buzzards. (*See* BUZZARD.)

PERNAMBUCO, a north-eastern Atlantic State of Brazil. Area, 38,312 sq.m.; pop. (1920) 2,154,835. It comprises a comparatively narrow coastal zone, a high inland plateau, and an intermediate zone formed by the terraces and slopes between the two. Its surface is much broken by the remains of the ancient plateau which has been worn down by erosion, leaving escarpments and ranges of flat-topped mountains, called *chapadas,* capped in places by horizontal layers of sandstone. The coastal zone is low, well wooded and fertile. It has a hot, humid climate, relieved to some extent by the south-east trade winds. This region is locally known as the *mattas* (forests). The middle zone, called the *caatinga* or *agreste* region, has a drier climate and lighter vegetation. The inland region, called the *sertão,* is high, stony, and dry, and frequently devastated by prolonged droughts (*sêccas*). The climate is characterized by hot days and cool nights, and is considered healthy, though the daily change tends to provoke bronchial, catarrhal and inflammatory diseases. There are two clearly defined seasons, a rainy season from March to June, and a dry season for the remaining months. The rivers of the State include a number of small plateau streams flowing southward to the São Francisco river, and several large streams in the eastern part flowing eastward to the Atlantic. The largest of the coastal rivers are the Goyanna, which is formed by the confluence of the Tracunhaem and Capibaribemirim, and drains a rich agricultural region in the north-east part of the State; the Capibaribe, which has its source in the Serra de Jacarará and flows eastward to the Atlantic at Recife with a course of nearly 300 m.; the Ipojuca, which rises in the Serra de Aldeia Velha and reaches the coast south of Recife; the Serinhaen and the Una.

The State of Pernambuco is, for the most part, agricultural, the lowlands being devoted to sugar and fruit, with coffee in some of the more elevated localities, the *agreste* region to cotton, tobacco, Indian corn, beans and stock, and the *sertão* to grazing and in some localities to cotton. Sugar, molasses, rum (*aguardiente* or *cachaça*), tobacco and fruit are largely exported. Coconuts, cacao, bananas, mangoes and other tropical fruits are produced in profusion, but the production of foodstuffs (beans, Indian corn, mandioca, etc.) is not sufficient for local consumption. Mangabeira rubber is collected to a limited extent, and piassava fibre is an article of export. Orchids are also collected for export in the districts of Garanhuns and Timbaúba. Cotton-weaving and cigar-making are the principal manufacturing industries, after the large *engenhos* devoted to the manufacture of sugar and rum. The railways of the State are parts of the Great Western of Brazil railway. All these lines concentrate at the port of Recife.

The capital of the State is Recife, a city that is commonly known among foreigners as Pernambuco. There is a number of large towns in the State, but the 1920 census returns include their populations in those of the *municipios* (communes) to which they belong. The most important are: Bezerros (48,190), Bom Jardim (92,515), Brejo da Madre de Deus (48,784), a town of the higher *agreste* region, Cabo (31,911), Caruarú (61,636), Escada (63,723), Garanhuns (21,135, covering six towns and villages), Gloria de Goytá (33,626), Goyanna (53,854), Limoeiro (52,573), Olinda (52,199), the old colonial capital and episcopal see, Rio Formoso (16,126), Timbaúba (52,526) and Victoria (59,572).

Pernambuco, at its inception in 1526, was settled by Christovão Jacques, who founded a settlement on the Rio Iguarassú that was afterwards abandoned. The first permanent settlement was made by Duarte Coelho Pereira at Olinda in 1530, and four years later he was granted a *capitania* of 50 leagues extending from the mouth of the São Francisco northward to that of the Iguarassú. Adjacent to this grant on the north was the *capitania* of Itamaracá, granted to Pero Lopes de Souza, which covered the remainder of the present State. The *capitania* of Pernambuco was ably governed and took an active part in the expulsion of the French from the trading posts established along the coast northward to Maranhão, and in establishing Portuguese colonies in their places.

In 1630 Pernambuco was occupied by the Dutch and continued under their rule until 1654. Although an active guerrilla warfare was waged against the Dutch during a large part of that period, they did much to promote the agricultural and commercial interests of the colony, especially under the wise administration of Maurice of Nassau.

In 1817 Pernambuco was the scene of a revolutionary outbreak, which resulted in the separation of the present States of Alagôas and Rio Grande do Norte, Ceará and Parahyba having been detached in 1799. There was another insurrection in 1822 when the Portuguese captain general, Luiz de Rego, and his garrison were expelled, and in 1824 dissatisfaction with the arbitrary proceedings of Dom Pedro I. at Rio de Janeiro led to a separatist revolution for the formation of a new State, to be called the Federação do Equador. There was another outbreak in 1831 and frequent disorders down to 1848, when they culminated in another unsuccessful revolution. The population of the Pernambuco *sertão* has always been noted for its turbulent, lawless character, due partly to distance from the coast where the bulk of the population is concentrated, partly to difficult means of communication, and partly to the fact that this remote region has long been the refuge of criminals from the coast towns.

PERNAU: *see* PÄRNU.

PERNERSTORFER, ENGELBERT (1850–1918), Austrian politician, was born in Vienna on April 27, 1850 Acquainted since childhood with Viktor Adler, Pernerstorfer studied and sympathized with the young Austrian labour movement since his earliest days as a teacher In 1870, together with Adler, Friedjung, the historian, and others, he formed a league for the study of social movements His first political activities were, however, linked with Schonerer's extreme German Nationalist movement He was one of the authors of the German Nationalist *Linzer Programm* (1880), but he left this party and entered parliament in 1889 as an independent As deputy he enjoyed the right of free speech and began to act as the mouthpiece of the Social Democrat party, to which he was of the greatest service He joined the party in 1896, and sat for it in parliament from 1901 until his death, in latter days being president of its parliamentary faction and vice-president of the House (1909, 1911) Pernerstorfer was rather an advanced liberal, who adopted Socialism from love of humanity and hatred of absolutism and clericalism His own principal interests were literary and educational His fearless and generous personality did much for the poorer classes of his fellow men in days when they were practically political and social outcasts He died in Vienna on Jan 6, 1918

PERNICIOUS ANAEMIA: *see* ANAEMIA; BLOOD, PATHOLOGY OF

PÉRONNE, a town of northern France, capital of an arrondissement of the department of Somme, on the right bank of the Somme, at its confluence with the Cologne, 35 m E by N of Amiens by rail Pop (1926), 4,087 The Frankish kings had a villa at Péronne and a monastery was founded here in the 7th century by, or for, Scottish monks; a collegiate church was built and dedicated to St Fursy, the first abbot By about 1200 it had escheated to the French crown, and Philip Augustus gave it a charter (1209). By the treaty of Arras (1435) it was given to the Burgundians, bought back by Louis XI, it passed again into the hands of Charles the Bold in 1465 On the death of Charles, however, in 1477, Louis XI resumed possession In 1536 the emperor Charles V besieged Péronne without success It was the first town after Paris at which the League was proclaimed in 1577 Wellington took Péronne in 1815, the Germans captured it in 1871 and again in 1914; the French retook it, March, 1917, lost it again March, 1918, and took it finally, with Australian help, in Sept. 1918.

PEROVSKITE, a mineral consisting of calcium titanate, $CaTiO_3$, usually with a small proportion of the calcium replaced by iron, discovered in 1839 at Achmatovsk in the Urals, and named in honour of Count L. A. Perovsky. The crystals when found in schistose rocks have the form of cubes, but when occurring as an accessory constituent of eruptive rocks are octahedral in form and microscopic in size; although geometrically cubic, they are always doubly refracting, and sometimes show evidence of complex mimetic twinning; their structure as shown in polarized light is very similar to that of the mineral boracite, and they are therefore described as pseudo-cubic. The colour varies from pale yellow to blackish-brown and the lustre is adamantine to metallic. In the Urals large cubes occur with calcite and magnetite in a chlorite-schist, and similar crystals are found in talc-schist at Zermatt, Switzerland The microscopic octahedral crystals are characteristic of melilite-basalt and nepheline-basalt; they have also been found in peridotite and serpentine

PEROWNE, JOHN JAMES STEWART (1823–1904), English bishop, was born, of Huguenot ancestry, at Burdwan, Bengal, on March 13, 1823. He was educated at Norwich and at Corpus Christi college, Cambridge, becoming a fellow in 1849. After holding a chair in King's college, London, he was appointed vice-principal at St. David's college, Lampeter (1862–72) He was elected canon of Llandaff in 1869, dean of Peterborough 1878, and in 1891 succeeded Henry Philpott as bishop of Worcester Perowne was a good Hebrew scholar and sat on the Old Testament Revision Committee. He resigned his see in 1901, and died on Nov. 6, 1904

PĒRŌZ, Sassanid king of Persia, A.D. 457–484, son of Yazdegerd II He rebelled against his brother Homizd III, and in 459 defeated and killed him with the help of the Ephthalites, or White Huns, who had invaded Bactria He also killed most of his other relatives, and persecuted the Christians But he favoured the introduction of Nestorianism, in opposition to the orthodox creed of Byzantium With the Romans he maintained peace, but he tried to keep down the Ephthalites, who began to conquer eastern Iran The Romans supported him with subsidies; but all his wars were disastrous Once he was himself taken prisoner and had to give his son Kavadh as hostage till after two years he was able to pay a heavy ransom Then he broke the treaty again and advanced with a large army But he lost his way in the eastern desert and perished with his whole army (484). (ED M)

PERPENDICULAR PERIOD, in architecture, the latest style of English Gothic, roughly embracing the period from 1375 to the introduction of the Renaissance, during the 16th and 17th centuries It gains its name from the dominance of vertical lines in window tracery and wall panelling; in windows the vertical mullions sometimes carry unbroken from the sill to the under side of the arch and the upper part of the window is further sub-divided by additional, smaller, vertical mullions carried by the apex of arches connecting the larger mullions Continuous horizontal lines of arches and cornices are sometimes carried across high windows to divide the whole into many small arched lights, in each one of which could be placed the effigy of a saint in stained glass In structure the tendency is toward the reduction of wall surface, the increase of window area, the continuity of vertical lines and supports and the lavish development of decorative vaulting by means of liernes and, later, the elimination of structural vaulting ribs altogether, and the substitution of cut-stone, traceried fan vaults (*q v*)

Timber-trussed ceilings and roofs were developed to a point of great perfection and richness as in that of Westminster hall, London (1395–99) and in countless simpler parish churches, *e g*, Chipping Norton, Holy Trinity, Hull The period also saw the construction of many beautifully outlined and lavishly detailed church towers, usually square and without spires Those of Gloucester cathedral (1450–57), Magdalen college, Oxford (1492–1505), the central tower at Canterbury (1495) and the west towers of York (1432–70) are typical In decorative detail the period is marked by the introduction of the four-centred or Tudor arch, the covering of wall surfaces with ranges of traceried panels, chiefly rectangular, the general flatness of moulding profiles, diminished importance of the capital, the enclosing of door and window arches within a rectangular hood mould and the replacement of the earlier naturalism in carved ornament by a rather dry, incisive and, at times, mechanical, conventionalism.

The Perpendicular Period appears first in work in Gloucester cathedral about 1360, but the spread of the style was so rapid that by 1380 Perpendicular work was being built throughout the

country. It was a style so vital that it yielded but slowly to the influx of Renaissance ideas, and, particularly in Oxford, its effect is felt in building well into the 17th century. Characteristic examples are: the choir (1347–77) and cloister (1351–1412) of Gloucester cathedral; nave and west transepts of Canterbury cathedral (1378–1411); choir of York (1389–1407); King's college chapel, Cambridge (1447–1512); St. George's chapel, Windsor (completed 1508); Henry VII chapel, Westminster (completed 1512) and the hall of Christ Church college, Oxford (1630). (T F H)

PERPETUAL MOTION or PERPETUUM MOBILE, in its usual significance, not simply a machine which will go on moving for ever, but a machine which, once set in motion, will go on doing useful work without drawing on any external source of energy, or a machine which in every complete cycle of its operation will give forth more energy than it has absorbed Briefly, a perpetual motion usually means a machine which will create energy in the form of motion.

The earlier seekers after the "perpetuum mobile" did not always appreciate the exact nature of their quest; for we find among their ideals a clock that would periodically rewind itself, and thus go without human interference as long as its machinery would last. The energy created by such a machine would simply be the work done in overcoming the friction of its parts, so that its projectors might be held merely to have been ignorant of the laws of friction and of the dynamic theory of heat Most of the perpetual motionists, however, had more practical views, and explicitly declared the object of their inventions to be the doing of useful work, such as raising water, grinding corn, and so on Like the exact quadrature of the circle, the transmutation of metals and other famous problems of antiquity, the perpetual motion has now become a venerable paradox. Still, like these others, it retains a great historical interest for as a result of the vain quest, there grew up the greatest of all the generalizations of physical science, the principle of the conservation of energy.

There was a time when the problem of the perpetual motion was one worthy of the attention of a philosopher. Before that analysis of the action of ordinary machines which led to the laws of dynamics, and the discussion of the dynamical interdependence of natural phenomena which accompanied the establishment of the dynamical theory of heat, there was nothing plainly unreasonable in the idea that work might be done by the mere concatenation of machinery. It had not then been proved that energy is uncreatable and indestructible in the ordinary course of nature; even now that proof has only been given by induction from long observation of facts. There was a time when wise men believed that a spirit, whose maintenance would cost nothing, could by magic art be summoned from the deep to do his master's work; and it was just as reasonable to suppose that a structure of wood, brass and iron could be found to work under like conditions

The principle of the conservation of energy, which in one sense is simply denial of the possibility of a perpetual motion, rests on facts drawn from every branch of physical science; and, although its full establishment only dates from the middle of the 19th century, yet so numerous are the cases in which it has been tested, so various the deductions from it that have been proved to accord with experience, that it is now regarded as one of the best-established laws of nature. Consequently, on any one who calls it in question is thrown the burden of proving his case. If any machine were produced whose source of energy could not at once be traced, a man of science (complete freedom of investigation being supposed) would in the first place try to trace its power to some hidden source of a kind already known; or in the last resort he would seek for a source of energy of a new kind and give it a new name.

If a man likes to indulge the notion that, after all, an exception to the law of the conservation of energy may be found, then provided he submits his idea to the test of experiment at his own charges without annoying his neighbours, all that can be said is that he is engaged in an unpromising enterprise. The case is otherwise with the projector who comes forward with some machine which claims by the mere ingenuity of its contrivance to multiply the energy supplied to it from some of the ordinary sources of nature and sets to work to pester scientific men to examine his supposed discovery, or attempts therewith to induce the credulous to waste their money. This is by far the largest class of perpetual-motion-mongers nowadays.

It was no doubt the barefaced fallacy of most of the plans for perpetual motion that led the majority of scientific men to conclude at a very early date that the "perpetuum mobile" was an impossibility. We find the Paris Academy of Sciences refusing, as early as 1775, to receive schemes for the perpetual motion, which they class with solutions of the duplication of the cube, the trisection of an angle and the quadrature of the circle. Stevinus and Leibnitz seem to have regarded its impossibility as axiomatic; and Newton at the beginning of his *Principia* states a principle which virtually amounts to the same thing

The famous proof of P de la Hire simply refers to some of the more common gravitational perpetual motions. The truth is that, if proof is to be given, or considered necessary, it must proceed by induction from all physical phenomena.

By far the most numerous class of perpetual motions is that which seeks to utilize the action of gravity upon rigid solids We have not read of any actual proposal of the kind, but the most obvious thing to imagine in this way would be to procure some substance which intercepts gravitational attraction. If this could be had, then, by introducing a plate of it underneath a body while it was raised, we could elevate the body without doing work, then, removing the plate, we could allow the body to fall and do work; eccentrics or other imposing device being added to move the gravitation intercepter, behold a perpetual motion complete! The great difficulty is that no one has found the proper material for an intercepter.

Fig. 1 represents one of the most ancient and oftenest-repeated of gravitational perpetual motions The idea is that the balls rolling in the compartments between the felloe and the rim of the wheel will, on the whole, so comport themselves that the moment about the centre of those on the descending side exceeds the moment of those on the ascending side Endless devices, such as curved spokes, levers with elbow-joints, eccentrics, etc, have been proposed for effecting this impossibility The student of dynamics at once convinces himself that no machinery can effect any such result; because if we give the wheel a complete turn, so that each ball returns to its original position, the whole work done by the ball will, at the most, equal that done on it. We know that if the laws of motion be true, in each step the kinetic energy given to the whole system of wheel and balls is equal to that taken from the potential energy of the balls less what is dissipated in the form of heat by frictional forces, or vice versa, if the wheel and balls be losing kinetic energy—save that the friction in both cases leads to dissipation. So that, whatever the system may lose, it can, after it is left to itself, never gain energy during its motion

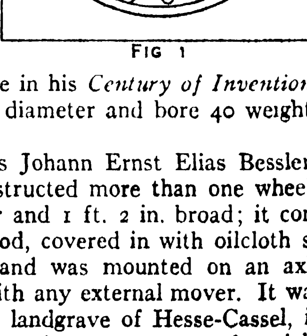


FIG 1

The two most famous perpetual motions of history, viz., the wheels of the marquis of Worcester (d 1667) and of Councillor Orffyreus, were probably of this type The marquis of Worcester alludes to the marvellous performance of his machine in his *Century of Inventions* (1663): the wheel was 14 feet in diameter and bore 40 weights of 50 pounds apiece!

Orffyreus (whose real name was Johann Ernst Elias Bessler) (1680–1745) appears to have constructed more than one wheel. his last one was 12 ft. in diameter and 1 ft. 2 in. broad; it consisted of a light framework of wood, covered in with oilcloth so that the interior was concealed, and was mounted on an axle which had no visible connection with any external mover. It was examined and approved of by the landgrave of Hesse-Cassel, in whose castle at Weissenstein it is said to have gone for eight

weeks in a sealed room. The most remarkable thing about this machine is that it evidently imposed upon the mathematician W. J. 'sGravesande, who wrote a letter to Newton giving an account of his examination of Orffyreus's wheel undertaken at the request of the landgrave, wherein he professes himself dissatisfied with the proofs theretofore given of the impossibility of perpetual motion, and indicates his opinion that the invention of Orffyreus is worthy of investigation. He himself, however, was not allowed to examine the interior of the wheel. The inventor seems to have destroyed it himself. One story is that he did so on account of difficulties with the landgrave's government as to a licence for it; another that he was annoyed at the examination by 'sGravesande, and wrote on the wall of the room containing the fragments of his model that he had destroyed it because of the impertinent curiosity of 'sGravesande.

The overbalancing wheel perpetual motion seems to be as old as the 13th century. Dircks quotes an account of an invention by Wilars de Honecort, an architect whose sketchbook is still preserved in the Écoles des Chartes at Paris. De Honecort says, "Many a time have skilful workmen tried to contrive a wheel that shall turn of itself; here is a way to do it by means of an uneven number of mallets, or by quicksilver." He thereupon gives a rude sketch of a wheel with mallets jointed to its circumference. It appears that Leonardo da Vinci worked with similar notions.

Another scheme of the perpetual motionist is a water-wheel which shall feed its own mill-stream. This notion is probably as old as the first miller who experienced the difficulty of a dry season. One form is figured in the *Mathematical Magic* (1648) of Bishop Wilkins (1614–1672); the essential part of it is the water-screw of Archimedes, which appears in many of the earlier machines of this class. Some of the later ones dispense with even the subtlety of the water-screw, and boldly represent a water-wheel pumping the water upon its own buckets.

Perpetual motions founded on the hydrostatical paradox are not uncommon; Denis Papin exposes one of these in the *Philosophical Transactions* for 1685. The most naïve of these devices is that illustrated in fig. 2, the idea of which is that the larger quantity of water in the wider part of the vessel weighing more will overbalance the smaller quantity in the narrower part, so that the water will run over at C, and so on continually.

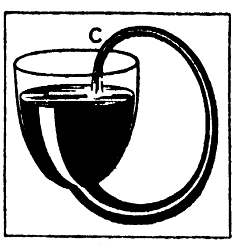


FIG. 2

Capillary attraction has also been a favorite field for the vain quest; for, if by capillary action fluids can be made to disobey the law of never rising above their own level, what so easy as thus to produce a continual ascent and overflow, and thus perpetual motion? Various schemes of this kind, involving an endless band which should raise more water by its capillary action on one side than on the other, have been proposed. The most celebrated is that of Sir William Congreve (1772–1828). EFG (fig. 3) is an inclined plane over pulleys; at the top and bottom travels an endless band of sponge, *abcd*, and over this again an endless band of heavy weights jointed together. The whole stands over the surface of still water. The capillary action raises the water in *ab*, whereas the same thing cannot happen in the part *ad*, since the weights squeeze the water out. Hence, inch for inch, *ab* is heavier than *ad;* but we know that if *ab* were only just as heavy inch for inch as *ad* there would be equilibrium, if the heavy chain be also uniform; therefore the extra weight of *ab* will cause the chain to move round continually in the direction of the arrow.

The more recondite vehicles of energy, such as electricity and magnetism, are more seldom drawn upon by perpetual-motion inventors than might perhaps be expected. William Gilbert, in his treatise *De Magnete*, alludes to some of them, and Bishop Wilkins mentions among others a machine "wherein a loadstone is so disposed that it shall draw unto it on a reclined plane a bullet of steel, which, still, as it ascends near to the loadstone, may be contrived to fall through some hole in the plane and so to return unto the place whence at first it began to move, and being there, the loadstone will again attract it upwards, till, coming to this hole, it will fall down again, and so the motion shall be perpetual." The fact that screens do exist whereby electrical and magnetic action can be cut off would seem to open a door for the perpetual-motion seeker. Unfortunately the bringing up and removing of these screens involves in all cases just that gain or loss of work which is demanded by the law of the conservation of energy. A shoemaker of Linlithgow called Spence pretended that he had found a black substance which intercepted magnetic attraction and repulsion, and he produced two machines which were moved, as he asserted, by the agency of permanent magnets, thanks to the black substance. The fraud was speedily exposed, but it is worthy of remark that Sir David Brewster thought the thing worth mentioning in a letter to the *Annales de chimie* (1818), wherein he states "that Mr. Playfair and Captain Kater have inspected both of these machines and are satisfied that they resolve the problem of perpetual motion."

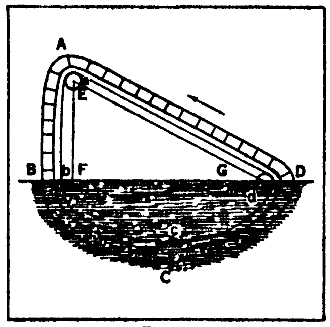


FIG. 3

One more page from this chapter of the book of human folly; the author is the famous Jean Bernoulli the elder. We translate his Latin, as far as possible, into modern phraseology. In the first place we must premise the following. (*See* fig. 4.) (1) If there be two fluids of different densities whose densities are in the ratio of G to L, the height of equiponderating cylinders on equal bases will be in the inverse ratio of L to G. (2) Accordingly, if the height AC of one fluid, contained in the vase AD, be in this ratio to the height EF of the other liquid, which is in a tube open at both ends, the liquids so placed will remain at rest. (3) Wherefore, if AC be to EF in a greater ratio than L to G, the liquid in the tube will ascend; or if the tube be not sufficiently long the liquid will overflow at the orifice E (this follows from hydrostatic principles). (4) It is possible to have two liquids of different density that will mix. (5) It is possible to have a filter, colander, or other separator, by means of which the lighter liquid mixed with the heavier may be separated again therefrom.

Construction.—These things being presupposed (says Bernoulli), I thus construct a perpetual motion. Let there be taken in any (if you please, in equal) quantities two liquids of different densities mixed together (which may be had by hyp. 4), and let the ratio of their densities be first determined, and be the heavier to the lighter as G to L, then with the mixture let the vase AD be filled up to A This done let the tube EF, open at both ends, be taken of such a length that $AC:EF > 2L:G+L$; let the lower orifice F of this tube be stopped, or rather covered with the filter or other material separating the lighter liquid from the heavier (which may also be had by hyp. 5); now let the tube thus prepared be immersed to the bottom of the vessel CD; I say that the liquid will continually ascend through the orifice F of the tube and overflow by the orifice E upon the liquid below.

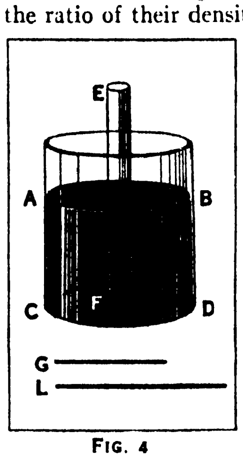


FIG. 4

Demonstration.—Because the orifice F of the tube is covered by the filter (by constr.) which separates the lighter liquid from the heavier, it follows that, if the tube be immersed to the bottom of the vessel, the lighter liquid alone which is mixed with the heavier ought to rise through the filter into the tube, and that, too, higher than the surface of the surrounding liquid (by hyp. 2), so that $AC:EF = 2L:G+L$; but since by constr. $AC:EF > 2L:G+L$ it necessarily follows (by hyp. 3) that the lighter liquid will flow over by the orifice E into the vessel below, and there will meet the heavier and be again mixed with it; and it will then penetrate the filter, again ascend the tube, and be a second time driven through the upper orifice. Thus, therefore,

will the flow be continued for ever.—Q.E.D.

Bernoulli then proceeds to apply this theory to explain the perpetual rise of water to the mountains, and its flow in rivers to the sea, which others had falsely attributed to capillary action—his idea being that it was an effect of the different densities of salt and fresh water.

One really is at a loss with Bernoulli's wonderful theory, whether to admire most the conscientious statement of the hypothesis, the prim logic of the demonstration, so carefully cut according to the pattern of the ancients, or the weighty superstructure built on so frail a foundation. Most of our perpetual motions were clearly the result of too little learning; surely this one was the product of too much. (G. Cl.)

The foregoing article by the distinguished mathematician George Chrystal, who died in 1911, is devoted to a delusion which is still distressingly prevalent. A certain number of weak heads genuinely succeed in deceiving themselves with the old fallacies, and often spend money which they can ill afford in taking out patents for patent absurdities. No man of science who has any susceptibilities can receive their communications without a certain compassion. On the other hand we have the conscious charlatans, who prey upon a class of people, by no means extinct, which possesses great cupidity, some money, a dangerous smattering of science and no sense. The form under which the perpetual motion is presented for the benefit of the credulous and affluent has been modified of recent years, to keep pace with the march of science. Whereas formerly the perpetual motion engine was usually a mechanical arrangement of weights, wheels and water-buckets, or such like, which did work without a supply of energy, to-day the form under which the invention is presented is usually an electrical one. Frequently the vendor or inventor makes no claim to create energy out of nothing, a point to which he directs special attention, admitting that this is known to be impossible by such shrewd and learned men as the prospective purchaser of shares, but states that his machine takes in a certain amount of electrical energy and turns out a greater amount of energy—a steady supply of 20 kilowatts is turned into an output of 37·5 kilowatts, say. The popular confusion between work and power, and between volts and amperes and electrical energy renders it easy to delude the self-satisfied victim, and the plausible denial of any creation of something out of nothing makes the creation of much out of little seem comparatively reasonable.

The latest scientific invention is often made the basis of a perpetual motion claim, in more or less good faith. For instance, shortly after the liquid air machine became a commercial success, claims are put forward—not by the inventor of the machine, of course—that part of the air liquefied by such a machine could be made to furnish a source of motive power which would run the machine itself, so that a continuous and increasing supply of liquid air could be produced without input of energy, once the machine was started.

The kind of perpetual motion which has been considered in Professor Chrystal's article is against all the ordered experience which is embodied in the first law of thermodynamics. This law states the equivalence of heat and work as alternative forms of energy, and denies that energy can be created. There is, however, nothing in the first law of thermodynamics against the following line of argument: Heat is equivalent to work. It is possible to build machines which turn heat into work. Therefore it must be possible to build a machine which will take heat from some ordinary body at atmospheric temperature, say a pond, and turn it into work. The pond will, of course, grow colder, but this need not disturb us, as for a very slight cooling we should obtain a large amount of work. For instance, a pond 200 yards across and of an average depth of 6 feet, cooling 1° centigrade, would yield 75,000 horse-power-hours if the heat lost could all be turned into work. It is usual to speak of a machine which could convert the heat of surrounding bodies into work as effecting a *perpetual motion of the second kind,* perpetual motion of the first kind being that which creates energy out of nothing. A perpetual motion of the second kind involves no creation of energy, but a conversion of energy under certain conditions.

The second law of thermodynamics (*see* Thermodynamics), which, like the first law, is an embodiment of the physical experience of generations of experimenters and observers of the first rank, denies that it is possible to derive mechanical energy from bodies by cooling them below the temperature of the surrounding object, that is, it denies precisely that a perpetual motion of the second kind is possible. For us to be able to convert heat into work we must have a source of heat above the temperature of the surrounding bodies, or, in the language of the engineer, we must have both a boiler and a condenser (although, of course, we need not actually build the condenser, but can use the surrounding air as condenser if for any reasons, such as exist in the case of the locomotive, a condenser is impracticable). The bigger the difference of temperature between the hot source of heat and the cold condenser, the bigger the fraction of the heat of the source which we can turn into work: when the temperature difference is zero we can turn none of the heat into work.

The impossibility of a perpetual motion, either of the first or of the second kind, is implicit, then, in the two great laws of Thermodynamics, which express our knowledge of the behaviour of matter in such quantities as are handled in ordinary mechanical and chemical processes. They are statistical laws, and do not apply to individual molecules, or to small collections of molecules, but to matter as we deal with it in engineering, where the smallest particle considered consists of millions of millions of millions of molecules! When we come down to microscopic and ultra-microscopic particles perpetual motion is possible, as exemplified by the ceaseless movement of tiny particles held in suspension in a fluid at a uniform temperature. (*See* Brownian Movement.) Such movement of microscopic particles, however, does not enable us to derive useful work from the heat agitation of the liquid, that is, from the perpetual motion of the molecules themselves. It does not contradict, but supplements our knowledge of the behaviour of matter in bulk, which tells us that perpetual motion is a mechanical impossibility. (E. N. da C. A.)

PERPETUAL PENSIONS: *see* Pensions: Perpetual or Hereditary.

PERPETUITY, in law the tying-up of an estate for a lengthened period for the purpose of preventing or restricting alienation. As being opposed to the interest of the State and individual effort, the creation of interests indefinite in time has been considerably curtailed, and the rule against perpetuities in Great Britain now forbids the making of an executory interest unless beginning within the period of any fixed number of existing lives and an additional period of 21 years (with a few months added, if necessary, for the period of gestation). The rule applies to dispositions of personal property (*see* Accumulations) as well as of real property. Section 163 of the Law of Property Act, 1925, enacts in effect that a remainder to children at an age in excess of 21 years is to be read as at 21 years, thereby making the remainder legal instead of void (*see* also ss. 164–166 of the Law of Property Act, 1925). There are certain exceptions to the rule, as in the case of limitations in mortmain and to charitable uses, and of a perpetuity created by act of parliament. In the United States the English common-law rule against perpetuities obtains in many of the States; in others it has been replaced or reinforced by statutory rules. (*See* Gray on *Alienation.*) The general tendency of American legislation is to favour tying up estates to a greater extent than was formerly approved.

PERPIGNAN, a town of France, capital of the department of Pyrénées-Orientales, on the Têt, 7 m. from the Mediterranean and 42 m. S. by W. of Narbonne by rail. Pop. (1926) 57,370. Perpignan dates at least from the 10th century. In the 11th and 12th centuries it was a capital of the counts of Roussillon, from whom it passed in 1172 to the kings of Aragon. In the 13th century it belonged to the kingdom of Majorca, and its sovereigns resided there until, in 1344, that small state reverted to the kings of Aragon, who in 1349 founded a university at Perpignan. When Louis XI. occupied Roussillon as security for money advanced by him to the king of Aragon, Perpignan resisted the French arms and yielded only in 1475. Roussillon was restored to Aragon by Charles VIII. and Perpignan was again unsuccessfully besieged

in 1542 under Francis I. Later on, however, the inhabitants, angered by the Spanish governor, surrendered the town to Louis XIII. The citadel held out until 1642, and the place was formally ceded to France by the treaty of the Pyrenees (1659). In 1602 the bishopric of Elne was transferred to Perpignan.

On the south the town is overlooked by a citadel enclosing a castle (13th century) of the kings of Majorca. The chapel is a mixture of the Romanesque, Pointed and Moorish styles. The ramparts surrounding the citadel are the work of Louis XI., Charles V. and Vauban. The cathedral of St. Jean (14th to 16th centuries) has a remarkable 17th century reredos.

Commanding the gateway of Notre-Dame (1481) is a curious machicolated stronghold of the 14th and 15th centuries.

Perpignan has tribunals of first instance and of commerce, a chamber of commerce and a board of trade-arbitrators. The higher tribunal of Andorra sits at Perpignan. Trade is in wine, iron, wool, oil and corks.

PERQUISITE, a term properly used of the profits which accrue to the holder of an office over and above the regular emoluments; also, in law, the casual profits, such as accrue by heriots, fines, reliefs, etc., to a lord of a manor above the yearly revenue from the copyholds. The word is used generally of the casual profits allowed by custom to servants or other employees.

PERRAULT, CHARLES (1628–1703), French author, was born in Paris on Jan. 12, 1628. His father, Pierre Perrault, was a barrister, whose four sons were all men of some distinction: Claude (1613–1688) was a physician and architect, and translated Vitruvius (1673). Charles was brought up at the Collège de Beauvais, and after quarrelling with his masters followed his own bent. He took his degree of *licencié en droit* at Orleans in 1651, and was called to the Paris bar, where he practised for a short time. In 1654 his brother became receiver-general of Paris, and made Charles his clerk. About ten years later he became Colbert's secretary. He was controller-general of the department of public works, member of the commission that afterwards developed into the *Académie des inscriptions,* and in 1671 he was admitted to the *Académie française.*

Colbert's death in 1683 put an end to Perrault's official career, and he then gave himself up to literature, beginning with *Saint Paulin évêque de Nole, avec une épître chrétienne sur la pénitence, et une ode aux nouveaux convertis.* The dispute of the ancients and moderns arose from a poem on the *Siècle de Louis le Grand* (1687), read before the Academy by Perrault, on which Boileau commented in violent terms. Perrault had a will of his own, and he published (4 vols., 1688–1696) his *Parallèle des anciens et des modernes.* The controversy that followed raged hotly both in France and England.

The first of Perrault's famous contes, *Grisélidis,* in verse, appeared in 1691, and was reprinted with *Peau d'âne* and *Les Souhaits ridicules,* also in verse, in a *Recueil de pièces curieuses* (The Hague, 1694). But Perrault was no poet, and the merit of these pieces is entirely obscured by that of the prose tales, *La Belle au bois dormant, Petit chaperon rouge, La Barbe bleue, Le Chat botté, Les Fées, Cendrillon, Riquet à la houppe* and *Le Petit poucet,* which appeared with the title of *Histoires ou contes du temps passé avec des moralités* (*c.* 1697). The frontispiece contained a placard with the inscription, *Contes de ma mère l'oie.* Perrault's other works include his *Mémoires,* giving much information on Colbert's ministry; an *Enéide travestie* written in collaboration with his two brothers, and *Les Hommes illustres qui ont paru en France pendant ce siècle* (2 vols., 1696–1700). He died on May 16, 1703, in Paris. His son, Perrault d'Arma-Court, was the author of *Contes des fées,* containing the story of Cinderella, etc.

Except the tales, Perrault's works have not recently been reprinted. Of these there are many modern editions, *e.g.,* by Paul Lacroix (1876), and by A. Lefèbvre ("Nouvelle collection Jannet," 1875); also *Perrault's Popular Tales* (Oxford, 1888), which contains the French text edited by Andrew Lang, with an introduction, and an examination of the sources of each story. *See* also Hippolyte Rigault, *Hist. de la querelle des anciens et des modernes* (1856).

PERRERS (or De Windsor), **ALICE** (d. 1400), mistress of the English king Edward III., belonged probably to the Hertfordshire family of Perrers, although it is also stated that she was of humbler birth. She entered the service of Edward's queen, Philippa, before 1366, and was married to Sir William de Windsor, deputy of Ireland (d. 1384). Her intimacy with the king began about 1366. Alice was accused of interfering in the courts of law to secure sentences in favour of her friends, and the parliament of 1376 forbade all women from practising in the law courts. Alice was banished, but John of Gaunt allowed her to return to court in June 1376, and the parliament of 1377 reversed the sentence against her. She was again banished in June 1377; but this sentence was annulled two years later, and Alice regained some influence at court.

PERROT, SIR JOHN (*c.* 1527–1592), lord deputy of Ireland, the son of Mary Berkley (afterwards wife of Thomas Perrot) was generally reputed to be a son of Henry VIII., and was attached to the household of William Paulet, 1st marquess of Winchester. Perrot was knighted at the coronation of Edward VI. and though imprisoned during Mary's reign on the charge of harbouring heretics, he received the castle and lordship of Carew in Pembrokeshire, and at the beginning of Elizabeth's reign was entrusted with the naval defence of South Wales. In 1570 Perrot became lord president of Munster, in which capacity he hunted down James Fitzmaurice Fitzgerald, whose submission he received in 1572. Perrot resented the reinstatement of Gerald Fitzgerald, 15th earl of Desmond, and after vainly seeking his own recall left Ireland without leave in July 1573, and presenting himself at court was allowed to resign his office, in which he was succeeded by Sir William Drury. He returned to his Welsh home, where he was occupied with his duties as vice-admiral of the Welsh seas.

In 1584 Perrot succeeded Arthur Grey, Lord Grey de Wilton, as lord deputy of Ireland, and was instructed to divide the confiscated estates of the earl of Desmond among English landlords who were to supply English labour. But his plans were disturbed by the raids of the Macleans and the MacDonnells, invited to Ulster by Sorley Boy, whom he reduced to submission in 1586. In 1585 Perrot succeeded in completing the "composition of Connaught," a scheme for a contract between Elizabeth and the landholders of the province by which the queen should receive a small quitrent. During his career as lord deputy he had established peace, and had deserved well of Elizabeth, but his indiscretions had made him numerous enemies. A plan for the conversion of the revenues of St. Patrick's Cathedral, Dublin, to provide funds for the erection of two colleges, led to a quarrel with Adam Loftus, archbishop of Armagh, and in Jan. 1588 he returned to London in disgrace. After his return a forged letter purporting to be from him to Philip II. of Spain gave colour to a charge of treason. He was found guilty, but died in the Tower in September 1592.

A life of Sir John Perrot from a MS. dating from the end of Elizabeth's reign was printed in 1728. Sir James Perrot (1571–1637), writer and politician, was his illegitimate son.

PERRY, BLISS (1860–), American author, was born at Williamstown (Mass.), on Nov. 25, 1860. He graduated from Williams college in 1881 (A.M., 1883), continuing his studies at the universities of Berlin and Strasbourg. He was professor of English at Williams college, 1886–93, and professor of oratory and aesthetic criticism at Princeton university, 1893–1900. In 1907 he became professor of English literature at Harvard university, and was Harvard lecturer at the University of Paris, 1909–10. He was the editor of the *Atlantic Monthly* for the decade beginning 1899. Although he has written some fiction, he is chiefly known as an essayist and critic.

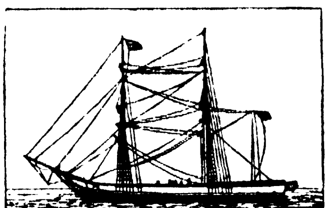
PERRY, MATTHEW CALBRAITH (1794–1858), American naval officer, was born in South Kingston, R.I., April 10, 1794. He became a midshipman in 1809, and served during the War of 1812, and in 1813 was made lieutenant. In 1826 he became a commander, and during 1826–30 was in the recruiting service at Boston, where he took a leading part in organizing the first naval apprentice system of the U.S. navy. He was promoted in 1837 to the rank of captain (then the highest actual rank in the U.S. navy), and in 1838–40 commanded the "Fulton II.," the first American steam war vessel. In 1843, with the honorary rank of commodore, he assumed command of a squadron sent to the African coast by the United States, under the Webster-Ash-

burton treaty, to aid in suppressing the slave trade. On Oct. 23–24, 1846, during the Mexican War, Perry, in command of six vessels, attacked and captured Frontera and Tobasco, thereby cutting off Mexico from Yucatan. He relieved Commodore David Conner at Vera Cruz on March 21, 1847, and after a two days' bombardment the city wall was breached sufficiently to admit the entrance of troops.

Perry's distinctive achievement was his negotiation of the treaty between the United States and Japan. On July 14, 1853, accompanied by his officers and by armed marines and sailors (in all about 300 men), he went ashore and presented to commissioners especially appointed by the *shōgun* to receive them, President Fillmore's letters to the emperor, and his own credentials. A few days later the American fleet sailed for Hong-Kong with the understanding that Perry would return in the following spring to receive the emperor's reply. Accordingly, on Feb. 11, 1854, he reappeared in the Bay of Yedo with his fleet of six vessels, and despite the protests of the Japanese selected an anchorage about 12m. farther up the bay, nearly opposite the present site of Yokohama, and within about 10m. of Yedo (Tōkyō). Here, on March 31, 1854, was concluded the first treaty (ratified at Simoda on Feb. 21, 1855, and proclaimed on June 22 following) between the United States and Japan. The more important articles of this treaty provided that the ports of Simoda and Hakodate were constituted as ports for the reception of American ships, where they could buy such supplies as they needed; that Japanese vessels should assist American vessels driven ashore on the coasts of Japan, and that the crews of such vessels should be properly cared for at one of the two treaty ports; that shipwrecked and other American citizens in Japan should be as free as in other countries, within certain prescribed limits; that ships of the United States should be permitted to trade at the two treaty ports under temporary regulations prescribed by the Japanese, and that privileges granted to other nations thereafter must also be extended to the United States. Commodore Perry died in New York city on March 4, 1858.

See the official record, *Narrative of the Expedition of an American Squadron to the China Seas and Japan* (1856). The first volume of this work, containing Commodore Perry's narrative, was also published separately. A brief biography of Perry is included in Charles Morris's *Heroes of the Navy in America* (Philadelphia, 1907). *See* also William E. Griffis's *Matthew Calbraith Perry, a Typical American Naval Officer* (Boston, 1887).

PERRY, OLIVER HAZARD (1785–1819), American naval officer, was born at South Kingston, R.I., on Aug. 23, 1785. He entered the navy as midshipman (1799) with his father, Christopher Raymond Perry (1761–1818), a captain in the navy, and saw service against the Barbary pirates. At the beginning of the War of 1812 he was in command of a flotilla at Newport, but was transferred (Feb. 1813) to the Lakes. He served with Commodore Chauncey, and then was sent from Lake Ontario to Lake Erie, where he took up the chief command at the end of March 1813. With the help of a strong detachment of officers and men from the Atlantic coast he equipped a squadron consisting of one brig, six fine schooners and one sloop, with which superior force he completely defeated the British squadron under Captain Barclay off Amherstburg. Perry commanded the "Java" in the Mediterranean expedition of 1815–16. He died of yellow fever at Port of Spain in Trinidad on Aug. 23, 1819.



BY COURTESY OF THE ERIE (N.Y.) CHAMBER OF COMMERCE
PERRY'S FLAGSHIP "THE NIAGARA"

See O. H. Lyman, *Commodore O. H. Perry and the War on the Lakes* (1905); James Cooke Mills, *Oliver Hazard Perry and the Battle of Lake Erie* (1913); and Charles Oscar Paullin (Ed.), *The Battle of Lake Erie* (1918).

PERRY, STEPHEN JOSEPH (1833–89), English astronomer, was born in London, Aug 26, 1833. He was educated as a priest but his mathematical interests led him into astronomy and in 1868 he assumed charge of the Stonyhurst College observatory. Perry devoted his energies chiefly to solar physics, discovered the phenomenon known as "veiled spots" and was a pioneer in photographing the spectra of sunspots. He journeyed to many parts of the world to observe transits of Venus and total eclipses of the sun. While off the coast of French Guiana on the latter errand he died, Dec. 27, 1889.

See A. L. Cortie, *Father Perry, the Jesuit Astronomer* (1890).

PERRY, a city of Dallas county, Iowa, U.S.A., 40 m. N.W. of Des Moines, on the Raccoon river; served by the Chicago, Milwaukee, St. Paul and Pacific, the Minneapolis and St. Louis, and electric railways. Pop. (1925 state census) 5,778. It has large railroad shops, packing plants, canneries and milk-condensing plants, and there are extensive nurseries in the vicinity.

PERRY, a village of Wyoming county, New York, U.S.A., on Silver lake, 35 m. S.W. of Rochester; served by the Buffalo, Rochester and Pittsburgh railway. Pop. (1925) 4,636 (State census). It has large knitting mills, a condensed-milk plant and other manufacturing industries. Silver lake is a summer resort. The village was founded about 1814 and was incorporated in 1830.

PERRY, an alcoholic beverage made from pears. Made by the vinous fermentation of pear juice, perry is a product bearing the same relation to the pear as cider (*q.v.*) to the apple. As in the latter case, special varieties of the fruit possessing vintage qualities which render them unsuitable for edible purposes are required for the preparation of a beverage of prime quality.

The districts noted for the making of perry are less numerous and extensive than those associated with cider production, and are in general specialized centres in the latter areas. Parts of Brittany and Normandy in France and the counties of Gloucester, Hereford and Worcester in England are the best known sources of the beverage. The acreage under perry pear trees is much less than that devoted to the culture of cider fruit and the total output of perry is insignificant in comparison with that of cider.

The varieties of perry pears do not fall into a natural classification according to chemical composition as in the case of cider apples. The following English varieties are most generally favoured: Aylton Red, Barland, Blakeney Red, Butt, Huffcap, Longland, Moorcroft, Oldfield, Taynton Squash, and Rock.

Most kinds of perry pears yield juices of a medium degree of acidity and a more or less marked astringency. The chief problem of perry making is the tendency of the beverage to develop a milky turbidity after the final clarification. (B. T. P. B.)

PERRYVILLE, a town of Boyle county, Ky., U.S.A., about 10 m. W. of Danville. Pop. (1920) 631. Here on Oct. 8, 1863 Gen. Braxton Bragg, in command of the Confederate army of the Mississippi of about 16,000 men, with which he had invaded Kentucky, faced about in his slow retreat across the State and gave battle to the Union army of the Ohio of about 40,000 (of whom only about 22,000 were actually engaged) commanded by Major-Gen. Don Carlos Buell. Bragg's order to attack was disregarded by Major-Gen. Leonidas Polk, who preferred adopting the "defensive-offensive" rather than engage the whole of Buell's force. At length after much delay on Polk's part the Confederate army joined battle with McCook's corps. The Confederate lines were broken and driven back through Perryville, where caissons, ammunition wagons and 140 officers and men were captured. Darkness had now come on, and in the night Bragg withdrew. His losses were reported as 510 killed, 2,635 wounded and 251 missing. The Union loss was 845 killed, 2,851 wounded and 515 captured or missing. The battle was drawn tactically, but strategically it was a Union victory and it virtually closed Bragg's Kentucky campaign, sometimes called the Perryville campaign.

PERSEPHONE was the daughter of Zeus and Demeter. In cult and in mythology Demeter and Persephone were closely associated, being known together as the two goddesses, the venerable or august goddesses, sometimes as the great goddesses. The latter is often called *Korē* ("the Maiden"); whether this results from the identification of two different goddesses, or not, is uncertain. She is the consort of Hades (*see* PLUTO), who carried her off as she was gathering flowers.

Demeter sought her in vain; in her sorrow, she caused a famine, and men would have died of hunger if Zeus had not

persuaded Hades to let Persephone go. But she had eaten, in the underworld, the seed of a pomegranate, and thus she could not stay away from him for ever. So it was arranged that she should spend two-thirds (according to later authors, one-half) of every year with her mother and the heavenly gods, and should pass the rest of the year with Hades beneath the earth. There can be little doubt that this is a mythological expression for the growth of vegetation in spring and its disappearance in autumn. As wife of Hades Persephone sent spectres, ruled the ghosts, and carried into effect the curses of men. From the head of a dying person she, or *Thanatos* (Death), was supposed to cut a lock of hair which had been kept sacred and unshorn through life (Virgil, *Aen.*, iv. 698 et seq., Eurip. *Alc.*, 74–76).

On the other hand, in her character of goddess of spring Persephone was honoured with flower-festivals in Sicily and at Hipponium in Italy. Sicily was a favourite haunt of the two goddesses, and ancient tradition affirmed that the whole island was sacred to them. The Sicilians claimed to be the first on whom Demeter had bestowed the gift of grain, and hence they honoured the two goddesses with many festivals. They celebrated the festival of Demeter when the grain began to shoot, and the descent of Persephone when it was ripe. Demeter and Persephone were worshipped together by the Athenians at the greater and less Eleusinian festivals, held in autumn and spring respectively (*see* MYSTERY). At Rome Persephone's name was corrupted into Proserpina (*q.v.*); she was sometimes identified with the native Latin goddess Libera. The pomegranate was Persephone's symbol, and the pigeon and cock were sacred to her. In works of art she appears with a cornucopia or with ears of wheat and a cock. As the wife of Hades she was represented with the insignia of royalty and a torch. The regular form of her name was Persephone, but various other forms occur: Phersephone, Persephassa, Phersephassa, Pherrephatta, etc.

For bibliography *see* under DEMETER.

PERSEPOLIS, an ancient city of Persia, situated some 40 m. N.E. of Shiraz, not far from where the small river Pulwar flows into the Kur (Cyrus). The site is marked by a large terrace with its east side leaning on *Kuh-i-Rahmet* ("the Mount of Grace"). The other three sides are formed by a retaining wall, varying in height with the slope of the ground from 14 to 41 ft.; on the west side a magnificent double stair, of very easy steps, leads to the top. On this terrace are the ruins of a number of colossal buildings, all constructed of dark-grey marble from the adjacent mountain. The stones were laid without mortar, and many of them are still *in situ*. Especially striking are the huge pillars, of which a number still stand erect. These ruins, for which the name "Sad-Sutun" ("the 100 columns"), can be traced back to the 4th century, are now known as *Takht-i-Jamshid* ("the throne of Jamshid"). That they represent the Persepolis captured and partly destroyed by Alexander the Great has been beyond dispute at least since the time of Pietro della Valle

Behind Takht-i-Jamshid are three sepulchres hewn out of the rock in the hillside, the façades, one of which is incomplete, being richly ornamented with reliefs. About 8 m. N.N.E., on the opposite side of the Pulwar, rises a perpendicular wall of rock, in which four similar tombs are cut, at a considerable height from the bottom of the valley. The modern Persians call this place Naksh-i-Rustum ("the picture of Rustam") from the Sassanian reliefs beneath the opening, which they take to be a representation of the mythical hero Rustam. That the occupants of these seven tombs were kings might be inferred from the sculptures, and one of those at Naksh-i-Rustam is expressly declared in its inscription to be the tomb of Darius Hystaspis, concerning whom Ctesias relates that his grave was in the face of a rock, and could only be reached by means of an apparatus of ropes. Ctesias mentions further, with regard to a number of Persian kings, either that their remains were brought "to the Persians," or that they died there. Now we know that Cyrus was buried at Pasargadae (*q.v.*) and if there is any truth in the statement that the body of Cambyses was brought home "to the Persians" his burying-place must be sought somewhere beside that of his father. In order to identify the graves of Persepolis we must bear in mind that Ctesias assumes that it was the custom for a king to prepare his own tomb during his lifetime. Hence the kings buried at Naksh-i-Rustum are probably, besides Darius, Xerxes I., Artaxerxes I. and Darius II. Xerxes II., who reigned for a very short time, could scarcely have obtained so splendid a monument, and still less could the usurper Sogdianus (Secydianus). The two completed graves behind Takht-i-Jamshid would then belong to Artaxerxes II. and Artaxerxes III. The unfinished one is perhaps that of Arses, who reigned at the longest two years, or, if not his, then that of Darius III. (Codomannus), who is one of those whose bodies are said to have been brought "to the Persians" (*see* Arian iii. 22, 1). Another small group of ruins in the same style is found at the village of Takht-i-Tā'us, on the Pulwar.

Since Cyrus was buried in Pasargadae, which moreover is mentioned in Ctesias as his own city, and since, to judge from the inscriptions, the buildings of Persepolis commenced with Darius I., it was probably under this king, with whom the sceptre passed to a new branch of the royal house, that Persepolis became the capital (*see* PERSIA: *Ancient History*) of Persia proper. As a residence, however, for the rulers of the empire, a remote place in a difficult alpine region was far from convenient, and the real capitals were Susa, Babylon and Ecbatana. This accounts for the fact that the Greeks were not acquainted with the city until it was taken and plundered by Alexander the Great. Ctesias must certainly have known of it, and it is probable that he may have named it simply Πέρσαι, after the people, as is undoubtedly done by certain writers of a somewhat later date. Sir H. Rawlinson and J. Oppert were right in assuming that the words *anā Pārsā*, "in this Persia," which occur in an inscription on the gateway built by Xerxes (D. l. 14), signify "in this *city* of Pārsā," and consequently prove that the name of the city is identical with the name of the country. The form Persepolis (with a play on πέρσις, destruction) appears first in Cleitarchus, one of the earliest annalists of the exploits of Alexander.

It has been universally admitted that "the palaces" or "the palace" (τά βασίλεια) burned down by Alexander are those now in ruins at Takht-i-Jamshid. Several of these bear evident traces of having been destroyed by fire. The locality described by Diodorus after Cleitarchus corresponds in important particulars with Takht-i-Jamshid, for example, in being supported by the mountain on the east. If Diodorus says that the rock at the back of the palace containing the royal sepulchres is so steep that the bodies could be raised to their last resting-place only by mechanical appliances, it is evident that he or his source (Cleitarchus), who can scarcely have visited the place, confounded the tombs behind the palaces with those of Naksh-i-Rustum.

In 316 B.C. Persepolis was still the capital of Persis as a province of the great Macedonian empire. The city gradually declined; but the ruins of the Achaemenidae remained as a witness to its ancient glory. It is probable that the principal town of the country, or at least of the district, was always in this neighbourhood. About A.D. 200 we find there the city Istakhr (properly *Stakhr*) as the seat of the local governors. There the foundations of the second great Persian empire were laid, and Istakhr acquired special importance as the centre of priestly wisdom and orthodoxy. The Sassanian kings have covered the face of the rocks in this neighbourhood, and in part even the Achaemenian ruins, with their sculptures and inscriptions, and must themselves have built largely here, although never on the same scale of magnificence as their ancient predecessors. The Romans knew as little about Istakhr as the Greeks had done about Persepolis, in spite of the fact that for four hundred years the Sassanians maintained relations, friendly or hostile, with the empire.

At the time of the Arabian conquest Istakhr offered a desperate resistance, but the city was still a place of considerable importance in the 1st century of Islam (*see* CALIPHATE), although its greatness was speedily eclipsed by the new metropolis Shiraz. In the 10th century Istakhr had become an utterly insignificant place, as may be seen from the descriptions of Istakhr, a native (*c.* 950), and of Mukaddasi (*c.* 985). During the following centuries Istakhr gradually declines, until, as a *city*, it ceased to

exist. This fruitful region, however, was covered with villages till the frightful devastations of the 18th century; and even now it is, comparatively speaking, well cultivated. The "castle of Istakhr" played a conspicuous part several times during the Mohammedan period as a strong fortress. It was the middlemost and the highest of the three steep crags which rise from the valley of the Kur, at some distance W. or N.W. of Naksh-i-Rustum.

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PERSEUS, in Greek legend, son of Danaë and Zeus. When Perseus was grown to manhood Polydectes, king of Seriphus, cast his eye on Danaë, and, in order to rid himself of the son, exacted of him a promise that he would bring him the head of the Gorgon Medusa. The Gorgons (*q.v*) dwelt with their sisters the Graeae in the west. Guided by Hermes and Athena, Perseus came to the Graeae. They were three hags, with but one eye and one tooth between them. Perseus stole the eye and the tooth, and would not restore them till the Graeae had guided him to the Nymphs, from whom he received the winged sandals, a wallet (κίβισις, resembling a gamekeeper's bag) and the helmet of Hades, which rendered him invisible. Thus equipped and armed by Hermes with a curved sword (*harpe*), he came upon the Gorgons as they slept, and cut off Medusa's head, while with averted eyes he looked at her reflection which Athena showed him in the mirror of her shield. Perseus put the Gorgon's head in his wallet, and fled, pursued by Medusa's sisters, to Ethiopia, where he delivered Andromeda (*q v.*) from a sea-monster and afterwards married her With her he returned to Seriphus in time to rescue his mother from Polydectes, whom with all his court he turned to stone by showing them the Gorgon's head. Perseus then gave the head of Medusa to Athena, and, with Danaë and Andromeda, hastened to Argos to see his grandfather, Acrisius, once more But before his arrival Acrisius, fearing the oracle, had fled to Larissa in Thessaly. Thither Perseus followed him, and unwittingly slew his grandfather by the throw of a discus. Ashamed to return to Argos, Perseus gave his kingdom to Megapenthes (Acrisius's nephew) and received from him Tiryns in exchange. There he reigned and founded Mideia and Mycenae and became the ancestor of the Persides, amongst whom were Eurystheus and Heracles.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

PERSEUS AND ANDROMEDA, FROM A COPY OF THE ORIGINAL IN THE CAPITOLINE MUSEUM, ROME

See E. S Hartland, *The Legend of Perseus* (1894–96).

PERSEUS, in astronomy, a constellation of the northern hemisphere, called after the Greek legendary hero. It contains a double cluster forming an interesting object for low-power telescopes. The second brightest star in the constellation is the famous eclipsing variable ALGOL (*q v*).

PERSEUS OF MACEDONIA (b. *c.* 212 B.C), the last king of Macedonia, eldest son of Philip V. He had his brother Demetrius killed, and thus cleared his way to the throne in 179. War broke out with Rome in 171 B.C. when P. Licinius Crassus was sent to attack him. Perseus defeated Crassus at Callinicus in Thessaly, but in 168 he was annihilated at Pydna by L. Aemilius Paulus. He died in captivity at Alba Fucens. (*See* MACEDONIA.)

PERSHING, JOHN JOSEPH (1860–), American soldier, was born near Laclede, Mo., on Sept 13, 1860—destined to as astonishing a rise from humble circumstances as Joffre, the first commander-in-chief in the World War of the other great republic. By teaching in a children's school he gained the means to study at the Kirksville, Mo., normal school and then seized the chance to compete for entry into the U.S. Military Academy, proving successful. Passing out in 1886, he was commissioned in the 6th Cavalry and saw immediate service against the Apaches in Arizona. In 1890, during an uprising of the Sioux, he served in Dakota, in charge of the Indian scouts. In 1891 he was appointed military instructor at the University of Nebraska, where he took the opportunity to graduate in the law school After being instructor in tactics at the U.S Military Academy, he served in Cuba through the Santiago campaign (1898), where he earned from his commander the tribute, "Pershing is the coolest man under fire I ever saw." Soon afterwards he had the chance to show that he was more than merely brave and energetic, for, sent to the Philippines, he pacified by 1903 the fanatical Moros of Mindanao through an apt blend of force and diplomacy. In 1905 he went to Japan as military attaché and witnessed part of the campaign in Manchuria. As a reward for his success in the Philippines, President Roosevelt in 1906 promoted him direct from captain to brigadier general, passing him over 862 senior officers Subsequently, he returned to the Philippines as commander of the department of Mindanao and governor of the Moro Province Returning in 1913, he was sent from San Francisco in 1916 to command the punitive expedition into Mexico against Francisco Villa, and after the death of Maj. Gen Funston in 1917 he succeeded him as commander on the Mexican border

On America's entrance into the World War Pershing was chosen to command the American Expeditionary Force in Europe, an honour gained perhaps not only by his record of achievement but also by his proofs in Mexico of extreme loyalty to Government authority under hampering circumstances With his staff he reached England on June 9, 1917, and four days later landed in France. To pass from guerilla expeditions in jungle, mountain and desert to the vast siege then in progress—or stagnation—on the western front was an extreme test, but in compensation for a military experience limited to petty expeditions he brought a trained administrative sense, with the will and knack of carrying through plans under difficulties. From the start Gen Pershing insisted that the integrity of the American army be preserved, making a firm stand against French tutelage and against the French desire to infuse the new blood of America's man-power into their own military system. And while the Washington war department was contemplating a limited liability war, Pershing in France was methodically laying the foundation for an army of 3,000,000 men—stamped with the Pershing seal If this plan, inevitably slow in fruition, imposed a severe strain on the exhausted Allies, it was justified not only by the proverbial warning against "putting new wine into old bottles"; for the alternative would have demanded an unprecedented sacrifice of national prestige If the realization of an independent American army would be, as Pershing felt, a serious blow to German morale, it was also likely to uplift the military spirit and self-confidence of the United States not only for the moment but for all time.

The disasters of early 1918 seemed to show that a great risk had been taken in pursuit of this ideal, and they led Pershing to place all his resources freely at Foch's disposal But directly the crisis began to pass he reverted to his policy, and at St. Mihiel in September it was consummated by the victory of the first American army in the first entirely American operation. This was followed by the Meuse-Argonne battle (*q v.; see* also WORLD WAR) under Pershing's direction. If the attainment of its aims was slower and more costly than had been expected, Pershing had accepted the actual battle-ground in deference to his allies and against his own preference for a blow towards Metz. Even so, it is probable that he underrated the difficulties of breaking through a strongly organized trench system, as well as the causes that had sapped the offensive spirit of the French. He had a Grant-like ruthlessness, similarly lacking the personal magnetism which leads men to lay down their lives gladly, but he had the character which compels men not only to die but to work, grumbling perhaps but respecting him.

It was a just recognition of his achievement in creating almost

from nothing the vast structure of the national army that, on Sept. 1, 1919, he was confirmed in the permanent rank of general, a grade held previously by only four Americans—Washington, Grant, Sherman and Sheridan. In 1921 he was appointed chief-of-staff, and during his tenure of office he designed the new permanent framework of the United States army. Subsequently, appointed by President Coolidge as the United States representative and *ex-officio* head of the commission to supervise the plebiscite under the Tacna-Arica arbitration award, he went to Arica in July, 1925, but, owing to health, had to resign. He returned home in Feb. 1926. (*See* TACNA-ARICA QUESTION.) (B. H. L. H.)

PERSHORE, market town, Evesham parliamentary division, Worcestershire, England, 113 m. N.W. of London and 8 m. S.E. of Worcester on the G.W. railway. Pop. (1921) 4,035. Market gardening and fruit-growing (especially plums) are carried on and agricultural implements are manufactured. The churches of Holy Cross and St. Andrew face one another across a road, the former being a mitred Benedictine abbey.

PERSIA, a kingdom of western Asia, bounded on the north by the Caspian sea and the Transcaucasian and Transcaspian territories of Russia; on the east by Turkistan, Afghanistan and Baluchistan; on the south by the Persian gulf, and the Oman gulf of the Arabian sea, and on the west by Turkey in Asia and the new State of Iraq.

Frontiers.—The frontier from Mt. Ararat to Astara on the Caspian sea is that laid down in the treaty of Turmanchai (Feb. 22, 1828) and further defined in a Convention of July 8, 1893. The boundary between Russia and Persia starts from the slopes of Mt. Ararat (Aghri Dagh) and runs north-east to the Aras river, which it follows to lat. 48° E. It then runs for about 35 m. south-east through the Mughan steppes to Pilsowar on the Bulgharu river and then south with a bend to the west, to the Astara river and port, whence it follows the shore of the Caspian until it touches the bay of Hasan Quli, north of Astarabad. East of the Caspian and beginning at Hasan Quli Bay the river Atrek serves as the frontier as far as Chat. It then extends east and south-east to Sarakhs on the Tején river. The frontier east of the Caspian was defined by the Akhal-Khurasan Boundary Convention of Dec. 21, 1881, and the Frontier Convention of July 8, 1893, which separates Persia from Afghanistan and British India.

The eastern frontier extends from Sarakhs on the north to a point on the coast of the Gulf of Oman near Gwattar, a distance of some 800 m. first following the river Tejen, or Hari Rud, to a point near Kuhsan, thence almost due south to the border of Seistan in Lat. 31 N. It then follows the line fixed by Sir F. Goldsmid in 1872 and by Sir A. H. MacMahon in 1903–05 to Kuh-i-Malik Siah. From this point to the sea the frontier separates Persian territory from British Baluchistan and runs south-east to Kuhak and then south-west to Gwattar. This last section was determined by Sir F. Goldsmid's Commission in 1871.

The south boundary is the coast line from the mouth of the Shatt-el-Arab to the vicinity of Gwattar, a distance of some 870 m. The islands in the Persian Gulf nearest to the Persian shore are Persian territory; they are, from east to west, Hormuz, Larak, Qishm, Henjam, Farur, Qais, Hinderabi, Shaikh Shu'aib Kharag and Kharagu.

Southwards from Mt. Ararat the frontier dividing Persia first from Turkey later from Iraq, extends for about 700 m. until it cuts the left bank of the river Shatt-el-Arab about 12 m. above Mohammerah, whence it follows the high-water mark line of the river to its mouth at Qasbah opposite Fao, leaving the fairway channel in Turkish, now Iraq, territory. This is the line referred to in the Treaty of Erzeroum of 1847, as finally demarcated in 1914 by Perso-Turkish Commissioners, assisted by British and Russian Commissioners with arbitral powers, appointed in virtue of a special agreement concluded in 1913 between Persian and Turkish plenipotentiaries at Constantinople. (P. Z. C.)

GEOLOGY

Persia lies within the great Alpine-Himalayan fold system, forming the connecting link between the Taurus structures and those of Afghanistan and Baluchistan. It may be divided into three major zones:—

1. The Elburz (Elbrus) mountains—folded mountains with a thick sedimentary series showing movement towards the north. Large volcanoes are situated in these ranges.
2. Central Persia—a high plateau region but with large depressions; old crystalline rocks, early Palaeozoics and Mesozoics poorly developed. Volcanoes active throughout the Tertiary.
3. The Zagros system—the mountain belt of S.W. and S. Persia, strongly folded and overthrust structures, the movement having been directed against the Arabian foreland. Some Palaeozoic rocks, thick Cretaceous and Tertiary series.

Geological History.—Nothing is known of the pre-Palaeozoic history of Persia. Ancient crystalline rocks, granite, gneiss and schists have been described from many localities, but they may represent in part metamorphosed Palaeozoic sediments.

The oldest marine rocks of Persia are of Cambrian age (probably Middle). A shallow sea seems to have transgressed over an old levelled surface in Central Persia and in the Gulf region. Near Kerman and at Narghun, 65 miles S.W. of Isfahan, a thin series of trilobite limestones, shales and sandstones has been found. Farther south the Middle Cambrian is developed in a lagoonal facies. Fossiliferous limestones and dolomites, together with sandstones with "salt pseudomorphs," shales and gypsum, have been carried up by intrusive salt masses. The salt is probably also of Cambrian age. The fossils include trilobites with *Ptychoparia* affinities in igneous intrusive rocks of post Cambrian and pre Cenomanian age are present.

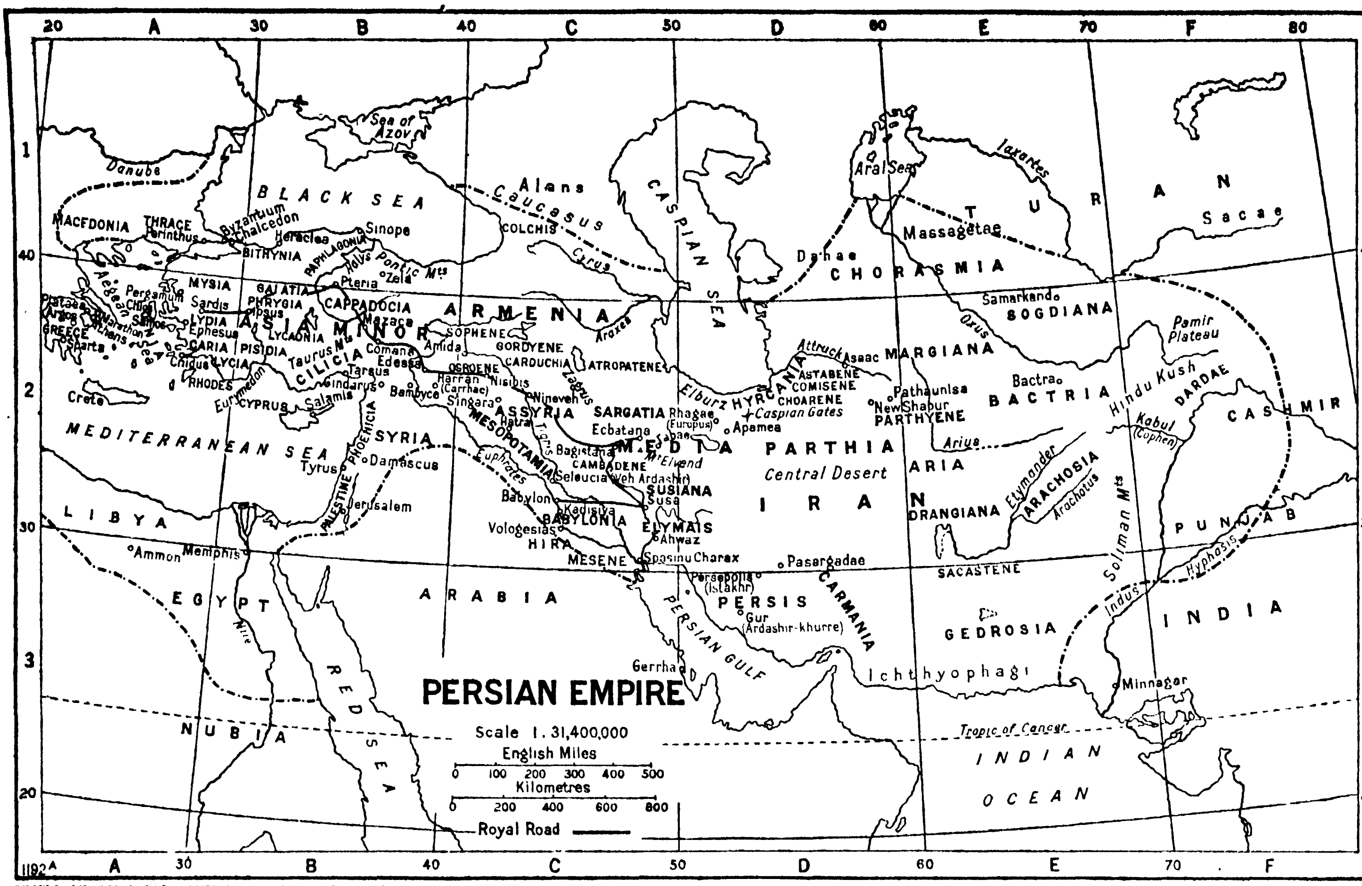
Ordovician and Silurian rocks are unknown in Persia, the next marine transgression being of Middle Devonian age. In the Araxes Valley, the Middle Devonian is represented by grey argillaceous limestone containing *Calceola sandalina* (L.), etc., the Upper by reddish limestones with *Spirifer verneuili* Murch. On the south flank of the Elburz mountains, the Devonian is developed in an Old Red Sandstone facies. Middle Devonian limestones are known near Isfahan. At Narghun a limestone of either Devonian or Lower Carboniferous age is separated from the Cambrian by only 100 ft. of white and pink spotted sandstones. No angular unconformity has been observed.

Carboniferous limestones extend in North Persia from the Araxes valley through the Elburz mountains. Along the Elwand range there is a great development of phyllites or grauwackes. An interbedded limestone has yielded an *Orionastraea* type of coral, probably Lower Carboniferous. Permo-Carboniferous limestones with a Punjabian fauna occur at Julfa and in Luristan, in the Kalian Kuh and Kuh-i-Kellar.

The Upper Permian and the Trias are unknown in Persia. A thick series of plant beds perhaps of Rhaetic age is present in the Elburz, followed by marine Lias and Bajocian. East of Lake Urmia, Upper Lias, Callovian and Lower Kimmeridgian fossils have been found. The Upper Jurassic is well developed in north Persia, extending from Armenia eastward to the Hindu Kush. In Central Persia, Lias plant-bearing shales are coal-bearing at several places along the line Hamadan, Isfahan, Kerman. Upper Lias is marine in the Grestener facies. No Jurassic fossils have been found in the Zagros, but a series of red and green radiolarian cherts, associated with basic intrusive and extrusive rocks may be of Upper Jurassic or Lower Cretaceous age.

Lower (Neocomian) and Upper Cretaceous rocks are widespread in the Elburz. In the Zagros mountains, Valanginian and Aptian are known in isolated localities. Upper Cretaceous is well developed and from this time onward to late Tertiary sedimentation was continuous in the Mesopotamian—south-west Persian geosyncline. Upper Cretaceous consists of limestones, locally hippuritic, and fossiliferous marls, often bituminous, which attain a thickness in places of about 3,000 ft. Cretaceous limestones form many of the highest ranges. In Central Persia, Upper Cretaceous is irregularly developed, in places resting with marked unconformity on older rocks.

Eocene is present throughout the greater part of North Persia, but it does not attain any great thickness. In Central Persia it overlies Upper Cretaceous or older rocks unconformably and consists of limestones and marls with interbedded tuffs and andesitic



lava flows. In the Zagros mountains Eocene is present as massive nummulitic limestones or as globigerina marls, up to 2,500 ft. in thickness.

Oligocene is probably represented by tuffs and lavas in North and Central Persia, in Zagros by limestones with Lepidocyclina or *Nummulites intermedius-Fichteli,* conformably overlying the Eocene.

Miocene unconformably overlies older rocks in North and Central Persia. It consists of limestones, marls and some gypsum. It is not a thick series except in some of the major depressions such as Dasht-i-Kavir. In the Zagros, the Lower Miocene is represented by a massive limestone known as the Asmari limestone and important as the main reservoir rock of the oil-fields. This is overlain by the Lower Fars gypsum group, then a Middle Miocene marine limestone group, the Middle Fars, followed by a thick series of marls, sands and conglomerates (Upper Fars and Bakhtiaris), extending in age up to Upper Pliocene. In Central Persia, Pliocene is present only in isolated basins. A Pontian bone deposit with *Hipparion gracile* has been found at Maragha in North Persia, also in Bakhtiari country where it is cemented with bitumen.

Tectonics.—Little is known of Palaeozoic earth movements. The lack of Ordovician and Silurian suggests Caledonian movement. During the Mesozoic-Tertiary movements, Central Persia acted as a "Zwischengebirge," while strong folding outwards took place in the Elburz on one side and in the Zagros on the other. The first folding phase is of Middle Cretaceous age and in Central Persia there was a Cretaceous Eocene phase. The greatest movements were in the late Tertiary continuing into the late Pliocene. In the Zagros, great overthrust nappes have been formed in the inner zones. Farther south-west is a belt of anticlinal folding, the intensity of which diminishes in the direction of the unfolded Arabian table-land. Cretaceous and Eocene limestones form the higher mountains, while the foothills are formed exclusively of Miocene and Pliocene sediments. Central Persia was elevated to form a great plateau, but isolated depressions were formed in which sedimentation and later folding took place.

Economic Geology.—Lack of modern transport facilities prevents the exploitation of the many ore deposits of Persia. The following metals are known:—Gold, silver, lead, copper, zinc, tin, mercury, nickel, chrome iron, and iron, also antimony and manganese. Lower Jurassic coal is worked on the flanks of Mt. Demavend for market in Tehran.

Minor indications of oil are very widespread, but as yet the only proved oil-fields are at Masjid-i-Sulaiman and Haft Kal, near Shushtar. The production of oil for 1927 was 4,831,800 tons. (*See* ANGLO-PERSIAN OIL CO., LTD.)

Large deposits of salt, gypsum and sulphur are common, but they are only exploited for local use. Precious stones are won on a small scale, rubies near Meshed, turquoise at Maadan near Nishapur and at Khun, south of Jewezm and north of Shahr-babek. Iron, ochre and rock salt mines are worked with profit in the Persian gulf.

See A. F. Stahl, *Persien, Handbuch der regionalen Geologie,* 1911; H. de Böckh and others, *Tectonics of Asia,* British Association, 1928. (*See* also PERSIAN GULF, *Geology.*) (G. M. L.)

Physical Geography.—The kingdom of Persia, excepting the lowlands of Khuzistan and the maritime plains bordering the Caspian sea and the Persian gulf, forms the western and larger half of what is known as the great *Iranian* plateau, raised aloft between the valleys of the Tigris and the Indus. To the north-west this plateau is united by the highlands of Armenia with the mountains of Asia Minor, while to the north-east the Paropamisus range and the Hindu Kush link it with the Himalayas and the highlands of Tibet. Between those zones of connection the plateau is bounded, on the north by the desert steppes of South Russia, Khiva and Bokhara, the scarp being formed by the Kuren and Kopet ranges to the east, and the main Caucasus range to the west, of the intervening depression formed by the Caspian sea. From Mount Ararat south-eastwards the wall of the plateau is formed by the Zagros range and its extensions, running more or less parallel to the course of the river Tigris and the lie of the Persian gulf until they reach the Indo-Persian frontier in Baluchistan. On the east the plateau is bounded by the ranges overhanging the valley of the Indus. The total area thus enclosed is somewhat over 1,000,000 square miles of which

Persia occupies upwards of 600,000. Its average height above sea-level is probably about 4,000 feet, varying from 8,000 ft. or even more in certain of the outer features to not more than 500 in the most depressed portions of the centre. This greatly increased elevation towards the rim clearly demonstrates the basin-like character of the plateau. The lie of the mountain ranges is for the most part from north-west to south-east. The main system, which extends almost unbroken for nearly 800 miles, from Azerbaijan to Baluchistan, may aptly be called the *Central Range*. It has many peaks 9,000 to 10,000 feet in height, and some of its summits rise to an elevation of 11,000 feet, and, near Kerman, of nearly 13,000 feet (Kuh-i-Jupar). The valleys and plains west of the Central Range, as for instance those of Mahallat, Joshekan, Isfahan, Sirjan, have an elevation of 5,000 to 6,500 feet; those within the range, as Jasp, Ardal, So, Pariz, are about 1,000 feet higher; and those east of it slope from an elevation of 5,000 to 6,000 feet down to the depressions of the central plateau which, east of Qum, are not more than 2,600 feet, and east of Kerman 1,500 to 1,700 feet above sea-level. Some of the ranges west of the Central Range, which form the highlands of Kurdistan, Luristan, Bakhtiari and Fars, and are parallel to it, end near the Persian gulf; others follow the Central Range, and take a direction to the east at some point between Kerman and the sea on the western frontier of Baluchistan. Some of the western ranges rise to considerable elevations; those forming the Turko-Persian frontier west of the lake of Urmia have peaks 11,000 feet in height, while the Sahand, east of the Lake and south of Tabriz, has an elevation of 12,000 feet. Farther south, the Takht-i-Bilkis, in the Afshar district, rises to 11,200 feet, and the Elvend (ancient Orontes) near Hamadan, to 11,600. The Shuturun Kuh south of Burujird is over 11,000 feet in height, the Shahan Kuh, Kuh-i-Gerra, Zardeh Kuh and Kuh-i-Karan, all in the Bakhtiari country west of Isfahan, are 12,800 to 13,000 feet in height.

Still farther south, towards Kerman, there are several peaks (Bid-Khan, Lalehzar, Shah-Kuh, Jamal Bariz, etc.) which rise to an elevation of 13,000 feet or more and the Kuh-i-Hazar, south of Kerman, is 14,700 feet in height. Beginning near Ardebil in Azerbaijan, where the cone of Savelan rises to an elevation of 15,792 feet (Russian trigonometrical survey), and ending in Khorasan, the great Elburz range presents on its southern or inward face a more or less abrupt scarp rising above immense gravel slopes, and reaches in some of its summits a height of nearly 13,000 feet; and the peak of Demavend, north-west of Tehran, has a height of 18,600 feet. There are several important ranges in Khurasan, and one of them, the Binalud, west of Meshed and north of Nishapur, has several peaks of 11,000 to 12,000 feet in height. In south-eastern Persia the Kuh-i-Basman, a dormant volcano, 11,000 to 12,000 feet in height, in the Basman district, and the Kuh-i-Taftan, an active triple-peaked volcano in the Sarhad district, 12,681 feet in height, are notable features.

Of the surface drainage of the Iranian plateau as a whole less than half flows outwards. Taking the area occupied by Persia at 628,000 sq. miles the drainage may thus be distributed: (1) into the Arabian Sea and the Persian Gulf, 135,000 sq. miles; (2) into the Caspian, 100,000; (3) into the Seistan depression, 43,000; (4) into the Urmia Lake, 20,000; (5) into the interior of Persia, 330,000. The first district comprises most of the south-western provinces and the whole of the coast region as far east as Gwattar; the second relates to the tracts west, south and east of the southern part of the Caspian sea. The tracts south of the Caspian are not more than 20 to 50 miles wide; those on the west widen out to a depth of 250 miles, meeting the watershed of the Tigris on the one side and that of the Euphrates and Lake Van on the other, and embracing between the two the basin of Lake Urmia. On the east the watershed of the Caspian gradually increases in breadth, the foot of the scarp extending considerably to the north of the south-eastern angle of that sea, three degrees east of which it turns to the south-east, parallel to the axis of the Kopet Dagh. The third drainage area comprises Persian Seistan with part of the Helmund basin and a considerable tract adjoining it on the west. The fourth is a comparatively small area on the western frontier containing the basin of Lake Urmia, shut off from the rest of the inland drainage, and the fifth area takes in a part of Baluchistan, most of Kerman, a part of Fars, all Yezd, Isfahan, Kashan, Qum, Iraq, Khamseh, Kazvin, Tehran, Samnan, Damghan, Shahrud, Khurasan and the central desert regions.

Four rivers belonging exclusively to Persia, in reference to the Caspian watershed, are the Safid Rud or Kizil Uzain on the south-west, the Herhaz on the south and the Gurgan and Atrek at the south-eastern corner of that inland sea. The Safid Rud rises in Persian Kurdistan in about 35° 50′ north, and 46° 45′ east, a few miles from Senendij. It has a very tortuous course of nearly 500 m. for the distance from its source to the Caspian, 58 m. east of Resht, is only 210 m. in a straight line. The Kizil Uzain takes up some important affluents and is called Safid Rud from the point where it breaks through the Elburz to the sea, a distance of 70 miles. It drains 25,000 to 30,000 square miles of country. The Herhaz, though not important in length of course, or drainage, also, like the Safid Rud, breaks through the Elburz range from the inner southern scarp to the north. It rises on the slopes of the Kasil Kuh, a peak 12,000 feet in height within the Elburz, and about 25 miles north of Tehran, flows easterly through the Lar plateau, where it is known as the Lar river, and takes up several affluents; turns to the north-east at the foot of Demavend, leaving that mountain to the left, and flows due north past Amol to the Caspian. Its length is about 120 miles. The Gurgan rises on the Armutlu plateau in Khurasan east of Astarabad, and enters the Caspian in 37° 4′ north, north-west of Astarabad, after a course of about 200 miles. The Atrek rises a few miles from Kuchan and enters the Caspian at the Bay of Hassan Kuli in 37° 21′ north, after a course of about 300 miles. From the sea to the Russian frontier-post of Chat the river forms the frontier between Persia and the Russian Transcaspian region.

The drainage of the rivers which have no outlet to the sea and form inland lakes and swamps (Kavîr) may be estimated at 350,000 square miles, including the drainage of Lake Urmia, which is about 20,000 square miles. Fourteen small rivers flow into the lake. During heavy rains and when the snows on the hills melt, thousands of streams flow from all directions into the innumerable depressions of inner Persia, or help to swell the perennial rivers which have no outlet to the sea. These latter are few in number, and some of them barely suffice for purposes of agricultural irrigation, and in summer dwindle to small rills.

"The great desert region of Persia," writes Le Strange (*Lands of the Eastern Caliphate*, 1905), "stretches right across the high plateau of Irah going from north-west to south-east, and dividing the fertile provinces of the land into two groups; for the desert is continuous, from the southern base of the Elburz mountains, which to the north overlook the Caspian, to the arid ranges of Makran, which border the Persian Gulf. Thus it measures nearly 800 miles in length, but in breadth varies considerably; for in shape this immense area of drought is somewhat like an hour-glass, with a narrow neck, measuring only some 100 miles across, dividing Kerman from Seistan, while both north and south of this the breadth expands and in places reaches to over 200 miles. At the present day the desert, as a whole, is known as the Lût or Dasht-i-Lût; the saline swamps and the dry salt area being more particularly known as the Dasht-i-Kavîr, the term Kavîr being also occasionally applied to the desert as a whole."

Climate.—In winter the prevailing winds are north-easterly, but in the north are interrupted three or four times a month by the eastward passage of depressions from the Mediterranean, bringing westerly winds and moderate rainfall. In summer a strong dust-laden northerly wind blows almost unceasingly for about four months. This wind is known as the *Shamal;* in June it often carries dust far out into the Persian Gulf, but in July the south-west monsoon sets in along the coast, and the northerly winds are mostly limited to the interior. Seistan, in Eastern Persia, is known as "The Land of the Winds," and is especially noted for the "Wind of 120 days" which sets in at the end of May and blows from a little west of north until the end of September, reaching a velocity of over 70 miles an hour.

The mean annual temperature reaches 80° F over the coast of Mekran and is 75° F at Bushire, but in the interior it is consid-

erably lower, owing to the greater altitude and the cold winds of winter. The annual variation of temperature is very great in the north, where July is more than 40° F warmer than January, but diminishes rapidly southward to 22° on the south coast. The highlands have very severe winters; thus Tehran, at a height of 4,000 feet, has a January mean of 35° F, while extreme temperatures below 0° F have been recorded in Isfahan. The most pleasant season on the highlands is spring, with a moderate temperature and ground still moist from the winter rain and snow. In autumn, though the temperature is moderate, the air is dry and dusty. Summer is everywhere very hot, the mean temperature in July and August exceeding 80° F over almost the whole country. The day temperature is very high, but the nights are cool. Maximum temperatures exceeding 110° F have occurred at elevations of 5,000 feet, and even at Dehbrid (8,000 feet) 93° F has been recorded. On the coast the nights are very warm and oppressive.

Annual Rainfall in Persia

Station	Lat. N.	Long. E.	Altitude	Period of observations	Annual rainfall
	° ′	° ′	Feet	Years	Inches
Lenkoran .	38 46	48 51	−66	50	41·62
Merv . .	37 35	61 47	686	1	6·36
Urmia (Sair)	37 28	45 8	6,225	1	21·51
Resht . .	37 17	49 35	−50	2	56·45
Ashurada .	36 54	53 55	−80	19	17·07
Astarabad .	36 52	54 26	−70	7–8	16·28
Meshed . .	36 16	59 35	3,104	26	9·22
Tehran .	35 41	51 25	4,002	25	9·53
Isfahan . .	32 40	51 44	5,817	27	4·49
Seistan . .	31 0	62 0	2,000	9	1·88
Husseinabad	30 52	61 23	1,600	3–5	2·20
Bushire . .	28 59	50 53	14	44	10·39
Jask . .	25 44	57 47	13	28	4·51

The rainfall is small everywhere except on the Elburz mountains, which receive a heavy fall in winter owing to depressions which originate over the Caspian. At Resht, the annual average is 56 inches, but the amount decreases rapidly eastwards to less than 20 inches over the eastern end of the range. Over the plateau south of the mountains the annual total is about 9 inches in the north, but decreases southward and especially south-eastward, being only two inches a year at Husseinabad and Seistan. At the head of the Persian Gulf the rainfall is somewhat greater, slightly over ten inches, but the Mekran coast has again a very small amount, generally about 5 inches. The rainfall is almost entirely limited to the months of October to May inclusive and is heaviest from December to March, any one of which may be the wettest month. The rainfall is very spasmodic, and more than half the annual total may fall in a single day; thus 5·53 inches fell in one day at Bushire, and falls of more than an inch have been recorded at Husseinabad and Seistan. In consequence of this variability, disastrous droughts sometimes occur. Thunderstorms are experienced on a few days each year. Taking Persia as a whole the snowfall may be said to be very variable and uncertain. In the maritime areas a fall of snow is naturally a very rare occurrence. In the highlands, on the other hand, country over 4,000 feet in altitude is liable in any winter to be under snow for days and not infrequently weeks together, between December and April. During such periods of severe weather the passes leading from the plains to the plateau become closed to wheeled traffic, while during the ensuing thaw they are little less difficult for pack-animals. During the World War, when British troops were located along the Baghdad-Enzeli route and the line of communications had necessarily to be kept open, great labour was involved in keeping the track clear of snowdrifts, especially on either side of the Sultan Bulagh pass between Hamadan and Kazvin. An interesting account of the migration of a Bakhtiari tribe, from the plains of Arabistan to their summer quarters in the highlands near Isfahan under severe snow conditions, is to be found in *Grass* by C. Merian Cooper (1925).

Flora.—In the provinces of Gilan, Mazandaran and Astarabad on the Caspian, from the shore to an altitude of about 3,000 ft. on

Variations of Monthly Mean Temperature in Persia

Station	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Yr.
	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
Lenkoran . .	38	40	45	54	65	74	77	77	71	61	52	43	58
Meshed . .	34	37	46	56	67	74	77	74	66	56	47	39	56
Tehran .	35	41	49	60	70	80	85	84	77	64	53	42	62
Isfahan . .	35	41	49	59	68	78	82	79	73	62	50	40	60
Seistan . .	46	51	59	71	80	86	91	88	80	68	56	46	69
Husseinabad .	45	49	60	70	82	89	91	89	79	67	59	50	69
†Fâo . . .	51	55	62	70	80	86	91	91	83	75	66	55	72
Bushire . .	58	59	65	74	82	86	90	90	87	79	70	61	75
Jask . .	67	68	73	80	85	90	91	89	87	83	76	71	80

†29° 58′ N., 48° 30′ E.— Height unknown.

the northern slopes of the great mountain range which separates those provinces from the highlands of Persia, the flora is similar to that of Grisebach's "mediterranean region." At higher altitudes many forms of a more northern flora appear. As we approach inner Persia the flora rapidly gives place to "steppe vegetation" in the plains, while the mediterranean flora predominates in the hills. The steppe vegetation extends in the south to the outer range of the hills which separate inner Persia from the Persian Gulf and the Indian Ocean. Beyond this outer range and along the shore of the sea the flora is that of the "Sahara region," which extends eastwards to Sind.

Generally speaking, everywhere, excepting in the northern lowlands and in a few favoured spots in the hilly districts, the vegetation is scanty. In inner Persia the hills and plains are bare of trees, and steppe and desert predominate. The date-palm thrives well as far north as Tabbas in latitude 33° 36′ and at an altitude of 2,000 ft. and in the south extensive date-groves, producing excellent fruit, exist at altitudes of 2,000 to 5,000 ft. The olive is cultivated at Rudbar south of Resht in Gilan, and a few isolated olive-trees have been observed in central and southern Persia.

Of fruits the variety is great, and nearly all the fruits of Europe are well represented. The common, yet excellent melons, watermelons, grapes, apricots, cherries, plums, apples, are within the reach of the poorest. Less common and picked fruits are expensive, particularly so when cost of transport has to be considered; for instance, a good orange costs 2d. or 3d. in Tehran, while in Mazandaran (only 100 m. distant), whence the oranges are brought, it costs ⅛d. Some fruits are famous and vie in excellence with any that European orchards produce; such are the peaches of Tabriz and Meshed, the sugar melons of Kashan and Isfahan, the apples of Demavend, pears of Natanz, figs of Kermanshah, etc. The strawberry was brought to Persia about 1859, and is much cultivated in the gardens of Tehran and neighbourhood; the raspberry was introduced at about the same time, but is not much appreciated. Currants and gooseberries are now also grown. The common vegetables also are plentiful and cheap, but only a few, such as the broad-bean, egg-plant (*Solanum melongena*), onion, carrot, beetroot, black turnip, are appreciated by the natives. Nearly all the European garden flowers can be seen.

Fauna.—W. T. Blanford, after a journey taken in 1872, divided Persia into five zoological zones: (1) the Persian plateau, from the Kopet Dagh southwards nearly to Lat. 28 N., including all Khorasan up to the Perso-Afghan border, its western limit being indicated by a long line to the north-west from near Shiraz, taking in the whole of northern Persia west of that line to the Elburz and the Russian frontier; (2) the provinces south and south-west of the Caspian; (3) a narrow strip of wooded country south-west of the Zagros range, from the Diyala R. (then in Turkey in Asia, now in Iraq) to Shiraz; (4) the Persian side of the Shatt-el-Arab, and Arabistan (now Khuzistan) east of the Tigris; and (5) the shores of the Persian Gulf and Baluchistan.

The fauna of (1) he described as "Palaearctic, with a great prevalence of desert forms; or perhaps more correctly, as being of the desert type with Palaearctic species in the more fertile regions."

In the Caspian provinces he found the fauna, on the whole, Palaearctic also, "most of the animals being identical with those of south-eastern Europe." Some, however, were essentially indigenous and he observed "a singular character given to the fauna by the presence of certain eastern forms, unknown in other parts of Persia, such as the tiger; a remarkable deer of the Indo-Malayan group, allied to *Cervus Axis;* and a pit viper (*Halys*)."

Coupling the oak-forests of Fars with the wooded slopes of the Zagros, he found as regards his third division that however little known was the tract, it appeared to contain, like the second, "a Palaearctic fauna with a few peculiar species."

As to the 4th division, Persian Mesopotamia, he considered its fauna, as far as he was in a position to judge, to belong to the same Palaearctic region as Syria. The 5th and last division, Baluchistan and the shores of the Persian gulf, presented, he considered, among those animals common to it and to the highlands, "for the most part desert types, whilst the characteristic Palaearctic species almost entirely disappear, their place being taken by Indian or Indo-African forms."

Blanford wrote in 1876, but his work is out of date only in matters of detail.

Among the mammals, it is to be feared that the lion, fairly plentiful in places, at the time he wrote, is now practically extinct (1929), no live specimen being in existence in captivity and no authoritative report of its occurrence having been received for some years past.

The Mazamdaran tiger though not so plentiful as of yore is still to be met with. There was at one time a disposition to regard it as a distinct race on the score of smallness of size and paleness of colour, but the character of specimens obtained in recent years by Colonel R. L. Kennion hardly supports that theory. The same officer's sporting activities have also demonstrated that the wild sheep of Persia are separable into two if not three races: one found on the southern slopes of the Elburz identical with the Armenian moufflon (*Ovis orientalis*); a second on the north of the range, of the urial or shapu type; and farther eastward in the Kopet Dagh range another race of the urial type but distinctly bigger and described by Dr. Lydkker as *Ovis vignei arkal.*

The Caspian red deer is now known to science as *Cervus elephus maral,* the type locality being the Caspian provinces of Persia. Of the axine deer and the fallow deer mentioned by Blanford no specimens have been forthcoming for many years.

A roe has been found to occur sparsely in the lower slopes of the Zagros in Southern Kurdistan, and in the neighbourhood of Kermanshah. This deer is distinguished from other known members of the genus *Capreolus* by the cold-grey coloration of its winter coat, and has accordingly been described as a distinct species (*Cervus capreolus coxi*), the nearest allied species being the roe-deer of normal dark colour found in the mountains of Talish and Mazandaran (*C.C. armenius*). Apart from the species referred to above the following occur in a wild state, in suitable localities: ibex, moufflon, wild ass, leopard, lynx, brown bear, hyaena, wolf, jackal, hog, badger, fox, hare, porcupine, polecat, weasel, marten. Lastly, Persia boasts an indigenous cat, with a world wide reputation. From it with careful breeding spring the beautiful creatures familiar as "Persian Cats."

In the domain of ornithology, over 400 species and races of birds are known in Persia. Since Blanford wrote his work much has been done both by British and Russian ornithologists. Zarudny, Witherby and Buxton in Persia and Cox and Cheesman in the Persian gulf have given a comprehensive account of the birds in those regions and have added largely to Blanford's list. Persia is essentially Palaearctic in its fauna and flora, but its Aves display a slight infiltration from the Oriental Region and perhaps one or two relic species from the Ethiopian Region, namely *Hypercolius ampelinus* and *Acrocephalus griseldis.* Within itself, Persia shows many marked differences in its Avian population. The Elburz mountains appear to have developed slight differences among the birds which inhabit them, and in many cases those living on the damper northern slopes differ from the same bird when living on the dry southern slopes. Again those birds living in South-west Persia, within any species, show marked differences from those living in the arid desert regions of East Persia, the latter country together with its birds more closely resembling conditions usual in Central Asia north of the Oxus. Of game birds (*Tetrogallus*), pheasant (*Phasianus colchicus*), black partridge (*Francolinus*), chukor (*Alectoris graeca*), the see-see or sand partridge (*Ammoperdix*), and Indian grey-partridge (*Francolinus pondicerianus*) occur in those parts of the country suitable to their habits. In winter large numbers of wildfowl, woodcock and snipe visit the country. Flamingoes and pelican breed on the northern shores of the Persian gulf. The dryness of the Persian climate favours the rearing of poultry which are of good quality, especially the turkey which can be seen in huge droves and can be purchased for comparatively small sums.

The fish principally caught along the southern shore of the Caspian are: the sturgeon, "sagmahi," literally "*dogfish,*" for which the word is also used (*Acipenser ruthenus* and *A. huso*); sheatfish or silure, "simm" or "summ" (*Silurus glanis*); salmon, "azadmahi" (*Salmo salar*); trout, "maseh" or "qizil" (*Salmo trutta*); carp, "kupur" (*Cyprinus ballerus* and *C. carpio*); bream, "subulu" (*Abramis brama*); pike-perch, "mahi-sufid" (*Perca lucioperca* or *Sandra lucioperca*). There is also a herring which frequents only the southern part of the Caspian, not passing over the shallow portion of the sea from Baku eastwards: as it was first observed near the mouth of the R.Kur it has been named *Clupea kurensis.* Our knowledge of the freshwater fish is meagre.

Population.—The population of Persia is estimated by recent competent authorities at about 12,000,000, which gives an average of about nineteen per sq.m. Various partial censuses have been taken in the past and, in 1927, a more complete and general census of the country was under way, but in 1928 was still incomplete. (*The Financial & Economic Situation in Persia.* By A. C. Millspaugh. Published by the Persian Government 1926.)

Towns.—With the exception of Tehran, only rough estimates of the population of towns—on which little reliance should be placed, as they cannot be substantiated by actual figures—are available. The principal towns of Persia with their estimated populations are:—Teheran [Tehran] (210,000, census of 1922); Tabriz (200,000); Isfahan (80–100,000); Meshed (60–80,000); Hamadan (70,000); Kerman, Kermanshah, Shiraz, Yezd (50–60,000); Kazvin (40–50,000); Barfurush, Kashan, Urmia (35–40,000); Resht, Senna (Sinandaj) (30–35,000); Zinjan (25,000); Burujird, Dizful, Khoi, Qum (20–25,000); Birjand, Bushire, Khunsar, Maragha, Sabzawar, Semnan, Shushter (15–20,000); Astarabad, Ardabil, Bandar Abbas, Bujnurd, Damghan, Kuchan, Lahijan, Minab, Nishapur, Sari, Saveh (10–15,000); Amol, Bam, Darab, Firuzabad, Gulpaigan, Kazerun, Khurramabad, Lar, Lingeh, Mohammerah, Nusratabad (Seistan), Niriz, Pahlavi (Enzeli), Qain, Saujbulaq, Sultanabad, Turbat-i-Haidari (4–10,000).

Constitution and Government.—Up to the year 1906 the government of Persia was an absolute monarchy, resembling in its principal features that of the Ottoman Empire; but with this exception, that the ruler was not the spiritual as well as the temporal head of the community. His powers were consequently qualified by the limitations imposed by the *Shara'a* or divine law of Islam. In 1905 however the public began to press for reform, more particularly in the administration of justice, and in 1906 went a step further and forced the reigning Shah to grant a Constitution, under which a Majlis or National Consultative Assembly should be established. This parliamentary body, now generally referred to as the Majlis was to be representative of various classes of the community; princes, clergy, chiefs, nobles, landowners, agriculturists, merchants and tradesmen, and racial and religious minorities. The number of elected deputies, who were to function during the sessions of 2 years, was fixed at 60 for the capital and 102 for the provinces, to be increased up to 200, as necessary; in 1928 there were 136. Electors must be males not less than 25 years of age, while the qualifications for membership of parliament were: age between 30 and 70, ability to read and write the Persian language and a good reputation in the constituency. Persons serving in the army, or navy, or other government employ, were to be considered ineligible, as well, of course,

as undischarged bankrupts and persons who had been convicted of criminal offences. Deputies were to be immune from prosecution, except with the consent of parliament.

By a rescript dated Feb. 2, 1907 Mohammed Ali Shah confirmed the previous ordinance of Dec. 1906, and on Oct. 8, 1907, signed the Constitution in its final form and took the oath of kingship prescribed therein, in the presence of the assembled Majlis. As time passed however this monarch, chafing under the unwonted trammels of constitutional government, rashly attempted to suppress the Majlis and overthrow the Constitution, but his effort proving abortive resulted in his enforced abdication and exile to Europe, and the accession of his son, Sultan Ahmed Shah (a child of 12 years of age), in accordance with the provision of the Constitution, perpetuating the Kajar dynasty.

During a precarious reign of 16 years this young potentate contrived to alienate the affections of his subjects completely and on Oct. 31, 1925, the Majlis voted by a large majority for his deposition and for the convening of a Constituent Assembly which should amend the articles of the existing Constitution dealing with the Kajar dynasty and appoint the then prime minister, Reza Khan Pahlavi, as head of a provisional government with authority to function until the Constituent Assembly had concluded its labours. This body having ultimately voted for the elevation of the said Reza Khan Pahlavi to the throne of Persia, the new Shah forthwith took the prescribed oath of kingship and ascended the throne on Dec. 16, 1925.

Under the Constitution, the Shah's powers are in general those ordinarily accorded to the ruler of a State under a Cabinet system of government. The prime minister, who is the constitutional executive, actually receives his appointment from the Shah, but is responsible to the Majlis, whose approval and support are of course a sine qua non. He, in turn, selects his ministers and introduces them to the Shah and to the Majlis. With his ministers he constitutes the Cabinet, or Council of Ministers, which possesses general executive powers, issues decrees for the enforcement of laws, and, during the usual parliamentary recesses, exercises a measure of provisional legislative power; but the sole right of imposing, reducing, or abolishing taxes, making appropriations, approving loans, or granting concessions, rests with the Majlis.

In 1928 the Council of Ministers was composed of the prime minister and eight ministers holding the following portfolios: War, Interior, Foreign Affairs, Finance, Justice, Posts and Telegraphs, Public Instruction and Public Works.

POLITICAL AND ADMINISTRATIVE DIVISIONS

Persia, for purposes of administration, was, in 1928, divided into twenty-six provinces, which are governed by Governors-General who, in many cases, are officers of high rank. The provincial governors are directly responsible to the Central Government and come under the jurisdiction of the Ministry of the Interior. Provinces are sub-divided, either wholly or in part, into districts (*buluk*) each under a deputy-governor (*naib-ul-hukumeh*), and comprising a number or group of villages rather than a definite area. The buluk, however, is usually only a name, the administrative unit being the village. Local government in the villages is simple, the principal authority in agricultural affairs being the *Kadkhuda*, or head-man. In addition to a Kadkhuda, many of the larger villages appoint as their representatives a number of elders or grey-beards who take the side of the villagers in the event of a dispute. In many districts, the distribution of water is in the special charge of a waterman. When a dispute arises over water or land, it is often submitted to the impartial decision of these elders. When any case requiring a legal judgment arises, appeal is made to the local *Mullahs,* to the deputy-governor, or even to the governor of the province.

The cities and towns are in general governed by municipal commissions. The last vestiges of the ancient satrapal system of local administration are rapidly disappearing in Persia; but for a long time after its forms had vanished its spirit prevailed and administrative services such as the post, telegraphs, the mint and the collection of various taxes were "farmed" out. As a result, administration became local and personal, and there were no uniform regulations applying to the whole country. To-day, modern and uniform principles of administration are becoming universal. The Constitution provides that, throughout the empire, provincial and departmental councils shall be established, the members of which shall be elected by the local inhabitants. Legal provision has accordingly been made for the election of rural and town councils.

In 1928, the 26 provinces of Persia were as follows:—

(1) Astarabad	(13) Kermanshah
(2) Azerbaijan (Tabriz)	(14) Khurasan
(3) Burujird	(15) Khuzistan
(4) Damghan (hitherto combined with Semnan, now separated)	(16) Kurdistan
	(17) Malayir
	(18) Mazanderan
(5) Fars and Southern ports	(19) Nehavend
(6) Gilan	(20) Qazwin (Kazvin)
(7) Gulpaigan	(21) Qum
(8) Hamadan	(22) Semnan
(9) Iraq	(23) Shah Rud
(10) Isfahan	(24) Tehran
(11) Kashan	(25) Yezd
(12) Kerman	(26) Zinjan

Armed Forces.—The Persian armed forces consisted in 1927 of a regular army of some 40,000 men, a Gendarmerie (Amnieh) of about 7,000 and a police-force of 5,000. The existing regular army is entirely the creation of Reza Shah Pahlavi, whose elevation to the throne of Persia was effected mainly through the instrumentality of the homogeneous force which he had created out of the motley military formations to which political exigencies and periodic aspirations in the direction of reform on the part of the Persian people had at various times given birth. The more important of these forces were the South Persia Rifles, organised and trained by British officers, the Persian Cossack Division, commanded by Russian officers, the Gendarmerie, which had made a promising start under Swedish officers during the few years preceding the World War, and the decrepit remnants of the Nizam, the old Persian regular army, formed and reformed by successive "missions" of European officers of French, British, Austrian and other nationalities, since the time when Abbas Mirza, the son of Fateh Ali Shah, first decided that drilled and disciplined troops could more effectively oppose Russia than the irregular masses of tribesmen upon which Persia had hitherto relied for her defence Reza Pahlavi, when he became minister of War in 1921, set himself in the first place to eliminate foreign influence entirely from the army, and in the second place to weld these various forces, with their different organisations, their diverse methods of training, even their different words of command, into a uniform and truly national Perisan army, obedient to himself and imbued with some spirit of patriotism. Under his leadership the army, officered entirely by Persians, rapidly established a mastery over the country, such as had been unknown for many years. A degree of security remarkable in comparison with the disorder of previous years was achieved and maintained with fair consistency; the tribes who for long had been almost a law unto themselves, were brought to submission, and the payment of revenue regularly enforced. The country was divided into six military districts, five of which, the Central, the North-Western, the Western, the Southern and the Eastern, with headquarters respectively at Tehran, Tabriz, Kermanshah, Shiraz and Meshed, are each garrisoned by a lashkar (a force approximating to a division), and the sixth by a strong independent brigade with headquarters at Resht. Each of these forces is composed of cavalry, artillery, and infantry with the essential ancillary services, in proportions and strengths varying according to local needs, the greatest strength and the most mobile troops being maintained at Tehran whence they are despatched as need arises to reinforce the provincial divisions. A small air force of 10 to 15 machines is located at the capital.

Recruitment for the ranks of the army is by conscription. Officers are recruited partly from the ranks and partly from the Military Cadet college at Tehran. A considerable number of officers have in recent years received further training in Europe. The Shah personally exercises the supreme command

and is assisted by a chief-of-staff, who controls the two branches of the army staff the general and the administrative. The gendarmerie (*Amnieh*) has for its principal duties the policing of the country outside the towns, and also the patrolling, and (in co-operation with the army) the protection of roads. It is organised in mixed units in the proportion, usually, of one of cavalry to four of infantry.

Navy.—The Persian Government possesses the following vessels: *Persepolis.* An old gunboat of 600 tons and 450 h.p. built in 1884; in bad condition and of no fighting value. *Mozafferi.* An old Belgian yacht of 379 tons, built in 1899. *Pehlevi.* An ex-minesweeper of German type, built in 1917. 200 tons 800 h.p. Burns oil fuel. *Ivy.* An English yacht formerly employed on the Niger. Acquired by the Shaikh of Mohammerah after the war. An old gunboat on the Caspian. Captured by Soviet forces in 1920, but understood to have been restored to the Persian Government. Several small river steamers.

Religion.—At the present day it may be said that with the exception of Persian Kurdistan which like the rest of the Kurdish element is Sunni, practically the whole of Persia is Shiah. Under this faith the power wielded by the priestly hierarchy has always been very great, owing no doubt to the fact that the foundations of Society were based almost exclusively on religious law. But there is no sacerdotal caste; any person capable of reading the Koran and interpreting its laws may function as a priest or *"mullah,"* and as soon as one of them has established a reputation for just interpretation of the *shari'a* or divine law, and a profound knowledge of the "traditions" and articles of faith (usually acquired only by many years of study at the Holy Places) he is accorded the title of *"Mujtahid."* This word which means literally "one who strives" (*i.e.,* after knowledge) was without any doubt intended to denote "a doctor of law," but as it is in fact the religious luminaries who interpret the law, it has become synonymous with "learned divine" or "chief priest." Time was when there were only 4 or 5 recognized mujtahids in Persia, but nowadays every large town boasts of one or more of them, as well as of several *mullahs* or *akhunds.* Nevertheless those of the highest eminence and repute seem to gravitate almost invariably to the Holy Places of Iraq, Karbala, and Najaf, where they live in a great odour of sanctity and whence their decisions are announced and accepted throughout Shiah Islam. It is to be noted that neither the Shah nor the government has any voice whatever in the appointment of these mujtahids or of the lesser lights; on the other hand in every large town where there are several mosques there is an important religious functionary called the *"Imam Juma"* who does receive his appointment from the Government and enjoys certain allowances. His function is to preach in the principal mosque and to read the Friday oration, or maintain a deputy for the purpose, known as a *"khătīb."* The leader of the congregation's prayers is called the *"Pishnamaz,"* and the crier who calls to prayers, the *"Muazzin."* Priests are often, but not necessarily, appointed guardians of the shrines or tombs of honoured scions of the Prophet's line; these are known as *"mutawalis"* and are responsible for the careful administration of the endowments. The shrines of some of the more famous or favourite saints are so richly endowed by pious testators as to be able to keep up an immense staff of attendant priests, servants, and miscellaneous retainers.

Zoroastrianism.—The few remaining Zoroastrians, commonly known in Persia as *"gabrs,"* are to be found principally round Yezd and Kerman, though small communities of them also inhabit Tehran, Kashan, Isfahan, and Shiraz. They are mostly engaged in commerce but have earned the reputation of being expert gardeners and individuals are in demand for that purpose throughout Persia. Their interests as a minority community are looked after by their co-religionists in India whose representative either resides in Tehran or pays periodical visits. They have their own deputy in the parliament.

The Armenians of Persia, numbering probably 60,000, are divided into two main communities, the one in Azerbaijan and the other at Isfahan, whither they were transplanted by Shah Abbas. The larger moiety appertain to the former centre and have their bishop located at Tabriz, with scattered communities at Tabriz, Khoi, Salmas, Urmia, and Maragha and in some 30 villages close to the Turco-Persian frontier. The other half, with headquarters and a bishop at Isfahan, have small colonies in Tehran, Hamadan, Isfahan (Julfa), Shiraz, Bushire, Resht, and other towns. The Armenian is an astute man of business and engages freely in trade and commerce, often possessing considerable capital, but the bulk of them live on the proceeds of agriculture. The prominent services of Yeprim and other Armenians during the Persian revolution of 1909 did a good deal to earn the good will of the Persian public and relations between the two nationalities improved considerably in consequence. The Armenians also are represented by a deputy in the Majlis.

The Nestorians (*q.v.*), whose church has been established in Persia since the year A.D. 435, possessed, at the time of the outbreak of the World War, a large community numbering from 50,000 to 60,000 souls, occupying the city of Urmia and numerous towns and villages in that neighbourhood. As a Christian community their sympathies were naturally with the Allies, and as long as Russia was one of them they had little to fear; but on Russia's defection in the spring of 1918 they were left in the air in a position of great danger. In May 1918 a Turkish force moving on Tabriz via Urmia was effectively checked for the time by the gallant and stubborn opposition of the "Jelus" (as they were called by British troops) but later in the summer, during the absence of 2,000 of their best men who had been sent to Bijar to bring back a convoy of ammunition supplied by the British army in Iraq, the Turks made a determined attack on Urmia, and the Christian inhabitants feeling that resistance was useless poured out of the town and fled towards Bijar after their absent comrades. They suffered very great losses on the way, both from the pursuing enemy and from sickness and privation. The enemy pursuit was indeed checked at Sain Kala by the British 14th Hussars, but only some 50,000 reached Bijar out of 80,000 who were believed to have started on the trek. These were gradually evacuated in batches to a large refugee camp prepared for them at Baquba near Baghdad and maintained there at British expense until peace had been declared and they could, as far as possible, be repatriated. It will be realised that this small nation was badly shattered and it is difficult yet to ascertain precisely to what extent and in what numbers they have been able to re-establish themselves.

Protestants, Roman Catholics, Jews and Baha'is, including Europeans and converted Armenians and Nestorians, probably number about 7,000. The religious missions administering to their welfare are:

(1) The Board of Foreign Missions of the Presbyterian Church of America, established since 1835. (2) The Church Missionary Society established since 1869. (3) The Anglican Mission established by the Archbishop of Canterbury for work among the Nestorians. (4) The London Society for promoting Christianity among the Jews. (5) The British and Foreign Bible Society.

Roman Catholics, European and natives (mostly Armenians) number from 4 to 5 thousand and have churches at Tehran, Julfa, and Tabriz, served by members of the French Lazariste Mission.

The Jews in Persia number about 40,000 and are to be found in nearly all the chief cities in the country, but communities with synagogues and priests exist only in the larger cities.

Baha'ism formerly Babiism (*q.v.*) is a creed of recent origin which only made its appearance in 1844. Though for many years past the followers of the Bab have been immune from persecution by the Persian Government, they have from time to time been made the target of violent fanaticism on the part of the Shiah population. There was a bad outbreak in 1903 in Yezd and several other towns in Persia, and a serious outbreak against them at Sultanabad in 1920. Owing to this liability to persecution, the majority of Baha'is still think it prudent to conceal their beliefs, so that it is not possible to make any satisfactory estimate of their numbers. There is no doubt however that the movement is gaining steadily in force. In so far as it is possible in these circumstances to speak of the Baha'is as a community they are friends of progress and reform and ready to co-operate towards

their attainment.

Instruction.—Public instruction, properly so-called, is a plant of comparatively recent growth in Persia. Previous to the reign of H.M. Nasr-ud-Din Shah the people of Persia were lamentably uneducated. Each town and village, it is true, has generally some sort of school, but it was often nothing more than a class held by a Mullah in the local mosque, where children were taught the rudiments of the Persian equivalent of "the three R's" and a parrot knowledge of the Koran. Comparatively few ever mastered the art of writing and anyone who could read and write passably styled himself "*mirza*." Such as it was however this measure of education could be had cheaply, the fees amounting to less than two shillings per month for each child. At that period there were no higher schools, the only form of secondary education, and that of a very limited extent, being provided by the *Madressehs,* or religious colleges, which catered for those aspiring to the professions of religion, law, or medicine. Every town of importance boasted of one or more of these, many of them richly endowed by pious testators, but none of them in any way subject to the control of the Government. Realising how backward his kingdom was in this respect, one of Nasr-ud-Din's first acts on ascending to the throne was to found an institution in the capital, styled the "Madresseh-i-Shah" or King's college, to be maintained by the State through a Ministry of Public Instruction. Pupils for this college could be entered at all ages and remained as a rule for 6 or 7 years. Colleges, nominally on the same basis, were opened in due course at Tabriz and Isfahan; excellent in their way but on too small a scale to make any appreciable impression on the general conditions of illiteracy. In the reign of Muzaffar-ud-Din Shah (1898), a further advance was made by the transfer of a number of private establishments to State control and the opening of new schools in Tehran and other towns. From that time onwards education fared better, mainly owing to the activities of foreign missions. All these were supported by voluntary subscriptions and donations and provided instruction for boys and girls alike. Educational institutions are still gravely inadequate but under the progressive régime of Reza Khan Shah Pahlavi the educational system of the country is being improved from year to year and greater facilities for education provided for both sexes. In addition to the Government schools, educational establishments are also maintained by the following foreign missions: the English Church Missionary Society; the American Presbyterian Mission; the Alliance Française; the Alliance Israelite; and the French Roman Catholic Mission; and there are schools run by the Russian and German Governments. The figures of the Ministry of Public Instruction show that for the year 1927 there were in the country 298 Government schools, 272 national schools, 112 private schools, 279 religious schools and 245 foreign schools, providing instructions for about 250,000 individuals of both sexes.

The religious schools still subsist on their liberal endowments, but the Government pays the whole of the budget of the Government schools and also makes grants to the public, private and foreign institutions. Apart from general education technical colleges or schools have been founded for the study of medicine, fine arts, pedagogy, engineering, and mechanical science and chemistry, law and political science, agriculture, and military subjects. The agricultural school has an American director, while the law, medical, and political schools are under the supervision of foreign experts of various nationalities. A scheme is understood to have been recently approved under which a number of promising young students will be sent to Europe annually to complete their studies; 100 in 1928, 200 in 1929, and so on until a maximum contingent of 600 is reached. An account of the educational position in Persia at the present epoch would be incomplete without reference to the educational work of the Anglo-Persian Oil Company in southern Persia. At Masjid-i-Sulaiman two elementary schools have been inaugurated, for the sons of employees; at Ahwaz the Company maintains a primary and a secondary school, and at Abadan an elementary school; these latter institutions offer education free to all suitable boys whether sons of employees or not.

Judicial System.—There exist at present in Persia two mutually contradictory judicial systems, that of the State, as expressed in legislation, and in decrees, and that of the Islamic law, as traditionally interpreted and administered in Persia. This dualism is an essential part of the fundamental laws of 1906 and 1907, by which the present constitutional system is regulated, and its abolition is an indispensable preliminary to any serious improvement in the judicial and legislative system, which is indisputably the least satisfactory branch of governmental activity in Persia, and that in which the least progress has been made.

Under the fundamental laws of 1906 and 1907, themselves contradictory and without logical structure, all legislation whatever passed by the Majlis must conform to Islamic law, and 5 doctors forming a committee of religious law (*ulama*) are empowered to veto any law or part of any law which in their view contravenes this principle. Though this veto has been seldom exercised, many laws have been enforced without submission to such a committee, and there is always a possibility that they may be declared unconstitutional by a judicial tribunal, or by the committee itself.

Apart from Islamic law, and from the fundamental laws above mentioned, the *corpus* of Persian legislation consists in the main of the following enactments:—

1. *Penal Code.* This is based on French law, but is subject (under Act 1) to Islamic law, which treats crimes dealt with therein on wholly different lines. This fundamental contradiction inevitably renders the application of the law by the Courts inconsistent and uncertain. The law itself leaves much to be desired.

2. *Civil Code* is still under preparation. It is understood to be based on Islamic law, with some adaptations from French and Egyptian legislation.

3. *Code of Civil Procedure* is based on the Russian law of 1910 and is now under revision, but no improvement seems possible so long as the dualism referred to above is maintained and enforced.

4. *Code of Criminal Procedure.* This is based on the Russian Code of 1910, and is likewise under revision.

5. *Commercial Code* is an incomplete adaptation of French law, which is considered by experts to be defective, especially as regards limited liability companies.

6. *Civil Service Law.* Under revision.

7. *Registration of Lands and Documents.* It is understood that it is intended to revise this law, which is in many respects highly defective.

Jurisdiction over Foreigners.—Until 1920 most foreigners resident in Persia were subject to the jurisdiction of their respective Consular authorities in matters exclusively affecting them. Thus suits between foreigners of the same nation were heard and decided in a Consular Court, subject, in certain cases, to appeal to the Courts of the country concerned. Matrimonial and testamentary cases and similar matters were dealt with in like manner. This system of extraterritoriality, which is frequently, but incorrectly, referred to as "the capitulations" on the analogy of Turkey, originated in a voluntary grant made by Shah Abbas in 1600 to Sir Anthony Sherley, an English knight, as an inducement to British merchants to enter Persia for purposes of trade. These and cognate privileges were, in course of time, extended to other foreigners, but were not formally recognised until, as part of the settlement of Russia arising out of the disastrous war of 1827, they were embodied, with certain limitations, in the Treaty of Turkmanchai. Other nations, including Great Britain, were accorded, under later treaties, most favoured nation treatment. In May 1928 extraterritorial jurisdiction over foreigners came to an end, but the Persian Government agreed to introduce certain safeguards in respect of British subjects, which may be briefly summarised as follows:—

The rules of international law will be followed by the Persian Government in all its relations with foreigners.

In all civil or commercial cases to which one of the parties is a foreigner, only written evidence will be admitted. All judg-

ments will be in writing and will contain the considerations of law and fact on which they are based. Copies of evidence and judgment will be obtainable.

Only the Courts subordinate to the Ministry of Justice will be competent to deal with cases in which one of the parties is a foreigner. In the event, however, of the proclamation of martial law when a case brought before a special tribunal has been established, such a tribunal may take cognizance of the case.

Foreigners can only be tried by non-religious tribunals.

Persons will only be sentenced to imprisonment by a police-court who ask for imprisonment in lieu of fine. Such imprisonment shall not exceed a week in duration. No sentence of corporal punishment shall be inflicted on foreigners.

No foreigner may be arrested or imprisoned without a warrant save *flagrante delictu,* nor may he be kept imprisoned for more than 24 hours without being brought before a magistrate. No entry or search of foreigners' houses or offices may be undertaken without a warrant.

Foreigners arrested and imprisoned shall have the right to communicate with their nearest consul, who shall be permitted to visit them.

Facilities for release on bail shall be granted save in cases of serious crime.

Trials will be held in public save in very exceptional cases.

The accused is free to choose his own counsel, who need not be a Persian.

Prisons "fulfilling the necessary hygienic conditions" are to be constructed. A foreigner sentenced to more than a month's imprisonment may claim transfer to one of these.

In affairs of succession, divorce, and status non-Muslim British subjects in Persia shall have recourse to their own Courts, if they so wish. Muslim British subjects will be subject to Persian religious Courts "till the question is definitely settled."

No tax or impost shall be levied on foreigners which is not levied on Persian subjects.

All judgments given by the former tribunals shall stand.

Questions relating to security for costs, orders for the payment of costs and expenses, execution of judgments, etc., shall be regulated by separate conventions.

British subjects are permitted to acquire, occupy, or possess such property in Persia "as is necessary for their dwelling and for the exercise of their commerce and industry."

British subjects cannot be arrested or suffer restraint in their individual liberty in order that civil claims of a pecuniary nature against them may be provisionally safe, except where there would seem to be a serious risk that distraint to be made, owing to any act on the part of a debtor, upon that debtor's possessions which are actually in Persia, would not be effective and could not otherwise be assured.

Similar safeguards over other foreign subjects will doubtless be embodied in due course by the Persian Government in treaties with other foreign powers.

AGRICULTURAL PRODUCTS

Generally speaking agriculture, in extent, yield, diversity and method, has changed little in the past half-century—or, indeed—for centuries, in all probability. There is no disposition, on the part of the sons of landlords and gentry, to go on the land and apply their education to the development of their properties. They prefer to remain town-dwellers or absentee landlords, rarely putting back into their properties a proportion of the rents received except it be in the form of repairs to *qanats.*

The method of cultivation of cereals is governed—geographically for the most part—by the division into irrigated and unirrigated lands; the Caspian zone, with a rainfall which may exceed 50 inches and produces great humidity, being to some extent an exception, though even there the rice-fields need irrigation. The rivers of Persia capable of being worked for irrigation by gravitation are few; on the northern seaward slopes, the Safid Rud, Harhaz, Gurgan and Atrak; in the S. the Karun, Jarrahi and Qara Agach, which reach the Gulf. The main Iranian plateau is watered by a number of streams, mostly of inconsiderable length, which in some years when swollen by snow or excessive rainfall, run away to waste in marshes or lakes, but are ordinarily dry watercourses for eight months of the year. In such conditions agriculture relies for the most part on irrigation, drawn either by (i.) gravitation from those rivers holding a supply from spring to autumn, or more commonly by (ii.) *"qanats,"* artificial subterranean canals starting from the foot hills and collecting water for long distances, possibly 12–20 miles till they are brought to the surface, and the stream led above-ground to the lands to be irrigated.

Cereal and other crops raised by means of such irrigation are watered at regular intervals from March to June, and what are known as "summer crops" from May till September. The return on irrigated land for wheat and barley sown is rarely more than ten-fold, usually much less. Side by side with this irrigation in some districts, and exclusively in some of the higher altitudes on the central Iranian plateau, between 6,000 and 8,000 feet, dry cultivation, dependent entirely on the rainfall, is practised. Dry cultivation is indeed the sole resource of the great alluvial Persian Gulf plain extending from the province of Khuzistan to the southern extremity of Dashti district, and in the Sistan belt in the east. On the shores of the northern end of the Gulf the rainfall may average 12 inches at Bushire; and at Shiraz, 120 miles inland across the mountains, 13 inches, as compared with a bare 3 inches in the year at Isfahan on the central plateau.

Wheat and barley are sown after the ground, hard baked by the powerful summer sun, is sufficiently softened by the first rain which may be as early as the first week in November, or as late as the first week in January. In the case of barley reaping will not be later than the 15th to 20th of April, while wheat is harvested from the end of April to the first days of May, roughly one month earlier than in upper Fars, and 2½ months earlier than harvesting in the altitudes above 6,000 ft. A full ploughing season is reckoned by the peasants as 40 days. The all-important factor, in the dry cultivation as distinct from the irrigated crop, is a succession of regular and soaking rainfalls between February 15th and April 1st, particularly about March 21st. If such timely rains occur (even if sowing should have been delayed till late December or early January), a yield of 20 times the quantity of seed sown is common, as compared with up to 12-fold in the transmontane districts of Fars. On the other hand, excellent rains during November to January, are often followed by a hold-off of rain in late February and March, the result of which is a meagre harvest hardly returning the seed sown. Harvest records in the Persian Gulf zone may be summarized over cycles of 11 years as 1 good year, 2 to 3 medium, 4 poor and 2 or 3 extremely bad. In years of penury numbers of peasants migrate, from spring to autumn, to work in the date-gardens of the Shatt-el-Arab.

A law for re-assessment of the land-tax due from private properties, on a basis of 3½ per cent of the average yield of four years, was passed in 1926; but such re-assessment by 1928 had covered only a small portion of the country. In 1925 the Ministry of Finance estimated the total production of wheat in Persia at the equivalent of some 1,092,000 standard tons (of which Khurasan province 145,000; Azerbaijan province 145,000; Fars 87,500; Kerman 72,500; Kermanshah 72,500; Kurdistan 58,000); and of barley at 568,000 tons, while the figures of the Customs administration, for the year March 1925–26 give the total export from Persia as wheat 2,460, barley 430 standard tons, nearly all to Russia. Export duty 1 kran per 130 lb.

In years of fair harvest the price of wheat in provincial towns may be the equivalent of 5s. 6d. per cwt. and upwards, rarely much less.

The usual ploughing implement is of rough hewn wood with an iron shoe for share, drawn by a pair of bullocks or donkeys, furrows being rarely more than 3 to 4 inches deep; the seed is ploughed in, in most cases, on sandy soil not prepared by a preliminary cleaning or manure. Reaping is by sickles, and the grain is trodden out from the straw by bullocks or asses on the threshing-floors of the Bible. Ridging in the European sense is not practised. By 1928, except perhaps for a few machines in the Karun valley, in the whole country south of Isfahan only two

tractors had been introduced (and these by European farmers). The experience of the latter is that the deeper ridging by machinery, and ploughing before the rains begin make both for economy in seed, and a stronger, heavier crop. In the Tehran district the Government since 1921 has instituted farms for training students, and given exhibitions of farming machinery, while certain of the great magnates have imported tractors for their estates; but, in general, agricultural machinery is rarely in use. The peasants, particularly in the south, look with no kindly eye on such improvements, and are inclined to thwart experiments or changes, the absence of skilled or reliable mechanics being an additional obstacle to the use of agricultural machines.

Rice cultivation flourishes above all in the Caspian provinces, Gilan and Mazandaran, production there being estimated by the Ministry of Finance at the equivalent of some 230,000 standard tons. But, though this was considered eight-ninths of the whole production of Persia, in all parts where there is irrigation from rivers and springs (*i.e.*, except in the Persian Gulf zone, Baluchistan and the east), and in the higher altitudes rice is grown mainly for local consumption, in the form of *pilau* chiefly, it being almost as much a staple food as bread, especially in the Caspian zone.

In the Persian year 1925–26 the export of rice—almost all to Russia—amounted to 61,450 standard tons; while on the Persian shore of the Gulf 20,380 tons were imported from India.

In Gilan sowing takes place in March, transplanting and pricking out in May, and after two or three hoeings harvest in August or September. In South Persia (Fars) early in April the seed is put in a wet cloth or a pit and left for some 36 days to sprout, then into a bed till the seedlings are well up where they are finally transplanted into large squares and kept regularly flooded till the end of September, when water is cut off; cutting takes place in late October and the stalks are then put under the feet of cattle for the paddy to be separated. The yield in some southern districts is given as high as 60-fold, but is generally from 15 to 20. Prices in the south of Persia are about 26s. 8d. per cwt. for the best quality ("*champa*") and less than 20s. for second grades.

Other cereals grown as "summer crops" (*saifi*) for local consumption are: maize (*Zea mays*), sown at the end of May and harvested in September: beans (*Faba vulgaris*): lentils (*Ervum lens*): millet or sorgo (*Sorghum vulgare*). Peas (*Pisum sativum*) are grown as a winter crop (*shitwi*).

Among agricultural products for commerce are:—

Opium.—From 1880 cultivation greatly increased with the demand from the Far East, both landowners and peasants finding it more profitable to put part of their corn-land under poppy (*Papaver somniferum*, L. var. *album* D.C.). It has become one of the chief methods for financing the payment of imported goods by merchants, for in the districts of production the opium season releases large sums in cash, which, passing through a number of hands—cultivator pedlars, petty merchants, brokers or landowners—till the opium reaches the merchant and is paid for by bills on the ports or abroad, enable purchases of all kinds of goods to be made and impart activity to trade. The export of the prepared drug weighed 770,516 lb. in 1913–14: 875,166 lb. in 1914–15 and, after falling to 255,697 lb. in 1921–22, rose again to 660,647 lb. in 1922–23, 1,077,290 lb. in 1924–25 and 1,130,057 lb. in 1925–26. (The prepared drug includes *gunjideh* gum, and other solvents used for adulterating opium to the percentage of morphine desired.) This represented an export invoice value of £698,416 in 1913–14, £1,565,121 in 1925–26. The crude sap coming under government excise control in 1923–24 weighed 1,340,000 lb., but the Persian Government estimated that total production in that year was not less than 1,950,000 lb. Though a proportion is doubtless smuggled, consumption in the country mainly accounts for this difference, between 5 and 10 per cent of the population in the interior being reckoned as addicts to opium smoking.

Cotton (*Gossypium herbaceum*) is grown, in nearly all provinces of Persia for home consumption (and the total production has been estimated as high as 30,000 tons), but for export preponderantly on the Caspian seaboard, and in the Khorassan, Isfahan and Yazd provinces. In the year 1925–26, 17,728 tons, of which eleven-twelfths to Russia, one-twelfth to British India, were exported. It is too short in the staple, too weak and uneven in quality, and contains too many impurities owing to the absence of ginning machinery, to find a market in western or central Europe. An American variety, acclimatized in Asiatic Russia, has been introduced to Khorassan of recent years, and experiments have been made since 1925 in Fars with American cotton acclimatized in Iraq. It is sown after the danger of frost is considered past, *i.e.*, from the end of March to early May, flooded by surface irrigation water about six times, and picked from October to November, according to the climate of the province.

Dried and fresh fruits form an important export and source of wealth to the country. In the year March 1925–26 the Customs gave the total weight as 88,811 tons, of a total approximate value of £1,762,090. Of this Russia took 26,370 tons of dried raisins, 4,094 tons of dried apricots, 2,752 tons of oranges and limes, 1,853 tons of almonds and other nuts, 3,102 tons of other fresh or dry fruit; while 43,709 tons of dates were exported, from Khuzistan province almost entirely, to the British Empire and Protectorates, and 2,280 tons of almonds and pistachio nuts. Scientific fruit-growers in Europe think that the parents of many of the cultivated fruits of Europe are to be found in north Azerbaijan and the Caucasus region; but little or no attempt through the centuries has been made to improve stocks by grafting.

The vine grows well in all regions except the Gulf littoral and, apart from the exports of raisins mentioned above, there is a very large consumption in the country of the fruit in the fresh or dried state. The making of wine (and of arak, a spirit distilled from grapes), forbidden to Muslims, is limited to the requirements of the country, chiefly the Jewish and Armenian communities: it probably has not increased much since 1666 when Tavernier, the French traveller, noted that the wine of Shiraz (the best-known in Persia, almost entirely made nowadays from grapes of the Khullar district) weighed 200,025 mans.

Silk.—The mulberry is grown for sericulture chiefly in Gilan and Mazandaran, to a lesser extent in Yazd and Kashan. In the 16th and 17th centuries the finding of a market for the silk trade of Persia was a source of preoccupation and profit for the Safavi monarchs, and up to 1860 the total production annually was valued at £1,000,000. The breeding of silk-worms from 1864–1890 declined to small proportions (about 90 tons of cocoons) owing to the disease "pebrine"; but, at the end of the 19th century, an import to Gilan of selected silk-worm eggs from Brusa in Turkey led to a revival of the industry, the output of dried cocoons in 1911 being nearly 1,700 tons, while in the year 1925–26 some 216 tons were exported, chiefly to Italy and Russia, besides about 1,000 tons of raw floss and waste silk. One factory for spinning silk exists at Resht. The hand weaving of silk carpets and other stuffs in Kashan, Yazd and other places accounts for the balance production. "Pebrine" is considered to have died out, but another disease "flacherie" is endemic.

Wool.—In a country where the rearing and maintenance of flocks of sheep is the principal occupation of the nomad tribes in particular and of the peasantry in general it is perhaps remarkable that the export of raw wool did not exceed 5,420 tons in 1925–26. But the explanation is to be sought in the requirements of the carpet-weaving industry, which in addition to home needs in that year exported 3,840 tons of non-aniline and 1,086 tons of aniline-dyed carpets and rugs, valued respectively at £2,163,765 and £449,140. In 1925–26, in order of importance, the chief centres where the exported carpets were woven, were Sultanabad, Hamadan, Tabriz, Qum, Shiraz, Kerman, Khorassan, Fars. Further, 653,043 lambskins were exported, nearly all to Russia.

Tobacco.—In recent years excise taxation and the growing habit of cigarette smoking have been responsible for the reduced acreage under cultivation of that distinct species of tobacco known as *Nicotiana Persica* ("Tambaku") for smoking in water-pipes, *i.e.*, kalians or hookahs. Some 1,028 tons were exported, almost entirely to Egypt, in 1925–26, whereas about 1885 some 4,000 tons were exported annually, and in Isfahan province alone in 1900 the crop was about 3,000 tons, and in 1911 1,500 tons. "Tutun"

(*Nicotiana rustica*) is cultivated in the Urmia and other districts near the Turkish frontier, and was introduced to Gilan about 1875; several varieties of it are now grown for cigarette smoking. "Tambaku" for export comes chiefly from Isfahan and Kashan districts; that from the Simakan, Jahrum and other parts of south and east Fars is favoured for home consumption.

Forests and Timber.—The main forest belt still existing in Persia lies on the northern slopes of the Elburz range towards the Caspian, in particular the provinces of Gilan and Mazandaran. Little use has been made of them industrially, except in the case of boxwood, which from 1865 began to be bought by traders from Russia and Europe, and from 1886–1909 was exploited to such an extent under a monopoly that the lower lands have been largely denuded of this valuable wood. The export of this, walnut and other woods has exceeded £50,000 in value in some years, though since 1920 of small account. Kurdistan, Luristan and the Bakhtiari are also well wooded in parts. South Persia, except for the northern portion of the Kuhgilu tribal district, and a few miles of dwarf oaks in central Fars, is practically de-forested, although ample supplies for the needs of towns and villages in firewood and charcoal still exist. No replacement of this cut wood by afforestation on the part of the landowners or Government is apparently taking place. Since 1926 however a German forest expert has been employed to report on these matters, and supervise the forests of Mazandaran. Trees flourishing in Persia are, among others:—Alder (*Alnus glutinosa, A. barbata, A. cordifolia*), Ash (*Fraxinus excelsior*), Beech (*Fagus sylvatica*), Elm (*Ulmus campestris, U. effusa, U. pedunculata*), Wych-elm (*U. montana*), Hornbeam (*Carpinus betulus*), Juniper (*Juniperus excelsa, J. communis, J. sabina*), Maple (*Acer campestre, A. pseudo-platanus*), Oak (*Quercus ballota, Q. castaneaefolia, Q. sessiliflora, Q. pedunculata*), Walnut (*Juglans nigra*), Tamarisk (*Tamarix*), various kinds of poplar, Jujube (*Zizyphus*), etc.

Manufactures.—The State is nowadays primarily an agricultural rather than an industrial one. If we exclude oil products, bullion and re-exports, 68% of her exports during the year 1926–27 consisted of agricultural products and only 25% of articles of home manufacture. Owing, no doubt, in a great measure to the fact that their wealth is mainly in the form of property and kind, Persians themselves cannot readily find money for investment in industrial enterprise, while practically all attempts made during the past half-century to finance Persian industries with foreign capital have ended in failure. Manufactures of gas, glass, sugar, matches, and cotton textiles have all been tried but have all succumbed in turn from one cause or another. It is encouraging however to note that some signs of industrial revival are now apparent. An enterprising Kazvini, who for some time has had a cotton-spinning factory in operation at Tabriz has achieved sufficient success there to enable him (in 1928) to erect works for wool-spinning in his native town; silk is being spun at Resht; a defunct cotton and wool-spinning factory has been restarted in Tehran; while a new spinning and weaving factory, equipped with German machinery, which was erected in Isfahan in 1926 is said to be turning out excellent blankets and rough cloth. It is perhaps questionable however whether it could continue to thrive but for the accord of strenuous support on the part of the Central Government, in the shape of cash and contracts and the issue of decrees making it incumbent on officials to wear home-made cloth. So much for machine made goods. The hand-made carpets and rugs of Persia which have been so famous for the last 5 centuries still constitute her most important and valuable industry and in 1925–26 were exported to the value of nearly 2½ millions sterling. Nevertheless experts are not without misgiving for the future of the industry, owing partly to the appearance of new and more accessible sources of manufacture but also, unfortunately, to the increasing employment of the aniline dye, which has done so much to harm the time-honoured reputation of the Persian carpet. Other countries, it is true, make use of aniline dyes, but with them the yarn is dyed faster and the colours are superior in quality to the crude shades of red and fuchsine which the Persian weaver is prone nowadays to use in such abundance. At the same time Chinese and Italian production is making rapid progress; Anatolia is once more becoming a serious competitor, and the looms set up in Greece by the Greek and Armenian weavers expelled from Turkish territory during the War are also beginning to make their influence felt. Another interesting industry is the calico-printing of Isfahan and the neighbourhood—Manchester calico block-printed in colours. As a rule one block-design is used for the whole piece, and the resulting prints are popular for use as summer curtains, bed-coverlets, and table-cloths. The material is also used locally for shrouds for the dead, for which purpose special designs are used bearing suitable inscriptions from the Koran. During the summer the dry bed of the Zindeh Rud at Isfahan may be seen covered with bright and freshly printed fabrics laid out to dry in the sun. Space forbids more than brief mention of several other minor arts and industries such as the pierced brass-work of Isfahan, used especially for lamps, of beautiful design; the repousse silver-work of Shiraz and Isfahan; the wood-carving of Abadeh and Gulpaigan; the mosaic and tile-work of Shiraz and Kerman; and last but not least, the beautiful decorative painting work carried out on lacquered papier-maché which the pictorial artists of Persia have found a facile medium for the expression of their art in the form of Qalamdans (reed-pen boxes), mirror backs, book-covers, Koran-stands, and such like articles; while inseparable from the Qalamdan is the finely engraved seal.

Fisheries.—The fisheries of the Persian littoral of the Caspian are a valuable asset and source of revenue to the State. In 1868 they were leased, as a monopoly, to a Russian firm, the concession being renewed for short periods from time to time until 1906 when a long extension was granted to 1925. The upheaval caused by the World War having, however, resulted in failure on the part of the concessionnaire to pay the royalties, the concession was withdrawn by the Persian Government in 1918 and leased to another Russian firm. This lease was short-lived, for the port of Enzeli (Pahlavi), which is the headquarters of the industry, soon afterwards fell into the hands of the Soviet authorities and with it the control of the fisheries. It is hoped however as the result of negotiations which have been in progress (1928) that this rich industry will shortly be restored to the control of the Persian Government.

No such concession or regularized fisheries have been in vogue in the case of the Persian shore of the Persian Gulf. Here the ordinary fishing is unrestricted, and a considerable element of the riparian population take part in the famous pearl fisheries of the Gulf, the small port of Lingah being the chief distributing centre for the Persian shore.

Roads.—The existing roads in Persia may be placed very roughly into four categories:—

(a) Metalled, *i.e.*, consisting of stones loosely thrown on the surface which the passage of transport is expected to crush into permanent condition—about 700 m.

(b) Partially metalled, *i.e.*, with a light surfacing of stone or gravel—about 1,700 m.

(c) Unmetalled tracks, but passable for light motor traffic, at most seasons, though sometimes with difficulty—about 3,300 m.

(d) Natural caravan tracks.

Till the Road-tax law was enacted in 1926, various tolls and municipal taxes were levied on merchandise in transport and supposedly spent on the roads; but in that year the various imports were replaced by a compounded road-tax leviable at the frontiers on all exports and imports, and the road administration placed under an American engineer. In 1926–27, the Persian Government spent £240,000 on the construction of new roads and £200,-000 on the repair and maintenance of existing roads. The number of motor lorries in operation had increased from 103 in 1925 to 492 in 1926 and 967 in 1927, while motor cars had increased from 529 to 1,330 in the same period. Motor transport is thus tending to replace pack transport on a few of the principal roads.

The principal constructed roads more or less suitable for heavy as well as light motor-traffic, are as follows:—

(1) Tehran–Kazvin–Resht–Pahlavi (Enzeli) = 230 m. (This road was constructed by the Russians, but ceded to the Persian Government by treaty in 1921.)

(2) Kazvin–Hamadan–Kirmanshah–Qasr Shirin = 380 m.

(3) Tehran–Hamadan, via Nubaran = 204 m.

(4) Tabriz–Julfa–Khoi = 140 m. The first section of this road runs alongside the Tabriz–Julfa railway and would lose some of its utility should the latter be put into running order.

The principal roads of categories (b) and (c), *i.e.*, lightly metalled, or unmetalled, or partly the one and partly the other, but generally passable for light motor traffic, are the following:—

(1) Tehran–Semnan–Damghan–Shah Rud–Nishapur–Meshed = 58 m.

(2) Tehran–Firuzkuh–Aliabad–Meshed-i-Sar; and Aliabad–Sari–Bandar Jaz–Astarabad.

(3) Meshed-Kuchan-Ashgabad (Trans-Caspian railway) = 160 m.

(4) Tehran–Qum–Nazar–Dalijan–Isfahan = 287 m.

(5) Isfahan–Yezd-i-Khast–Shiraz = 290 m.

(6) Isfahan–Nain–Yezd–Kerman = 400 m

(7) Isfahan–Sultanabad–Gulpaigan–Hamadan = 267 m.

(8) Kazvin–Zinjan–Mianeh–Tabriz = 270 m.

(9) Meshed–Turbet-i-Haidari–Birjand–Duzdab (Indian railhead) = 600 m.

(10) Bushire–Borasjun–Kazerun–Shiraz = 180 m.

(11) Bushire–Bandar Dilam–Hindiyan–Khalafabad–Ahwaz = 550 m. (The Khalafabad and Hindiyan rivers are crossed by pontoon bridges erected by the A P.O Co)

(12) Hamadan–Malayer–Khurramabad = 190 m.

(13) Mohammerah–Ahwaz (90 m)–Dizful (190 m.).

(14) Mohammerah–Abadan = 10 m.

Railways.—In 1892 the only railway in operation was a metre-gauge line connecting the capital with the shrine of Shah Abdul Azim 5 miles away, used solely for conveying pilgrims to the mosque. Since then there has been a measure of concrete progress. Firstly, a line 85 miles in length has been built from Tabriz to the Perso-Russian frontier, making connection at Julfa with the Russian Caucasus system. From Sofian station on this line a branch 30 miles in length takes off to the shores of Lake Urmia at Sharifkhaneh. These two sections were built by a Russian company, opened to traffic in 1916, and transferred to the Persian Government in 1921. Secondly, a short length of 7½ miles of narrow-gauge line has been brought into operation between Resht and Pir-i-Bazar on the Enzeli lagoon, whence goods are taken by water to Pahlavi Port on the Caspian. In addition to the foregoing, 104 miles of rail were laid by the Government of India during the World War from their railhead at Mirjawa to Duzdab. This is at present a part of the North-western Railway system of India, but its future, at all events as regards the portion in Persian territory, is uncertain. Another stretch of about 35 miles of narrow-gauge line was built by the Anglo-Persian Oil Company in 1923, from Dir-i-Kazineh on the Karun to the oilfields at Musjid-i-Sulaiman, but as it is privately owned and is employed only for transport to and from the oil-fields it hardly comes within the category of national railway development The history of the railway problem in Persia during the past quarter of a century does not however begin and end with the execution of the above modest projects. A considerable amount of negotiation and survey work has at any rate taken place with an eye to more ambitious schemes. Thus, in 1911 a British company, "The Persian Railways Syndicate," was formed for the purpose of constructing railways in Southern Persia, the first of which was to be a line from Mohammerah, on the Shatt-el-Arab, to connect with a line to be built under Russian auspices from Khurrumabad to Tehran via Hamadan and Kazvin, with an extension from Kazvin to Resht, which would have given through communication between the Caspian and the Persian Gulf and from Tehran to the north and south. This project was the outcome of negotiations carried on early in 1911 between the British group and the Persian Government during the regency of Nasir-ul-Mulk, the Russian representative being brought into the discussion later, in respect of that portion of the line, between Burujird and Tehran, lying within the Russian sphere of influence.

As the result a comprehensive scheme of railway construction was evolved covering the main transport routes throughout Persia, it being agreed (1) that the railways within the Russian sphere should be built with Russian capital, and (2) that the first railway to be undertaken should be that from the Persian Gulf to the Caspian, with a branch from Kazvin to Tehran, because of its greater importance in Persian eyes and the greater prospects of remunerative working which it offered. These arrangements were upset by the fall of M. Shuster, the Treasurer General of the Persian Government (*see* later, *History*) and then by the World War. In 1920, the Persian Government intimated to the Syndicate that they had now come to the decision that the most needed line for construction at the moment was one from Khanikin to Tehran, connecting with the Iraq line from Khanikin to Baghdad and so providing speedier communication between Tehran and the Mediterranean, especially in the event of the contemplated Baghdad to Haifa railway taking shape. Such a line they considered would also be of great service to Shiah pilgrims travelling to Kerbela. They asked the Syndicate to undertake the survey of this line on the same terms as in the case of the previous survey. The invitation was accepted by the Syndicate and the survey duly carried out; it is the more disappointing therefore to have to record that the services thus rendered by the British syndicate and their constantly expressed readiness to exercise their options for the execution of the projects contemplated have borne no fruit, and that even their claims for survey work done remain unsettled (1928). Meanwhile a concession for the construction of the southern line above referred to, but with its terminus on the Khor Musa instead of at Mohammerah as previously contemplated, has been given to a German-American syndicate. Preparations for construction work are understood to be in train and the prospective terminus has been officially styled "Bandar Shahpur." It is clear that the realisation of this project, traversing as it will the mountainous region of Luristan, will be no mean engineering achievement, and its execution must occupy several years, but Persia is much to be congratulated on having an important trunk railway at last in sight, which when completed will materially promote the development of her rich natural resources

Posts.—The past history of postal services in Persia has been one of considerable interest Down to 1874 there were no regular post-offices in the interior of Persia, nor indeed any at all except those maintained by the Government of India in the Persian ports of the Persian Gulf. Previous to that time, arrangements for the carriage of letters had been "farmed out," the head farmer being known as the *Chaparchi-bashi*, and letters and small parcels being conveyed by him and his agents at high and arbitrary rates and without any responsibility. But as one of the results of Nasir-ud-Din Shah's visit to Europe in 1873, two officials of the Austrian postal service were engaged (1874) and in the course of the 3 years following postage stamps were brought into use (1875) and some modest experimental services inaugurated between the capital and outlying districts. The general organisation gradually improved and in 1877, with the support of the Government of India, Persia was admitted to membership of the International Postal Union

In the meantime in 1864 on the urgent representations of its local agents the Government of India had decided, in the interests of the British communities concerned, to establish a postal service of its own between Bombay and the ports on both shores of the Persian Gulf and in Turkish Arabia, mails being conveyed under contract by the British India Steam Navigation Co , whose vessels plied regularly to the Persian Gulf ports and Basrah Under these arrangements post-offices of the Indian inland system were successively installed in the British consular agencies at Bushire, Lingeh, Bandar Abbas and Jask, British Indian stamps being used for franking the letters. On the entry of Persia into the International Postal Union the existence of these post-offices assumed a somewhat anomalous aspect, and became a fruitful source of friction with the local Persian authorities. At the same time their safe and efficient amenities had been a great boon to the British and Indian communities in the Persian Gulf and they were naturally loth to be deprived of the time-honoured privilege. However in 1920, as the result of friendly negotiations between the Indian and the Persian postal authorities, on behalf of their Governments, the British Indian offices were withdrawn.

Since the engagement of the two Austrians above mentioned Persian postal services have been administered under the supervision of European experts, and, assisted by the gradual improvement of road-communications and an increasing public demand for facilities, have made substantial progress. Thus, a weekly mail-service is in operation (1928) between Tehran and Pahlavi, and between Tehran and the rail-head of the Iraq system at Khanikin, connecting with the weekly trans-desert service between Baghdad and Beirut. An air-mail service has also been inaugurated, the German Junkers Company having taken a contract for a subsidised weekly mail service between Tehran and Pahlavi, Tehran and Bushire, and Tehran and Kuraitu (on the Iraq frontier); but this service is still in its infancy. The Tehran-Pahlavi section of the above service links up with a Pahlavi-Baku section, operated by Russians and Persians, but included, it is understood, in the contract with Junkers. From Baku the Russian air lines communicate with Moscow.

Telegraphs.—Lying, as she does, across the most direct course from Europe to India, Persia finds herself exceptionally well equipped in this respect and the history of the country in the sphere of telegraphy is one of no little interest. In addition to a net-work of some thousands of miles of local lines belonging to the Persian Government, worked by Persian telegraphists in the Persian character, for internal traffic, two important trunk lines traverse the country, owned by the Indo-European Telegraph Company and the Indo-European Telegraph Department of the Government of India, and worked by British personnel in the Roman character.

The first length of line to be constructed in Persia was a domestic one, from Tehran, 160 miles in the direction of Tabriz. This was commenced in 1859 and finished in 1862, but in the year following it was extended to the Russian frontier at Julfa, where junction was effected with the Russian system. In the same year a Convention was concluded between the British and Persian Governments for the construction of a land-line through Persia with the object of linking up the Indian and the European systems, the project being carried out by British engineers at the cost of the British Government. The alignment chosen was from Baghdad, the last station on the Turkish system, to Kermanshah, Hamadan, Tehran, Isfahan, Shiraz and Bushire on the Persian Gulf, from whence there was a cable to India But experience showed that this line was so liable to interruption that it was unsafe to rely on it for international work, and an alternative route was accordingly provided by an extension of the Turkish land-line from Baghdad to Fao, at the mouth of the Shatt-el-Arab, and the laying of a short length of cable onwards to Bushire. Communication with India was effected for the first time in January 1865 on completion of this project, but the service still failed to give complete satisfaction owing to the frequent delays which occurred in the passage of messages between India and Europe. The complaints which arose led in 1866 to the formation of committee of the British Parliament which considered various proposals put before it for the improvement of the service, with the result that the firm of Siemens and Company of London and Berlin offered to construct a double line from London to Tehran, provided that they enjoyed the effective support of H.M.'s Government. This being duly accorded the Company was able to obtain the necessary concessions from Germany, Russia and Persia for the passage of the line through their territories, and an English organisation, the "Indo-European Telegraph Company," was formed to work the section London-Tehran, while the section Tehran-Karachi, via Bushire, was undertaken by the Indo-European Telegraph Department of the Government of India. Through communication by this route was established on January 31, 1870, and worked satisfactorily. Towards the end of the century the largely increased volume of traffic pointed to the need for a supplementary line between Tehran and Karachi and accordingly in 1901 a further Convention was concluded with Persia which provided for the construction of a 3-wire line from Tehran via Yezd and Kerman to the Indo-Persian frontier at Hurmak, there to meet an extension constructed by the Indo-European Telegraph Department from Quetta. This line, which was designated the "Central Persian Line," was opened for traffic in 1907. By the terms of the current Convention, which continues until January 31, 1945, the Persian Government are entitled to the use of one of the three wires for messages between stations in Persia, while the 2 remaining wires remain available for international traffic. Revenue derived from messages originating or terminating in Persia is shared between Persia and the British organisations, while for international messages in transit a fixed royalty is paid to the Persian Government. If we except the occasional local depredations of irresponsible tribal riflemen on migration, to whom the insulators form an irresistible attraction, the telegraph lines and operating staff are treated with universal respect and goodwill by the inhabitants, while as a service the personnel have earned a deservedly high reputation as well as the gratitude of numberless travellers who have enjoyed their hospitality and co-operation when in difficulty. At the present time this modest system of 700 to 800 miles is probably as efficiently run as any line in the world.

Until 1909 the domestic lines of the Persian Government were ordinarily farmed out to individuals under contract, but since that date they have been operated directly by the Ministry of Posts and Telegraphs for the Government. There were in 1928 about 150 offices in the country with a total length of nearly 10,000 miles. Persia became a member of the International Telegraph Union as far back as 1860.

Wireless.—In the spring of 1925 a high power wireless plant purchased by the Ministry of War from the Soviet, was erected outside Tehran. This developed into "The Pahlavi Radiotelegraph Station" notified by the Persian Telegraph Administration in December 1927 to the International Telegraph Bureau at Berne, as having been installed and opened for international telegraphic correspondence. It is understood to work on the continuous wave system with a wave-length of 4,000 metres.

Telephones.—A Persian limited company has held a monopoly from the Central Government for some 25 years past for the establishment of telephone systems in the towns of Persia, except those of the Gilan province wherein telephones have been installed by a local firm. Tehran, which boasts of some 1,500 subscribers, and the other principal towns are now equipped and the service generally is being improved. In addition to these urban services communication has also been established in some localities between one town and another, but 100 miles is about the limit of distance in these cases.

The British telegraph lines are of course fitted with telephone attachments for use between control stations.

Currency and Weights and Measures.—The coinage of the country is a silver one, and it fluctuates in value according to the market price of silver.

The monetary unit is called a "Kran," with its decimal variations, of higher and lower value, viz., the "Toman" (=10 krans) and the "Shahi" ($=\frac{1}{20}$ kran). The superscription in Persian is "Yek Hazar dinar" (=1,000 dinars), a conservative employment of the ancient title appearing on the coin when first established in the country.

The subsidiary coins to the kran are the 1-shahi and 2-shahi pieces: One shahi=·05 of a kran (5 cents); two shahis=·10 of a kran (10 cents), there being 20 shahis to one kran. These are represented by a good type of nickel coin struck in Birmingham

Two-kran "Do Hazar dinar" and 5-kran "Panj Hazar dinar" silver coins are also in circulation, the 2-kran piece being more universally in demand.

The kran weighs one miscal or 71·04 grains, and is of 900 fineness, and taking silver at its present (1928) price of 26¼d. and allowing for all charges of minting, etc., it would bring the present day intrinsic value of the kran in sterling to 4·8d.

In recent years the currency has been greatly improved, a good deal of it being struck in Russia and in England, while through the good offices of the Imperial Bank of Persia in assisting the Government, the currency has been cleansed by persistent withdrawals from circulation of the short weight, short value and badly minted coins struck at the Tehran mint.

For all practical purposes there are no gold coins in circulation, though a few gold coins are specially minted each year.

Note Issue.—Supplementary to the silver coinage, a cumbersome medium of currency owing to its weight, is the note issue of the Imperial Bank of Persia. These circulate throughout all the large cities of the country in denominations of 1, 2, 5, 10, 20, 50 and 100 tomans.

Weights and Measures are not uniform throughout the country. The Tabriz maund is the unit more universally in use, and is equal to approximately 6 lb. 9 oz. or 2·970 kilogrammes. For weighing heavy solids the Kharvar (donkey load) is generally commercially used, equivalent to about 650 lb.

There are various new weights and measures under an act passed by Parliament on May 31, 1926, based on the decimal system, to be brought into force within three years of its passing, the Government to create the machinery necessary for its enforcement four months previously, by giving notice in every district of the impending change.

Finance.—Of recent years the Persian Government has devoted much attention to the reform of the methods of collection of its revenues and to the presentation of annual financial statements on the lines adopted by all European States. Considerable progress has been made in both directions, and even more would have been achieved but for frequent changes in the administration of the Ministry of Finance. Doctor A. C. Millspaugh, a U.S. citizen nominated in 1922 at the request of the Persian Government by the U.S. Government, as administrator general of Persian finances, was the third westerner to hold that office. On the expiry of his contract in 1927 his place was taken by a German citizen, who was simultaneously appointed as treasurer general.

The receipts from all sources for the year ending March 21, 1927, were officially estimated as follows:—

	Millions of krans
Direct and indirect taxes	126
Customs	92
Royalties	70
Crown domains and road taxes	49
Post and telegraphs	20
	357

Expenditure for the same period was estimated at 243 million krans, made up as follows:—

	Millions of krans
Army and police	100
Civil list	80
Public works	18
Post and telegraphs	18
Education	11
Interest on public debt	7
Municipal grants	6
Parliamentary expenses and salaries	3
	243

Receipts thus show a surplus over expenditure of 113 million krans, apart from a sum of about £1,000,000 p.a., the proceeds of a special surtax on imported tea and sugar, the proceeds of which are earmarked for railway construction.

It will be seen from the foregoing that land taxes and customs are the most important sources of revenue, closely followed by the royalties on oil paid by the Anglo-Persian Oil Co., Ltd. (16% on net profits), the total thus paid for the year 1926–1927 being nearly £1,400,000.

The re-survey of taxable areas has been attempted, but in the absence of an accurate cadastral survey and of skilled officials, little progress has been made; it is moreover open to question whether the results likely to be obtained would justify the heavy expenditure involved and the mentally unsettling effect of the operations upon the peasant population and on landowners.

The collection of land revenue has been systematised and is now effected by agents of the central Government posted throughout the country, with satisfactory results.

The Customs Department is efficiently administered by Belgians who have been in charge of this department since 1902: but the proportion of Persians appointed to responsible posts is being steadily increased.

The national debt of Persia cannot be precisely stated, as various claims arising out of the War are unsettled, but it is estimated at between 3 and 4 million pounds, or not much more than 7s. 6d. per head of the population and is being steadily reduced: the Persian Government has at all times scrupulously fulfilled its admitted obligations, and its financial status since the War has been correspondingly satisfactory. The action of the Government of the U.S.S.R. in officially cancelling the Persian debt to Russia, amounting to 32½ million gold roubles, and the large sums expended in Persia by the belligerents, including the British Government during the World War, greatly contributed to the sound financial position in which Persia finds herself to-day.

Banking.—No banking system existed in Persia till 1899 when Baron Julius de Reuter obtained a concession for a State bank. The concession primarily conveyed to the bank a monopoly of the issue of notes, and mining rights, and contained also other privileges, such as exemption from taxation, stamp duties, etc., but subject to payment by the Bank of a royalty of 6% on its net profits. In the same year the Imperial Bank of Persia was formed in London under a British royal charter with an authorised capital of £4,000,000 in £10 shares, of which £1,000,000 was issued at £12 per share and fully paid up. Despite the conditions under which it has had to conduct its business and its varying fortunes, it has continued to progress, and is the repository for the Government's funds. It has 24 branches in Persia, with its chief office at Tehran.

Other banks established in the country include branches of the New Oriental Banking Corporation at Bushire, Isfahan, Tehran and Tabriz, which were latterly (1890) absorbed by The Imperial Bank of Persia; the Banque de Prêts de Perse, a Russian institution which disappeared with the Russian tsarist régime, and although its assets (and liabilities) were handed over to the Persian Government by the Soviet as a free gift, it has never functioned under its new owners, who restyled it the Bank-i-Iran (Bank of Persia); and has confined itself to the collection of outstanding loans.

The *Bank-i-Pahlavi* formed as a convenience for Persian army officers was established in 1925, but its activities are now confined to minor matters connected with military movements and transport of mails, etc.

A National Bank is also in process of formation constituted by an act of the Majlis in May, 1927. It is to be an entirely Persian national institution, and the direction of its affairs is to be controlled by officials selected by ministers of State. A German citizen was appointed in 1928 as director.

A Soviet-owned bank, "Ruspers" is also established in Northern Persian towns, its activities being restricted to financing Russo-Persian trade. The Imperial Ottoman Bank has also some agencies in the country.

The main function of the Imperial Bank of Persia is to finance the requirements of the Persian Government and the trade of the country, both local and foreign. In this latter sphere extreme caution is necessary, in view of the special circumstances of the country. Insistence upon European standards and principles of banking has done much to improve conditions, yet there is still a great deal of room for improvement. For example up to quite recently there has been no proper safeguard for bills of exchange and no machinery exists by which an irregular bill of exchange can be noted or protested, but an improvement in this respect is foreshadowed by discussions in Parliament of a commercial code, the compilation of which has been entrusted to Continental jurists.

Commerce.—Persia was formerly a much more generally self-supporting country than at present and produced almost all she needed, leaving a surplus of certain of her products for export. Since the introduction of cheap machine-made articles, many of the home industries of Persia have languished and to-day Persia is dependent largely on external sources for the supply of many of her manufactured necessities, *e.g.*, cotton goods and yarns,

metal goods, machinery, etc. Among food commodities, largely imported, are tea and sugar. The principal exports of Persia are natural products: mineral oils, raw materials (cotton, silk, wool), fruits, opium, rice, skins and hides, gums and tobacco. Almost the only manufactured product exported by Persia is carpets. The principal centres of active trade are Tabriz, Tehran, Kermanshah, Resht, Shiraz, Kerman, Meshed and Duzdab; the chief ports are Pahlavi (Enzeli), Bushire, Mohammerah, Abadan and Bandar Abbas.

The value (in thousands of krans) of Persia's foreign trade, including oil shipments and bullion and specie, for the fiscal years ending March 20, for which complete customs statistics are available, is as follows:—

Year	Imports	Exports	Total
1911–12	570,208	420,785	990,993
1912–13	567,576	436,333	1,003,909
1913–14	647,165	455,840	1,103,005
1914–15	499,322	396,058	895,380
1915–16	464,108	377,135	841,243
1916–17	494,771	433,895	928,666
1917–18	468,066	338,714	806,780
1918–19	476,287	270,869	747,156
1919–20	629,793	367,817	997,610
1920–21	482,352	371,199	853,551
1921–22	609,775	502,045	1,111,820
1922–23	619,201	733,983	1,353,184
1923–24	681,322	768,392	1,449,714
1924–25	771,445	1,000,163	1,771,608
1925–26	881,025	1,059,390	1,940,415
1926–27 (approx.)	768,000	1,104,000	1,890,800

Excluding bullion and specie and oil shipments, the total trade of Persia amounted to 1,053,408 in 1913–14 (the year immediately preceding the War) and 1,340,969 in 1925–26.

It would be erroneous to regard this as necessarily indicating an *increase* in the volume of Persia's general trade, when the rise in prices is taken into consideration.

Table showing the *Balance of Trade* for the years 1925–26 and 1926–27 (in thousands of krans):—

	1925–26	1926–27
Imports—		
Merchandise	834,873	779,240
Bullion and specie	46,152	7,560
Total	881,025	786,800
Exports—		
Merchandise	505,983	441,386
Bullion and specie	8,719	8,264
A.P.O.C. shipments	544,688	654,350
Total	1,059,390	1,104,000
Total Trade (all categories)	1,940,415	1,890,800
Excess of *Exports* over *Imports* (all categories)	178,365	317,200
Excess of *Imports* over *Exports* (excluding bullion and specie and A.P.O.C.)	228,890	337,854

Thus if bullion and specie and oil products are excluded there is an adverse balance of trade. This adverse merchandise balance amounted in

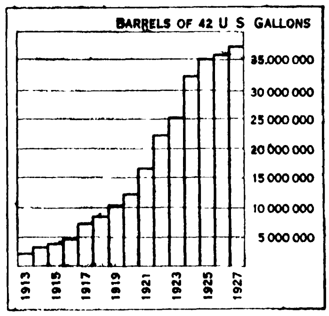
1919–20 to 442,403 krans (thousands).
1922–23 „ 313,544 „
1923–24 „ 298,827 „
1924–25 „ 286,083 „

showing in general a gradual downward tendency until 1925–26, when an upward tendency set in. It is probable, however, that Persian exports are under-valued as compared with imports, and that this adverse balance is largely fictitious.

Tables showing the principal *Articles of Import and Export*:—

Imports	Percentage of total 1926–27	Percentage of total 1925–26	Origin, in order of importance
Cotton tissues	28·1	29·5	G.Br., Br. Ind., Rus.
Sugar	15·7	15·7	Rus., Belg.
Tea	8·8	7·4	Br. Ind.
Cereals and flour	1·0	4·4	Rus., Br. Ind.
Mineral oils	4·0	2·8	Rus.
Cotton yarn	3·1	2·5	G.Br., Br. Ind., Japan
Rice	1·2	2·0	Br. Ind.
Carriages, motors and accessories	4·5	1·8	U.S.A., G.Br.
Machines, tools, iron manufs.	4·4	3·5	G.Br., Rus., Germ
Woollen tissues	2·6	1·6	G.Br., France
Exports			
Mineral oils	59·3	51·4	G.Br.,Br. Ind., Egypt
Carpets (woollen)	11·1	11·1	U.S.A., Turkey, G.Br.
Opium	8·7	6·6	Singap.,Rus.,Jap.,China
Fresh and dried fruits	2·9	7·3	Rus., Br. Ind.
Raw cotton	5·1	5·9	Rus., Br. Ind.
Rice	1·9	4·1	Rus.
Wool	2·1	2·1	Rus., Br. Ind.
Hides and skins	1·7	2·3	Rus., G.Br.
Gum tragacanth	1·3	·7	G.Br., Iraq., Rus.
Cotton tissues	·3	·6	Rus., Afgh.
Tobacco	·3	·4	Egypt

Two of the items of export call for special comment. Regarding mineral oils, although Persia possesses enormous oil resources—this product forming from 50–60% of her annual exports—the country nevertheless until recently supplied its needs almost entirely from Russia, as the difficulties and cost of transport from S. W. Persia of this commodity made it impossible to supply the markets of Central and N. Persia from Abadan. Energetic steps are now being taken by the Anglo-Persian Oil Co., with the benevolent assistance of the Persian Government, to place its products on the market in N. and Central Persia in competition with those of Russia.



GRAPH SHOWING THE PRODUCTION OF CRUDE PETROLEUM IN PERSIA
Figures for 1927 are preliminary

Next to oil production the manufacturing of carpets forms the most important of Persian industries, the export of this commodity constituting about 11% of the total export trade. The value of carpets exported amounted in 1924–25 to 101,881,000 krans, 1925–26 to 117,581,000 krans and 1926–27 to 122,563,000 krans. Despite the apparent increase in the trade during the past three years, there are indications that this special industry of Persia is meeting with increasing competition from the Indian, Chinese, Armenian and Greek productions of a similar nature. The looms set up in Greece in particular, by Greek and Armenian weavers, expelled from Turkey after the Great War, are already making their influence felt.

Table showing *Percentage of Total Trade* (including bullion and specie and oil shipments) of Persia with the principal countries:—

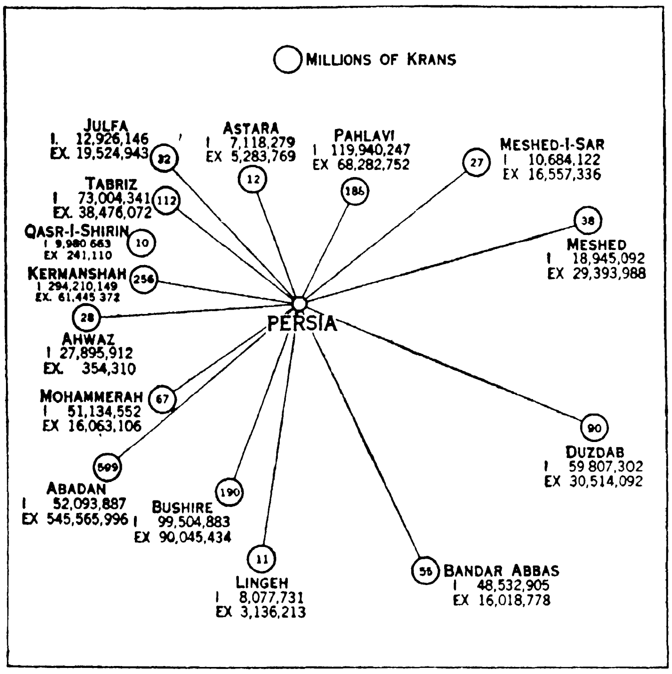
	Percentages 1926–27	Percentages 1913–14
Great Britain	32	12
India	18	9
Russia	18	60
Egypt	7	.
United States	5	1
France	4	2
Iraq	3	(Included in Turkey)
Germany	2	3
Italy	2	1
Turkey	2	5
All other countries	7	7

Thus in the year before the World War the trade of Russia reached 60% of the total trade as against 21% for the British Empire To-day the position is reversed, being British Empire 57% and Russia 18% in 1925–26, and 60% and 18% respectively in 1926–27

Table showing the *Principal Lines of Trade,* into and out of Persia, in 1925–26:—

Direction	Centre	Percentage of	
		Total trade	Excluding oil products
W.	Kermanshah	13·2	19
N.W.	Tabriz (and Julfa)	7 4	10 7
N.	Pahlavi (Enzeli)	9·7	14·0
N.E	Meshed	2·0	2·8
S.E	Duzdab (Indian railhead)	4 6	6·7
S.	Bandar Abbas	2 8	4·1
S.W.	Bushire	9 8	14·1
S.W.	Mohammerah	3·4	5
S.W.	Abadan	30	

Diagram showing the principal lines of trade into and out of Persia—with amount of imports, exports and total trade



The total *Tonnage of Trade*, in 1925–26, at all the ports of Persia, amounted to 4,241,000 tons, of which 299,000 tons represent imports and 3,942,000 tons exports. This trade was distributed as follows.—

	Imports	Exports	Total
Caspian Sea	(tons)	(tons)	(tons)
Pahlavi	79,000	55,000	134,000
Meshed i Sar	10,000	9,000	19,000
Astara	7,000	9,000	16,000
Bandar Jaz	9,000	7,000	16,000
Other ports	8,000	28,000	36,000
Total Caspian Sea	113,000	108,000	221,000
Persian Gulf			
Abadan	64,000	3,770,000	3,834,000
Mohammerah	44,000	22,000	66,000
Bushire	44,000	8,000	52,000
Bandar Abbas	14,000	5,000	19,000
Lingeh	10,000	5,000	15,000
Other ports	10,000	24,000	34,000
Total Persian Gulf	186,000	3,834,000	4,020,000
Total all ports of Persia	299,000	3,942,000	4,241,000

Excluding Abadan (the trade of which consisted almost wholly of oil shipments), the total trade, by way of the Gulf ports was 186,000 tons, as compared with 221,000 tons through the ports of the Caspian sea. The Caspian Sea trade was entirely Russian; of the Persian Gulf trade, 70% was British, the bulk of the remainder being Persian, German, and Japanese.

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ARCHAEOLOGY

The fact that the archaeology of the Iranian plateau is scarcely known before an advanced period in the Iron Age is due mainly to insufficient exploration and an absence of excavation In Elam, geographically a part of Mesopotamia, but politically attached to Persia in modern times as in the 6th century B C , civilization began as early as in Babylonia, and the two countries were using related types of painted pottery before 3000 B C. Some of this Elamite pottery, found at Susa (*see* SUMERIANS) has counterparts in a district of Turkestan contiguous to the north-east frontier of modern Persia, and in Sistan on the borders of Persia, Baluchistan and Afghanistan, hence the progress of exploration may be expected to reveal traces of this very ancient culture at many places in the intervening plateau, if not in the Caspian depression.

Of life on the plateau in the third and second millennia B C , practically nothing can be stated, but it may be inferred that dissimilar physical features prevented such a development as took place in Elam, which followed in the wake of Mesopotamia Perhaps the older portions of the Avesta, which may have been composed in Northern Persia early in the first millennium, describe the conditions prevalent throughout Iran during the early Iron Age, these reveal an insecurity, resulting from an absence of large communities, which left the small settled population to the mercy of nomads and rival chieftains Significant material remains could not be expected from such a society, especially since unbaked brick and small timber would normally be used for building. A pair of fire-altars of the Zoroastrian cult, cut from the rock near Persepolis, perhaps antedate the Achaemenian period, for their mouldings offer no known parallel; the only other monuments of early type, rock-cut tombs and reliefs in the Zagros mountains which separate the plateau from Mesopotamia, might

conceivably be due to a local school of the Achaemenian age and in any case cannot be more than a few centuries older. On the routes from Mesopotamia towards the Caspian and Turkestan, already traversed by caravans and occasionally by Assyrian armies, the local chiefs were compelled to construct forts on patterns supplied from Nineveh, but of neither of these nor of the market-towns along the roads have traces yet been found. Fortified hill-tops, such as are frequently seen in Persia, must go back in many cases to remote antiquity: they were used in the Bronze Age by the megalithic people of the Caspian basin, but on the plateau the one familiar example is the fortress at Pasargadae, known as the *Takht-i-Suliman* or Throne of Solomon, which has been attributed to Cyrus but must have been built later in the Achaemenid dynasty or during the Hellenistic Age, because the regularity of the masonry indicates Greek influence of about the fourth century.

It is questionable whether there survives so much as a description of any work of the short-lived Median empire, which grew up in the Assyrian sphere of influence in North Persia, but the monuments of its Achaemenid successors are very numerous and represent practically every reign (550–331 B.C.). Two buildings at Pasargadae bear the inscriptions of a King Cyrus, almost certainly to be identified with Cyrus the Great, founder of the Persian empire, not with the ambitious prince in whose rebellion Xenophon took part. An oblong hall, supported by pillars, forms the main feature of each building, while small rooms or towers projected at the corners and were connected by pillared porches. The walls themselves were of mud brick, although stone was used for the foundations, for the pillars, for the door-ways and for tall blocks at the corner of each room, which are notched at the top to contain the beams of the wooden ceiling. No evidence exists for the presence of an upper storey in any Achaemenian building, indeed the exceptional slimness of the columns would render it impracticable; the roofs must have been flat, being formed no doubt of a thick bed of compressed earth, in accordance with the local conditions. The king must have required far more accommodation for his large retinue of servants and clerks, his harem and his guards, and these were doubtless housed in buildings entirely composed of mud-brick and therefore easily destroyed through the action of the weather, leaving only the stone portions of these two palaces, intended respectively for private business and for public audiences.

In shape the ruins bear a certain relation to the *bit hilani* or pillared house of Syria and Asia Minor, sometimes adopted by the Assyrians, but the type may possibly have been indigenous to the wooded hills of Anshan, the original principality of Cyrus. One of his palaces at Pasargadae was lined with a dado of carved slabs, the few scraps of which appear to represent foreigners bringing tribute to the king; both dado and subject are almost invariable features of the Assyrian palace. One side of a doorway is occupied with a relief of a winged genius, whose head bears a crown imitated from that of Egyptian deities; here again the composition and details have a clear similarity to Assyrian work, while the dress is identical with that worn by the last Elamite king on the Assyrian reliefs of the late seventh century, and by figures in the rock-carvings of the Zagros mountains. The inscription cut above the figure, "I, Cyrus, the king, the Achaemenid," misled former scholars into the belief that the sculpture was a portrait, but the formula recurs in various parts of both ruins and, like the similar inscriptions in Mesopotamia, refers merely to the author of the buildings.

The tomb of Cyrus, also at Pasargadae, was doubtless constructed during his lifetime. In a small court, surrounded by pillared cloisters, stands a stepped platform, surmounted by a little gabled building that resembles Lycian tombs in western Asia Minor, which in their details display Greek influence. It is, therefore, not surprising that the base, with horizontal flutings, of one of the columns of the cloister, resembled to a certain extent a type used at Ephesus, in the temple begun with the help of Croesus but probably completed during the reign of Cyrus. Professor Herzfeld, who minimises the Greek influence in Persia, has recently claimed that the only foreign elements in the tomb come from eastern Asia Minor or from the north; but it is impossible to deny that the Persian work offers fewer analogies to the scantily known architecture of those regions than to the architecture of western Asia Minor, the sphere of Greek influence. This remark applies also to the so-called fire-temples of Pasargadae and Nakht-i-Rustam (near Persepolis), tall, rectangular buildings of yellow limestone, supplied with a doorway and two tiers of blind windows in black limestone; the interior contains a small chamber, presumably for sepulchral purposes, since neither light nor air could be admitted except through the door, which was carefully constructed so that when closed it hermetically sealed the chamber. The two-colour scheme, reproducing the effect of brick and wood, characterises the buildings of Cyrus, so that these tombs may be assigned to Cambyses or other members of the family of Cyrus.

Darius commemorated his stormy accession by a great inscription and relief carved, perhaps in 516, upon the cliff at Behistun (Bisitun), near the scene of one of his victories. He is shown, attended by two nobles at his back, planting his foot upon the prostrate body of the Magian, behind whom comes a line of nine other rebels, standing in chains; the last, a Scythian wearing a tall, pointed hat, was carved later than the others, obliterating part of the inscription. The symbol of the god Ahuramazda, which floats in the air above the prisoners, is carved after the manner of the Assyrian Asshur, and many of the other details as well as the plan of the whole relief, are purely Assyrian. But the figures project further from the background, so that the forms require more rounding than was necessary in Mesopotamia, while the region of the eyes and the folds of the drapery are rendered in a more naturalistic style than had ever been seen in these countries. The nearest parallel to the drapery over the legs of Darius and his nobles occurs in a column-base from the temple at Ephesus, and the evident attempt to vary the facial types of the personages may likewise be due to Greek influence.

Later in his reign, Darius began the construction of a new capital at Persepolis, lower down the valley of the river which flows past Pasargadae. A low spur of rock, that projects into the valley from the bounding range of hills, was levelled into three terraces and strongly fortified. The buildings which arose upon the platform were composed, like the palaces of Cyrus, of unbaked brick reinforced with stone, but differ from them in many particulars. Thus the two-colour scheme is abandoned; the pillared rooms are square instead of oblong and much larger than those at Pasargadae (the Hall of the Hundred Columns actually measures two hundred and twenty-five feet in each direction); small rooms are interpolated round the main hall, in the palace for private audiences; walls had no dado of carved slabs but were broken by stone windows and by niches of the same size and shape, which served as cupboards or tables; doorways bear the feather-crowned cornice characteristic of Egyptian work, instead of a simple, flat-faced dripstone; the columns have their shafts invariably fluted instead of smooth, their bases and caps have elaborate floral ornaments, and they terminate in a heavy member topped by the fronts of two kneeling bulls, set back to back —a motive that occurs in older bronzes from Armenia, as a pedestal for figures of deities, while complete winged bulls seem to have been used in Assyria for the bases of columns. The palaces had ceilings of cedarwood, carried on thick baulks that rested on the backs of the bulls; the ends of the beams penetrated to the exterior of the building, and on the cornice above these ran a frieze of lions.

Sculpture within the palaces was otherwise confined to the door-jambs, on which the king is seen enthroned, walking or standing with his attendants, or unconcernedly stabbing a rampant monster in the traditional pose of Mesopotamian art. Greek influence was perhaps responsible for a change in the carving of the beard during the reign of Darius; at Behistun the king's beard is represented frontally on a profile head, following the Assyrian convention, while at Persepolis both are invariably seen in profile like the rest of the figure. Magnificent double staircases placed flat against the walls—an architectural innovation—are lined with a number of figures of the royal guards and also of several

foreign subjects bringing tribute (*see* Dress), in rows preceded by panels of an allegorical scene of a lion killing a bull. There remain at Persepolis, it is said, 1,200 figures, all monotonously applied to these few subjects, and although a space of 150 years intervenes between the earliest and the latest reliefs the difference in style is insignificant. The increase of Greek influence—official approval of which is now guaranteed by the statement that the sculptor Telephanes was employed by Darius and Xerxes (presumably the first two kings of those names)—results in greater grace and delicacy in the reign of Xerxes, to whom most of the buildings probably owe their construction or at least their completion The main gateway, guarded by pairs of enormous human-headed bulls at either side, bears only the name of Xerxes: it should also be noted that on the winged monsters of the east side the tips of the wings curl upwards, as in the art of Asia Minor and Greece, whereas the Assyrian colossi, which in other respects they so closely resemble, have straight wings.

Some of the buildings carry no inscriptions, perhaps because the death of a king left them incomplete, and it is therefore possible that these fill the gap of 465–358, between Xerxes and Artaxerxes III, the only other king whose works can be identified His name appears on a palace, with reliefs distinguished merely by their crudity, as well as on a staircase, bearing excellent reliefs, which was added to the side of a palace begun by Darius and continued by Xerxes, in the latter instance the sculptures possibly antedate the inscription by several generations.

The palace at Susa, built by Darius and rebuilt by Artaxerxes II. (404–358) after a fire, contains friezes in glazed and coloured bricks of lions, monsters and archers, reaching in the human figures a fairly high standard, but lacking the freshness of the best work at Persepolis, which indeed at the time of Xerxes had no peer in the world, but was soon eclipsed by the over-naturalistic work of Greece and declined rapidly throughout the fourth century Incidentally the Elamites had used glazed bricks at Susa, in other respects Mesopotamian influence in Persian art was derived from Assyrian rather than Babylonian sources, in spite of the fact that the Assyrian empire fell before the Medes, but the Babylonian empire before the Persians themselves. Whether or not the Median empire acted as an intermediary cannot yet be decided, and the states of Elam and Anshan may be suggested as an alternative; the Elamites are known, from an inscription of Assurbanipal, to have followed the Assyrian custom of placing guardian monsters at the gates, but in other relevant points the arts of these kingdoms remain obscure.

Further evidence of the decay of Achaemenian sculpture is obtained from the rock-cut tombs of the kings Of those at Nakht-i-Rustam near Persepolis, one bears the inscription of Darius, while the remaining three are usually connected with the names of his immediate successors, while the three similar tombs in the cliff behind the platform of Persepolis doubtless belong to later members of the dynasty and their sculptures exhibit inferior qualities In every case the central part of the sculpture, 60 ft in width, represents the façade of a palace, and above (as though upon the roof) is set a dais, supported by figures of subject races, upon which the king worships the gods, whose presence is indicated by the symbol of Auramazda and the Moon The interiors of the tombs are simple chambers with niches cut in the rock for the reception of bodies: but a skeleton has been found at Susa buried in a bronze tub and, from the Greek accounts of his tomb, the same practice seems to have been followed in the burial of Cyrus

Apart from the royal remains, nothing is known of the buildings of the age; houses must all have been of mud brick and it is questionable whether any temples existed The only private sculptures of the age are a couple of reliefs found near the capital of the satrap of northern Asia Minor The Achaemenid art was essentially dynastic, not national, confined to the king and his courtiers. The same condition extends to the minor arts; the gold and silver ornaments and vessels (such as comprise the British Museum's "Treasure of the Oxus"), the stone vases, the engraved gems, are all luxuries suited only to the houses of rich nobles. Here again, as in architecture and sculpture, Persian art reveals itself as a modification of Assyrian art, with elements drawn from Egypt and Asia Minor, and a varying measure of Greek influence in the style.

In some statuettes from the Oxus treasure the Greek influence is overwhelming, but these may be later than the destruction of the Achaemenid empire by Alexander, which brought with it the eclipse of Asiatic art. In Syria and north India, however, the Achaemenian palace was imitated during the Hellenistic age, while in Mesopotamia and Persia it was ignored in the fashion for Hellenism. Apparently under both Macedonian and Parthian rule, a Hellenistic style was adopted in Persian buildings, and in the Parthian rock-carvings of Behistun Hellenistic methods are applied to oriental subjects of royal glorification. no other sculptures of the Parthian age have been discovered in Persia, except a couple of satyr-heads by a Greek sculptor, which may have belonged to one of the numerous Greek settlers The art of the Parthian period has left more traces in Mesopotamia where lay the capital of the empire; in Persia itself there is obscurity

The Sassanids restored Persia to its former predominance in western Asia, with the result that art flourished once more within the borders of their ancestral principality. The traditions of the Parthian empire were, however, retained under the new rulers and it is possible that among the great mass of "Sassanian" material are included a few objects which in reality should be described as Parthian; this claim has been advanced both for buildings and for some pieces of silver plate Since the Sassanid monarchy was modelled on the Achaemenid, the main features of the Persepolitan palace were preserved—the great hall for public levées, the hall for private audiences with small adjacent offices—but these features were united into one and the same building. Moreover the method of construction was radically different from that of the pre-classical period; instead of mud-brick walls, carrying flat mud roofs on wooden ceilings, walls of small-cut stones or burnt bricks bound with mortar, carried barrel-vaults over the offices or corridors, and domes over the halls The barrel-vault had already been employed on a grand scale in the palace at Hatra, which dates from the first or second century A D The development of the dome is still obscure but it seems to have proceeded in the east rather than in the west the Pantheon in Rome has a hemispherical roof, constructed on the lines of a barrel-vault, over a building itself following the same curve, while the use of the dome over a square chamber was apparently a Sassanian invention.

The chronology of "Sassanian" buildings has been much disputed; indeed the two great ruins on Persian soil, the palaces at Firuzabad and Sarvistan, were described by Dieulafoy as Achaemenian, and the theory has not yet been completely abandoned in all quarters, although it is generally modified to a suggestion of Parthian date On archaeological grounds neither building can reasonably be ascribed to a period earlier than the palace at Hatra, and a date in the third century is more plausible. No sound objection can be reared against the view that Firuzabad was built by the first Sassanid king and that Sarvistan shows a further development of the same plan In the former, a large vaulted entrance flanked by side chambers, forms a block, which is connected with a triple row of domed rooms and these in turn lead to the small rooms that surround the great court The blank external walls are relieved by arcades and pilasters, of no structural import, as at Hatra and in Roman Syria, while arched doorways and niches break the line of inner walls, and a cornice with the Egyptian cavetto rises incongruously over the arch to emphasise the resemblance to Persepolis At Ctesiphon, in the palace built during the next reign, the entrance again serves as audience-hall, but at Sarvistan a shallow porch communicates with the great domed hall and this again leads into a court behind, while the smaller rooms to right and left form separate entities, which communicate with the outside as well as with the central block. The result has more the character of a residence than has Firuzabad, which might serve in case of need as a fortress

The walls bore no ornaments except perhaps of stucco or

other applied work; legend says that the walls of Ctesiphon were encrusted with precious stones, suggesting that some kind of coloured ornamentation, perhaps friezes, were present. Persian influence may be traced in pictures in the caves of Chinese Turkestan and presumably that influence was directly pictorial. Statues must have been as rare as under the Achaemenids and in the normal course of events Muslim prejudice would prevent their survival; indeed a statue near Shapur, the colossus of a standing king, is the sole example. There remain a few statuettes attributable to the Sassanian period but the characteristic sculpture of the epoch was the rock-cut relief, in which as in other forms of art the relationship to Achaemenian work is noticeable; moreover the carvings of the Sassanids were sometimes placed next to monuments of the earlier dynasty with the deliberate intention of provoking comparison. For instance, a relief of the first king, Ardashir is cut in the cliff of Nakht-i-Rustam, which holds the tombs of Darius and his successors. Here the god Auramazda (on the right) hands the king the symbol of sovranty, a large ring tied round with ribbons; a servant holds a fly-whisk over the king's head. Beneath the feet of each horse is a human figure, that on the right representing Ahriman, the Evil Spirit, the other the last of the Parthian kings. This relief, though less adept than later works, yet exemplifies most of the virtues and defects of Sassanian sculpture; in monumental power the style has had few rivals, but it suffers from laboured symmetry, heaviness, and a lack of grace in the minute details, in which, as with the coins and gems, the mixed classical and oriental art of the Parthians enjoys a renaissance after the Achaemenian model. The limitations of artists' knowledge led to distortions of the human body, though it is questionable whether these have a deleterious effect; thus the figure is represented in profile though the breast and the eye are seen from the front. The style grew more naturalistic with time, the more obvious errors being corrected: this was largely due to Roman influence, which rapidly becomes very marked; portions of the reliefs depicting the capture of the emperor Valerian, in 260, might even be mistaken for classical work, and lend colour to a legend that Roman prisoners were employed on the royal monuments.

Towards the latter end of the third century, sculpture reached its acme, simultaneously with the coins. Reliefs of the middle of the dynasty are inclined to be traditional and have less merit, but an interesting theory traces in some battle-scenes the influence of China, a country with which Persia had come into close contact through a mutual interest in the silk trade. Remarkably pictorial in treatment is the latest group of reliefs, cut by order of Khosru II. (590–629), in which an Indian influence seems to have provoked the large landscape scenes, while debased classical elements are conspicuous in other panels; the latter have parallels in the paintings of Chinese Turkestan and were probably derived from the Gandharan or Bactrian art of this region, instead of from the Mediterranean world, where they had long since passed out of fashion. Although contemporary coins are deplorable, the details of these reliefs are excellently carved; they give in particular much information as to the fine vestments worn by the Sassanians.

Muslim historians tell of a magnificent tapestry at Ctesiphon, but such work survives only in small scraps, which bear designs of flowers and animals (more or less fantastic), scenes of the king at the chase or in battle, etc. These silk tapestries travelled to the ends of the known world, to both the Merovingian and the Chinese courts, and were much imitated abroad. Equally wide was the vogue for Sassanian plate, showing the exploits of king Bahram Gur (420–438): the old treasuries of Europe contain other pieces, south and east Russia is full of such work, and it seems to have been extensively imitated round the Caspian sea, while a Persian shape of jug was adopted in eastern Asia. After the Muslim conquest, the manufacture of plate and textiles continued without appreciable alteration; moreover Sassanian motives were taken into the arts of nearly every region of the east and long survived the dynasty. Thus the characteristic recumbent animals, enclosed in the curling tendrils of plants, were used in the Caliphs' palace at Samarra, the Sassanian type of bird was adopted both in 'Iraq and in Chinese Turkestan. Turkish patterns have their exact Sassanian prototypes, and in many respects the decorative work of Persia has remained unchanged. Sassanian influence reached Europe when naturalism had ceased to satisfy, and the development of the Byzantine school must have been stimulated by contact with its formal ideals, while the Byzantine architects followed the Persians in the use of the dome.

(*See* also BEHISTUN, ECBATANA, PASARGADAE, PERSEPOLIS, SUSA.)

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(A. W. LA.)

HISTORY

A.—ANCIENT, TO THE FALL OF THE SASSANID DYNASTY

The Name.—"Persia," in the strict significance of the word, denotes the country inhabited by the people designated as Persians, *i.e.*, the district known in antiquity as Persis (*q.v.*), the modern Fars. Custom, however, has extended the name to the whole Iranian plateau; and it is in this sense that the term Persia is here employed.

Ancient Ethnography.—In historical times we find the major portion of Iran occupied by peoples of Indo-European origin, terming themselves Aryans (*Arya;* Zend, *Airya*) and their language Arvan—so in the inscriptions of Darius—the same name used by the consanguineous tribes of India who were their nearest relations. The whole country is designated Ariana (Zend, *Airyana*) —"the land of the Aryans"—the original of the Middle-Persian *Eran* and the modern *Iran;* the Greek geographers Eratosthenes and Strabo were in error when they limited the name to the eastern districts of Iran. Thus the name of Iranians is understood to comprehend all these people of Aryan nationality.

Besides the Iranians, numerous tribes of alien origin were found in Iran. In Baluchistan, even yet, we find side by side with the eponymous Iranian inhabitants, who only penetrated thither a few centuries ago, the ethnologically and philologically distinct race of the Brahui, who are probably connected with the Dravidians of India. In them we may trace the original population of these districts; and to the same original population may be assigned the tribes here settled in antiquity: the Paricanii and Gedrosii (Gadrosii), and the Myci (Herod. iii. 93, vii. 68; the *Maka* of Darius, the modern *Mekram*), to whom the name "Aethiopians" is also occasionally applied (Herod. iii. 94, vii. 70). In Media the Greek geographers mention a people of Anariacae (Strabo xi. 508, 514; Pliny, *Nat. Hist.* vi. 48; Ptolem. vi. 25; in Polyb. v. 44. 9, Ἀνιαρακαι) *i.e.*, "Non-Arians." To these the Tapuri, Amardi, Caspii, and especially the Cadusii or Gelae—situated in Ghilan on the Caspian—probably belonged. In the chain of Zagrus we find, in Babylonian and Assyrian times, no trace of Iranians; but numerous smaller tribes that we can refer to no known ethnological group, *e.g.*, the Gutaeans and Lulubaeans, the Cossaei and in Elymais or Susiana the Elymaeans (Elamites).

That the Iranians must have come from the East to their later home, is sufficiently proved by their close relationship to the Indians, in conjunction with whom they previously formed a single people, bearing the name *Arya*. Their residence must have lain chiefly in the great steppe which stretches north of the Black sea and the Caspian, through South Russia, to Turan (Turkestan) and the Oxus and Iaxartes. For here we continually discover traces of Iranian nationality. The names and words of the Scythians (*Scoloti*) in South Russia, which Herodotus has preserved, are for the most part perfectly transparent Iranian formations, identified by Zeuss and Müllenhoff; among them are many proper names in *Aria-* (Αριο-) and *aspa* (-horse, -ασπος; Zend, *aspa*). The predatory tribes of Turan (*e.g.*, the Massagetae) seem to have belonged to the same stock. These tribes are distinguished by the Iranian peasants as Daha (Gr. Δάαι), "enemies," robbers"; by the Persians as Sacae; and by the Greeks generally as Scythians.

From the region of the steppes the Aryans must have penetrated

into the cultivable land of Eastern Iran: thence one part spread over the district of the Indus, then on again to the Ganges; another moved westward to Zagrus and the borders of the Semitic world.

The date of this migration cannot yet be determined with certainty. We know only that the Aryans of India already occupied the Punjab in the Vedic era, *c.* 1600 B.C. On the other hand, Aryan names appear at first in contemporary documents from the 16th century downwards in Mesopotamia and Syria. In the kingdom of Mitanni (in northern Mesopotamia) the Aryan origin of the dynasty is proved by the names of the kings (Artatama, Shutarna, Artasumara, Dushratta); in a treaty the Indian gods Mithra and Varuna, Indra and the Nasatyas are invoked by the side of the Mitarnian gods, and in the archives of Boghazkeui a book on Norse races written by a Mitarnian, named Kikkuli, has been found, in which Indian numerals and other Indian words are used. Among the dynasts of Syria and Palestine whose correspondence to their sovereign, the Pharaoh of Egypt, is preserved in the archives of Tel-el-Amarna (about 1400 B.C.), many bear Iranian names, *e.g.*, Artamanya, Arzawiya, Shuwardata, and their portraits are represented in Egyptian reliefs (*e.g.*, in the tomb of Haremhab, now in Leyden), and whose features are of an European character, totally different from those of the Semites and of the Hittites. Later still, in the Assyrian inscriptions we occasionally meet with Iranian names borne by North-Syrian princes—*e.g.*, Kundaspi and Kustaspi (=Hystaspis).

It appears, then, that towards the middle of the second millennium before Christ, in the time of the Hyksos empire, Indian and Iranian tribes made a great forward movement to the West, at first probably in the rôle of mercenaries. In the Egyptian and Hittite texts they form a ruling military class under the Aryan name "Marianni" *i.e.*, warriors. Some of their leaders founded principalities of their own in Mesopotamia, Syria and Palestine, much as did the Germans under the Roman empire, the Normans, Turks, etc. With this we may probably connect the well known fact that it was about this very period (1700 B.C. approximately) that the horse made its appearance in Babylonia, Egypt and Greece, where for centuries subsequently its use was confined to war and the war-chariot. Before this it was as foreign to the Babylonians, even in the time of Khammurabi, as to the Egyptians under the XIIth Dynasty. On the other hand, it had been familiar to the Aryans from time immemorial: indeed they have always been peculiarly a people of riders. Thus it is quite conceivable that they brought it with them into Western Asia: and the quarter from which it came is sufficiently indicated by the fact that the Babylonians write the word "horse" with a group of signs denoting "ass of the East."

These Aryan warriors and dynasts in the West were extirpated in the many wars with the Egyptians, Hittites and Arryrians, or absorbed by the native population. At the same time, the great highland of Iran was occupied by the Iranians. They are divided into numerous tribes: these, again, being subdivided into minor tribes and clans. The principal, according to the inscriptions of Darius—which closely agree with Herodotus—are the following, several of them being also enumerated in the *Avesta*:—

1. The Medes (*Mada*) in the north-west (*see* MEDIA)

2. The Persians (*Parsa*) in the south (*see* PERSIS). To these belong the Carmanians and the Utians (*Yutiya*), who are mentioned expressly by Darius as inhabiting a district in Persis (*Beh.* III. 40).

3. The Hyrcanians (*Varkāna* in Darius, Zend *Vehrkāna*) on the eastern corner of the Caspian, in the fertile district of Astarabad

4. The Parthians (*Parthyaei;* Pers. *Parthava*) in Khurasan (*see* PARTHIA).

5. The Arīans (Ἀρεῖοι, Pers. *Haraiva*), in the vicinity of the river Arius (*Heri-rud*), which derived its name from them. This name, which survives in the modern Herat, has of course no connection with that of the Aryans.

6. The Drangians (*Zaranka* in Darius, *Sarangians* in Herod. ii. 93, 117, vii. 67), situated south of the Arians, in the north-west of Afghanistan (Arachosia) by the western affluents of Lake Hamun, and extending to the present Seistan.

7. Arachotians (Pers. *Harauvati*), in the district of the Helmand and its tributaries round Kandahar. They are mentioned in the lists of Darius and by the Greeks after Alexander. In Herodotus their place is taken by the Pactyans, whose name survives to the present day in the word *Pushtu*, with which the Afghans denote their language (Herod. iii. 102, iv. 44, vii. 67, 85). Probably it was the old tribal name, Arachosia being the local designation. The Thamanaeans, who appear in Herodotus (iii. 93, 117), must be classed with them.

8. The Bactrians (Pers. *Bākhtri*), on the northern declivity of the Hindu Kush, as far as the Oxus. Their capital was Bactra, the modern *Balkh* (*see* BACTRIA).

9. The Sogdians (Pers. *Sugudu*), in the mountainous district between the Oxus and Iaxartes.

10. The Chorasmians (Khwarizmians, Pers. *Uvarazmiya*) in the great oasis of Khiva, which still bears the name Khwarizm. They stretched far into the midst of the nomadic tribes.

11. The Margians (Pers. *Margu*), on the river Margus (Murghab); chiefly inhabiting the oasis of Merv, which has preserved their name. Darius mentions the district of Margu but, like Herodotus, omits them from his list of peoples; so that ethnographically they are perhaps to be assigned to the Arians.

12. The Sagartians (Pers. *Asagarta*); according to Herodotus (vii. 85), a nomadic tribe of horsemen; speaking, as he expressly declares, the Persian language. Hence he describes them (i. 125) as a subordinate nomad clan of the Persians. They, with the Drangians, Utians and Myci, formed a single satrapy (Herod. iii. 93). Ptolemy (vi. 2, 6) speaks of Sagartians in the Eastern Zagros in Media.

13. We have already touched on the nomadic peoples (*Dāha, Dahans*) of Iranian nationality, who occupied the steppes of Turkestan as far as the Sarmatians and Scythians of South Russia (about 700 B.C.). That these were conscious of their Aryan origin is proved by the names Ariantas and Ariapeithes borne by Scythian (Scolot) kings (Herod. iv. 76, 87). Still they were never counted as a portion of Iran or the Iranians. To the settled peasantry, these nomads of the steppe were always "the enemy" (*dana, daha,* Δάαι, Dahae). Side by side with this name we find "Tūrān" and "Turanian"; a designation applied both by the later Persians and by modern writers to this region. The origin of the word is obscure, derived perhaps from an obsolete tribal name. It has no connection whatever with the much later "Turks," who penetrated thither in the 6th century after Christ. Though found neither in the inscriptions of Darius nor in the Greek authors, the name Turan must nevertheless be of great antiquity; for not merely is it repeatedly found in the *Avesta*, under the form *Tura*, but it occurs already in a hymn, which, without doubt, originates from Zoroaster himself, and in which "the Turanian Fryāna" and his descendants are commemorated as faithful adherents of the prophet (*Yasna*, 46, 62).

The dividing line between Iranian and Indian is drawn by the Hindu Kush and the Soliman mountains of the Indus district. The valley of the Kabul (Cophen) is already occupied by Indian tribes, especially the Gandarians; and the Satagydae (Pers. *Thatagu*) there resident were presumably also of Indian stock. The non-Aryan population of Iran itself has been discussed above Of its other neighbours, we must here mention the Sacae, a warlike equestrian people in the mountains of the Pamir plateau and northward, who are probably also of Aryan origin. Herodotus relates that the Persians distinguished "all the Scythians"—*i.e.*, all the northern nomads—as Sacae; and this statement is confirmed by the inscriptions of Darius. The Babylonians employ the name Gimiri (*i.e.*, Cimmerians) in the same sense.

Beginnings of History.—A connected chain of historical evidence begins with the time when under Shalmaneser (Salmanassar II.), the Assyrians in 836 B.C. began for the first time to penetrate farther into the mountains of the east; and there, in addition to several non-Iranian peoples, subdued a few Median tribes. These wars were continued under successive kings, till the Assyrian power in these regions attained its zenith under Sargon (*q.v.*), who (715 B.C.) led into exile the Median chief Dayuku (*see* DEIOCES), a vassal of the Mini (Mannaeans), with all his family, and subjected the princes of Media as far as the mountain of Bikni

(Elburz) and the border of the great desert. At that time 28 Median "town-lords" paid tribute to Nineveh; two years later, (713 B.C.) no fewer than 46. Sargon's successors down to Assur-bani-pal (668–626 B.C.) maintained and even augmented their suzerainty over Media. Not till the last years of Assur-bani-pal, on which the extant Assyrian annals are silent, can an independent Median empire have arisen.

For the history of this empire *see* MEDIA. In 612 B.C. Nineveh and the other capitals of the Assyrian empire were conquered and destroyed by Cyaxares of Media and Nebopolassar of Babylon, and the provinces divided between the victors. The Median empire extended far over Iran; the kings of Persia also became their vassals. In the west Armenia and Cappadocia were subdued by Cyaxares; in a war with the Lydian empire the decisive battle was broken off by the celebrated eclipse of the sun on May 28, 585 B.C., foretold by Thales (Herod. i. 74). After this a peace was arranged by Nebuchadrezzar of Babylon and Syennesis of Cilicia, recognizing the Halys as the borderline. In this state of equilibrium the great powers of the Near East remained during the first half of the 6th century.

The Empire of the Achaemenids.—The balance, however, was disturbed when the Persian Cyrus, king of Anshan in Elam (*Susiana*), revolted against his suzerain Astyages, the son of Cyaxares, and three years later defeated him at Pasargadae (*q.v.*)[1]. Shortly afterwards Astyages was taken prisoner, Ecbatana reduced, and the Median empire replaced by the Persian. The Persian tribes were welded by Cyrus into a single nation, and now became the foremost people in the world (*see* PERSIS and CYRUS). At first Nabonidus of Babylon hailed the fall of the Medes with delight and utilized the opportunity by occupying Harran (Carrhae). But before long he recognized the danger threatened from that quarter. Cyrus and his Persians paid little heed to the treaties which the Median king had concluded with the other powers; and the result was a great coalition against him, embracing Nabonidus of Babylon, Amasis of Egypt, Croesus of Lydia, and the Spartans, whose highly efficient army seemed to the Oriental states of great value. In the spring of 546 B.C., Croesus opened the attack. Cyrus flung himself upon him, beat him at Pteria in Cappadocia and pursued him to Lydia. A second victory followed on the banks of the Pactolus; by the autumn of 546 Sardis had already fallen and the Persian power advanced at a bound to the Mediterranean. In the course of the next few years the Greek littoral towns were reduced, as also the Carians and Lycians. The king of Cilicia (Syennesis) voluntarily acknowledged the Persian suzerainty. In 539 Nabonidus was defeated and Babylon occupied, while, with the Chaldean empire, Syria and Palestine also became Persian (*see* JEWS). The east of Iran was further subdued, and, after Cyrus met his end (528 B.C.) in a war against the eastern Nomads (Dahae, Massagetae), his son Cambyses conquered Egypt (525 B.C.). Cyprus and the Greek islands on the coast of Asia Minor also submitted, Samos being taken by Darius. On the other hand, an expedition by Cambyses against the Ethiopian kingdom of Napata and Meroe came to grief in Nubia The usurpation of Smerdis (522–521 B.C.) and his death at the hands of Darius was the signal for numerous insurrections in Babylon, Susiana, Persis, Media, Armenia and many of the Eastern provinces. But, within two years (521–519), they were all crushed by Darius and his generals.

The causes of this astonishing success, which, in the brief space of a single generation, raised a previously obscure and secluded tribe to the mastery of the whole Orient, can only be partially discerned from the evidence at our disposal. The decisive factor was of course their military superiority. The chief weapon of the Persians, as of all Iranians, was the bow, which accordingly the king himself holds in his portraits, *e.g.*, on the Behistun rock and the coins (*darics*). In addition to the bow, the Persians carried short lances and short daggers. But it was not by these weapons, nor by hand-to-hand fighting, that the Persian victories were won. They overwhelmed their enemy under a hail of arrows, and never allowed him to come to close quarters. While the infantry kneeled to shoot, the cavalry swarmed round the hostile squadrons, threw their lines into confusion, and completed their discomfiture by a vigorous pursuit. In a charge the infantry also might employ lance and dagger; but the essential point was that the archers should be mobile and their use of the bow unhampered.

Consequently, only a few distinguished warriors wore shirts of mail. For purposes of defence the rank and file merely carried a light hide-covered shield, which the infantry, in shooting, planted before them as a sort of barrier against the enemy's missiles. Thus the Persian army was lost, if heavy-armed hoplites succeeded in gaining their lines. In spite of all their bravery they succumbed to the Greek phalanx, when once the generalship of a Miltiades or a Pausanias had brought matters to a hand-to-hand conflict; and it was with justice that the Greeks—Aeschylus, for instance—viewed their battles against the Persian as a contest between spear and bow. None the less, till Marathon, the Persians were successful in discomfiting every enemy before he could close, whether that enemy consisted of similarly accoutred bowmen (as the Medes), of cavalry armed with the lance (as the Lydians), or of heavily armoured warriors (as the Babylonians, Egyptians and Greeks).

To all this should be added the superiority of their leaders; Cyrus especially must have been an exceedingly able general. Obviously, also, he must have understood the art of organizing his people and arousing the feeling of nationality and the courage of self-sacrifice In his time the Persians were a strong manly peasantry, domiciled in a healthy climate and habituated to all hardships—a point repeatedly emphasized, in the tales preserved by Herodotus, as the cause of their successes (*e.g.*, Herod. ix. 122). Herodotus, however, also records (i. 135) that the Persians were "of all mankind the readiest to adopt foreign customs, good or bad," a sentence which is equally applicable to the Romans, and which in the case of both nations goes far to explain, not merely their successes, but also the character of their empires.

Organization of Darius.—The fundamental features of the imperial organization must have been due to Cyrus himself. Darius followed in his steps and completed the vast structure. His rôle, indeed, was peculiarly that of supplementing and perfecting the work of his great predecessor. The organization of the empire is planned throughout on broad, free lines; there is nothing mean and timorous in it. The great god Ahuramazda, whom king and people alike acknowledge, has given them dominion "over this earth afar, over many peoples and tongues"; and the consciousness is strong in them that they are masters of the world. Thus their sovereign styles himself "the king of kings" and "the king of the lands"—that is to say, of the whole civilized world. For the provinces remaining unsubdued on the extreme frontiers to the west, the north and the east are in their view almost negligible quantities. And far removed as the Persians are from disavowing their proud sense of nationality ("a Persian, the son of a Persian, an Aryan of Aryan stock" says Darius of himself in the inscription on his tomb)—yet equally vivid is the feeling that they rule the whole civilized world, that their task is to reduce it to unity, and that by the will of Ahuramazda they are pledged to govern it aright.

This is most clearly seen in the treatment of the subject races. In contrast with the Assyrians and the Romans the Persians invariably conducted their wars with great humanity. The vanquished kings were honourably dealt with, the enemy's towns were spared, except when grave offences and insurrections, as at Miletus and Athens, rendered punishment imperative; and their inhabitants were treated with mildness. Like Cyrus, all his successors welcomed members of the conquered nationalities to their service, employed them as administrators or generals and made them grants of land: and this not only in the case of Medes, but also of Armenians, Lydians, Jews and Greeks. The whole population of the empire was alike bound to military service. The subject-contingents stood side by side with the native Persian troops; and the garrisons—in Egypt, for instance—were composed of the most varied nationalities.

Among the subject races the Medes particularly stood high in favour. Darius in his inscriptions always names them immediately after the Persians. They were the predecessors of the Per-

[1]*See* further, BABYLONIA AND ASSYRIA: *History*.

sians in the empire and the more civilized people. Their institutions, court ceremonial and dress were all adopted by the Achaemenids. Thus the tribal distinctions began to recede, and the ground was prepared for that amalgamation of the Iranians into a single, uniform nation, which under the Sassanids was completely perfected—at least for the west of Iran

The lion's share, indeed, falls to the dominant race itself. The inhabitants of Persis proper—from which the eastern tribes of Carmanians, Utians, etc , were excluded and formed into a separate satrapy—pay no taxes. Instead, they bring the best of their possessions (*e.g* , a particularly fine fruit) as a gift to their king on festival days; peasants meeting him on his excursions do the same (Plut. *Artax* 4. 5; Dinon ap. Aelian *var. hist* i. 31; Xen. *Cyr.* viii. 5, 21, 7, 1). In recompense for this, he distributes on his return rich presents to every Persian man and woman—the women of Pasargadae, who are members of Cyrus's tribe, each receiving a piece of gold (Nic. Dam fr. 66. Plut *Alex* 69). In relation to his Persians, he is always the people's king At his accession he is consecrated in the temple of a warrior-goddess (Anaitis?) at Pasargadae, and partakes of the simple meal of the old peasant days —a mess of figs, terebinths and sour milk (Plut *Artax* 3) The Persians swear allegiance to him and pray to Ahuramazda for his life and the welfare of the people, while he vows to protect them against every attack, and to judge and govern them as did his fathers before him (Herod i 132; Xen *Cyr.* xviii. 5, 25, 27). For helpers he has at his side the "law-bearers" (*databara* Dan iii. 2, and in Babyl. documents; *cf.* Herod iii 31, v. 25, vii 194; Esther i. 13, etc.). These—the Persian judges—are nominated by the king for life, and generally bequeath their office to their sons. The royal decision is based on consultation with the great ones of his people; and such is the case with his officials and governors everywhere (*cf.* the Book of Ezra).

Every Persian able to bear arms is bound to serve the king—the great landowners on horseback, the commonalty on foot The noble and well-to-do, who need not till their fields in person, are pledged to appear at court as frequently as possible Their children are brought up in company with the princes "at the gates of the king," instructed in the handling of arms, in riding and hunting, and introduced to the service of the state and the knowledge of the law, as well as the commandments of religion. Then such as prove their worth are called to high office and rewarded, generally with grants of land

The highest rank was held by the descendants of the six great families, whose heads stood by Darius at the killing of the Magian The Greeks class them and the king together, under the name of "the seven Persians" These enjoyed the right of entering the presence unannounced, and possessed princely estates in the provinces Besides these, however, numbers of other Persians were despatched to the provinces, settled there, and endowed with lands. There existed, in fact, under the Achaemenids a strong colonizing movement, diffused through the whole empire, traces of this policy occur more especially in Armenia, Cappadocia and Lycia, but also in the rest of Asia Minor, and not rarely in Syria and Egypt These colonists formed the nucleus of the provincial military levy, and were a tower of strength to the Persian dominion They composed, moreover, the Persian council and vice-regal household of the Satraps, exactly as the Persians of the home-country composed that of the king

Though the world-empire of Persia was thus deeply impressed by a national character, care was nevertheless exercised that the general duties and interests of the subject races should receive due consideration We find their representatives, side by side with the Persians, occupying every sort of position in the regal and vice-regal courts They take their part in the councils of the satraps, precisely as they do in military service (*cf* the evidence of Ezra); and they, too, are rewarded by bounties and estates To wield a peaceful authority over all the subjects of the empire, to reward merit, and to punish transgression—such is the highest task of king and officials.

On his native soil Cyrus had built a town, with a palace and a tomb, in the district of Pasargadae (now the ruins of Murghab). This Darius replaced by a new capital, deeper in the centre of the country, which bore the name "Persian" (*Pārsa*), the Persepolis (*q.v.*) of the later Greeks. But the district of Persis was too remote to be the administrative centre of a world-empire. The natural centre lay, rather, in the ancient fertile tract on the lower Tigris and Euphrates The actual capital of the empire was therefore Susa, where Darius I. and Artaxerxes II. erected their magnificent palaces The winter months the kings chiefly spent in Babylon: the hot summer, in the cooler situation of Ecbatana, where Darius and Xerxes built a residence on Mt Elvend, south of the city From a palace of Artaxerxes II. in Ecbatana itself, the fragments of a few inscribed columns (now in the possession of Lindo Myers and published by Evetts in the *Zeitschr. f. Assyr. V*) have been preserved To Persis and Persepolis the kings paid only occasional visits especially at their coronations.

Method of Government.—Within the empire, the two great civilized states incorporated by Cyrus and Cambyses, Babylon and Egypt, occupied a position of their own After his defeat of Nabonidus, Cyrus proclaimed himself "king of Babel"; and the same title was borne by Cambyses, Smerdis and Darius. So, in Egypt, Cambyses adopted in full the titles of the Pharaohs In this we may trace a desire to conciliate the native population, with the object of maintaining the fiction that the old state still continued Darius went still farther. He encouraged the efforts of the Egyptian priesthood in every way, built temples, and enacted new laws in continuance of the old order In Babylon his procedure was presumably similar, though here we possess no local evidence But he lived to see that his policy had missed its goal. In 486 B C Egypt revolted and was only reduced by Xerxes in 484. It was this, probably, that induced him in 484 to renounce his title of "king of Babel," and to remove from its temple the golden statue of Bel-Marduk (Merodach), whose hands the king was bound to clasp on the first day of each year This proceeding led to two insurrections in Babylon (probably in 484 and 479 B C), which were speedily repressed After that the "kingship of Babel" was definitely abolished In Egypt the Persian kings still retained the style of the Pharaohs; but we hear no more of concessions to the priesthood or to the old institutions, and, apart from the great oasis of el-Kharga, no more temples were erected

At the head of the court and the imperial administration stands the commandant of the body-guard—the 10,000 "Immortals," often depicted in the sculptures of Persepolis with lances surmounted by golden apples. This grandee, whom the Greeks termed "Chiliarch," corresponds to the modern vizier In addition to him, we find seven councillors (Ezra vii. 14; *cf.* Esther i. 14) Among the other officials, the "eye of the king" is frequently mentioned To him was entrusted the control of the whole empire and the superintendence of all officials

The orders of the court were issued in a very simple form of the cuneiform script, probably invented by the Medes This comprised 36 signs, almost all of which denote single sounds In the royal inscriptions, a translation into Susan (Elamitic) and Babylonian was always appended to the Persian text In Egypt one in hieroglyphics was added, as in the inscriptions of the Suez canal; in the Grecian provinces, another in Greek (*e g* , the inscription of Darius on the Bosporus, Herod iv. 37, *cf* iv 91) The cuneiform script could only be written on stone or clay Thus there has been discovered in Babylon a copy of the Behistun (*q.v.*) inscription preserved on a block of dolerite (Weissbach. *Babylonische Miscellen* , p 24). For administrative purposes, however, it would seem that this inconvenient material was not employed, its place being taken by skins (διφθέραι, parchment), the use of which was adopted from the western peoples of the empire. On these were further written the journals and records kept at the court (*cf* Diod ii 22, 32; Ezra iv 15, v. 17, vi 2; Esther vi. 1, ii. 23). With such materials the cuneiform script could not be used; instead, the Persian language was written in Aramaic characters, a method which later led to the so-called Pahlavi, *i.e.*, Parthian script. This mode of writing was employed in the state-services since Darius I.; and so may be explained the fact that, under the Achaemenids, the Persian language rapidly declined, and, in the inscriptions of Artaxerxes III., only

appears in an extremely neglected guise (*see* CUNEIFORM INSCRIPTIONS; ALPHABET).

Side by side with the Persian, the Aramaic, which had long been widely diffused as the speech of commerce, enjoyed currency in all the western half of the empire as a second dominant language. Thus all deeds, enactments and records designed for these provinces were furnished with an official Aramaic version (Ezra iv. 7). To the three cuneiform inscriptions of his tomb at Nakshi Rustem Darius added an Aramaic version; and of the account of his deeds in the inscription in Behistun he distributed copies in Aramaic over his empire; of one of these, written in beautiful characters, large fragments have been preserved in the papyri of the Jewish garrison at Elephantine, together with numerous documents in the same tongue.[1] The coins minted by the satraps and generals usually bear an Aramaic inscription. (So, also, a lion-weight from Abydos, in the British Museum). The Demotic in Egypt was employed in private documents. In the Hellenic provinces only of the empire Greek replaced Aramaic (*cf.* the letter to Pausanias in Thuc. i. 129; an edict to Gadatas in Magnesia, Cousin et Deschamps, *Bulletin de corresp. hellénique,* xii. 530; Dittenberger, *Sylloge* 2; so, also, on coins)—a clear proof that the Persians had already begun to recognize the independent and important position of Greek civilization.[2]

Provincial Organization.—Darius I. divided the Persian empire into 20 great provinces, satrapies, with a "guardian of the country" (*khshathrapavan; see* SATRAP) at the head of each. A list is preserved in Herodotus (iii. 89 *sqq.*); but the boundaries were frequently changed. Each satrapy was again subdivided into several minor governorships. The satrap is the head of the whole administration of his province. He levies the taxes, controls the legal procedure, is responsible for the security of roads and property, and superintends the subordinate districts. The heads of the great military centres of the empire and the commandants of the royal fortresses are outside his jurisdiction: yet the satraps are entitled to a body of troops of their own, a privilege which they used to the full, especially in later periods. The satrap is held in his position as a subject by the controlling machinery of the empire, especially the "eye of the king"; by the council of Persians in his province with whom he is bound to debate all matters of importance; and by the army: while in the hands of the messengers (Pers. ἀστάνδαι or ἄγγαροι—a Babylonian word: *see* ANGARIA) the government despatches travel "swifter than the crane" along the great imperial highways, which are all provided with regular postal stations (*cf.* the description of the route from Susa to Sardis in Herod. v. 52).

Within the satrapies the subject races and communities occupied a tolerably independent position; for instance, the Jews, under their elders and priests, convened a popular assembly in Jerusalem (*cf.* the Books of Ezra and Nehemiah). Obviously also, they enjoyed, as a rule, the privilege of deciding lawsuits among themselves, their general situation being similar to the former situation of the Christian nationalities under the Ottoman empire, or to that of many tribes in the Russian empire before the revolution. The pressure of despotism was manifest, not so much in that the king and his officials consistently interfered in individual cases, but that they did so on isolated and arbitrary occasions, and then swept aside the privileges of the subject, who was impotent to resist.

The subject population can be divided into distinct groups. In the desert (as among the Arabian and Turanian nomads), in wild and sequestered mountains (as in Zagrus in north Media, and Mysia, Pisidia, Paphlagonia and Bithynia in Asia Minor), and also in many Iranian tribes, the old tribal constitution, with the chieftain as its head, was left intact under the imperial suzerainty. The great majority of the civilized provinces were subdivided into local administrative districts governed by officials of the king and his satraps. These the Greeks named ἔθνη, "peoples." Within these, again, there might lie large town settlements whose internal affairs were controlled by the elders or the officials of the community: as Babylon, Jerusalem, the Egyptian cities, Tarsus, Sardis and others. On the same footing were the dominions of the high priests, with their great temple-property; as Bambyce in Syria, the two Comanas in Cappadocia, and so forth. Vast districts were either converted into royal domains (παράδεισοι) with great parks and hunting grounds under royal supervision, or else bestowed by the king on Persians or deserving members of the subject-races (the "benefactors") as their personal property. Many of these estates formed respectable principalities: *e.g.*, those of the house of Otanes in Cappadocia, of Hydarnes in Armenia, Pharnabazus in Phrygia, Demaratus in Teuthrania, Themistocles in Magnesia and Lampsacus. They were absolute private property, handed down from father to son for centuries, and in the Hellenistic period not rarely became independent kingdoms. These potentates were styled by the Greeks δυνάσται or μόναρχοι.

The last class, quite distinct from all these organizations, was formed by the city-states (πόλεις) with an independent constitution—whether a monarchy (as in Phoenicia), an aristocracy (as in Lycia), or a republic with council and popular assembly (as in the Greek towns). The essential point was that they enjoyed a separate legalized organization (autonomy). This was only to be seen in the extreme western provinces of the empire, among the Phoenicians, Greeks and Lycians, whose cities were essentially distinct from those of the east; which, indeed, to Greek eyes, were only great villages (κωμοπόλεις). It is readily intelligible that their character should have proved practically incomprehensible to the Persians, with whom they came into perpetual collision. These sought, as a rule, to cope with the difficulty by transferring the government to individual persons who enjoyed their confidence: the "tyrants" of the Greek towns. Only Mardonius, after his suppression of the Ionic revolt—which had originated with these very tyrants—made an attempt to govern them by the assistance of the democracy (492 B.C.).

Coinage, Commerce and Civilization.—The provinces of the empire differed as materially in economy as in organization. In the extreme west, a money currency in its most highly developed form—that of coinage minted by the state, or an autonomous community—had developed since the 7th century among the Lydians and Greeks. In the main portion, however, of the Oriental world—Egypt, Syria, Phoenicia and Babylonia—the old mode of commerce was still in vogue, conducted by means of gold and silver bars, weighed at each transaction; a money currency only began to make headway in these districts in the 4th century B.C. In the eastern provinces, on the other hand, the primitive method of exchange by barter still held the field. Only in the auriferous and civilized frontier districts of India (the Punjab) did a system of coinage find early acceptance. There Persian and Attic money was widely distributed, and imitations of it struck, in the 5th and 4th pre-Christian centuries.

Thus the empire was compelled to grapple with all these varied conditions and to reconcile them as best it might. At the court, "natural economy" was still the rule. The officials and Oriental troops received payment in kind. They were fed "by the table of the king," from which 15,000 men daily drew their sustenance (*cf.* Heracleides of Cyme in Athen. iv. 145 B, etc.) and were rewarded by gifts and assignments of land. The Greek mercenaries, on the contrary, had to be paid in currency; nor could the satraps of the west dispense with hard cash. The king, again, needed the precious metals, not merely for bounties and rewards, but for important enterprises in which money payment was imperative. Consequently, the royal revenues and taxes were paid partly in the precious metals, partly in natural produce—horses and cattle, grain, clothing and its materials, furniture and all articles of industry (*cf.* Theopomp. fr. 124, 125, etc.). The satraps, also in addition to money payments, levied contributions "for their table," at which the officials ate (Nehem. v. 14).

The precious metals brought in by the tribute were collected in the great treasure-houses at Susa, Persepolis, Pasargadae and Ecbatana, where gigantic masses of silver and, more especially, of gold, were stored in the bullion or partially wrought into vessels

[1] Sayce and Cowley, *Aramaic Papyri discovered at Assuan* (1906); Sachan, *Aramäische Papyri und Ostraka aus einer jüdischer Militärkolonie für Elephantine* (1911); Cowley, *Aramaic Papyri of the Fifth Century* (1923).

[2] Weissbach, *Die Keilinschriften der Achämeniden* (1911) (transscriptions and translation of all the texts).

(Herod. iii. 96; Strabo xv. 731, 735; Arrian iii. 16, etc.); exactly as was the case over 2,000 years later in the shah's treasure-chamber. When the king required money he minted as much as was necessary. A reform in the coinage was effected by Darius, who struck the *daric* (Pers. *Zariq, i.e.*, "piece of gold"; the word has nothing to do with the name of Darius), a gold piece of 130 grains (value about 23s.); this being equivalent to 20 silver pieces ("Median shekels," σίγλοι) of 86·5 grains (value according to the then rate of silver—$13\frac{1}{3}$ silver to 1 gold—about 1s. 2d.). The coinage of gold was the exclusive prerogative of the king; silver could be coined by the satraps, generals, independent communities and dynasts.

The extent of the Persian empire was, in essentials, defined by the great conquests of Cyrus and Cambyses. Darius was no more a *conquistador* than Augustus. The task he set himself was to round off the empire and secure its borders: for this purpose in Asia Minor and Armenia he subdued the mountain-tribes and advanced the frontier as far as the Caucasus, Colchis alone remaining an independent kingdom under the imperial suzerainty. So, too, he annexed the Indus valley and the auriferous hill-country of Kafiristan and Cashmir (Κάσπιοι or Κάσπειροι, Herod. iii. 93, vii. 67, 96; Steph. Byz.), as well as the Dardae in Dardistan on the Indus (Ctesias, *Ind. fr.* 12. 70, etc.). From this point he directed several campaigns against the Amyrgian Sacae, on the Pamir Plateau and northwards, whom he enumerates in his list of subject races, and whose mounted archers formed a main division of the armies despatched against the Greeks. It was obviously an attempt to take the nomads of the Turanian steppe in the rear and to reduce them to quiescence, which led to his unfortunate expedition against the Scythians of the Russian steppes (*c.* 512 B.C.; *see* DARIUS).

Side by side with these wars, we can read, even in the scanty tradition at our disposal, a consistent effort to further the great civilizing mission imposed on the empire. In the district of Herat, Darius established a great water-basin, designed to facilitate the cultivation of the steppe (Herod. iii. 117). He had the course of the river Indus explored by the Carian captain Scylax of Caryanda, who then navigated the Indian ocean back to Suez (Herod. iv. 44) and wrote an account of his voyage in Greek. The desire to create a direct communication between the seclusion of Persis and the commerce of the world is evident in his foundation of several harbours, described by Nearchus, on the Persian coast. But this design is still more patent in his completion of a great canal, already begun by Necho, from the Nile to Suez, along which several monuments of Darius have been preserved. Thus it was possible, as says the remnant of an hieroglyphic inscription there discovered, "for ships to sail direct from the Nile to Persia, over Saba." In the time of Herodotus the canal was in constant use (ii. 158, iv. 39): afterwards, when Egypt regained her independence, it decayed, till restored by the second Ptolemy. Even the circumnavigation of Africa was attempted under Xerxes (Herod. iv. 43).

Religion and Art.—It has already been mentioned, that, in his efforts to conciliate the Egyptians, Darius placed his chief reliance on the priesthood: and the same tendency runs throughout the imperial policy towards the conquered races. Thus Cyrus himself gave the exiled Jews in Babylon permission to return and rebuild Jerusalem. Darius allowed the restoration of the Temple; and Artaxerxes I., by the protection accorded to Ezra and Nehemiah, made the foundation of Judaism possible (*see* JEWS: §§19 *sqq.*). Analogously in an edict, of which a later copy is preserved in an inscription (*see* p. 569), Darius commands Gadatas, the governor of a domain (παράδεισος) in Magnesia on the Maeander, to observe scrupulously the privileges of the Apollo-sanctuary. With all the Greek oracles—even those in the mother-country—the Persians were on the best of terms. And since these might reasonably expect an enormous extension of their influence from the establishment of a Persian dominion, we find them all zealously mediatizing during the expedition of Xerxes.

For the development of the Asiatic religions, the Persian empire was of prime importance. The definite erection of a single, vast, world-empire cost them their original connection with the state, and compelled them in future to address themselves, not to the community at large, but to individuals, to promise, not political success nor the independence of the people, but the welfare of the man. Thus they became at once universal and capable of extension by propaganda; and, with this, of entering into keen competition one with the other. These traits are most clearly marked in Judaism; but after the Achaemenid period, they are common to all Oriental creeds, though our information as to most is scanty in the extreme.

In this competition of religions that of Iran played a most spirited part. The Persian kings—none more so than Darius, whose religious convictions are enshrined in his inscriptions—and, with the kings, their people, were ardent professors of the pure doctrine of Zoroaster; and the Persians settled in the provinces diffused his creed throughout the whole empire. Thus a strong Persian propagandism arose especially in Armenia and Cappadocia, where the religion took deep root among the people, but also in Lydia and Lycia. In the process, however, important modifications were introduced. In contrast with Judaism, Zoroastrianism did not enter the lists against all gods save its own, but found no difficulty in recognizing them as subordinate powers—helpers and servants of Ahuramazda. Consequently, the foreign creeds often reacted upon the Persian. In Cappadocia, Aramaic inscriptions have been discovered (1900), in which the indigenous god, there termed Bel the king, recognizes the "Mazdayasnian Religion" (*Din Mazdayasnish*)—*i.e.*, the religion of Ahuramazda personified as a woman—as his sister and wife (Lidzbarski, *Ephem. f. semit. Epigr.* i. 59 *sqq*).

The gorgeous cult of the gods of civilization (especially of Babylon), with their host of temples, images and festivals, exercised a corresponding influence on the mother-country. Moreover, the unadulterated doctrine of Zoroaster could no more become a permanent popular religion than can Christianity. For the masses can make little of abstractions and an omnipotent, omnipresent deity; they need concrete divine powers, standing nearer to themselves and their lot. Thus the old figures of the Aryan folk-religion return to the foreground, there to be amalgamated with the Babylonian divinities. The goddess of springs and streams (of the Oxus in particular) and of all fertility—*Ardvisura Anahita, Anaitis*—is endowed with the form of the Babylonian Ishtar and Belit. She is now depicted as a beautiful and strong woman, with prominent breasts, a golden crown of stars and golden raiment. She is worshipped as the goddess of generation and all sexual life (*cf.* Herod. i. 131, where the names of Mithras and Anaitis are interchanged); and religious prostitution is transferred to her service (Strabo xi. 532, xii. 559). At her side stands the sun-god Mithras, who is represented as a young and victorious hero. Both deities occupy the very first rank in the popular creed; while to the theologian they are the most potent of the good powers—Mithras being the herald and propagator of the service of Light and the mediator betwixt man and Ahuramazda, who now fades more into the background. Thus, in the subsequent period, the Persian religion appears purely as the religion of Mithras. The festival of Mithras is the chief festival of the empire, at which the king drinks and is drunken, and dances the national dance (Ctes. *fr.* 55; Duris *fr.* 13). This development culminated under Artaxerxes II., who, according to Berossus (*fr.* 16 *ap.* Clem. Alex. *prot.* i. 5, 65), first erected statues to Anaitis in Persepolis, Ecbatana, Bactria, Susa, Babylon, Damascus and Sardis. The truth of this account is proved by the fact that Artaxerxes II. and Artaxerxes III. are the only Achaemenids who, in their inscriptions, invoke Anaitis and Mithra side by side with Ahuramazda. Other gods, who come into prominence, are the dragon-slayer Verethraghna (Artagnes) and the Good Thought (Vohumano, Omanos); and even the Sacaean festival is adopted from Babylon (Berossus *fr.* 3; Ctes. *fr.* 16; Strabo xi. 512, etc.). The chief centres of the Persian cults in the west were the district of Acilisene in Armenia (Strabo xi. 532, etc.) the town of Zela in Cappadocia (Strabo xii. 559), and several cities in Lydia.

The position of the Persian monarchy as a world-empire is characteristically emphasized in the buildings of Darius and Xerxes in Persepolis and Susa. The peculiarly national basis, still

recognizable in Cyrus's architecture at Pasargadae, recedes into insignificance. The royal edifices and sculptures are dependent, mainly, on Babylonian models, but, at the same time, we can trace in them the influence of Greece, Egypt and Asia Minor; the last in the rock-sepulchres. All these elements are combined into an organic unity, which achieved the greatest creations that Oriental architecture has found possible. Nevertheless, the result is not a national art, but the art of a world-empire; and it is obvious that foreign craftsmen must have been active in the royal services—among them, the Greek sculptor Telephanes of Phocaea (Pliny xxxiv. 68). So, with the collapse of the empire, the imperial art vanishes also: and when some 500 years later, a new art arose under the Sassanids, whose achievements stand to those of Achaemenid art in much the same relation as the achievements of the two dynasties to each other, we discover only isolated reminiscences of its predecessor.

For the organization and character of the Persian empire, *see* Barnabas Brisson, *De regio Persarum principatu libri iii.* (1590); Heeren, *Ideen über Politik, Handel und Verkehr der alten Welt,* i.; G. Rawlinson, *History of Herodotus,* ii. 555 *sqq ; Five Eastern Monarchies,* iii.; Eduard Meyer, *Geschichte des Altertums,* iii. On the Satrapies, *cf.* Krumbholz, *De Asiae minoris satrapiis persicis* (1883). *See* also MITHRAS. The rock sculptures and part of the ruins of the Achaemenids and the Sassanids are published and analysed in the work of Sarre and Herzfeld, *Iranische Felsreliefs* (1910). *See* also Sarre, *Die Kunst der Alten Perser* (1925). Many ruins and inscriptions have since then been discovered by Herzfeld; *cf.* his preliminary account in *Zeitschrift d. deutschen Morgent. Ges.* (Bd. 80, 1926). *See* also MITHRAS.

The Achaemenids: Sources.—The history of the Persian empire was often written by the Greeks. The most ancient work preserved is that of Herodotus (*q.v.*), who supplies rich materials up to 479 B.C. These are drawn partly from sound tradition, partly from original knowledge—as in the account of the satrapies and their distribution, the royal highway, the nations in Xerxes' army and their equipment. They also contain much that is admittedly fabulous: for instance, the stories of Cyrus and Croesus, the conquest of Babylon, etc. Forty years later (*c.* 390 B.C.), the physician Ctesias of Cnidus, who for 17 years (414–398 B.C.) remained in the service of the Great King, composed a great work on the Persian history, known to us from an extract in Photius and numerous fragments. Ctesias (*q.v.*) possesses a more precise acquaintance with Persian views and institutions than Herodotus; and, where he deals with matters that came under his own cognizance, he gives much useful information. For the early period, on the other hand, he only proves how rapidly the tradition had degenerated since Herodotus; and here his narrations can only be utilized in isolated cases, and that with the greatest caution. Of more value was the great work of Dinon of Colophon (*c.* 340), which we know from numerous excellent fragments; and on the same level may be placed a few statements from Heraclides of Cyme, which afford specially important evidence on Persian institutions. To these must be added the testimony of the other Greek historians (Thucydides, Ephorus, Theopompus, etc., with the histories of Alexander), and, before all that of Xenophon in the *Anabasis* and *Hellenica.* The *Cyropaedia* is a didactic romance, written with a view to Greek institutions and rarely preserving genuine information on the Persian empire. Of Oriental sources, only the contemporary books of Ezra and Nehemiah are of much importance; also, a few statements in the much later Esther romance. Berossus's history of Babylon contained much valuable and trustworthy information, but next to nothing has survived. That the native tradition almost entirely forgot the Achaemenid empire, has been mentioned above. For a more detailed account of the empire of these sources *see* separate articles on HERODOTUS, etc.; EZRA; and NEHEMIAH. The scanty amount of original documents from the time of the Achaemenids (among them a large quantity of business contracts from Babylonia, dated after the years of the Kings) has been greatly increased by the Aramaic documents from Elephantine (*see* above) from the time of Darius II., which throw light on the administration and the judicial procedures in Egypt (*cf.* Eduard Meyer, *Zu den aram. Papyri am Elephantine, Sitzungsberichte der preuss. Akad.* 1911, 1026 *sqq.*). For the struggle of the Egyptians for independence in the 4th century we obtain some information from the so-called "Demotic Chronicle," published in 1914; *cf.* Eduard Meyer, *Aegyptische Documente aus der Perserzeit,* Sitzungsberichte der Berl. Ak. 1915, 287 *sqq.* (reprinted in *Kleine Schriften,* vol. II. 1924).

The external history of the empire is treated under the individual kings (*see* also history sections of articles GREECE; EGYPT; etc.). The order is as follows:—

CYRUS (558–528); conquered the Medes in 550; king of Babylon from 538.
CAMBYSES (528–521).
SMERDIS (521).
DARIUS I. (521–485).
XERXES I. (485–465).
ARTAXERXES I. (465–425).
XERXES II. and Secydianus or Sogdianus (425–424).
DARIUS II. Nothus (424–404).
ARTAXERXES II. (404–359).
ARTAXERXES III. Ochus (359–338).
ARSES (338–336).
DARIUS III. (336–330).

The chronology is exactly verified by the Ptolemaic canon, by numerous Babylonian and a few Egyptian documents, and by the evidence of the Greeks. The present article gives only a brief conspectus of the main events in the history of the empire.

The Wars Against Greece.—Though, unlike Cyrus and Cambyses, Darius made no new expeditions of conquest, yet a great empire, which is not bounded by another equally great, but touches on many small tribes and independent communities, is inevitably driven to expansion. We have already seen that the attempt of Darius to control the predatory nomads in the north led to his expedition against the Scythians; this, again, led to the incorporation of Thrace and Macedonia, whose king Perdiccas submitted. And since a great portion of the Mediterranean coast-line belonged to the empire, further complications resulted automatically. In contrast with the Greeks Carthage took the part of Persia. Darius, indeed, numbers the city—under the name of Karka—among his dominions; as also the Maxyans (Maciya) on the Syrtes (Andreas, *Verhandl. d. xiii. oriental. Congresses,* Hamburg, 1902, p. 97). But, above all, the Greek cities with their endless feuds and violent internal factions, were incessant in their appeals for intervention. Nevertheless, Darius left European Greece to itself, till the support accorded to the Ionian and Carian insurgents by Athens and Eretria (499 B.C.) made war inevitable. But not only the expeditions of Mardonius (492) and Datis (490), but even the carefully prepared campaigns of Xerxes, in conjunction with Carthage, completely failed (480–479). On the fields of Marathon and Plataea, the Persian archers succumbed to the Greek phalanx of hoplites; but the actual decision was effected by Themistocles, who had meanwhile created the Athenian fleet which at Salamis proved its superiority over the Perso-Phoenician armada, and thus precluded beforehand the success of the land-forces.

The wreck of Xerxes' expedition is the turning-point in the history of the Persian empire. The superiority of the Greeks was so pronounced that the Persians never found courage to repeat their attack. On the contrary, in 466 B.C. their army and fleet were again defeated by Cimon on the Eurymedon, the sequel being that the Greek provinces on the Asiatic coast, with all the Thracian possessions, were lost. In itself, indeed, this loss was of no great significance to such a vast empire; and the attempts of Athens to annex Cyprus and conquer the Nile valley, in alliance with the revolted Egyptians, ended in failure. Athens, in fact, had not sufficient strength to undertake a serious invasion of the empire or an extensive scheme of conquest. Her struggles with the other Hellenic states constrained her, by the peace of Callias (448), definitely to renounce the Persian war; to abandon Cyprus and Egypt to the king; and to content herself with his promise—not that he would surrender the littoral towns, but that he would abstain from an armed attack upon them. The really decisive point was, rather, that the disasters of Salamis and Plataea definitely shattered the offensive power of the empire; that the centre of gravity in the world's history had shifted from Susa and Babylon

to the Aegean sea; and that the Persians were conscious that in spite of all their courage they were henceforward in the presence of an enemy superior in arms as well as in intellect whom they could not hope to subdue by their own strength.

Decay of the Empire.—Thus the great empire was reduced to immobility and stagnation—a process which was assisted by the deteriorating influences of civilization and world-dominion upon the character of the ruling race. True, the Persians continued to produce brave and honourable men. But the influences of the harem, the eunuchs, and similar court officials, made appalling progress, and men of energy began to find the temptations of power stronger than their patriotism and devotion to the king. Thus the satraps aspired to independence, not merely owing to unjust treatment, but also to avarice or favourable conditions. As early as 465 B C., Xerxes was assassinated by his powerful vizier (chiliarch) Artabanus, who attempted to seize the reins of empire in fact, if not in name. A similar instance may be found in Bagoas (*q v*) after the murder of Artaxerxes III. (338 B C.). To these factors must be added the degeneration of the royal line —a degeneration inevitable in Oriental states Kings like Xerxes and more especially Artaxerxes I and Artaxerxes II, so far from being gloomy despots, were good-natured potentates, but weak, capricious and readily accessible to personal influences. The only really brutal tyrants were Darius II., who was completely dominated by his bloodthirsty wife Parysatis, and Artaxerxes III who, though he shed rivers of blood and all but exterminated his whole family, was successful in once more uniting the empire, which under the feeble sway of his father had been threatened with dissolution.

The upshot of these conditions was, that the empire never again undertook an important enterprise, but neglected more and more its great civilizing mission In considering, however, the subsequent disorders and wars, it must be borne in mind that they affected only individual portions of the empire, and only on isolated occasions involved more extensive areas in long and serious strife. To most of the provinces the Achaemenid dominion was synonymous with two centuries of peace and order Naturally, however, the wild tribes of the mountains and deserts, who could be curbed only by strict imperial control, asserted their independence and harassed the neighbouring provinces. Among these tribes were the Carduchians in Zagrus, the Cossaeans and Uxians in the interior of Elam, the Cadusians and other non-Aryan tribes in northern Media, the Pisidians, Isaurians and Lycaonians in the Taurus, and the Mysians in Olympus. All efforts to restore order in these districts were fruitless; and when the kings removed their court to Ecbatana, they were actually obliged to purchase a free passage from the mountain tribes (Strabo xi 524; Arrian iii. 17, 1). The kings (*e g.*, Artaxerxes II.) repeatedly took the field in great force against the Cadusians, but unsuccessfully. When, in 400 B C. Xenophon marched with the mercenaries of Cyrus from the Tigris to the Black sea, the authority of the king was non-existent north of Armenia, and the tribes of the Pontic mountains, with the Greek cities on the coast, were completely independent. In Paphlagonia, the native dynasts founded a powerful though short-lived kingdom, and the chieftains of the Bithynians were absolutely their own masters. The frontier provinces of India were also lost. Egypt, which had already revolted under Libyan princes in the years 486–484, and again with Athenian help in 460–454, finally asserted its independence in 404. Henceforward the native dynasties repelled every attack, till they succumbed once more before Artaxerxes III. and Mentor of Rhodes

In the other civilized countries the old passion for freedom had been completely obliterated; and after the days of Darius I.—apart from the Greek, Lycian and Phoenician towns—not a single people in all these provinces dreamed of shaking off the foreign dominion All the more clearly, then, was the inner weakness of the empire revealed by the revolts of the satraps. These were facilitated by the custom—quite contrary to the original imperial organization—which entrusted the provincial military commands to the satraps, who began to receive great masses of Greek mercenaries into their service Under Artaxerxes I. and Darius II., these insurrections were still rare. But when the revolt of the younger Cyrus against his brother (401 B.C.) had demonstrated the surprising ease and rapidity with which a courageous army could penetrate into the heart of the empire—when the whole force of that empire had proved powerless, not only to prevent some 12,000 Greek troops, completely surrounded, cut off from their communications, and deprived through treachery of their leaders, from escaping to the coast, but even to make a serious attack on them—then, indeed, the imperial impotence became manifest. After that, revolts of the satraps in Asia Minor and Syria were of everyday occurrence, and the task of suppressing them was complicated by the foreign wars which the empire had to sustain against Greece and Egypt.

At this very period, however, the foreign policy of the empire gained a brilliant success. The collapse of the Athenian power before Syracuse (413 B C.) induced Darius II. to order his satraps Tissaphernes and Pharnabazus, in Asia Minor, to collect the tribute overdue from the Greek cities. In alliance with Sparta (*see* PELOPONNESIAN WAR), Persia intervened in the conflict against Athens, and it was Persian gold that made it possible for Lysander to complete her overthrow (404 B C). True, war with Sparta followed immediately, over the division of the spoils, and the campaigns of the Spartan generals in Asia Minor (399–395) were all the more dangerous as they gave occasion to numerous rebellions. But Persia joined the Greek league against Sparta, and in 394 Pharnabazus and Conon annihilated the Lacedaemonian fleet at Cnidus Thus the Spartan power of offence was crippled; and the upshot of the long-protracted war was that Sparta ruefully returned to the Persian alliance, and by the Peace of Antalcidas (*q.v.*), concluded with the king in 387 B C, not only renounced all claims to the Asiatic possessions, but officially proclaimed the Persian suzerainty over Greece. Ninety years after Salamis and Plataea, the goal for which Xerxes had striven was actually attained, and the king's will was law in Greece. In the following decades, no Hellenic state ventured to violate the king's peace, and all the feuds that followed centred round the efforts of the combatants—Sparta, Thebes, Athens and Argos—to draw the royal powers to their side (*see* GREECE. *Ancient History*).

But, for these successes, the empire had to thank the internecine strife of its Greek opponents, rather than its own strength. Its feebleness, when thrown on its own resources, is evident from the fact that, during the next years, it failed both to reconquer Egypt and to suppress completely King Evagoras of Salamis in Cyprus. The satrap revolts, moreover, assumed more and more formidable proportions, and the Greek states began once more to tamper with them. Thus the reign of Artaxerxes II ended, in 359 B C, with a complete dissolution of the imperial authority in the west. His successor, Artaxerxes Ochus, succeeded yet again in restoring the empire in its full extent. In 355 B C, he spoke the fatal word, which, a second—or rather a third—time demolished the essentially unsound power of Athens In 342 he reduced Egypt, and his generals Mentor and Memnon, with his vizier Bagoas (*q.v.*), crushed once and for all the resistance in Asia Minor. At his death in 338, immediately before the final catastrophe, the empire to all appearances was more powerful and more firmly established than it had been since the days of Xerxes.

Progress of Greek Influence.—These successes were won only by means of Greek armies and Greek generals. And simultaneously the Greek civilization—diffused by mercenaries, traders, artists, prostitutes and slaves,—advanced in ever greater force. In Asia Minor and Phoenicia we can clearly trace the progress of Hellenism (*q v*), especially by the coinage. The stamp is cut by Greek hands and the Greek tongue predominates more and more in the inscription We can see that the victory of Greek civilization had long been prepared on every side. But the vital point is that the absolute superiority of the Hellene was recognized as incontestable on both hands. The Persian sought to protect himself against danger by employing Greeks in the national service and turning Greek policy to the interests of the empire. In the Greek world itself the disgrace that a people, called to universal dominion and capable of wielding it, should be dependent on the mandate of an impotent Asiatic monarchy, was keenly felt by all who were not yet absorbed in the rivalry of city with city. The

spokesman of this national sentiment was Isocrates; but numerous other writers gave expression to it, notably, the historian Callisthenes of Olynthus. Union between Greeks, voluntary or compulsory, and an offensive war against Persia, was the programme they propounded.

Nor was the time for its fulfilment far distant. The new power which now rose to the first rank, created by Philip of Macedon, had no ingrained tendency inimical to the Persian empire. Its immediate programme was rather Macedonian expansion, at the expense of Thrace and Illyria, and the subjection of the Balkan peninsula. But, in its efforts to extend its power over the Greek states, it was bound to make use of the tendencies which aimed at the unification of Greece for the struggle against Persia: and this ideal demand it dared not reject.

Thus the conflict became inevitable. In 340, Artaxerxes III. and his satraps supported the Greek towns in Thrace—Perinthus and Byzantium—against Macedonian aggression; in 338 he concluded an alliance with Demosthenes. When Philip, after the victory of Chaeroneia, had founded the league of Corinth (337) embracing the whole of Greece, he accepted the national programme, and in 336 despatched his army to Asia Minor. That he never entertained the thought of conquering the whole Persian empire is certain. Presumably, his ambitions would have been satisfied with the liberation of the Greek cities, and, perhaps, the subjection of Asia Minor as far as the Taurus. With this his dominion would have attained much the same compass as later under Lysimachus; farther than this the boldest hopes of Isocrates never went.

But Philip's assassination in 336 fundamentally altered the situation. In the person of his son, the throne was occupied by a soldier and statesman of genius, saturated with Greek culture and Greek thought, and intolerant of every goal but the highest. To conquer the whole world for Hellenic civilization by the aid of Macedonian spears, and to reduce the whole earth to unity, was the task that this heir of Heracles and Achilles saw before him. This idea of universal conquest was with him a conception much stronger developed than that which had inspired the Achaemenid rulers, and he entered on the project with full consciousness in the strictest sense of the phrase. In fact, if we are to understand Alexander aright, it is fatal to forget that he was overtaken by death, not at the end of his career, but at the beginning, at the age of 33.

The Hellenistic Dominion.—How Alexander conquered Persia, and how he framed his world-empire,[1] cannot be related in detail here. The essential fact, however, is that after the victory of Gaugamela (Oct. 1, 331 B.C.) and, still more completely, after the assassination of Darius—avenged according to the Persian laws, on the perpetrators—Alexander regarded himself as the legitimate head of the Persian empire, and therefore adopted the dress and ceremonial of the Persian kings.

With the capture of the capitals, the Persian war was at an end, and the atonement for the expedition of Xerxes was complete—a truth symbolically expressed in the burning of the palace at Persepolis. Now began the world-conquest. For an universal empire, however, the forces of Macedonia and Greece were insufficient; the monarch of a world-empire could not be bound by the limitations imposed on the tribal king of Macedon or the general of a league of Hellenic republics. He must stand as an autocrat, above them and above the law, realizing the theoretical doctrines of Plato and Aristotle, as the true king, who is a god among men, bound no more than Zeus by a law, because "himself he is the law." Thus the divine kingship of Alexander derives in direct lines, not from the Oriental polities—which (Egypt apart) know nothing of royal apotheosis—but from these Hellenic theories of the state. Henceforward it becomes the form of every absolute monarchy in a civilized land, being formally mitigated only in Christian states by the assumption that the king is not God, but king "by the grace of God." The expedition of 332 B.C. to the shrine of Ammon was a preliminary to this procedure, which, in 324, was sealed by his official elevation to divine rank in all the republics of Greece. To this corresponds the fact that, instead of acting on the doctrines of Aristotle and Callisthenes, and treating the Macedonians and Greeks as masters, the Asiatics as servants, Alexander had impartial recourse to the powers of all his subjects and strove to amalgamate them. In the Persians particularly he sought a second pillar for his world-empire. Therefore, as early as 330 B.C., he drafted 30,000 young Persians, educated them in Greek customs, and trained them to war on the Macedonian model. The Indian campaign showed that his Macedonian troops were in fact inadequate to the conquest of the world; and in the summer of 326 they compelled him to turn back from the banks of the Hypasis. On his return to Persia he consummated at Susa (February, 324 B.C.) the union of Persian and Macedonian by the great marriage-feast, at which all his superior officers, with some 10,000 more Macedonians, were wedded to Persian wives. The Macedonian veterans were then disbanded, and the Persians taken into his army. Simultaneously, at the Olympian festival of 324, the command was issued to all the cities of Greece to recognize him as god and to receive the exiles home.[2] In 323 B.C. the preparations for the circumnavigation and subjection of Arabia were complete: the next enterprise being the conquest of the West, and the battle for Hellenic culture against Carthage and the Italian tribes. At that point Alexander died in Babylon, on June 13, 323 B.C.

The Diadochi.—Alexander left no heir. Consequently, his death not only ended the scheme of universal conquest, but led to an immediate Macedonian reaction. The army, which was considered as the representative of the people, took over the government under the direction of its generals. The Persian wives were practically all discarded and the Persian satraps removed—at least from all important provinces. But the attempt to maintain the empire in its unity proved impracticable; and almost immediately there began the embittered war, waged for several decades by the generals (diadochi), for the inheritance of the great king.[3] It was soon obvious that the eastern rulers, at all events, could not dispense with the native element. Peucestas, the governor of Persis, there played the rôle of Alexander and won the Persians completely to his side; for which he was dismissed by Antigonus in 315 (Diod. xix. 48). A similar position was attained by Seleucus—the only one of the diadochi who had not divorced his Persian wife, Apama—in Babylonia, which he governed from 319 to 316 and regained in the autumn of 312. While Antigonus, who, since 315, had striven to win the kingdom of Alexander for himself, was detained by the war with his rivals in the west, Seleucus, with Babylon as his headquarters, conquered the whole of Iran as far as the Indus. In northern Media alone, which lay outside the main scene of operations and had only been partially subject to the later Achaemenids, the Persian satrap Atropates, appointed by Alexander, maintained his independence and bequeathed his province to his successors. His name is borne by north Media to the present day—Atropatene, modern Azerbaijan or Adherbeijan (*see* MEDIA). So, too, in Armenia the Persian dynasty of the Hydarnids held its ground; and to these must be added, in the east of Asia Minor, the kingdoms of Pontus and Cappadocia, founded *c.* 301, by the Persians Mithradates I. and Ariarathes I. These states were fragments of the Achaemenid empire, which had safely transferred themselves to the Hellenistic state-system

The annexation of Iran by Seleucus Nicator led to a war for the countries on the Indian frontier; his opponent being Sandracottus or Chandragupta Maurya (*q.v.*), the founder of the great Indian empire of Maurya (Palimbothra). The result was that Seleucus abandoned to the Indian king, not merely the Indian provinces, but even the frontier districts west of the Indus (Strabo

[1]*See* ALEXANDER THE GREAT; MACEDONIAN EMPIRE; HELLENISM (for later results).

[2]We can accept neither the discussion of these events by Hogarth, "The Deification of Alexander the Great," in the English *Historical Review*, ii. (1887) (*cf.* E. Meyer, *Kleine Schriften* i. 330) nor the article of W. Tarn, "Alexander's ὑπομνήματα and the World-Kingdom" *Journ. of Hellenic Studies*, XLI. 1921, who tries to prove that the account of Diodorus 18, 4 H. about Alexander's plans and their cessation by the army after his death is not taken from Hieronymus of Cardia and is quite untrustworthy.

[3]*See* PTOLEMIES; SELEUCID DYNASTY.

xv. 689–724) receiving as compensation 500 elephants, with other presents (Appian, *Syr.* 55; Justin xv. 4; Plut. *Alex.* 62; Athen. i. 18 D.). His next expedition was to the west to assist Lysimachus, Ptolemy and Cassander in the overthrow of Antigonus.

The battle of Ipsus, in 301, gave him Syria and the east of Asia Minor; and from then he resided at the Syrian town of Antiochia on the Orontes. Shortly afterwards he handed over the provinces east of the Euphrates to his son Antiochus, who, in the following years, till 282, exercised in the East a very energetic and beneficial activity, which continued the work of his father and gave the new empire and the Oriental Hellenistic civilization their form. In his campaigns Alexander had founded several cities in Bactria, Sogdiana and India, in which he settled his veterans, and before his death he had begun or planned the foundation of Greek cities in Media and other parts of Iran. These plans were now executed by the Seleucids on the largest scale. Most of the new cities were based on older settlements; but the essential point is, that they were peopled by Greek and Macedonian colonists, and enjoyed civic independence with laws, officials, councils and assemblies of their own; in other words, an autonomous communal constitution, under the suzerainty of the empire. A portion, moreover, of the surrounding land was assigned to them. Thus a great number of the country districts—the ἔθνη above mentioned—were transformed into municipal corporations, and thereby withdrawn from the immediate government of the king and his officials (satraps or *strategi*), though still subject to their control, except in the cases where they received unconditional freedom and so ranked as "confederates." The native population of these villages and rural districts, at first, had no civic rights, but were governed by the foreign settlers. Soon, however, the two elements began to coalesce; in the Seleucid empire, the process seems generally to have been both rapid and complete. Thus the cities became the main factors in the diffusion of Hellenism, the Greek language and the Greek civilization over all Asia as far as the Indus. At the same time they were the centres of commerce and industrial life: and this, in conjunction with the royal favour, and the privileges accorded them, continually drew new settlers (especially Jews), and many of them developed into great and flourishing towns (*see* further under HELLENISM) (*cf.* Eduard Meyer, *Blüte und Niedergang des Hellenismus in Asien,* 1925).

Shortly after his conquest of Babylonia, Seleucus had founded a new capital, Seleucia (*q.v.*), on the Tigris: his intention being at once to displace the ancient Babylon from its former central position, and to replace it by a Greek city. This was followed by a series of other foundations in Mesopotamia, Babylonia and Susiana (Elam). "Media," says Polybius (x. 27), "was encircled by a sequence of Greek towns, designed as a barrier against the barbarians." Among those mentioned are: Rhagae (Rai), which Seleucus metamorphosed into a Hellenic city, Europus, Laodiceia, Apamea and Heraclea (Strabo xi. 525; Plin. vi. 43: *cf.* MEDIA). To these must be added Achaea in Parthia, and, farther to the east, Alexandria Arion in Aria the modern Herat: also Antiochia Margiana (Strabo xi. 514, 516; Plin. 46, 93), now Merv, and many others; further, Alexandria in Arachosia, near Kandahar, and the towns founded by Alexander on the Hindu-Kush and in Sogdiana.

Thus an active Hellenic life soon arose in the East; and Greek settlers must have come in numbers and founded new cities which afterwards formed the basis of the Graeco-Bactrian kingdom. Antiochus's general Demodamas crossed the Iaxartes and set up an altar to the Didymaean Apollo (Plin. vi. 49). Another general, Patrocles, took up the investigation of the Caspian, already begun by Alexander. In contrast with the better knowledge of an older period, he came to the conclusion that the Caspian was connected with the ocean, and that it was possible to reach India on shipboard by that route (Strabo ii. 74, xi. 518; Plin. vi. 38). A project of Seleucus to connect the Caspian with the Sea of Azov by means of a canal is mentioned by Plin. (vi. 31). To Patrocles is due the information that an active commerce in Indian wares was carried on with the shores of the Black sea, *via* the Caspian (Strabo xi. 509).

While Hellenism was thus gaining a firm footing in all the East, the native population remained absolutely passive. Apart from the rude mountain tribes, no national resistance was dreamed of for centuries. The Iranians quietly accepted the foreign yoke, and the higher classes adopted the external forms of the alien civilization even though they were unable to renounce their innate characteristics. Eratosthenes, for instance, speaks (*ap.* Strabo i. 66) in high terms of the Iranians (*Ariani*), ranking them (as well as the Indians, Romans, and Carthaginians) on a level with the Greeks as regards their capacity for adopting city civilization. The later Parsee tradition contends that Alexander burned the sacred books of Zoroaster, the *Avesta,* and that only a few fragments were saved and afterwards reconstructed by the Arsacids and Sassanids. This is absolutely unhistorical. The Persian religion was never attacked by the Macedonians and Greeks. Under their dominion, on the contrary, it expanded with great vigour, not only in the west (Armenia, north Syria and Asia Minor, where it was the official religion of the kings of Pontus and Cappadocia), but also in the east, in the countries of the Indian frontier. That the popular gods—Mithras, Anaitis, etc.—had come to the forefront has already been mentioned. This propagandism, however, was void of all national character, and ran on precisely the same lines as the propagandism of the Syrian, Jewish and Egyptian cults. Only in Persis itself the national character of the religion survived side by side with the memory of their old imperial position; here a local Persian dynasty was allowed to rule in the centre of the province at Istakhr (*cf.* PERSIS).

Decline of the Seleucids.—In 282 B.C. Seleucus took the field against Lysimachus, and annexed his dominions in Asia Minor and Thrace. In 281 he was assassinated in crossing to Europe, and his son Antiochus I. was left supreme over the whole empire. From that time onward the Seleucid empire was never at rest. Its gigantic extent, from the Aegean to the Indus, everywhere offered points of attack to the enemy. The Lagidae, especially, with their much more compact and effective empire, employed every means to weaken their Asiatic rivals; and auxiliaries were found in the minor states on the frontier—Atropatene, Armenia, Cappadocia, Pontus and Bithynia, the Galatians, Pergamum, Rhodes and other Greek states. Moreover, the promotion of Greek civilization and city life had created numerous local centres, with separate interests and centrifugal tendencies, struggling to attain complete independence, and perpetually forcing new concessions from the empire. Thus the Seleucid kings, courageous as many of them were, were always battling for existence (*see* SELEUCID DYNASTY).

These disturbances severely affected the borders of Iran. While the Seleucid empire, under Antiochus II. Theos (264–247), was being harried by Ptolemy II. Philadelphus, and the king's attention was wholly engaged in the defence of the western provinces, the Greeks revolted in Bactria, under their governor Diodotus (*q.v.*). Obviously, it was principally the need of protection against the nomadic tribes which led to the foundation of an independent kingdom; and Diodotus soon attained considerable power over the provinces north of the Hindu-Kush. In other provinces, too, insurrection broke out (Strabo xi. 575; Justin, xli. 4); and Arsaces, a chief of the Parni or Aparni—an Iranian nomad tribe (therefore often called Dahan Scythians), inhabiting the steppe east of the Caspian—made himself master of the district of Parthia (*q.v.*) in 248 B.C. He and his brother Tiridates (*q.v.*) were the founders of the Parthian kingdom, which, however, was confined within very modest limits during the following decades. Seleucus II. Callinicus (247–226) successfully encountered Arsaces (or Tiridates), and even expelled him (*c.* 238); but new risings recalled Seleucus to Syria, and Arsaces was enabled to return to Parthia.

Greater success attended Antiochus III. the Great (222–187). At the beginning of his reign (220) he subdued, with the help of his minister Hermias, an insurrection of the satrap Molon of Media, who had assumed the royal title and was supported by his brother Alexander, satrap of Persis (Polyb. v. 40 *sqq.*). He further seized the opportunity of extorting an advantageous peace from King Artabazanes of Atropatene, who had considerably extended his power (Polyb. v. 55). After waging an

unsuccessful war with Ptolemy IV. for the conquest of Coele-Syria, but suppressing the revolt of Achaeus in Asia Minor, and recovering the former provinces of the empire in that quarter, Antiochus led a great expedition into the East, designing to restore the imperial authority in its full extent. He first removed (211) the Armenian king Xerxes by treachery (Polyb. viii. 25; John of Antioch, *fr.* 53), and appointed two governors, Artaxias and Zariadris, in his place (Strabo xi. 531). During the next year he reduced the affairs of Media to order (Polyb x 27); he then conducted a successful campaign against Arsaces of Parthia (209), and against Euthydemus (*q v.*) of Bactria (208–206), who had overthrown the dynasty of Diodotus (Polyb x 28 *sqq*, 48 *sqq.*, xi. 34; Justin xli. 5). In spite of his successes he concluded peace with both kingdoms, rightly considering that it would be impossible to retain these remote frontier provinces permanently. He next renewed his old friendship with the Indian king Sophagasenus (Subhagasena), and received from him 150 elephants (206 B C). Through Arachosia and Drangiane, in the valley of the Etymander (Helmand), he marched to Carmania and Persis (Polyb xi. 34) Both here and in Babylonia he re-established the imperial authority, and in 205 undertook a voyage from the mouth of the Tigris, through the Arabian gulf to the flourishing mercantile town of Gerrha in Arabia (now Bahrein) (Polyb xiii 9)

Shortly afterwards, however, his successful campaign against Ptolemy V. Epiphanes led to a war with Rome in which the power of the Seleucid empire was shattered (190 B C), Asia Minor lost, and the king compelled to pay a heavy contribution to Rome for a long term of years In order to raise money he plundered a wealthy temple of Bel in Elam, but was killed by the inhabitants, 187 B C (Diod. xxviii 3, xxix 15, Strabo xvi 744; Justin xxxii 2, S Jerome [Hieronymus] on *Dan* xi. 19, Euseb, *Chron.* i. 253) The consequence of this enfeeblement of the empire was that the governors of Armenia asserted their independence. Artaxias founded the kingdom of Great Armenia; Zariadris, that of Sophene on the Euphrates and the sources of the Tigris (Strabo xi 531). In other districts also, rebellions occurred; and in the east, Euthydemus and his successors (Demetrius, Eucratidas, etc) began the conquest of the Indus region and the Iranian borderland (Arachosia, Aria) (*See* BACTRIA, EUTHYDEMUS, EUCRATIDES, DEMETRIUS, MENANDER)

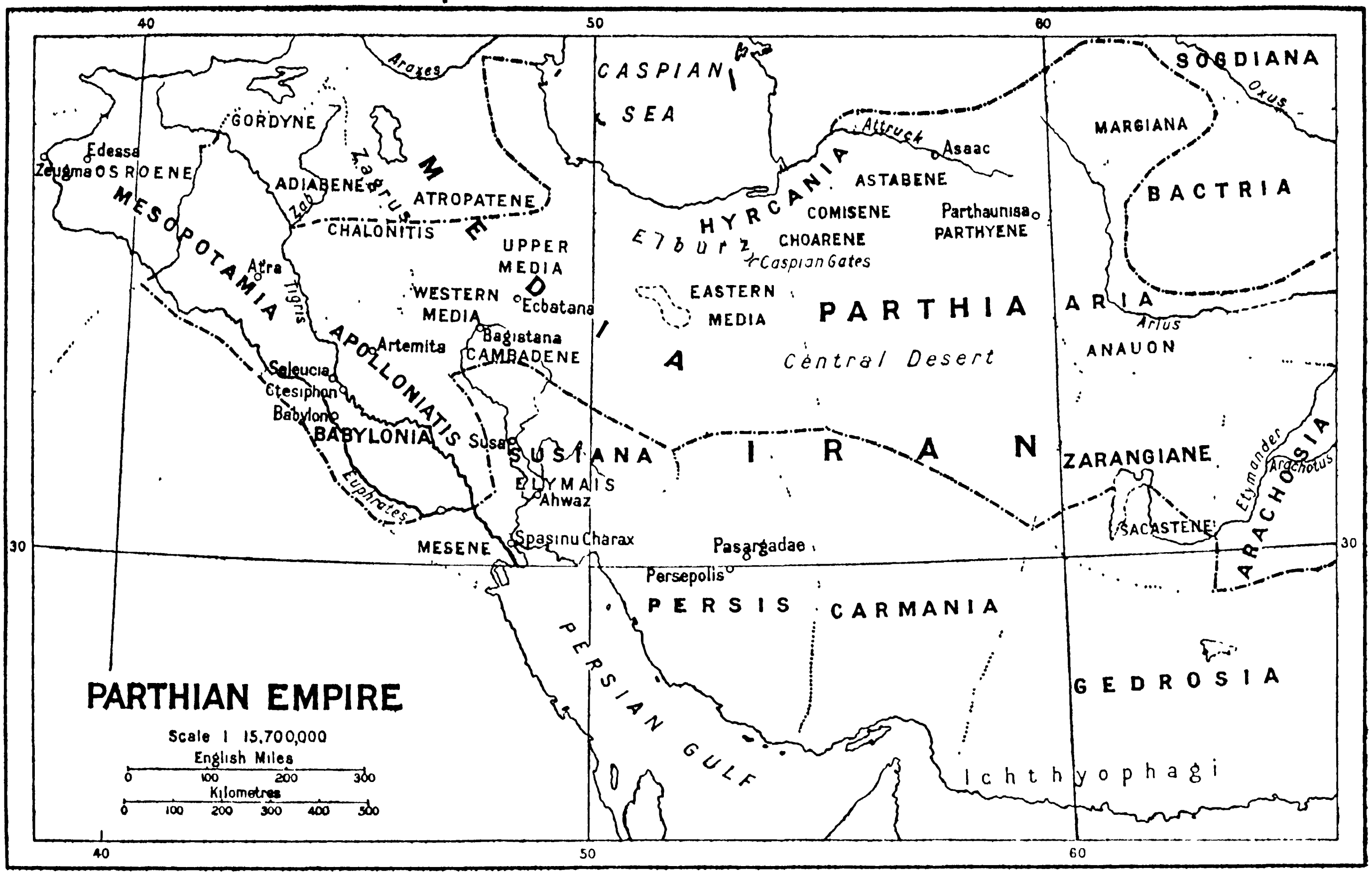
But the energetic Seleucids fought desperately against their fate. Antiochus IV Epiphanes (176–163) restored once more the Eastern dominion, defeated Artaxias of Armenia (Appian, *Syr.* 45; Diod xxxi. 17a; S. Jerome on *Dan* xi 40), restored several towns in Babylonia and subdued the Elymaeans His attempt, however, to plunder the sanctuary of Nanaia failed (Polyb. xxxi 11; *cf.* Maccab i 6, ii 1, 13; App *Syr.* 66). Persis, also, and Media were still subject to him He tried to strengthen Hellenism throughout his empire by settling Greek colonists and mercenaries in the native towns—then, also, in Babylon and Jerusalem—and granting them the right of Greek cities But after his death at Gabae (Isfahan) in Persis (163 B C; *cf* Polyb xxxi. 11; Maccab i. 6, ii 9; Jos *Ant Jud* xii 9. 1), the Romans took advantage of the dynastic broils to destroy the Seleucid empire. They reduced its army and fleet, and favoured every rebellion: among others, that of the Jews In spite of all, Demetrius I Soter (161–150) succeeded in suppressing (159) a revolt of Timarchus of Miletus, governor of Babylon, who had occupied Media, assumed the title of "great king," and had been recognized by the Romans (Appian, *Syr* 45–47; Trogus, *Prol.* 34; Diod xxxi 27 A; *cf.* the coins of Timarchus).[1]

The Parthian Empire.—Meanwhile, in the east, the Arsacids had begun their expansion Phraates I (*c.* 175–170) subdued the Mardians in Elburz. His brother Mithradates I. (*c.* 170–138) had to sustain a difficult war with Eucratides of Bactria, but eventually succeeded in wresting from him some districts on the Turanian frontier. Indeed, he penetrated as far as, and farther than, the Indus (Diod. xxxiii. 18; Oros. v. 4, 16). In the west he conquered Media, and thence subdued Babylonia. He further reduced the Elymaeans, sacked their temple in the mountains, and captured the Greek city of Seleucia on the Hedyphon (Strabo xvi. 744; Justin xli. 6). The Seleucids, meanwhile, were harassed by aggravated disorders and insurrections. Nevertheless, in 140, Demetrius II Nicator took the field in order to save the east, but was defeated and captured. Shortly afterwards Mithradates I. died. His son Phraates II. (*c.* 138–127) was attacked in 130 by Antiochus VII. Sidetes, the brother of Demetrius II., on which the Parthian king released the latter Antiochus pressed successfully on, and once more recovered Babylonia, but in 129 was defeated in Media and fell in a desperate struggle With this battle the Seleucid dominion over the countries east of the Euphrates was definitely lost The Babylonian towns, especially Seleucia (*q v*), were handed over by Phraates to his favourite, the Hyrcanian Himerus, who punished them severely for their resistance

During these wars great changes had taken place in eastern Iran In 159 Mongolian tribes, whom the Chinese call Yue-chi and the Greeks Scythians, forced their way into Sogdiana, and, in 139, conquered Bactria (Strabo xi 571, Justin xlii 1; Trog *Prol* 41, *see* BACTRIA) From Bactria they tried to advance farther into Iran and India Entering into an alliance with Antiochus VII, they assailed the Parthian empire Phraates II marched to encounter him, but was himself defeated and slain, and his country ravaged far and wide His successor Artabanus I (*c* 127–124), the uncle of Phraates, also fell in battle against the Tocharians, the principal Scythian tribe (Justin xlii 1, 2; Johannes Antiochen. *fr.* 66); but his son Mithradates II, surnamed "The Great" (*c.* 124–88), defeated the Scythians and restored for a while the power of the Arsacids He also defeated Artavasdes, the king of Great Armenia; his son Tigranes, a hostage in the hands of the Parthians, was only redeemed by the cession of 70 valleys (Strabo xi 532). When Tigranes attempted to seize Cappadocia, and the Roman praetor P Cornelius Sulla advanced against him, Mithradates in 92 B C. concluded the first treaty between Parthia and Rome (Plut *Sulla*, v; Liv *epit* 70) The dynastic troubles of the Seleucids in Syria gave him an opportunity for successful intervention (Jos *Ant Jud* xiii 13, 4, 14, 3). Shortly afterwards he died, and, with his death, the Arsacid power collapsed for the second time The possession of the western provinces and the dominant position in western Asia passed to the Armenian Tigranes (*q v*), who wrested from the Parthians Mesopotamia and the suzerainty of Atropatene, Gordyene, Adiabene, Osroene Simultaneously began a new and severe conflict with the Scythians. Parthian coins, probably dating from this period (Wroth *Catal. of the Coins of Parthia,* 1903, p xxx and p. 40), mention victorious campaigns of Parthian kings and a conquest of the provinces of Aria, Margiane and (?) Traxiane (*cf* Strabo xi. 505) But how confused the situation was is shown by the fact that in 76 B C the octogenarian king Sanatruces was seated on the Parthian throne by the Scythian tribe of the Sacaraucians (*cf* Strabo xi 511; Trog *Prol* 42) The names of his predecessors are not known to us Obviously this period was marked by continual dynastic feuds (*cf.* Trog *Prol* 42) Not till Sanatruces's successor Phraates III (70–57) do we find the kingdom again in a settled state

A fact of decisive significance was that the Romans now began to advance against Tigranes In vain Mithradates of Pontus and Tigranes turned to the Parthian king, the latter even proffering restitution of the conquered frontier provinces Phraates, though rightly distrusting Rome, nevertheless concluded a treaty with Lucullus (69 B C) and with Pompey, and even supported the latter in his campaign against Tigranes in 66 But after the victory it was manifest that the Roman general did not consider himself bound by the Parthian treaty. When Tigranes had submitted, Pompey received him into favour and extended the Roman supremacy over the vassal states of Gordyene and Osroene; though he had allured the Parthian king with the prospect of the recovery of his old possessions as far as the Euphrates Phraates complained, and simultaneously attacked Tigranes, now a Roman vassal (64 B C.). But when Pompey refused reparation Phraates recognized that he was too weak to begin the struggle

[1] For the whole of this period *see* further ANTIGONUS; ANTIOCHUS I–IV.; SELEUCID DYNASTY; HELLENISM.



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PARTHIA THE THICKER BROKEN LINE MARKS THE BOUNDARIES OF PROVINCES UNDER CONTINUOUS PARTHIAN RULE THE BOUNDARIES OF THE EMPIRE CONTINUALLY VARIED, AND THE OUTLINES OF CERTAIN VASSAL PROVINCES ARE SHOWN

with Rome, and contented himself with forming an alliance with Tigranes, in hopes that the future would bring an opportunity for his revenge (Dio Cass. xxxvi. 3, 5; xxxvii. 5 *sqq.;* Plut. *Luc.* 30; *Pomp.* 33, 38; *cf.* Sallust's letter of Mithradates to Arsaces)

Although Phraates III. had not succeeded in regaining the full power of his predecessors, he felt justified in again assuming the title "king of kings"—which Pompey declined to acknowledge—and even in proclaiming himself as "god" (Phlegon, *fr* 12 *ap* Phot. *cod.* 97; and on part of his coins), but in 57 B C. the "god" was assassinated by his sons Orodes and Mithradates.

Organization—The Parthian empire, as founded by the conquests of Mithradates I. and restored, once by Mithradates II. and again by Phraates III., was, to all exterior appearance, a continuation of the Achaemenid dominion. Thus the Arsacids now began to assume the old title "king of kings" (the *shahanshah* of modern Persia), though previously their coins, as a rule, had borne only the legend "great king." The official version, preserved by Arrian in his *Parthica* (*ap.* Phot. *cod.* 58: *see* PARTHIA), derives the line of these chieftains of the Parnian nomads from Artaxerxes II In reality, however, the Parthian empire was totally different from its predecessor, both externally and internally. It was anything rather than a world-empire. The countries west of the Euphrates never owned its dominion, and even of Iran itself not one-half was subject to the Arsacids. There were indeed vassal states on every hand, but the actual possessions of the kings—the provinces governed by their satraps—consisted of a rather narrow strip of land, stretching from the Euphrates and north Babylonia through southern Media and Parthia as far as Arachosia (north-west Afghanistan), and following the course of the great trade-route which from time immemorial had carried the traffic between the west of Asia and India. We still possess a description of this route by Isidore of Charax, probably dating from the Augustan period (in C. Müller, *Geographi graeci minores,* vol. i.), in which is contained a list of the 18 imperial provinces, known also to Pliny (vi. 112; *cf.* 41) Isidore, indeed, enumerates 19, but, of these, Sacastene formed no part of the Parthian empire, as has been shown by von Gutschmid

The lower provinces (*i.e.* the districts west of Parthia) are. (1) Mesopotamia, with northern Babylonia, from the Euphrates bridge at Zeugma to Seleucia on the Tigris, (2) Apolloniatis, the plain east of the Tigris, with Artemita; (3) Chalonitis, the hill-country of Zagrus; (4) Western Media, (5) Cambadene, with Bagistana (Behistun) the mountainous portions of Media, (6) Upper Media, with Ecbatana; (7) Rhagiane or Eastern Media Then with the Caspian Gates—the pass between Elburz and the central desert, through which lay the route from west Iran to east Iran—the upper provinces begin; (8) Choarene and (9) Comisene, the districts on the verge of the desert; (10) Hyrcania; (11) Astabene, with the royal town Asaac on the Attruck (*see* PARTHIA); (12) Parthyene with Parthaunisa, where the sepulchres of the kings were laid; (13) Apavarcticene (now Abiward, with the capital Kelat); (14) Margiane (Merv); (15) Aria (Herat); (16) Anauon, the southern portion of Aria; (17) Zarangiane, the country of the Drangians, on the lake of Hamun; (18) Arachosia, on the Etymander (Helmand), called by the Parthians "White India," extending as far as Alexandropolis (Kandahar), the frontier city of the Parthian empire

On the lower Etymander, the Sacae had established themselves—obviously on the inroad of the Scythian tribes—and after them the country was named Sacastene (now Sejistan, Seistan). Through it lay the route to Kandahar; and for this reason the district is described by Isidore, though it formed no part of the Parthian empire.

Round these provinces lay a ring of numerous minor states, which as a rule were dependent on the Arsacids. They might, however, partially transfer their allegiance on the rise of a new power (*e.g.* Tigranes in Armenia) or a Roman invasion. Thus it is not without justice that the Arsacid period is described, in the later Persian and Arabian tradition, as the period of "the kings of the part-kingdoms"—among which the Ashkanians (*i.e.*

the Arsacids, from Ashak, the later pronunciation of the name *Arshak*=Arsaces) had won the first place. This tradition, however, is nebulous in the extreme; the whole list of kings, which it gives, is totally unhistorical; only the names of one Balash (=Vologaeses) and of the last Ardewan (=Artabanus) having been preserved. The period, from the death of Alexander to the Sassanid Ardashir I., is put by the Persian tradition at 266 years; which was afterwards corrected, after Syro-Grecian evidence, to 523 years. The actual number is 548 years (*i.e.* 323 B.C. to A.D. 226). The statements of the Armenian historians as to this period are also absolutely worthless.

The ten most important of the vassal states were:—

1. The kingdom of Osroene (*q.v.*) in the north-east of Mesopotamia with Edessa as capital, founded about 130 B.C. by the chieftain of an Arabian tribe, the Orrhoei, which established itself there.

2. To this must be added, the numerous Arabian tribes of the Mesopotamian desert, under their chiefs, among whom one Alchaudonius comes into prominence in the period of Tigranes and Crassus. Their settlement in Mesopotamia was encouraged by Tigranes, according to Plutarch (*Luc.* 21) and Pliny (vi. 142). In later times the Arabic town Atra in an oasis to the west of the Tigris, governed by its own kings, gained special importance.

3 and 4. To the east of the Tigris lay two kingdoms: Gordyene (or Cordyene), the country of the Carduchians (now Bohtan), a wild mountainous district south of Armenia; and Adiabene (Hadyab) the ancient Assyria, on either side of the Zab (Lycus).

5. On the farther side of Zagrus, adjoining Adiabene on the east, was the kingdom of Atropatene in north Media, now often simply called Media (*q.v.*).

While the power of Armenia was at its height under Tigranes (86–69 B.C.) all these states owned his rule. After the victories of Pompey, however, the Romans claimed the suzerainty, so that, during the next decades and the expeditions of Crassus and Antony, they oscillated between Rome and Parthia, though their inclination was generally to the latter. For they were all Orientals and, consciously or unconsciously, representatives of a reaction against that Hellenism which had become the heritage of Rome. At the same time the loose organization of the Parthian empire, afforded them a greater measure of independence than they could hope to enjoy under Roman suzerainty.

6. In the south of Babylonia, in the district of Mesene (the modern *Maisan*), after the fall of Antiochus Sidetes (129 B.C.), an Arabian prince, Hyspaosines or Spasines (in a cuneiform inscription of 127, on a clay tablet dated after this year, he is called Aspasine) founded a kingdom which existed till the rise of the Sassanian empire. Its capital was a city (mod. Mohammerah), first founded by Alexander on an artificial hill by the junction of the Eulaeus (Karun) with the Tigris, and peopled by his veterans. The town, which was originally named Alexandria and then rebuilt by Antiochus IV. as Antiochia, was now refortified with dikes by Spasines, and named Spasinu Charax ("the wall of Spasines"), or simply Charax (Plin. vi. 138 *seq.*). In the following centuries it was the main mercantile centre on the Tigris estuary.

The kingdom of Mesene, also called Characene, is known to us from occasional references in various authors, especially Lucian (*Macrobii*, 16), as well as from numerous coins, dated by the Seleucian era, which allow us to frame a fairly complete list of the kings.[1] The Arabian dynasty speedily assimilated itself to the native population; and most of the kings bear Babylonian—in a few cases, Parthian—names. The official language was Greek, till, on the destruction of Seleucia (A.D. 164), it was replaced on the coinage by Aramaic. Another Babylonian dynast must have been Hadadnadinaches (*c.* 100 B.C.), who built in Tello the fortified palace which has been excavated by de Sarzec.

[1]*See* Saint-Martin, *Recherches sur la Mésène et la Characène* (1838); Reinaud, *Memoires sur le royaume de la Mésène* (1861); E. Babelon, "Numism. et chronol. des dynastes de la Characène" in *Journ. Internat. d'Archeol. numism.* vol. 1. (1898).

7. East of the Tigris lay the kingdom of Elymais (Elam), to which belonged Susa and its modern representative Ahwaz, farther down on the Eulaeus. The Elymaeans, who had already offered a repeated resistance to the Seleucids, were subdued by Mithradates I., as we have mentioned above; but they remained a separate state, which often rebelled against the Arsacids (Strabo xvi. 744; *cf.* Plut. *Pomp.* 36; Tac. *Ann.* vi. 50). Of the kings who apparently belonged to a Parthian dynasty, several bearing the name Cammascires are known to us from coins dated 81 and 71 B.C. One of these is designated by Lucian (*Macrobii*, 16) "king of the Parthians"; while the coinage of another, Orodes, displays Aramaic script (Allotte de la Fuÿe, *Rev. num.*, 4me serie, t. vi. p. 92 *sqq.*, 1902). The kingdom, which is seldom mentioned, survived till Ardashir I. In its neighbourhood Strabo mentioned "the minor dynasties of the Sagapenians and Silacenians" (xvi. 745). The Uxians, moreover, with the Cossaeans and other mountain tribes, maintained their independence exactly as under the later Achaemenids (Strabo xvi. 744; Plin. vi. 133).

8. The district of Persis, the local dynasts, became independent after the time of Antiochus IV. They perpetuated the Achaemenian traditions, and on their coins—which bear the Persian language in Aramaic characters, *i.e.*, the so-called Pahlavi—appear as zealous adherents of Zoroastrianism and the Fire-cult (*see* PERSIS). They were forced, however, to acknowledge the suzerainty of Parthia, to which they stood in the same position as the Persians of Cyrus and his forefathers to the Median empire (*cf.* Strabo xv. 728, 733, 736; Lucian, *Macrob.* 15). In later times, before the foundation of the Sassanid dominion, Persis was disintegrated into numerous small local states. Even in Carmania we find independent kings, one of whom gave his name to a town Vologesocerta (*Balashkert*).

9. The east of Iran—Bactria with Sogdiana, Eastern Arachosia and Gedrosia—was never subject to the Arsacids. Here the Graeco-Bactrian and Graeco-Indian kingdoms held their own, till, in 139 B.C., they succumbed before the invading Mongolian and Scythian tribes (*see* BACTRIA and works quoted there). But in the Indus district the Greek kings held their ground for an appreciably longer period and, for a while, widely extended their power (*see* MENANDER OF INDIA). Among the kings then following, only known to us from their coins, there appears a dynasty with Iranian and sometimes peculiarly Parthian names which seems to have reigned in the Punjab and Arachosia. Its best-known representative, Gondophares or Hyndopherres, to whom legend makes the apostle Thomas write, reigned over Arachosia and the Indus district about A.D. 20. Further, about A.D. 70, the *Periplus* of the Erythraean sea mentions that the great commercial town of Minnagar in the Indus Delta was under Parthian kings, "who spent their time in expelling one another." Here, then, it would seem there existed a Parthian dynasty, which probably went back to the conquests of Mithradates I. (*cf.* Vincent A. Smith, "The Indo-Parthian Dynasties from about 120 B.C. to A.D. 100," in the *Zeitschr. der deutschen morgenl. Gesellsch.* 60, 1906). Naturally, such a dynasty would not long have recognized the suzerainty of the Arsacids. It succumbed to the Indo-Scythian empire of the Kushana, who had obtained the sovereignty of Bactria as early as about A.D. 50, and thence pressed onward into India. In the period of the *Periplus* (*c.* A.D. 70) the Scythians were already settled in the Indus valley (pp. 38, 41, 48), their dominion reaching its zenith under Kanishka (*c.* A.D. 123–153).

This empire of the Kushana merits special mention here, on account of its peculiar religious attitude, which we may gather from the coins of its kings, on which an alphabet taken from the Greek is employed (*cf.* Aurel Stein, "Zoroastrian Deities on Indo-Scythian Coins," in *The Babylonian and Oriental Record*, vol. i., 1887). Kanishka, as is well known, had embraced Buddhism, and some of his coins bear the image and name of Buddha. Iranian divinities, however, predominate on his currency: Mithras (*Mihro* or *Helios*); the Moon *Mah* (also Selene); *Athro*, the Fire; *Orthragno* (Verethragna); *Pharro*=Farna (hvarena), "the majesty of kingship"; *Teiro*=Tir (Tistrya "the archer"); *Nana* (Nanaia); and others. Here, then, we have a

perfect example of syncretism; as in the Mithras cult in Armenia, Asia Minor, and still further in the Roman empire. Buddhism and Zoroastrianism have been wedded in the state religion, and, in characteristic Indian fashion, are on the best of terms with one another, precisely as, in the Chinese empire at the present day, we find the most varied religions, side by side, and on an equal footing.

10. Originally, a part of the Turanian steppe belonged to the Arsacids; it was the starting-point of their power. Soon, however, the nomads (Dahae) gained their independence, and, as we have seen, repeatedly attacked and devastated the Parthian empire in conjunction with the Tocharians and other tribes of Sacae and Scythians. In the subsequent period, again, we shall frequently meet them.

Character of the Empire.—It may appear surprising that the Arsacids made no attempt to incorporate the minor states in the empire and create a great and united dominion, such as existed under the Achaemenids and was afterwards restored by the Sassanids. This fact is the clearest symptom of the inner weakness of their empire and of the small power wielded by the "king of kings." In contrast alike with its predecessors and its successors, the Arsacid dominion was peculiarly a chance formation—a state which had come into existence through fortuitous external circumstances, and had no firm foundation within itself, or any intrinsic *raison d'être*.

Three elements, of widely different kinds, contributed to its origin and defined its character. It was sprung from a predatory nomad tribe (the Parnian Dahae, Scythians) which had established itself in Khorasan (Parthia), on the borders of civilization, and thence gradually annexed further districts as the political situation or the weakness of its neighbours allowed. Consequently, these nomads were the main pillar of the empire, and from them were obviously derived the great magnates, with their huge estates and hosts of serfs, who composed the imperial council, led the armies, governed the provinces and made and unmade the kings (Strabo xi. 515; Justin xli. 2; the former terming them συγγενεῖς "kinsmen" of the king, the latter *probuli*). Of these great families that of Surenas held the privilege of setting the diadem on the head of the new king (Plut. *Crass.* 21; Tac. *Ann.* vi. 42).

The military organization, moreover, was wholly nomadic in character. The nucleus of the army was formed of armoured horsemen, excellently practised for long-distance fighting with bow and javelin, but totally unable to venture on a hand-to-hand conflict, their tactics being rather to swarm round the enemy's squadrons and overwhelm them under a hail of missiles. When attacked they broke up, as it seemed, in hasty and complete flight, and having thus led the hostile army to break its formation, they themselves rapidly reformed and renewed the assault. How difficult it was for infantry to hold their own against these mounted squadrons was demonstrated by the Roman campaigns, especially in broad plains like those of Mesopotamia. In winter, however, the Parthians were powerless to wage war, as the moisture of the atmosphere relaxed their bows. The infantry, in contrast with its earlier status under the Persians, was wholly neglected. On the other hand, every magnate put into the field as many mounted warriors as possible, chiefly servants and bought slaves, who, like the Janissaries and Mamelukes, were trained exclusively for war. Thus Surenas, in 53 B.C., is said to have put at the king's disposal 1,000 mailed horsemen and, in all, 10,000 men, including the train, which also comprised his attendants and harem (Plut. *Crass.* 21; description of the military organization in Dio Cass. 40, 15; Justin xli. 2). In the army of 50,000 mounted men which took the field against Mark Antony there were, says Justin, only 400 freemen.

How vital was the nomadic element in the Parthian empire is obvious from the fact that, in civil wars, the deposed kings consistently took refuge among the Dahae or Scythians and were restored by them. But, in Parthia, these nomads were amalgamated with the native peasantry, and, with their religion, had adopted their dress and manners. Even the kings, after the first two or three, wear their hair and beard long, in the Iranian fashion, whereas their predecessors are beardless. Although the Arsacids are strangers to any deep religious interest (in contrast to the Achaemenids and Sassanids), they acknowledge the Persian gods and the leading tenets of Zoroastrianism. They erect fire-altars and even obey the command to abandon all corpses to the dogs and fowls (Justin xli. 3). The union, moreover, recommended by that creed, between brother and sister—and even son and mother—occurs among them. Consequently, beside the council of the nobility, there is a second council of "Magians and wise men" (Strabo xi. 515).

Again, they perpetuate the traditions of the Achaemenid empire. The Arsacids assume the title "kings of kings" and derive their line from Artaxerxes II. Further, the royal apotheosis, so common among them and recurring under the Sassanids, is probably not so much of Greek origin as a development of Iranian views. For at the side of the great god Ahuramazda there stands a host of subordinate divine beings who execute his will—among these the deified heroes of legend, to whose circle the king is now admitted, since on him Ahuramazda has bestowed victory and might.

This gradual Iranianization of the Parthian empire is shown by the fact that the subsequent Iranian traditions, and Firdousi in particular, apply the name of the "Parthian" magnates (*Pahlavan*) to the glorious heroes of the legendary epoch. Consequently, also, the language and writing of the Parthian period, which are retained under the Sassanids, received the name *Pahlavi, i.e.*, "Parthian." The script was derived from the Aramaic.

But to these Oriental elements must be added that of Hellenism, the dominant world-culture which had penetrated into Parthia and Media. It was indispensable to every state which hoped to play some part in the world and was not so utterly secluded as Persis and Atropatene; and the Arsacids entertained the less thought of opposition as they were destitute of an independent national basis. All their external institutions were borrowed from the Seleucid empire: their coinage with its Greek inscriptions and nomenclature; their Attic standard of currency; and, doubtless, a great part of their administration also. In the towns Greek merchants were everywhere settled. Mithradates I. even followed the precedent of the Seleucids in building a new city, Arsacia, which replaced the ancient Rhagae (Rai, Europus) in Media. The further the Arsacids expanded the deeper they penetrated into the province of Hellenism; the first Mithradates himself assumed, after his great conquests, the title of *Philhellen*, "the protector of Hellenism," which was retained by almost all his successors. Then follow the surnames *Epiphanes* "the revealed god," *Dikaios* "the just," *Euergetes* "the benefactor," all of them essentially Greek in their reference, and also regularly borne by all the kings. After the conquest of the Euphrates and Tigris provinces it was imperative that the royal residence should be fixed there. But as no one ventured to transfer the royal household and the army, with its hordes of wild horsemen, to the Greek town of Seleucia, and thus disorganize its commerce, the Arsacids set up their abode in the great village of Ctesiphon, on the left bank of the Tigris, opposite to Seleucia, which accordingly retained its free Hellenic constitution (*see* CTESIPHON AND SELEUCIA). So also Orodes I. spoke good Greek, and Greek tragedies were staged at his court (Plut. *Crass.* 33).

In spite of this, however, the rise of the Arsacid empire marks the beginning of a reaction against Hellenism—not, indeed, a conscious or official reaction, but a reaction which was all the more effective because it depended on the impetus of circumstances working with all the power of a natural force. The essential point is that the east is completely divorced from the Mediterranean and the Hellenic world, that it can derive no fresh powers from that quarter, and that, consequently, the influence of the Oriental elements must steadily increase. This process can be most clearly traced on the coins—almost the sole memorials that the Parthian empire has left. From reign to reign the portraits grow poorer and more stereotyped, and the inscriptions more neglected, till it becomes obvious that the engraver himself no longer understood Greek but copied mechanically the signs before his eyes, as is the case with the contemporary Indo-

Scythian coinage, and also in Mesene. Indeed, after Vologaeses I. (51–77), the Aramaic script is occasionally employed. The political opposition to the western empires, the Seleucids first, then the Romans, precipitated this development. Naturally enough the Greek cities beheld a liberator in every army that marched from the west, and were ever ready to cast in their lot with such—a disposition for which the subsequent penalty was not lacking. The Parthian magnates, on the other hand, with the army, would have little to do with Greek culture and Greek modes of life, which they contemptuously regarded as effeminate and unmanly. They required of their rulers that they should live in the fashion of their country, practise arms and the chase, and appear as Oriental sultans, not as Grecian kings.

These tendencies taken together explain the radical weakness of the Parthian empire. It was easy enough to collect a great army and achieve a great victory; it was absolutely impossible to hold the army together for any longer period, or to conduct a regular campaign. The Parthians proved incapable of creating a firm, united organization, such as the Achaemenids before them, and the Sassanids after them gave to their empire The kings themselves were toys in the hands of the magnates and the army who, tenaciously as they clung to the anointed dynasty of the Arsacids, were utterly indifferent to the person of the individual Arsacid Every moment they were ready to overthrow the reigning monarch and to seat another on his throne. The kings, for their part, sought protection in craft, treachery and cruelty, and only succeeded in aggravating the situation. More especially they saw an enemy in every prince, and the worst of enemies in their own sons. Sanguinary crimes were thus of everyday occurrence in the royal household; and frequently it was merely a matter of chance whether the father anticipated the son, or the son the father The conditions were the same as obtained subsequently under the Mohammedan caliphate (*q v*) and the empire of the Ottomans The internal history of the Parthian dominion is an unbroken sequence of civil war and dynastic strife

For the literature dealing with the Parthian empire *see* PARTHIA.

The Wars with Rome.—These conditions elucidate the fact that the Parthian empire, though founded on annexation and perpetually menaced by hostile arms in both the east and the west, yet never took a strong offensive after the days of Mithradates II. It was bound to protect itself against Scythian aggression in the east and Roman aggression in the west To maintain, or regain, the suzerainty over Mesopotamia and the vassal states of that region, as also over Atropatene and Armenia, was its most imperative task Yet it always remained on the defensive and even so was lacking in energy. Whenever it made an effort to enforce its claims, it retreated so soon as it was confronted by a resolute foe

Thus the wars between Parthia and Rome proceeded, not from the Parthians—deeply injured though they were by the encroachments of Pompey—but from Rome herself. Rome had been obliged, reluctantly enough, to enter upon the inheritance of Alexander the Great; and, since the time of Pompey, had definitely subjected to her dominion the Hellenistic countries as far as the Euphrates Thus the task now faced them of annexing the remainder of the Macedonian empire, the whole east from the Euphrates to the Indus, and of thereby saving Greek civilization (*cf.* Plut. *Comp. Nic et Crass* 4) The aristocratic republic quailed before such an enterprise, though Lucullus, at the height of his successes, entertained the thought (Plut *Luc.* 30). But the ambitious men, whose goal was to erect their own sovereignty on the ruins of the republic, took up the project. With this objective M. Licinius Crassus, the triumvir, in 54 B C, took the aggressive against Parthia, the occasion being favourable owing to the dynastic troubles between Orodes I, the son of Phraates III, and his brother Mithradates III Crassus fell on the field of Carrhae (June 9, 53 B C). With this Mesopotamia was regained by the Parthians, and King Artavasdes of Armenia now entered their alliance. But, apart from the ravaging of Syria (51 B C.) by Pacorus the son of Orodes, the threatened attack on the Roman empire was carried into effect neither then nor during the civil war of Caesar and Pompey. At the time of his assassination Caesar was intent on resuming the expedition of Crassus. The Parthians formed a league with Brutus and Cassius, as previously with Pompey, but gave them no support, until in 40 B.C. a Parthian army, led by Pacorus and the republican general Labienus, harried Syria and Asia Minor. But it was easily repulsed by Ventidius Bassus, the lieutenant of Mark Antony. Pacorus himself fell on June 9, 38 B.C. at Gindarus in northern Syria. Antony then attacked the Parthians in 36 B C., and penetrated through Armenia into Atropatene, but was defeated by Phraates IV—who in 37 B C. had murdered his father Orodes I. —and compelled to retreat with heavy losses The continuation of the war was frustrated by the conflict with Octavian. Armenia alone was again subdued in 34 B C by Antony, who treacherously captured and executed King Artavasdes.

Roman opinion universally expected that Augustus would take up the work of his predecessors, annihilate the Parthian dominion, and subdue the east as far as the Indians, Scythians and Seres (*cf* Horace and the other Augustan poets) But Augustus disappointed these expectations. His whole policy and the needs of the newly organized Roman empire demanded peace His efforts were devoted to reaching a *modus vivendi*, by which the authority of Rome and her most vital claims might be peacefully vindicated This the weakness of Parthia enabled him to effect without much difficulty. His endeavours were seconded by the revolt of Tiridates II, before whom Phraates IV was compelled to flee (32 B C), till restored by the Scythians. Augustus lent no support to Tiridates in his second march on Ctesiphon (26 B C), but Phraates was all the more inclined on that account to stand on good terms with him Consequently in 20 B C, he restored the standards captured in the victories over Crassus and Antony, and recognized the Roman suzerainty over Osroene and Armenia. In return, the Parthian dominion in Babylonia and the other vassal states were left undisputed

Thus it was due not to the success and strength of the Parthians but entirely to the principles of Roman policy as defined by Augustus that their empire appears as a second great independent power, side by side with Rome The precedence of the Caesars, indeed, was always admitted by the Arsacids; and Phraates IV. soon entered into a state of dependency on Rome by sending (9 B C) four of his sons as hostages to Augustus—a convenient method of obviating the danger threatened in their person, without the necessity of killing them In 4 B C, however, Phraates was assassinated by his favourite wife Musa and her son Phraates V In the subsequent broils a Parthian faction obtained the release of one of the princes interned in Rome as Vonones I. (A D 8) He failed, however, to maintain his position for long He was a stranger to the Parthian customs, and the feeling of shame at dependency on the foreigner was too strong So the rival faction brought out another Arsacid, resident among the Scythian nomads, Artabanus II, who easily expelled Vonones —only to create a host of enemies by his brutal cruelty, and to call forth fresh disorders

Similar proceedings were frequently repeated in the period following In the intervals the Parthians made several attempts to reassert their dominion over Armenia and there install an Arsacid prince; but on each occasion they retreated without giving battle so soon as the Romans prepared for war Only the dynasty of Atropatene was finally deposed and the country placed under an Arsacid ruler Actual war with Rome broke out under Vologaeses I (51–77), who made his brother Tiridates king of Armenia After protracted hostilities, in which the Roman army was commanded by Cn Domitius Corbulo, a peace was concluded in A D 63, confirming the Roman suzerainty over Armenia but recognizing Tiridates as king (*see* CORBULO) Tiridates himself visited Rome and was there invested with the diadem by Nero (A D. 66) After that Armenia continued under the rule of an Arsacid dynasty.

These successes of Vologaeses were counterbalanced by serious losses in the east. He was hampered in an energetic campaign against Rome by attacks of the Dahae and Sacae Hyrcania, also, revolted and asserted its independence under a separate line of kings. A little later the Alans, a great Iranian tribe in the south

of Russia—the ancestors of the present-day Ossets—broke for the first time through the Caucasian passes, and ravaged Media and Armenia—an incursion which they often repeated in the following centuries.

On the other side, the reign of Vologaeses I. is characterized by a great advance in the Oriental reaction against Hellenism. The line of Arsacids which came to the throne in the person of Artabanus II. (A.D. 10) stands in open opposition to the old kings with their leanings to Rome and, at least external, tinge of Hellenism. The new régime obviously laid much more stress on the Oriental character of their state, though Philostratus, in his life of Apollonius of Tyana (in reality a fantastical romance which contains scarcely any historical information), states that Vardanes I. (A.D. 40–45), the rival king to the brutal Gotarzes (A.D. 40–51), was a cultivated man (*Vit. Ap.* i. 22, 28, 31 *sqq.*); and Vologaeses I. is distinguished by the excellent relations which subsisted all his life between himself and his brothers Pacorus and Tiridates, the kings of Media and Armenia. But the coins of Vologaeses I. are quite barbarous, and for the first time on some of them appear the initials of the name of the king in Aramaic letters by the side of the Greek legend. The Hellenism of Seleucia was now attacked with greater determination. For seven years (A.D. 37–43) the city maintained itself in open rebellion (Tac. *Ann.* xi. 8 *seq.*), till at last it surrendered to Vardanes, who in consequence enlarged Ctesiphon, which was afterwards fortified by Pacorus (A.D. 78–105: v. Ammian, 23, 6, 23). In the neighbourhood of the same town Vologaeses I. founded a city Vologesocerta (Balashkert), to which he attempted to transplant the population to Seleucia (Plin. vi. 122: *cf.* Th. Nöldeke in *Zeitschr. d. deutsch. morgenl. Gesellschaft,* xxviii., 100). Another of his foundations was Vologesias (the Arabian *Ullaish*), situated near Hira on the Euphrates, south of Babylon, which did appreciable damage to the commerce of Seleucia and is often mentioned in inscriptions as the destination of the Palmyrene caravans.

After Vologaeses I. follows a period of great disturbances. The literary tradition, indeed, deserts us almost entirely, but the coins and isolated literary references prove that during the years A.D. 77 to 147, two kings, and sometimes three or more, were often reigning concurrently (Vologaeses II. 77–79, and III.–147; Pacorus 78–*c.* 105; Osroes 106–129; Mithradates V. 129–147; also Artabanus III. 80–81; Mithradates IV. and his son Sanatruces II. 115; and Parthamaspates 116–117). Obviously the empire can never have been at peace during these years, a fact which materially assisted the aggressive campaigns of Trajan (113–117). Trajan resuscitated the old project of Crassus and Caesar, by which the empire of Alexander as far as India was to be won for western civilization. In pursuance of this plan he reduced Armenia, Mesopotamia and Babylonia to the position of imperial provinces. On his death, however, Hadrian immediately reverted to the Augustan policy and restored the conquests. Simultaneously there arose in the east the powerful Indo-Scythian empire of the Kushana, which doubtless limited still further the Parthian possessions in eastern Iran.

An era of quiet seems to have returned with Vologaeses III. (147–191), and we hear no more of rival kings. With the Roman empire a profound peace had reigned since Hadrian (117), which was first disturbed by the attack of Marcus Aurelius and Aelius Verus in 162. This war, which broke out on the question of Armenia and Osroene, proved of decisive significance for the future development of the east, for, in its course, Seleucia was destroyed by the Romans under Avidius Cassius (164). The downfall of the great Greek city sealed the fate of Hellenism in the countries east of the Euphrates. Henceforward Greek culture practically vanishes and gives place to Aramaic; it is significant that in future the kings of Mesene stamped their coinage with Aramaic legends. This Aramaic victory was powerfully aided by the ever-increasing progress of Christianity, which soon created, as is well known, an Aramaic literature of which the language was the dialect of Edessa, a city in which the last king of Osroene, Abgar IX. (179–214), had been converted to the faith. After that Greek culture and Greek literature were only accessible to the Orientals in an Aramaic dress. Vologaeses III. is probably also the king Valgash, who, according to a native tradition, preserved in the *Dinkart,* began a collection of the sacred writings of Zoroaster—the origin of the *Avesta* which has come down to us. This would show how the national Iranian element in the Parthian empire was continually gathering strength.

The Roman war was closed in 165 by a peace which ceded north-west Mesopotamia to Rome. Similar conflicts took place in 195–202 between Vologaeses IV. (191–209) and Septimius Severus, and again in 216–217 between Artabanus IV. (209–226) and Caracalla. They failed, however, to affect materially the position of the two empires.

The Sassanian Empire.—That the Arsacid empire should have endured some 350 years after its foundation, was a result, not of internal strength, but of chance working in its external development. It might equally well have so existed for centuries more. But under Artabanus IV. the catastrophe came. In his days there arose in Persis—precisely as Cyrus had arisen under Astyages the Mede—a great personality. Ardashir (Artaxerxes) I., son of Papak (Babek), the descendant of Sasan, was the sovereign of one of the small states into which Persis had gradually fallen. His father Papak had taken possession of the district of Istakhr, which had replaced the old Persepolis, long a mass of ruins. Thence Ardashir I., who reigned from about A.D. 212, subdued the neighbouring potentates—disposing of his own brothers among the rest. This proceeding quickly led to war with his suzerain Artabanus IV. The conflict was protracted through several years, and the Parthians were worsted in three battles. The last of these witnessed the fall of Artabanus (A.D. 224), though a Parthian king, Artavasdes—perhaps a son of Artabanus IV.—who is only known to us from his own coins, appears to have retained a portion of the empire for some time longer. The members of the Arsacid line who fell into the hands of the victor were put to death; a number of the princes found refuge in Armenia, where the Arsacid dynasty maintained itself till A.D. 429. The remainder of the vassal states—Carmania, Susiana, Sakastan (Seistan), Mesene—were ended by Ardashir; and the autonomous desert fortress of Hatra in Mesopotamia was destroyed by his son Shapur (Sapor) I., according to the Persian and Arabian traditions, which, in this point, are deserving of credence. The victorious Ardashir then took possession of the palace of Ctesiphon and assumed the title "King of the kings of the Iranians" (*βασιλεὺς βασιλέων Ἀριανῶν*).

The new empire founded by Ardashir I.—the Sassanian, or Neo-Persian empire—is essentially different from that of his Arsacid predecessors. It is, rather, a continuation of the Achaemenid traditions which were still alive on their native soil. Consequently the national impetus—already clearly revealed in the title of the new sovereign—again becomes strikingly manifest. The Sassanian empire, in fact, is once more a national Persian or Iranian empire. The religious element is, of course, inseparable from the national, and Ardashir, like all the dynasts of Persis, was an ardent devotee of the Zoroastrian doctrine, and closely connected with the priesthood. In his royal style he assumed the designation "Mazdayasnian" (*Μασδάσνας*), and the fire-cult was everywhere vigorously disseminated. Simultaneously the old claims to world dominion made their reappearance. After the defeat of Artabanus, Ardashir, as heir of the Achaemenids, formulated his pretensions to the dominion of western Asia (Dio. Cass. 80, 3; Herodian vi. 2, 4; Zonar xii. 15; similarly under Shapur II.: Ammian. Marc. xvii. 5, 5). He attacked Armenia, though without permanent success (*cf.* von Gutschmid in *Zeitschr. d. d. morgenl. Ges.* xxxi. 47, on the fabulous Armenian account of these wars), and despatched his armies against Roman Mesopotamia. They strayed as far as Syria and Cappadocia. The inner decay of the Roman empire, and the widespread tendency of its troops to mutiny and usurpation, favoured his enterprise. Nevertheless, the armies of Alexander Severus, supported by the king of Armenia, succeeded in repelling the Persians, though the Romans sustained severe losses (231–233). Towards the end of his reign Ardashir resumed the attack; while his son Shapur I. (241–272) reduced Nisibis and Carrhae and penetrated into

Syria, but was defeated by Gordian III. at Resaena (243). Soon afterwards, however, the Roman empire seemed to collapse utterly. The Goths defeated Decius (251) and harried the Balkan peninsula and Asia Minor, while insurrections broke out everywhere and the legions created one Caesar after the other Then Shapur resumed the war, subdued Armenia and plundered Antioch. The emperor Valerian, who marched to encounter him, was overthrown at Edessa and taken prisoner (260). The Persian armies advanced into Cappadocia; but here Ballista or Balista (d. *c.* 264) beat them back, and Odenathus (Odainath), prince of Palmyra (*q v.*), rose in their rear, defeated Shapur, captured his harem, and twice forced his way to Ctesiphon (263–265). Shapur was in no position to repair the defeat, or even to hold Armenia; so that the Sassanid power failed to pass the bounds of the Arsacid empire. Nevertheless Shapur I., in contrast to his father, assumed the title "King of the kings of the Iranians and non-Iranians" (βασιλεὺς βασιλέων Ἀριάνων καὶ Αναριάνων; *shah an shah Iran we Aniran*), thus emphasizing his claim to world dominion His successors retained the designation, little as it corresponded to the facts, for the single non-Iranian land governed by the Sassanids was, as under the Parthians, the district of the Tigris and Euphrates as far as the Mesopotamian desert; western and northern Mesopotamia remained Roman

Organization—The Sassanid ruler is the representative of the "Kingly Majesty," derived from Ormuzd, which appears in the *Avesta* as the angel Kavaem Hvareno, "the royal glory," and, according to legend, once beamed in the Iranian kings, unattainable to all but those of royal blood A sculpture, which frequently recurs in the rock-reliefs of Ardashir I and Shapur I, represents the king and the god Ormuzd both on horseback, the latter in the act of handing to his companion the ring of sovereignty Thus it is explicable that all the Sassanids, as many of the Arsacids before them, include the designation of "god" in their formal style From this developed (as already under the Arsacids) that strict principle of legitimacy which is still vigorous in Firdousi It applies, however, to the whole royal house, precisely as it did later in the Ottoman empire. The person of the individual ruler is a matter of indifference He can readily be removed and replaced by another, but no usurper who was not of the legitimate blood can hope to become the genuine king Therefore the native tradition carries the Sassanid line back to the Achaemenids and, still further, to the kings of the legendary period.

Officially the king is all-powerful, and his will, which is guided by God and bound up in His law, unfettered Thus, externally, he is surrounded by all the splendour of sovereignty; on his head he wears a great and resplendent crown, with a high circular centre-piece, he is clothed in gold and jewels, round him is a brilliant court, composed of his submissive servants He sits in dazzling state on his throne in Ctesiphon All who would approach fling themselves to the ground, life and death depend on his nod Among his people he is accounted the fairest, strongest and wisest man of the empire; and from him is required the practice of all piety and virtue, as well as skill in the chase and in arms—especially the bow Ardashir I, moreover, and his successors endeavoured to establish the validity of the royal will by absorbing the vassal states and instituting a firmer organization Nevertheless they failed to attain the complete independence and power of the Achaemenids Not strong enough to break up the nobility, with its great estates, they were forced to utilize its services and still further to promote its interests; while their dependence on its good-will and assistance led inevitably to incessant gifts of money, lands and men This state of affairs had also prevailed under the later Achaemenids, and had materially contributed to the disintegration of the empire and the numerous insurrections of the satraps.

But the older Achaemenids held an entirely different position; and hardly a single Sassanid enjoyed even that degree of power which was still retained by the later Achaemenids. It was of fundamental importance that the Sassanian empire could not make good its claim to world dominion; and, in spite of the title of its kings, it always remained essentially the kingdom of Iran—or rather West Iran, together with the districts on the Tigris and Euphrates This fact, again, is most closely connected with its military and administrative organization. The external and internal conditions of the empire are in mutual reaction upon one another. The empire, which in extent did not exceed that of the Arsacids with its vassal states, was protected on the east and west by the great deserts of central Iran and Mesopotamia. For the defence of these provinces the mounted archers, who formed the basis of the army, possessed adequate strength; and though the Scythian nomads from the east, or the Romans from the west, might occasionally penetrate deep into the country, they never succeeded in maintaining their position But the power of the neo-Persian empire was not great enough for further conquests, though its army was capable and animated by a far stronger national feeling than that of the Parthians It still consisted, however, of levies from the retinue of the magnates led by their territorial lords; and, although these troops would stream in at the beginning of a war, they could not be kept permanently together. For, on the one hand, they were actuated by the most varied personal interests and antipathies, not all of which the king could satisfy; on the other hand he could not, owing to the natural character and organization of his dominions, maintain and pay a large army for any length of time Thus the great hosts soon melted away, and a war, begun successfully, ended ingloriously, and often disastrously Under such circumstances an elaborate tactical organization employing different species of arms, or the execution of a comprehensive plan of campaign, was out of the question The successes of the Sassanids in the east were gained in the later period of their dominion; and the Roman armies, in spite of decay in discipline and military spirit, still remained their tactical and strategical superiors A great victory might be won—even an emperor might be captured, like Valerian—but immediately afterwards successes, such as those gained against Shapur I (who was certainly an able general) by Ballista and Odenathus of Palmyra, or the later victories of Carus, Julian and others, demonstrated how far the Persians were from being on an equality with the Romans That Babylonia permanently remained a Sassanian province was due merely to the geographical conditions and to the political situation of the Roman empire, not to the strength of the Persians

Among the magnates six great houses—seven, if we include the royal house—were still regarded as the foremost, precisely as under the Achaemenids, and from these were drawn the generals, crown officials and governors (*cf* Procop *Pers* i 6, 13 *sqq*) In the last of these positions we frequently find princes of the blood, who then bear the royal title (shah) Some of these houses —whose origin the legends derive from King Gushtasp (*i e* Vishtaspa), the protector of Zoroaster (Marquart, *Zeitschr d d morgenl Ges* xlix 635 *sqq*)—already existed under the Arsacids, *e g*, the Suren (Surenas, *vide supra*, p 798) and Karen (Carenes, Tac. *Ann* xii 12 *sqq*), who had obviously embraced the cause of the victorious dynasty at the correct moment and so retained their position The name *Pahlavan*, moreover, which denoted the Parthian magnates, passed over into the new empire Below these there was an inferior nobility, the *dikhans* ("village-lords") and the "knights" (*aswar*); who, as among the Parthians, took the field in heavy scale-armour To an even greater extent than under the Arsacids the empire was subdivided into a host of small provinces, at the head of each being a *Marzban* ("boundary-lord," "lord of the marches") These were again comprised in four great districts With each of these local potentates the king could deal with as scant consideration as he pleased, always provided that he had the power or understood the art of making himself feared But to break through the system or replace it by another was impossible In fact he was compelled to proceed with great caution whenever he wished to elevate a favourite of humbler origin to an office which custom reserved for the nobility. Thus it is all the more worthy of recognition that the Sassanian empire was a fairly orderly empire, with an excellent legal administration, and that the later sovereigns did their utmost to repress the encroachments of the nobility, to protect the

commonalty, and, above all, to carry out a just system of taxation.

Religious Development.—Side by side with the nobles ranked the spiritual chiefs, now a far more powerful body than under the Arsacids. Every larger district had its upper Magian (*Magupat, mobed, i.e.,* "Lord of the Magian"). At their head was the supreme Mobed, resident in Rhagae (Rai), who was regarded as the successor of Zoroaster. In the new empire, of which the king and people were alike zealous professors of the true faith, their influence was extraordinarily strong (*cf.* Agathias ii. 26)—comparable to the influence of the priesthood in later Egypt, and especially in Byzantium and mediaeval Christendom. As has already been indicated, it was in their religious attitudes that the essential difference lay between the Sassanid empire and the older Iranian states. But, in details, the fluctuations were so manifold that it is necessary at this point to enter more fully into the history of Persian religion (*cf.* especially H. Gelzer, "Eznik u. d. Entwickel. des pers. Religions-systems," in the *Zeitschr. f. armen. Philol.* i. 149 *sqq.*).

The Persian religion, as we have seen, spread more and more widely after the Achaemenian period. In the Indo-Scythian empire the Persian gods were zealously worshipped; in Armenia the old national religion was almost entirely banished by the Persian cults (Gelzer, "Zur armen. Götterlehre," in *Ber. d. sächs. Gesch. d. Wissensch.*, 1895); in Cappadocia, North Syria and the west of Asia Minor, the Persian gods were everywhere adored side by side with the native deities. It was in the 3rd century that the cult of Mithras, with its mysteries and a theology evolved from Zoroastrianism, attained the widest diffusion in all Latin-speaking provinces of the Roman dominion; and it even seemed for a while as though the *Sol invictus Mithras*, highly favoured by the Caesars, would become the official deity-in-chief of the empire. But in all these cults the Persian gods are perfectly tolerant of other native or foreign divinities; vigorous as was their propagandism, it was yet equally far removed from an attack on other creeds. Thus this Parseeism always bears a syncretic character; and the supreme god of Zoroastrian theory, Ahuramazda (*i e.* Zeus or Jupiter), in practice yields place to his attendant deities, who work in the world and are able to lead the believer, who has been initiated and keeps the commendments of purity, to salvation.

But meanwhile, in its Iranian home and especially in Persis, the religion of Zoroaster lived a quiet life, undisturbed by the proceedings of the outside world. Here the poems of the prophet and fragments of ancient religious literature survived, understood by the Magians and rendered accessible to the faithful laity by versions in the modern dialect (Pehlevi). Here the opposition between the good spirit of light and the demons of evil—between Ormuzd and Ahriman—still remained the principal dogma of the creed; while all other gods and angels, however estimable their aid, were but subordinate servants of Ormuzd, whose highest manifestation on earth was not the sun-god Mithras, but the holy fire guarded by his priests Here all the prescriptions of purity—partly connected with national customs, and impossible of execution abroad—were diligently observed; and even the injunction not to pollute earth with corpses, but to cast out the dead to vulture and dog, was obeyed in its full force. At the same time Ahuramazda preserved his character as a national god, who bestowed on his worshippers victory and world dominion. In the sculptures of the Sassanids, as also in Armenian traditions, he appears on horseback as a war-god. Here, again, the theology was further developed, and an attempt made to annul the old dualism by envisaging both Ormuzd and Ahriman as emanations of an original principle of infinite time (Zervan), a doctrine which long enjoyed official validity under the Sassanids till, in the reign of Chosroes I., "the sect of Zervanites" was pronounced heretical.[1] But, above all, the ritual and the doctrine of purity were elaborated and expanded, and there was evolved a complete and detailed system of casuistry, dealing with all things allowed and forbidden, the forms of pollution and the expiation for each, etc., which, in its arid and spiritless monotony, vividly recalls the similar prescriptions in the Pentateuch. The consequences of this development were that orthodoxy and literal obedience to all priestly injunctions now assumed an importance far greater than previously; henceforward, the great commandment of Zoroastrianism, as of Judaism, is to combat the heresies of the heathen, a movement which had already had an energetic representative in the prophet himself. Heathenish cults and forbidden manners and customs are a pollution to the land and a deep insult to the true God. Therefore the duty of the believer is to combat and destroy the unbeliever and the heretic. In short, the tolerance of the Achaemenids and the indifference of the Arsacids are now replaced by intolerance and religious persecution.

Such were the views in which Ardashir I. grew up, and in their energetic prosecution he found a potent instrument for the building up of his empire. It has previously been mentioned that Vologaeses III. had already begun a collection of the holy writings; and the task was resumed under Ardashir. At his order the orthodox doctrines and texts were compiled by the high priest Jansar; all divergent theories were prohibited and their adherents proscribed. Thus arose the *Avesta*, the sacred book of the Parsees. Above all, the sacred book of laws, the *Vendidad*, breathes throughout the spirit of the Sassanian period, in its intolerance, its casuistry degenerating into absurdity, and its soulless monotony. Subscription to the restored orthodox doctrine was to the Iranian a matter of course. The schismatics Ardashir imprisoned for a year; if, at its expiration, they still refused to listen to reason, and remained stiff-necked, they were executed. It is even related that, in his zeal for uniformity of creed, Ardashir wished to extinguish the holy fires in the great cities of the empire and the Parthian vassal states, with the exception of that which burned in the residence of the dynasty. This plan he was unable to execute. In Armenia, also Ardashir and Shapur, during the period of their occupation, sought to introduce the orthodox religion, destroyed the heathen images—even those of the Iranian gods which were here considered heathen,—and turned the shrines into fire-altars (Gelzer, *Ber. sachs. Ges.* p. 135, 1895). Shapur I., who appears to have had a broader outlook, added to the religious writings a collection of scientific treatises on medicine, astronomy, mathematics, philosophy, zoology, etc., partly from Indian and Greek sources.

A short time afterwards, the Roman empire followed the example of the Sassanids and attempted to enforce unity of creed on all subjects: with Decius (A.D. 250) began the systematic persecution of the Christians. For, meanwhile, the Christian religion had spread far in east and west with an equally zealous propagandism and an equal exclusiveness and intolerance. In the countries of the Tigris and Euphrates, now altogether Aramaic, Christianity had everywhere gained a firm footing.[2] But its missionary enterprise stretched over the whole of Iran, and even farther. The time was come when, in the western and eastern worlds alike, the religious question was for large masses of people the most important question in life, and the diffusion of their own creed and the suppression of all others the highest and holiest of tasks. The man who thinks thus knows no compromise, and so Zoroastrianism and Christianity confronted each other as mortal enemies. Still the old idea that every religion contained a portion of the truth, and that it was possible to borrow something from one and amalgamate it with another, had not yet lost all its power. From such a conception arose the teaching of Mani or Manes. Our knowledge of Manichaeism (*q.v.*) has been greatly increased by the discovery of many fragments of its literature in Eastern Turkistan (Turfan); but they all are surpassed in importance by a large Chinese manuscript in the British Museum containing translations of Manichaean hymns

[1]It may be observed that this innovation was also known to the Mithras-cult of the west, where Zervan appears as αἰών.

[2]For the propagation and history of the Christians in the Sassanid empire, *cf.* Labourt, *Le Christianisme dans l'empire perse sous la dynastie sassanide* (1904); Harnack, *Die Mission und Ausbreitung des Christenthums in den ersten drei Jahrhunderten*, 2. Aufl. (1906), Bd. II. p. 121 *seq.*; Chabot, *Synodicon orientale* (1902) (a collection of the acts of the Nestorian synods held under the rule of the Sassanids).

and ritual; the publication and explanation of it has been begun by Waldschmidt and Lenz (*Jr. As. Soc.* 1926, 116f. *Die Stellung Jesu im Manichaeismus,* Abh. Preuss. Akad. 1926). We can now clearly see that Manichaeism originated from a Gnostic sect. Mani, a Persian from Babylonia, proclaimed himself as the last and greatest apostle of Jesus and as the paraclete announced in the Gospel of John. But with the Gnostic interpretation of the Gospel he tried to combine the doctrine of Zoroaster and Jesus to create a new universal religion. He is said to have made his first appearance as a teacher on the coronation day of Shapur I. At all events he found numerous adherents, both at court and among the magnates of the empire. The king even inclined to him, till in a great disputation the Magians gained the predominance. None the less Mani found means to diffuse his creed far and wide over the whole empire. Even the heir to the throne, Hormizd I. (reigned 272–273), was favourably disposed to him; but Shapur's younger son, Bahram I. (273–276), yielded to sacerdotal pressure, and Mani was executed. After that Manichaeism was persecuted and extirpated in Iran. Yet it maintained itself not merely in the west, where its head resided at Babylon—propagating thence far into the Roman empire—but also in the east, in Khurasan and beyond the bounds of the Sassanian dominion. There the seat of its pontiff was at Samarkand; thence it penetrated into Central Asia, where, buried in the desert sands which entomb the cities of eastern Turkistan, numerous fragments of the works of Mani and his disciples, in the Persian language (Pahlevi) and Syrian script, and in an East Iranian dialect, called Sogdian, which was used by the Manichaeans of Central Asia, have been discovered.

Art and Literature.—Like the Arsacids the kings resided in Ctesiphon, where, out of the vast palace built by Chosroes I., a portion at least of the great hall is still erect. On the ruins of Seleucia, on the opposite bank of the Tigris, Ardashir I. built the city of Veh-Ardashir ("good is Ardashir"), to which the later kings added new towns, or rather new quarters. In Susiana Shapur I. built the great city of Gondev-Shapur, which succeeded the ancient capital of the Persian empire. At the same time the mother-country again gained importance; especially the capital of Persia, Istakhr, which had replaced the former Persepolis (now the ruins of Hajjiabad). Farther in the south-east, Ardashir I. built Gur (now Firuzabad), under the name of Ardashir-khurre ("the glory of Ardashir"). At these places and in Sarwistan, near Shiraz and elsewhere, lie ruins of the Sassanid palaces, which in their design go back to the Achaemenid architecture, blending with it, however, Graeco-Syrian elements and serving in their turn as models for the structures of the Caliphs (*see* ARCHITECTURE: *Sassanian*). After its long quiescence under the Arsacids native art underwent a general renaissance which, though not aspiring to the Achaemenian creations, was still of no small importance. Of the Sassanian rock-sculptures some have already been mentioned; besides these, numerous engraved signet-stones have been preserved. The metal-work, carpets and fabrics of this period enjoyed a high reputation; they were widely distributed and even influenced western art.

In the intellectual life and literature of the Sassanid era the main characteristic is the complete disappearance of Hellenism and the Greek language. Ardashir I. and Shapur I. still appended Greek translations to some of their inscriptions; but all of later date are drawn up in Pahlavi alone. The coins invariably bear a Pahlavi legend—on the obverse the king's head with his name and title; on the reverse, a fire-altar (generally with the ascription "fire of Ardashir, Shapur, etc.," *i.e.* the fire of the royal palace), and the name of the place of coinage, usually abbreviated. The real missionaries of culture in the empire were the Aramaeans (Syrians), who were connected with the west by their Christianity, and in their translations diffused Greek literature through the Orient. But there also developed a rather extensive Pahlavi literature, beginning with the translations of the sacred books (the *Avesta*) though not limited to religious subjects, but containing works in *belles lettres,* modernizations of the old Iranian sagas and native traditions, *e.g.*, the surviving fabulous history of Ardashir I., ethical tales, etc., with translations of foreign literature, principally Indian,—one instance being the celebrated book of tales *Kalilah and Dimmah* (*see* SYRIAC LITERATURE), dating from Chosroes I., in whose reign chess also was introduced from India.

BIBLIOGRAPHY.—Side by side with the accounts of Roman and Greek authors stands the indigenous tradition which, especially for the later years of the empire, is generally trustworthy. It goes back to a native work, the *Khudai nama* ("book of Lords"), compiled under Chosroes I. and continued to Yazdegerd III. Its narrations are principally preserved in Tabari, though there combined with numerous Arabian traditions; also in the poetical adaptation of Firdousi. To these may be added Syrian accounts, particularly in the martyrologies, which have been excellently treated by G. Hoffmann, *Auszüge aus syrischen Akten persischer Märtyrer* (1880); also the statements of the Armenian historians.

The fundamental work on Sassanian history is Theodor Nöldeke's *Gesch. der Perser u. Araber zur Zeit der Sassaniden, aus der arabischen Chronik des Tabari* (1879, trans. with notes and excursuses chiefly on the chronology and organization of the empire). On this is based Nöldeke's *Aufsätze zur pers. Gesch.* (1887), containing a history of the Sassanian empire, pp. 86 *sqq.* A. Christensen, *L'empire des Sassanids* (Mém. de l'acad. de Danemark 1907). For the geography and numerous details of administration: J. Marquart, "Eranshahr" (*Abh. d. götting. Ges. d. Wissensch.,* 1901). For the monuments: Flandin and Coste, *Voyage en Perse* (1851); Stolze, *Persepolis* (1882); Dalton, *The Treasure of the Oxus* (Brit. Mus. 1905); Fr. Sarre and E. Herzfeld, *Iran Felsreliefs* (1910); Fr. Sarre, *die Kunst der Alten Persien* (1923).

History of the Sassanian Empire.—In foreign policy the problems under the Sassanid kings[1] remained as of old, the defence and, when possible, the expansion of the eastern and western frontiers. In the first two centuries of the Sassanid empire we hear practically nothing of its relations with the east. Only occasional notices show that the inroads of the Oriental nomads had not ceased, and that the extent of the empire had by no means exceeded the bounds of the Parthian dominion—Sacastene (Seistan) and western Afghanistan. Far to the east, on both sides of the Indus, the Kushana empire was still in existence, though it was already hastening to decay, and about A.D. 320 was displaced from its position in India by the Gupta dynasty. In the west the old conflict for Osroene and northern Mesopotamia (now Roman provinces), with the fortresses of Edessa, Carrhae and Nisibis, still smouldered. Armenia the Sassanids were all the more eager to regain, since there the Arsacid dynasty still survived and turned for protection to Rome, with whom, in consequence, new wars perpetually broke out. In the reign of Bahram II. (276–293), the emperor Carus, burning to avenge the disaster of Valerian, penetrated into Mesopotamia without meeting opposition, and reduced Coche (near Seleucia) and Ctesiphon; but his sudden death, in December of 283, precluded further success, and the Roman army returned home. Bahram, however, was unable to effect anything, as his brother Hormuzd was in arms, supported by the Sacae and other tribes. (Mamertin, *Panegyr. Maximin.* 7. 10; *Genethl. Maximin.* 5, 17.) He chose, consequently, to buy peace with Diocletian by means of presents. After his death (293), his uncle Narses was forced by his magnates to rebel against Bahram III. and gained the crown. In memory of his victory he has erected a great tower in the mountains west of the upper Diyala, at Paikuli, discovered 1843 by Rawlinson and explored in three expeditions by Herzfeld (published by Herzfeld, *Pai Kuli* 1924; since then, he has cleared a great number of

[1]List of kings (after Nöldeke, *Tabari,* p. 435).

Ardashir I., 224–241.	Peroz, 459-484.
Shapur I., 241–272.	Balash, 484–488.
Hormizd I., 272–273.	Kavadh I., 488–531.
Bahram I, 273–276.	(Djamasp. 406–408).
Bahram II., 276–293.	Chosroes (Khosrau) I, Anushirvan, 531–579.
Bahram III., 293.	Hormizd IV., 579–590.
Narseh (Narses), 293–302.	Chosroes II., *Parvez,* 590–628.
Hormizd II., 302–310.	(Bahram VI., *Cobin,* Bistam 590–596).
Shapur II., 310–379.	Kavadh II., *Sheroe,* 628.
Ardashir II., 379–383.	Ardashir III., 628–630.
Shapur III., 383–388.	(Shahrbaraz, 630).
Bahram IV., 388–399.	(Boran and others, 630–632).
Yazdegerd I., 399–420.	Yazdegerd III., 632–651.
Bahram V., Gor. 420–438.	
Yazdegerd II., 438–457.	
Hormizd III., 457–459.	

On most of these kings there are separate articles.

further blocks of the inscription, which are not yet published). It is covered with his busts and with a large inscription in the two forms of Pahlavi writing, the Parthian and the Persian, of which many blocks have been preserved. It contained an account of the way in which he defeated his opponent, and gives at the end a long list of the kings and dynasts, who sent embassies of congratulation at his accession, headed by the Kushan-shah of India and the Caesar of Rome. From this list we see that the east of Iran did not belong to the empire, but was ruled by a great many local dynasts, some of whom, just as the kings of the Arabic tribes in Babylonia (the Lakhmids of Hira, etc.), may have acknowledged the suzerainty of the Sassanids. After his victory, Narses occupied Armenia and defeated the emperor Galerius at Callinicum (296). But in the following year he sustained a severe reverse in Armenia, in which he lost his war-chest and harem. He then concluded a peace, by the terms of which Armenia remained under Roman suzerainty, and the steppes of northern Mesopotamia, with Singara and the hill-country on the left bank of the Tigris as far as Gordyene, were ceded to the victor (Ammian. Marc. xxv. 7, 9; Petr. Patr. *fr.* 13, 14; Rufus *brev.* 25). In return Narses regained his household. This peace, ratified in 297 and completely expelling the Sassanids from the disputed districts, lasted for 40 years.

After the death of Hormuzd II. (302–310), the son of Narses, the magnates imprisoned or put to death his adult sons, one of whom, Hormisdas, later escaped to the Romans, who used him as a pretender in their wars. Shapur II., a posthumous child of the late king, was then raised to the throne, a proof that the great magnates held the sovereignty in their own hands and attempted to order matters at their own pleasure. Shapur, however, when he came to manhood proved himself an independent and energetic ruler.

Shapur II.—Meanwhile the Roman empire had become Christian, the sequel of which was that the Syro-Christian population of Mesopotamia and Babylonia—even more than the Hellenic cities in former times—gravitated to the west and looked to Rome for deliverance from the infidel yoke. On similar grounds Christianity, as opposed to Mazdaism enforced officially by the Sassanids, became predominant in Armenia. Between these two great creeds the old Armenian religion was unable to hold its own; as early as A.D. 294 King Tiridates was converted by Gregory the Illuminator and adopted the Christian faith. For this very reason the Sassanid empire was the more constrained to champion Zoroastrianism. It was under Shapur II. that the compilation of the *Avesta* was completed and the state orthodoxy perfected by the chief *mobed*, Aturpad. All heresy was proscribed by the state, defection from the true faith pronounced a capital crime, and the persecution of the heterodox—particularly the Christians—began (*cf.* Sachall, "Die rechtlichen Verhältnisse der Christen in Sassanidenreich," in *Mitteilungen des Seminars für orientalische Sprachen für Berlin*, Bd. X., Abt. 2, 1907). Thus the duel between the two great empires now becomes simultaneously a duel between the two religions.

In such a position of affairs a fresh war with Rome was inevitable.[1] It was begun by Shapur in A.D. 337, the year that saw the death of Constantine the Great. The conflict centred round the Mesopotamian fortresses; Shapur thrice besieged Nisibis without success, but reduced several others, as Amida (359) and Singara (360), and transplanted great masses of inhabitants into Susiana. The emperor Constantius conducted the war feebly and was consistently beaten in the field. But, in spite of all, Shapur found it impossible to penetrate deeper into the Roman territory. He was hampered by the attack of nomadic tribes in the east, among whom the Chionites now begin to be mentioned. Year after year he took the field against them (353–358), till finally he compelled them to support him with auxiliaries (Ammian. Marc. 14, 3, 16, 9; 17, 5; 18, 4, 6). With this war is evidently connected the foundation of the great town New-Shapur (Nishapur) in Khorasan.

By the resolution of Julian (363) to begin an energetic attack on the Persian empire, the conflict, after the lapse of a quarter of a century, assumed a new phase. Julian pressed forward to Ctesiphon but succumbed to a wound; and his successor Jovian soon found himself in such straits, that he could only extricate himself and his army by a disgraceful peace at the close of 363, which ceded the possessions on the Tigris and the great fortress of Nisibis, and pledged Rome to abandon Armenia and her Arsacid protégé, Arsaces III., to the Persian.

Shapur endeavoured to occupy Armenia and introduce the Zoroastrian orthodoxy. He captured Arsaces III. by treachery and compelled him to commit suicide; but the Armenian magnates proved refractory, placed Arsaces's son Pap on the throne, and found secret support among the Romans. This all but led to a new war; but in 374 Valens sacrificed Pap and had him killed in Tarsus. The subsequent invasions of the Goths, in battle with whom Valens fell at Adrianople (375), definitely precluded Roman intervention; and the end of the Armenian troubles was that (*c.* 390) Bahram IV. and Theodosius the Great concluded a treaty which abandoned the extreme west of Armenia to the Romans and confirmed the remainder in the Persian possession. Thus peace and friendship could at last exist with Rome; and in 408 Yazdegerd I. contracted an alliance with Theodosius II. In Armenia the Persians immediately removed the last kings of the house of Arsaces (430), and thenceforward the main portion of the country remained a Persian province under the control of a *marzban*, though the Armenian nobles still made repeated attempts at insurrection. The introduction of Zoroastrianism was abandoned; Christianity was already far too deeply rooted. But the sequel to the Roman sacrifice of Armenian interests was that the Armenian Christians now seceded from the orthodoxy of Rome and Constantinople, and organized themselves into an independent national church. This church was due, before all, to the efforts of the *Catholicos* Sahak (390–439), whose colleague Mesrob, by his translation of the Bible, laid the foundations of an Armenian literature (*see* ARMENIAN CHURCH).

From Yazdegerd I. to the Turks.—In the interior of the Sassanian empire the old troubles broke out anew on the death of Shapur II. (379). At first the magnates raised his aged brother Ardashir II. to the throne, then in 383 deposed him and enthroned Shapur's son as Shapur III. In 388, however, he was assassinated, as was also his brother, Bahram IV., in 399. But the son of the latter, Yazdegerd I. (399–420), was an energetic and intelligent sovereign, who held the magnates within bounds and severely chastised their attempts at encroachment. He even sought to emancipate himself from the Magian Church, put an end to the persecutions, and allowed the Persian Christians an individual organization. In the Persian tradition he is consequently known as "the sinner." In the end he was probably assassinated. So great was the bitterness against him that the magnates would admit none of his sons to the throne. One of them, however, Bahram V., found an auxiliary in the Arab chief Mondhir, who had founded a principality in Hira, west of the lower Euphrates; and, as he pledged himself to govern otherwise than his father, he received general recognition. This pledge he redeemed, and he is, in consequence, the darling of Persian tradition, which bestows on him the title of *Gor* ("the wild ass"), and is eloquent on his adventures in the chase and in love. This reversal of policy led to a Christian persecution and a new war with Rome. Bahram, however, was worsted; and in the peace of 422 Persia agreed to allow the Christians free exercise of their religion in the empire, while the same privilege was accorded to Zoroastrianism by Rome. Under his son, Yazdegerd II. (438–457), who once more revived the persecutions of the Christians and the Jews, a short conflict with Rome again ensued (441): while at the same time war prevailed in the east against the remnants of the Kushan empire and the tribe of Kidarites, also named Huns.

Here a new foe soon arose in the shape of the Ephthalites (*Haitab*), also known as the "White Huns," a barbaric tribe which shortly after A.D. 450 raided Bactria and terminated the Kushana dominion (Procop. *Pers.* i. 3), and soon began to extend their invasions into India, where they destroyed the Gupta

[1] For the succeeding events *see* also under ROME: *Ancient History*; and articles on the Roman emperors and Persian kings.

empire about A.D. 500. These Ephthalite attacks harassed and weakened the Sassanids, exactly as the Tocharians had harassed and weakened the Arsacids after Phraates II. Peroz (457–484) fell in battle against them; his treasures and family were captured and the country devastated far and near. His brother Balash (484–488), being unable to repel them, was deposed and blinded, and the crown was bestowed on Kavadh I. (488–531), the son of Peroz As the external and internal distress still continued he was dethroned and imprisoned, but took refuge among the Ephthalites and was restored in 499 by their assistance—like so many Arsacids by the arms of the Dahae and Sacae To these struggles obviously must be attributed mainly the fact that in the whole of this period no Roman war broke out But, at the same time, the religious duel had lost in intensity, since, among the Persian Christians, the Nestorian doctrine was now dominant Peroz had already favoured the diffusion of Nestorianism, and in 483 it was officially adopted by a synod, after which it remained the Christian Church of the Persian empire, its head being the patriarch of Seleucia-Ctesiphon

Kavadh proved himself a vigorous ruler. On his return he restored order in the interior In 502 he attacked the Romans and captured and destroyed Amida (mod Diarbekr), but was compelled to ratify a peace owing to an inroad of the Huns Toward the close of his reign (527) he resumed the war, defeating Belisarius at Callinicum (531), with the zealous support of the wild Arab Mondhir II of Hira On his death his son Chosroes I concluded a peace with Justinian (532), pledging the Romans to an annual subsidy for the maintenance of the Caucasus fortresses In his home policy Kavadh is reminiscent of Yazdegerd I. Like him he had little inclination to the orthodox church, and favoured Mazdak, the founder of a communistic sect which had made headway among the people and might be used as a weapon against the nobles, of whom Mazdak demanded that they should cut down their luxury and distribute their superfluous wealth. Another feature of his programme was the community of wives. The crown-prince, Chosroes, was, on the other hand, wholly orthodox; and, towards the close of his father's reign, in conjunction with the chief Magian, he carried through the condemnation of the Mazdakites, who were butchered in a great massacre (528). Chosroes I (531–579), surnamed Anushirvan ("the blessed"), then restored the orthodox doctrine in full, publishing his decision in a religious edict. At the same time he produced the official exposition of the *Avesta*, an exegetical translation in the popular tongue (Pahlavi), and declared its contents binding. Defection from Zoroastrianism was punished with death, and therefore also the proselytizing of the Christians, though the Syrian martyrologies prove that the kings frequently ignored these proceedings so long as it was at all possible to do so

Chosroes I was one of the most illustrious sovereigns of the Sassanian empire From him dates a new and equitable adjustment of the imperial taxation, which was later adopted by the Arabs. His reputation as an enlightened ruler stood so high that when Justinian, in 529, closed the school of Athens, the last Neoplatonists bent their steps to him in hopes of finding in him the true philosopher-king Their disillusionment, indeed, was speedy and complete, and their gratitude was great, when, by the conditions of the armistice of 549, he allowed their return From 540 onward he conducted a great war against Justinian (527–565), which, though interrupted by several armistices, lasted till the 50 years' peace of 562 The net result, indeed, was merely to restore the *status quo;* but during the campaign Chosroes sacked Antioch and transplanted the population to a new quarter of Ctesiphon (540) He also extended his power to the Black sea and the Caucasus; on the other hand, a siege of Edessa failed (544). A second war broke out in 577, chiefly on the question of Armenia and the Caucasus territory. In this Chosroes ravaged Cappadocia in 575; but the campaign in Mesopotamia was unsuccessful. In the interval between these two struggles (570) he despatched assistance to the Arabs of Yemen, who had been assailed and subdued by the Abyssinian Christians; after which period Yemen remained nominally under Persian suzerainty till its fate was sealed by the conquests of Mohammed and Islam.

The Turks and the Arabs.—Meanwhile, about A.D. 560, a new nation had sprung up in the East, the Turks Chosroes concluded an alliance with them against the Ephthalites and so conquered Bactria south of the Oxus, with its capital Balkh. Thus this province, which, since the insurrection of Diodotus in 250 B.C., had undergone entirely different vicissitudes from the rest of Iran, was once more united to an Iranian empire, and the Sassanid dominions, for the first time, passed the frontiers of the Arsacids. This, however, was the limit of their expansion Neither the territories north of the Oxus, nor eastern Afghanistan and the Indus provinces, were ever subject to them That the alliance with the Turks should soon change to hostility and mutual attack was inevitable from the nature of the case; in the second Roman war the Turkish Khan was leagued with Rome

Chosroes bequeathed this war to his son Hormuzd IV. (579–590) who, in spite of repeated negotiations, failed to re-establish peace Hormuzd had not the ability to retain the authority of his father, and he further affronted the Magian priesthood by declining to proceed against the Christians and by requiring that, in his empire, both religions should dwell together in peace Eventually, he succumbed to a conspiracy of his magnates, at whose head stood the general Bahram Cobin, who had defeated the Turks, but afterwards was beaten by the Romans Hormuzd's son, Chosroes II, was set up against his father and forced to acquiesce in his execution. But immediately new risings broke out, in which Bahram Cobin—though not of the royal line—attempted to secure the crown, while simultaneously a Prince Bistam entered the lists Chosroes fled to the Romans and the emperor Maurice undertook his restoration at the head of a great army. The people flocked to his standard, Bahram Cobin was routed (591) and fled to the Turks, who slew him, and Chosroes once more ascended the throne of Ctesiphon, Bistam held out in Media till 596 Maurice made no attempt to turn the opportunity to Roman advantage, and in the peace then concluded he even abandoned Nisibis to the Persians

Chosroes II (590–628) is distinguished by the surname of *Parvez* ("the conqueror"), though, in point of fact, he was immeasurably inferior to a powerful sovereign like his grandfather, or even to a competent general He lived, however, to witness unparalleled vicissitudes of fortune The assassination of Maurice in 602 impelled him to a war of revenge against Rome, in the course of which his armies—in 608 and, again, in 615 and 626—penetrated as far as Chalcedon opposite Constantinople, ravaged Syria, reduced Antioch (611), Damascus (613), and Jerusalem (614), and carried off the holy cross to Ctesiphon; in 619 Egypt was occupied Meanwhile, the Roman empire was at the lowest ebb The great emperor Heraclius, who assumed the crown in 610, took years to create the nucleus of a new military power. This done, however, he took the field in 623, and repaid the Persians with interest Their armies were everywhere defeated In 624 he penetrated into Atropatene (Azerbaijan), and there destroyed the great fire-temple, in 627 he advanced into the Tigris provinces. Chosroes attempted no resistance, but fled from his residence at Dastagerd to Ctesiphon. These proceedings, in conjunction with the avarice and licence of the king, led to revolution Chosroes was deposed and slain by his son Kavadh II. (628); but the parricide died in a few months and absolute chaos resulted A whole list of kings and pretenders—among them the General Sharbaraz and Boran, a daughter of Chosroes—followed rapidly on one another, till finally the magnates united and, in 632, elevated a child to the throne, Yazdegerd III, grandson of Chosroes In the interval—presumably during the reign of Queen Boran—peace was concluded with Heraclius, the old frontier being apparently restored The cross had already been given back to the emperor

Thus the 100 years' struggle between Rome and Persia, which had begun in 527 with the attack of the first Kavadh on Justinian, had run its fruitless course, utterly enfeebling both empires and consuming their powers. Room was given to a new enemy who now arose between either state and either religion—the Arabs and Islam. In the same year that saw the coronation of Yazdegerd III.—the beginning of 633—the first Arab squadrons made their

entry into Persian territory. After several encounters there ensued (637) the battle of Kadisiya (Qadisiya, Cadesia), fought on one of the Euphrates canals, where the fate of the Sassanian empire was decided. A little previously, in the August of 636, Syria had fallen in a battle on the Yarmuk (Hieromax), and in 639 the Arabs penetrated into Egypt. The field of Kadisiya laid Ctesiphon, with all its treasures, at the mercy of the victor. The king fled to Media, where his generals attempted to organize the resistance; but the battle of Nehavend (641) decided matters there. Yazdegerd sought refuge in one province after the other, till, at last, in 651, he was assassinated in Merv (*see* CALIPHATE: §A, §1).

Thus ended the empire of the Sassanids, no less precipitately and ingloriously than that of the Achaemenids. By 650 the Arabs had occupied every province to Balkh and the Oxus. Only in the secluded districts of northern Media (Tabaristan), the "generals" of the house of Karen (Spahpat, Ispehbed) maintained themselves for a century as vassals of the caliphs—exactly as Atropates and his dynasty had done before them.

The fall of the empire sealed the fate of its religion. The Muslims officially tolerated the Zoroastrian creed, though occasional persecutions were not lacking. But little by little it vanished from Iran, with the exception of a few remnants (chiefly in the oasis of Yezd), the faithful finding a refuge in India at Bombay. These Parsees have preserved but a small part of the sacred writings; but to-day they still number their years by the era which begins on June 16, A.D. 632, with the death of Yazdegerd III., the last king of their faith and the last lawful sovereign of Iran, on whom rested the god-given Royal Glory of Ormuzd.

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B.—TRANSITION PERIOD: FROM THE FALL OF THE SASSANID DYNASTY TO THE DEATH OF TIMUR (1405)

Alien Rulers.—With the final defeat of the Sassanids under Yazdegerd III. at the battles of Kadisiya (Qadisiya) (637) and Nehavend (641) Persia ceased to exist as a single political unit. The country passed under a succession of alien rulers who cared nothing for its ancient institutions or its religion. For about 150 years it was governed, first from Medina and afterwards from Baghdad, by officers of the Mohammedan caliphs whose principal aim it was to destroy the old nationality by the suppression of its religion. The success of this policy was, however, only apparent, especially in Iran, the inhabitants of which adopted Islam only in the most superficial manner, and it was from Persia that the blow fell which destroyed the Omayyad caliphate and set up the Abbasids in its place (*see* CALIPHATE). Even before this event adventurers and dissatisfied Muslim officers had utilized the slumbering hostility of the Persian peoples to aid them in attacks on the caliphs, and the policy of eastern expansion brought the Arab armies perpetually into the Persian provinces.

In the reign of Merwan I. the Persians (who were mostly Shiahs) under a Muslim officer named Mokhtar (Mukhtar), whom they regarded as their mahdi, vainly attempted to assert their independence in Kufa, but were soon defeated. This rising was followed by many more (*see* CALIPHATE) in which the caliphs were generally successful, and Abdalmalik (d. 705) considerably strengthened the Muslim power by instituting a thorough system of Muslim currency and enforcing Arabic as the official language throughout the empire. In the succeeding reign Persia was further subdued by the great conqueror Qoteiba (Qotaiba) b. Moslim, the Arabic governor of Khorasan. Omar II., however, extended to non-Arabic Muslims immunity from all taxes except the *zakat* (poor-rate), with the result that a large number of Persians, who still smarted under their defeat under Mokhtar, embraced Islam and drifted into the towns to form a nucleus of sedition under the Shiah preachers. In the reign of Yazid II. (720–724) serious risings took place in Khorasan, and in spite of the wise administration of his successor Hisham (d. 743), the disorder continued to spread, fanned by the Abbasids and the Shiah preachers. Ultimately in the reign of Merwan II. the non-Arabic Muslims found a leader in Abu Moslim, a *maula* (client) of Persian origin and a henchman of Ibrahim b. Mohammed b. Ali, the Shiah imam, who raised a great army, drove the caliph's general Nasr b. Sayyar into headlong flight, and finally expelled Merwan. Thus the Abbasids became masters of Persia and also of the Arab empire. They had gained their success largely by the aid of the Persians, who began thenceforward to recover their lost sense of nationality. At the same time the Khorasanians had fought for the old Alid family, not for the Abbasids, and with the murder of Abu Moslim discontent again began to grow among the Shiahs (*q.v.*). In the reign of Harun-al-Rashid disturbances broke out in Khorasan which were temporarily appeased by a visit from Harun himself. Immediately afterwards Rafi' b. Laith, grandson of the Omayyad general Nasr b. Sayyar, revolted in Samarkand, and Harun on his way to attack him died at Tus (809). Harun's sons Amin and Mamun quarrelled over the succession; Amin became caliph, but Mamun by the aid of Tahir b. Ḥosain Dhu 'l-Yaminain ("the man with two right hands") and others succeeded in deposing and killing him. Tahir ultimately (820) received the governorship of Khorasan, where he succeeded in establishing a practically independent Muslim dynasty (the Tahirids) which ruled until about 873 in nominal obedience to Baghdad. From 825 to about 898 a similar dynasty, the Dulafids or Dolafids, reigned nominally as governors under the caliphs till they were put down by Motadid. In the reign of the caliph Motasim a serious revolt of Persian Mazdakite sectaries (the Khorrami) in alliance with Byzantium was with difficulty suppressed, as also a rising of Tabaristan under an hereditary chief Maziyar who was secretly supported by the Turkish mercenaries (*e.g.*, Afshin) whom the caliph had invited to his court. To another Turk, Itakh, the caliph Wathiq gave a titular authority over all the eastern provinces. In the reign of the tenth caliph Motawakkil the Tahirids fell before Yakub b. Laith al-Saffar, who with the approbation of the caliph founded a dynasty, the Saffarid in Seistan.

Minor Dynasties.—It is convenient at this point to mention several other minor dynasties founded by nominal governors in various parts of Persia and its borderland. From 879 to about 930 the Sajids ruled in Azerbaijan, while in Tabaristan an Alid dynasty (the Zaidites) was independent from 864 to 928, when it fell before the Samanids. Subsequently descendants of this house ruled in Dailam and Gilan. Throughout this period the caliphate was falling completely under the power of the Turkish officers. Mohtadi, the 14th Abbasid caliph, endeavoured vainly to replace them by Persians (the Abna). His successor Motamid was attacked by the Saffarid Yakub who however was compelled to flee (*see* CALIPHATE). Yakub's brother Amr (reigned 878–900) received the vacant position, but was taken prisoner by Isma'il b. Ahmad, the Samanid, and the Saffarids were henceforward a merely nominal dynasty under the Samanids (900–1229). The Samanids (*q.v.*) were the first really important non-Arabic Persian dynasty since the fall of Yazdegerd III. They held sway over most of Persia and Transoxiana, and under their rule scholarship and the arts flourished exceedingly in spite of numerous civil wars. Ultimately they fell before the Ghaznevid dynasty of Sabuktagin.

In the reign of Motadid who, as we have seen, put down the Dolafids, and also checked the Sajids of Azerbaijan in their designs on Syria and Egypt, the Kharijites of Mesopotamia were put down by the aid of the Hamdanites of Mosul, who were to become a dynasty of some importance. Subsequently the caliphate, which had temporarily recovered some of its authority, resumed its downward course, and the great families of Persia once again asserted themselves. In the reign of Qahir (d. 934), a new dynasty arose in Persia, that of the Buyids (Buwayhids). This

family was descended from one Abu Shaja Buya, who claimed to be of the old Sassanian house and had become a chieftain in Dailam. He had successively fought for the Samanids and the Ziyarids, a dynasty of Jorjan, and his son Imad addaula (eddowleh, originally Abu 'l Ḥasan Ali) received from Mardawij of the latter house the governorship of Karaj; his second son Rokn addaula (Abu Ali Ḥasan) subsequently held Rai and Isfahan, while the third, Moizz addaula (Abu 'l Ḥosain Ahmad) secured Kermān, Ahvaz and even Baghdad.

The reign of the caliph Mottaqi was a period of perpetual strife between the Dailamites, the Turks and the Hamdanid Nasir addaula of Mosul. In the next reign Moizz addaula took Baghdad (945) It was at this time that the three brothers took the titles Imad, Rukn (Rokn), and Moizz addaula The authority of the family was absolute, though they paid outward respect to the caliphs Moizz addaula repelled an attack of the Hamdanids of Mosul. The Buyids, and especially Adod addaula (Azud-ed-Dowleh, and similar forms), ruled Baghdad wisely and improved the city by great public works such as the great dike, still known as the Bend Amir on the Kur (Cyrus) near Persepolis Their sway extended from the Persian gulf to the Caspian sea Ultimately however, the Buyid dynasty grew weaker under the quarrels of its members and fell an easy prey to the Ghaznevids. In the meantime (999) the Sassanids fell before the Ilek-Khans of Turkestan, to the great advantage of the Ghaznevid princes

Ghaznevids and Seljuks.—The centre of force in Persian politics now changes from west to east Hitherto the ultimate power, at least nominally, had resided in the caliphate at Baghdad, and all the dynasties which have been noticed derived their authority formally from that source With the rise of the Ghaznevids and later the Seljuks, the Abbasid caliphate ceased to count as an independent power As we have seen, the Ghaznevid armies in a brief space destroyed most of the native dynasties of Persia The first of the house was Alptagin, a Turkish slave of the Samanid Mansur I, who, having quarrelled with his master, took refuge in Afghanistan and founded a semi-independent authority. After his death three unimportant governors of his house held sway, but in 977 the power fell to another former slave, Sabuktagin, who was recognized by the Samanid Nuh II His son and successor Mahmud (*q.v.*) was attacked by a brother, Isma'il, and retired from Khorasan (of which he had been governor). The Samanids then fell under the power of the Tatar Ilkhans, but Mahmud returned, triumphed over both the Samanids and the Tatars, and assumed the independent title of sultan with authority over Khorasan, Transoxiana and parts of northwest India Mahmud was a great conqueror, and wherever he went he replaced the existing religion by Mohammedanism He is described as the patron (if a somewhat ungenerous one) of literature, it was under his auspices that Firdousi collected the ancient myths of Persia and produced the great epic *Shahnama* (Book of the Kings) His descendants held a nominal rule till 1187, but in 1152 they lost all their extra-Indian territories to the Ghorids, and during the last 35 years reigned in diminished splendour at Lahore Even before this time, however, the supremacy which they enjoyed under Mahmud in Persia had fallen into the hands of the Seljuks who, in the reign of Mas'ud I, son of Mahmud, conquered Khorasan In 1037 Seljuk princes were recognized in Merv and Nishapur, and in the ensuing 18 years the Seljuks conquered Balkh, Jorjan, Tabaristan, Khwarizm, Hamadan, Rai, Isfahan, and finally Baghdad (1055) The Abbasid caliphs, who still enjoyed a precarious and shadowy authority at the pleasure of Turkish viziers, gladly surrendered themselves to the protection of the Mohammedan Seljuks, who paid them all outward respect

Thus for the first time since the Arab conquest of the Sassanian realm Persia was ruled by a single authority, which extended its conquests westward into Asia Minor, where it checked the rulers of Byzantium, and eastward to India and Central Asia. The history of this period is treated at length in the articles CALIPHATE and SELJUKS. The empire of the Seljuks was essentially military. Their authority over their own officers was so precarious that they preferred to entrust the command to Turkish slaves These officers, however, were far from loyal to their lords. In every part of the empire they gradually superseded the Seljuk princes and founded minor dynasties.

Khwarizm.—Before passing on to the Mongol conquerors of Persia it is necessary briefly to notice the shahs of Khwarizm, who have frequently been mentioned as overthrowing the minor dynasties which arose with the decay of the Seljuks These rulers were descended from Anushtajin, a Turkish slave of Ghazni, who became cupbearer to the Seljuk Malik Shah, and afterwards governor of Khwarizm (Khiva) in 1077 In 1138 the third of the line, Atsiz, revolted but was defeated and expelled by Sinjar. Shortly afterwards he returned, firmly established his power, and extended the Khwarizm empire as far as Jand on the Sihun The brief reigns of Il-Arslan and Sultan Shah Mahmud were succeeded by that of Tukush (1172–99) and Ala ed-din Mohammed (1199–1220) The former of these subdued Khorasan, Rai and Isfahan, while the latter brought practically all Persia under his sway, conquered Bokhara, Samarkand and Otrar, capital of the Karakitai, and had even made himself master of Ghazni when his career was stopped by the hordes of the Mongol Jenghiz Khan. In 1231 the last of his house, Jelal ud-din (Jalaluddin) Mangbarti, or Mango-berti, was banished, and thus the empire of the Khwarizm shahs, which for a brief period had included practically all the lands conquered by the Seljuks, passed away

Thus from the fall of the Samanids to the invasion of the Mongols five or at most six important dynasties held sway over Persia, while some 40 small dynasties enjoyed a measure of local autonomy. During the whole of this period the Abbasid caliphs had been nominally reigning throughout the Mohammedan world with their capital at Baghdad. But with hardly any exceptions they had been the merest puppets, now in the hands of Turkish ministers, now under the protection of practically independent dynasts The real rulers of Persia during the years 874–1231 were, as we have seen, the Samanids, the Buyids, the Ghaznevids, the Seljuks, the Salgharids and the Khwarizm shahs We now come to a new period in Persian history, when the numerous petty dynasties which succeeded the Seljuks were all swallowed up in the great Mongol invasion

Mongols.—In later years of the 12th century the Mongols began their westward march and, after the conquest of the ancient kingdom of the Karakitai, reached the borders of the territory of the Khwarizm shahs, which was at once overwhelmed Jenghiz Khan died in 1272, and the Mongol empire stretching from the Caspian to the Yellow sea was divided up among his sons Persia itself fell partly in the domain of Jagatai and partly in that of the Golden Horde The actual governor of Persia was Tului or Tule, whose son Hulagu or Hulaku is the first who can be rightly regarded as the sovereign of Persia His accession occurred in 1256 and henceforward Persia becomes after 600 years of spasmodic government a national unit Hulagu at once proceeded to destroy a number of nascent dynasties which endeavoured to establish themselves on the ruins of the Khwarizm empire; about 1255 he destroyed the dynasty of the Assassins by the capture of their stronghold of Alamut (Eagle's Nest), and finally in 1258 captured Baghdad The 38th and last Abbasid caliph, Mostasim, was brutally murdered, and thus the Mohammedan caliphate ceased to exist even as an emasculated pontificate The Persian empire under Hulagu and his descendants extended from the dominions of Jagatai on the north to that of the Egyptian dynasts on the south, and from the Byzantine empire on the west to the confines of China Its rulers paid a nominal homage to the Khakhan (Great Khan) in China, and officially recognized this dependence in their title of Ilkhan, *i e*, provincial or dependent khan From 1258 to 1335 the Ilkhans were not seriously challenged. Hulagu fixed his capital at Maragha (Meragha) in Azerbaijan, where he erected an observatory for Nasir ud-din Tusi, who at his request prepared the astronomical tables known as the *Zidj-i-Ilkhani* He died in 1265 and was succeeded by his son Abagha or Abaka, who married the daughter of Michael Palaeologus, the Byzantine ruler. Abagha was a peaceful ruler and endeavoured by wise administration to give order and prosperity to a country torn asunder by a

long period of intestine war and the Mongol invasion. He succeeded in repelling two attacks by other Mongolian princes of the house of Jenghiz Khan; otherwise his reign was uneventful. His brother Nikudar (originally Nicolas) Ahmad Khan succeeded him in 1281. This prince was converted to Islam, an event of great moment both to the internal peace and to the external relations of Persia. His persecution of the Christians led them into alliance with the Mongols, who detested Islam; the combined forces were too strong for Nikudar, who was murdered in 1284. The external results were of more importance. The Ilkhans, who had failed in their attempt to wrest Syria from the Mameluke rulers of Egypt had subsequently endeavoured to effect their object by inducing the European Powers to make a new crusade. The conversion of Nikudar put an end to this policy and Egypt was for some time free from Persian attack (*see* Egypt: *History*). The Mongol leaders put on the throne a son of Abagha, by name Arghun. His reign was troubled. His first minister Shams ud-din was suspected of having poisoned Abagha, and was soon put to death. His successor, the amir Bogha, conspired against Arghun and was executed. Under the third minister (1289–91), a Jewish doctor named Sa'd addaula (ed-Dowleh), religious troubles arose owing to his persecution of the Mohammedans and his favouring the Christians. The financial administration of Sa'd was prudent and successful, if somewhat severe, and the revenue benefited considerably under his care. But he committed the tactical error of appointing a disproportionate number of Jews and Christians as revenue officials, and thus made many enemies among the Mongol nobles, who had him assassinated in 1291 when Arghun was lying fatally ill. It is possible that it was Sa'd's diplomacy which led Pope Nicholas IV. to send a mission to Arghun with a view to a new crusade. The reign of Arghun was also disturbed by a rebellion of a grandson of Hulagu, Baidu Khan. Arghun died soon after the murder of Sa'd, and was succeeded by his brother Kaikhatu, or Gaykhatu, who was taken prisoner by Baidu Khan and killed (1295). Baidu's reign was cut short in the same year by Arghun's son Ghazan Mahmud, whose reign (1295–1304) was a period of prosperity in war and administration. Ghazan was a man of great ability. He established a permanent staff to deal with legal, financial and military affairs, put on a firm basis the monetary system and the system of weights and measures, and perfected the mounted postal service. Ghazan fought with success against Egypt (which country had already from 1293 to Dec. 1294 been ruled by a Mongol usurper Kitboga), and even held Damascus for a few months. In 1303, however, his troops were defeated at Merj al-Saffar, and Mongol claims on Syria were definitely abandoned. It was even suggested that the titular Abbasid caliphs (who retained an empty title in Cairo under Mameluke protection) should be reinstated at Baghdad, but this proposal was not carried into effect. Ghazan is historically important, however, mainly as the first Mongol ruler who definitely adopted Islam with a large number of his subjects. He died in 1304, traditionally of anger at the Syrian fiasco, and was succeeded by his brother Uljaitu (Oeljeitu). The chief events of his reign were a successful war against Tatar invaders and the substitution of the new city of Sultania as capital for Tabriz, which had been Ghazan's headquarters. Uljaitu was a Shiah and even stamped his coins with the names of the 12 Shiah imams. He died in 1316, and was succeeded by Abu Sa'id, his son. The prince, under whom a definite peace was made with Malik al-Nasir, the Mameluke ruler of Egypt, had great trouble with powerful viziers and generals which he accentuated by his passion for Bagdad-Khatun, wife of the amir Ḥosain and daughter of the amir Chupan. This lady he eventually married, with the result that Chupan headed a revolt of his tribe, the Selduz. Abu Sa'id died of fever in 1335, and with him the first Mongol or Ilkhan dynasty of Persia practically came to an end. The real power was divided between Chupan and Ḥosain the Jelair (or Jalair), or the Ilkhanian, and their sons, known respectively as the Little Ḥasan (Ḥasan Kuchuk) and the great Ḥasan (Ḥasan Buzurg). After a brief succession of obscure princes Ḥasan Buzurg definitely installed himself as the first khan of the Jelairid or Ilkhanian-Jelairid dynasty.

Practically from the reign of Abu Sa'id Persia was divided under five minor dynasties, (1) the Jelairids, (2) the Mozaffarids, (3) the Sarbadarids (Serbedarians), (4) the Beni Kurt and (5) the Jubanians, all of which ultimately fell before the armies of Timur. But the authority of Timur, which was dominant throughout Persia from at least as early as 1395 till his death in 1405, was never unchallenged. He passed from one victory to another, but the conquered districts were never really settled under his administration. Fresh risings of the defeated dynasties followed each new enterprise, and he had also to deal with the Mongol hordes whose territory marched with northern Persia. His descendants were for a brief period the overlords of Persia, but after Shah Rukh (reigned 1409–46) and Ala addaula (1447), the so-called Timurid dynasty ceased to have any authority over Persia. There were Timurid governors of Fars under Shah Rukh, Pir Mohammed (1405–09), Iskendar (1409–14), Ibrahim (1415–34) and Abdallah (1434); in other parts of Persia many of the Timurid family held governorships of greater or less importance.

Bibliography.—The works relating to Persia will be found under articles on the main dynasties (Caliphate; Seljuks; Mongols), and the great rulers (Jenghiz Khan; Mahmud of Ghazni; Timur). For general information and chronology *see* Stockvis, *Manuel d'histoire*, vol. i. (Leyden, 1888); Sir H. Howorth, *History of the Mongols* (1876–88); S. Lane Poole, *Mohammedan Dynasties* (1894).

(J. M. M.; F. M. S.)

C.—FROM THE DEATH OF TIMUR TO THE FALL OF THE SAFAVI DYNASTY, 1405–1736

Tamerlane died in harness. At the age of seventy, he actually started on a great expedition, which he had organised for the conquest of China, when he was taken ill and died.

Shah Rukh, 1404–1447.—There was a struggle for power after the death of the Great Conqueror, during which period his fourth son, Shah Rukh, who was Governor of Khorasan, consolidated his position. His rivals proved to be utterly incapable and he occupied Central Asia, but loving Herat, he continued to rule the empire from that city. Throughout his long reign, he worked incessantly to restore the prosperity of his empire and erected splendid buildings. He was also a successful soldier, defeating the Chief of the "Black Sheep" dynasty in three battles, and his empire stretched from Chinese Turkestan to Asia Minor.

Ulugh Beg, and Sultan Husayn.—His successor had ruled Samarcand under his father. Not only did he erect splendid buildings that still challenge our admiration, but, under his patronage, the astronomical tables were drawn up, which constitute the greatest legacy in that science that the East has bequeathed to the West. After his succession to the empire, the Turkoman sacked Herat, the Uzbegs looted Samarcand and, to complete the tragedy, he was murdered by his own son, in 1449. After the death of Ulugh, the Timurid dynasty rapidly broke up. The only remaining member of note was Sultan Husayn, who ruled over a much diminished empire from 1487 to 1506. He was the patron of a very great period, rivalling that of the Renaissance in Europe, the period of Jami the Poet, of Behzad the Painter, and of Mirkhond the historian.

The "Black Sheep" and "White Sheep" Turkoman.—During the decay of the Timurid dynasty, there was a fight for power between two families of Turkoman. Kara Yusuf, the Chief of the "Black Sheep" was, as mentioned above, defeated by Shah Rukh, but made peace with him and, at his death was a most powerful ruler in the country round Lake Van. His successor, Iskandar, the builder of the famous Blue Mosque of Tabriz, was captured and put to death by Uzun Hasan, the celebrated Chief of the "White Sheep." Hasan defeated the reigning Timurid Prince and was the virtual ruler of Persia.

After the capture of Constantinople by the Turks, in 1453, Venice attempted, albeit with scant success, to unite the Princes of Europe against the common foe. Uzun Hasan, who had been defeated by the Turks, sent an extremely welcome embassy to the Doge at this juncture. This step was probably inspired by his wife, Theodora, who was a daughter of one of the last Emperors of Trebizond. The return embassy was headed by Caterino Zeno, whose wife was a niece of Theodora. The ambassador was, in consequence, most kindly received and was able to induce Hasan to co-operate with the Venetian fleet in an attack on the

south coast of Asia Minor. In 1472, a body of Persian cavalry ravaged the province, but was defeated by a Turkish column. In the following year, a powerful Turkish force was repulsed in an attempt to cross the Euphrates, but Hasan who followed it up, suffered heavy losses. After this, he sent Caterino to rouse the rulers of Europe against the Turks, and wisely took no further direct action. Uzun Hasan died in 1478, and his successor was poisoned after a reign of seven years. The family then broke up, mainly owing to the struggle for power among its members, and thus made way for the coming national dynasty of the Safavi.

The Safavi Dynasty, 1499–1736.—The Persian nation was deeply attached to the Sasanian dynasty, overthrown by the Arabs early in the 7th century A.D. The religion founded by Mohammed was gradually adopted, but the national feeling found expression in the adoption as their spiritual leaders of the Caliph Ali and his descendants. They believed that Husayn, the son of Ali had married a daughter of their last king Yezdigird, and that his descendants inherited the divine right of the Sasanian monarchs. Mainly on this account, the Persians broke off from the "Sunnis" or "Traditionists," and termed themselves "Shiah" or "Separatists." Their chief doctrine was that of the *Imamate,* by which Ali and eleven of his descendants were considered to be sinless and to be spiritual and temporal leaders by divine right. The Safavi dynasty claimed unchallenged descent from the seventh *Imam* and was deeply venerated, especially Safi-u'-Din, from whom the family took its title of Safavi. Uzun Hasan gave one of his daughters to Haydar, later head of the family. She bore him three sons, the youngest of whom, Ismail, became the sole survivor and the founder of the dynasty. Raising a force of his adherents, he defeated the Chief of the "White Sheep" and marched on Tabriz, which surrendered. There, in 1499, he proclaimed himself Shah, this date marking the foundation of the dynasty. The coronation of Shah Ismail evoked a wave of national and religious sentiment of overwhelming force among his subjects who regarded Ismail as both Saint and Shah, and were ready to give their lives for him with fanatical devotion. Ismail spent the first years of his reign in extirpating the "White Sheep" dynasty and in annexing the provinces over which they had ruled. This was not accomplished without fighting, but Ismail was a formidable warrior and his activity was exceptional.

Defeat of the Uzbegs, 1510.—After making good his position in Western and Central Persia, Ismail determined to attack the Uzbegs, who devastated Khorasan every year. When he was ready, he marched with extreme rapidity towards Merv. His force was numerically weaker than that of Shaybani Khan, the Uzbeg Chief but, luring the enemy into an ambush, he cut them to pieces. The victory was crowned by the death of Shaybani Khan, whose skull was mounted in gold to serve as a goblet to the victor.

The Defeat of Ismail, 1514.—It was most unfortunate for Ismail that his contemporary on the throne of Turkey was Selim, the greatest soldier of the house of Othman. The rise of a Shiah family to the throne of Persia would naturally excite deep religious animosity and the Sultan determined to extirpate it before it struck roots. As a preliminary measure he sought out and put to death some forty thousand of his subjects, who were believed to belong to the heretical sect. He then marched to the Persian frontier.

Selim commanded the most formidable army of the period, consisting of thousands of long-service musketeers—the celebrated Janissaries—a strong artillery, and a division of cavalry. Ismail, on the other hand, depended entirely on his tribesmen, who were commanded by their chiefs. The Persian attempt to attack on both flanks was defeated by the deadly fire of the musketry and artillery. Ismail displayed the greatest gallantry, killing the Aga of the Janissaries, but he was wounded and nearly taken prisoner and, after suffering terrible losses, the survivors fled from the field. Selim massacred his prisoners and then marched on Tabriz, which submitted. Owing to the lack of supplies, which caused a mutiny, the victor was obliged to evacuate Tabriz, but he annexed Georgia, Diarbekr and Kurdistan. Of far greater importance was the deadly blow given to Persian *moral,* since it was realised that a force led by the Shah although able to defeat the Uzbegs, was no match for a Turkish army. It is stated that, after this defeat, Ismail never smiled again. He died in 1524, deeply regretted by his subjects. He is described by the Venetian Angiolello in the following words: "He is fair, handsome and pleasing; not very tall, but of a light and well framed figure. His hair is reddish, he only wears moustachios. He is as brave as a gamecock and stronger than any of his lords."

Shah Tahmasp, 1524–1576.—The eldest son of Ismail succeeded to the throne when a mere boy. Unfortunately for him he was a contemporary of Sulayman the Magnificent, who repeatedly invaded Persia, taking Tabriz and advancing as far into the interior as Sultania on one of his campaigns. He also captured Van, which was considered to be impregnable. Tahmasp followed an entirely defensive policy and is the theme of Milton's lines:

As when the Tartar from his Russian foe,
By Astracan, over the snowy plains,
Retires, or Bactrian Sophi, from the horns
Of Turkish crescent, leaves all waste beyond
The realm of Aladule, in his retreat
To Tauris and Casbeen.

(The *Sophi* is the Safavi monarch; Tauris and Casbeen are Tabriz and Kazvin.)

These lines reveal a remarkable knowledge of the political situation in Persia and there is every reason to believe that Milton gained his information from the account given by Anthony Jenkinson, who conceived the bold plan of trading with Persia across Russia. Descending the Volga, he crossed the Caspian Sea to Shamakha, where he was well received by the Persian Governor. At Kazvin, he presented the letters of Queen Elizabeth, but the fanatical Shah replied "Oh thou unbeliever, we have no need to have friendship with the unbelievers." The Shah, who was treating with Sulayman at the time, indeed thought of sending Jenkinson's head as a suitable gift to the Sultan, but the intrepid Englishman finally returned to England with good profits to show for the risks he had run.

Peace with Turkey, 1555.—As the years passed, fanaticism lessened and both powers grew weary of the constant warfare. Negotiations were opened and the Sultan laid down that "so long as the frontiers were respected, there would be no hostilities." Turkey considered that she was dealing with a defeated power. At the same time, the Sultan wished to reduce his commitments in Asia. It is of especial interest to note that Busbecq, the Ambassador of the Emperor at Constantinople, stated that: "It is only the Persian who stands between us and ruin."

The Death of Tahmasp.—In 1576, Tahmasp ended his long reign, leaving Persia much weaker than he had found it. After his death there was a period of anarchy, furious rivalries being unchained among the various rivals for power. At this period the position in Persia was one of anarchy, but it was destined to be followed by a reign, during which the dynasty reached its zenith.

Shah Abbas I., 1587–1629.—The 16th century was a wonderful epoch, alike in Europe and in Asia. It was an epoch of great rulers Charles V., Elizabeth, Sulayman and Akbar constituting a remarkable group, in which Shah Abbas can fittingly take his place. And yet, how unpromising were the prospects of the infant, who was destined to make Persia a great power. Left by his father, Khudabanda, in Khorasan, as its nominal ruler, he was a mere puppet throughout his boyhood in the hands of rival chiefs. His guardian, the Shamlu Chief fought the Chief of the Ustajlu, and Abbas took part in the fight, having his horse shot under him. The Ustajlu Chief, having won the day, stopped the pursuit to throw himself at the feet of young Abbas and secured his person. At this period Khudabanda, who was almost blind and entirely unfitted to reign, was attempting to enforce his authority in Fars, but Abbas was proclaimed Shah by his new guardian, who advanced on Kazvin and occupied it. The unfortunate Khudabanda was thereupon deserted by his followers and shortly afterwards died, and Abbas, who matured quickly, put his guardian to death and seized the reins of power.

Peace with Turkey, 1590.—In view of Turkish predominance, the position of Abbas was far from enviable. In 1587, a

Turkish force surprised and defeated a Persian army. This victory culminated in the occupation of the Western provinces of Persia, from Georgia in the north to Arabistan in the south. Abbas realised that he could not face the Turks and wisely decided to make peace with the Sultan as a temporary expedient, although it meant bringing Turkey on to the Caspian sea in the north and into the valley of the Karun in the south

Unfortunately for Abbas the Uzbegs attained the zenith of their power at this period under Abdulla II, who ruled an empire that stretched from Khotan to Balkh He raided Khorasan annually with impunity and even drove the Prince of Gilan, who was an ally of the Turks, from Astrabad. In Khorasan, Herat fell into his hands shortly after the accession of Abbas and the sacred city of Meshed was invested Abbas collected troops to relieve Meshed, but illness delayed his movements with the result that Meshed was also taken and sacked Finally the Shah appeared on the scene and, in 1597, inflicted a decisive defeat on the Uzbegs, who ceased their annual raids during his reign.

Sir Anthony and Sir Robert Sherley were typical adventurers, who had already distinguished themselves in various campaigns Upon the return of Abbas from his victory over the Uzbegs, they presented themselves (1598), as English knights who had heard of his fame and desired to serve him

Reorganisation of Army.—The young Shah was most favourably impressed by the brothers He realised, as did his advisers, that he could not defeat a Turkish army and expel the hated invaders from Persia, until he was master of a regular army, and he determined to utilise the services of the Englishmen for this purpose. His army consisted only of 60,000 light cavalry, who were brave but undisciplined, and would only obey their Chiefs, in whose hands the real power rested To meet this fundamental difficulty, Abbas reduced this force to one half and organised 10,000 cavalry, 10,000 infantry and some batteries of artillery, to be paid and officered by the crown. It is of interest to note that, in imitation of the Janissaries, the infantry and artillery were manned with Georgian and Armenian converts to Islam. As a still further counterpoise to the intriguing Chiefs, Abbas founded a tribe, termed Shah Savan or "Friends of the Shah." This step was entirely successful, thousands of men leaving their tribes to serve directly under the Shah, who was thus released from his dependence on the Chiefs

The Sherleys were well prepared for their task, having had the foresight to bring a cannon-founder among the members of their staff The Persian Commander-in-Chief and his officers all favoured the creation of a regular army, and their zeal seconded the knowledge of the Sherleys so well that, in a comparatively short time, a revolution was effected and, in place of an ill-organised mass of mounted tribesmen, an army consisting of cavalry, artillery and infantry was created

Persian Victories over the Turks.—Shah Abbas was eager to prove his new weapon, and fortunately, the Sultans who were his contemporaries were not great soldiers He broke the peace in 1603, and invested Tabriz, which surrendered and, after 18 years, again formed part of the Persian empire Abbas fully realised that, sooner or later, he would have to meet a powerful Turkish army. Nor was he mistaken for, upon the death of the voluptuary Mohammed III., the youthful Ahmad organised a large force, which marched to the Persian frontier Abbas like his predecessors, chose the plain in the vicinity of Lake Urmia for the trial of strength and, although the enemy were 100,000 strong against 62,000, they had lost much of their former efficiency whereas the Persians for the first time fought as a regular army. Abbas upset the Turkish plan of battle by detaching a considerable force of cavalry to make a wide detour, to demonstrate on the rear of the enemy, and to create the impression that this was the main force. The Turks were deceived and while they were countermarching, the Persians charged home and won a decisive victory, 20,000 heads being piled up in front of the Shah's tents. The fruits of this victory were the lost provinces of Persia, but, of greater importance, was the feeling that the Safavi dynasty was able to meet the hereditary foe in battle and defeat him.

Genius of Shah Abbas.—The fame of Abbas does not rest solely on his military exploits; it is also founded on his genius for administration. Realising the vital importance of communications, he built bridges and caravanserais on every main route. He repressed brigandage with merciless severity and encouraged trade, not only in Persia, but also with foreign countries, whose representatives were welcomed at his Court To prove his zeal for pilgrimages, he walked the entire distance of eight hundred miles from Isfahan to Meshed, to worship at the shrine of the *Imam* Riza His subjects, deeply influenced by the example of their beloved Shah, followed him by thousands, and these pilgrimages, perhaps more than anything else, welded the different races—Persians, Turks and Arabs—into a nation. The most striking administrative act of Shah Abbas was the creation of a new capital at Isfahan There, on almost the only river of the plateau, a superb city grew up, approached by stately bridges, which led past the luxurious gardens of the courtiers, to the Royal Square. The most important building was the *Chehel Sutun* or "Hall of Forty Columns" This great Hall of Audience was open in front, while the throne was set in a room opening out from it. Behind, was a gallery containing three immense oil paintings on each side

Capture of Hormuz, 1507.—One of the most important events in history was the rounding of the Cape of Good Hope by Bartholomew Diaz, in 1487, and the subsequent establishment of direct intercourse by sea between Europe and the East Greatest among the Portuguese captains was Alfonso D'Albuquerque who, with a squadron of six ships, captured the island emporium of Hormuz Owing to intrigues, D'Albuquerque was unable to retain his conquest on this occasion but, eight years later, he returned as Viceroy in command of a powerful fleet, and built the famous fort, which is almost as perfect to-day as at the date of its construction Throughout the 16th century, the Portuguese, owing to their sea-power, dominated the Persian Gulf, to the intense anger of the Shahs, whose ports were raided, and whose subjects were oppressed without mercy

Arrival of English, 1601.—The English appeared in Eastern waters just a century later than the Portuguese Their chief commodity was broadcloth, for which there was little demand in India, and it was consequently decided to open up relations with Persia, which was reported to have a cold climate In view of the position of the Portuguese in the Persian Gulf, it was decided to commence operations at Jask and, in 1616, a ship loaded with a trial cargo, was despatched to that port. The English were well received by Abbas Apart from the hope that they might help him to expel the Portuguese, he was most anxious to export silk, which was a royal monopoly, by the Persian Gulf, and thereby deprive the Turks of a large source of customs' revenue

The Portuguese viewed the arrival of the English with intense hostility They attempted to capture the pioneer ship, but were just too late However, when a second expedition appeared on the scene, they were waiting off Jask, and attacked the English In spite of their superior force, they were unable to capture the English ships, and were completely defeated The result of this action was most important The Shah realised that his hoped-for chance of expelling the Portuguese had come and, the English were induced to co-operate

As a preliminary operation, the English and their allies captured the fort of Kishm Island, on which the Portuguese depended for their supplies, Hormuz itself producing neither supplies nor fresh water, the entire surface of the island being covered with a salt efflorescence. The English then towed boats laden with Persian troops on the main objective The Portuguese squadron made no attack on the encumbered English and were tamely destroyed at anchorage. A battery was then set up on shore and a breach was effected. The garrison of the fort beat off a Persian assault, but their position was desperate and they surrendered to the English Thus fell Hormuz. This was the first great feat of arms performed by the English in the East and, since that date, their connection with Persia has been continuous.

Decline of Safavi Dynasty.—After the death of Shah Abbas,

his descendants occupied the throne for a century, but it was a period of decline, during which only the veneration in which the dynasty was held, prevented a powerful official from ousting his degenerate descendants. Thanks to the jealousy which Abbas had shown towards his sons, princes of the blood, instead of being trained to arms, were immured in harems under the tutelage of eunuchs. Shah Safi, who succeeded Abbas, not only put to death his own relations of both sexes, but he executed most of the generals and councillors, who had made the reign of his grandfather an illustrious epoch in Persian history The contemporary Sultan was Murad IV, the last of the warrior Sultans, who invaded Persia repeatedly, and massacred the inhabitants of Hamadan, Tabriz and Baghdad, which latter city was annexed Other monarchs reigned and displayed pomp and pageantry, which dazzled European travellers, until the accession of Sultan Husayn, in 1694. This monarch was both meek and pious, but was placed on the throne at a time when such qualities were as much out of place as they were in Edward the Confessor Under the Safavi dynasty, the province of Kandahar had been a bone of contention with the Moghul rulers of India It was in Persian hands when Sultan Husayn ascended the throne and, as the Ghilzais, whose chief city it was, were intriguing with Delhi, it was decided to send a Georgian Prince as Governor, supported by a strong Persian force Gurgin Khan, as the Persians called him, arrested Mir Wais, the Ghilzai Chief and instead of executing him, sent him as an exile to Isfahan There he won over the credulous Shah with a story that Gurgin Khan was conspiring to hand over Georgia to Peter the Great He was, thereupon, reinstated and, upon his return, successfully plotted against Gurgin Khan, who was killed, while his Persian escort was cut to pieces Mir Wais then strengthened his position at Kandahar until his death.

Ghilzai Invasion, 1722.—His successor, Mahmud, raided Persia in 1720, and captured Kerman, but was driven back to Kandahar by a capable Persian governor, who was subsequently dismissed Two years later, he again invaded Persia On this occasion he failed to take Kerman or Yezd, and was considering the advisability of retreating when envoys from the Shah offered him a large sum of money to leave the country. Encouraged by this proof of weakness, the raiders advanced on Isfahan and halted at Gulnabad, a village situated on the open plain, 11 miles from the capital

The Persian army was 50,000 strong and was provided with artillery Its base was the capital and it was fighting for the very existence of Persia The Ghilzais were 20,000 strong and their artillery consisted of one hundred camel guns They were in splendid training and despised their enemy The battle opened with a charge by the Persian right wing, which met with some success The Persian left wing also charged but suffered heavy losses from the Ghilzai guns The tribesmen then advanced and finding the Persian artillery without an escort, cut down the gunners and turned their guns on the infantry, who fled from the field in a panic Isfahan was then invested and, owing to the cowardice of its defenders, the Afghans were able to cut off its supplies During this investment, Tahmasp, the Heir-Apparent, left Isfahan and attempted to raise a force but failed Finally, famine compelled the Shah to surrender and Isfahan fell to a raiding band of Afghan tribesmen Although the dynasty was not actually ended until Nadir Kuli was crowned Shah, it ceased to rule when the meek Husayn surrendered and Persia fell, owing to the rule of Shahs who were trained by eunuchs

Action of Russia and Turkey.—The fall of Persia constituted the opportunity of Russia and Turkey Peter the Great was the first in the field He captured the key-fortress of Derbent in 1722 and, in the following winter, when the Afghans besieged Resht, he acceded to the prayer of its governor, and occupied not only the capital of Gilan, but also the province In the summer of 1723, he captured Baku

The Turks arrived on the scene rather late They, however, annexed Shirwan and Georgia They particularly coveted Baku, but were forestalled by Peter In 1724, the two powers agreed to the dismemberment of Persia, Russia to take the districts already occupied and the three Caspian provinces, while the share of Turkey was those western provinces, which she held at the accession of Shah Abbas. In the following year, the Turks enforced their claims by force of arms.

Ashraf, who had succeeded Mahmud, was a capable ruler, resembling his uncle Mir Wais. He enjoyed great prestige among his fellow-tribesmen, whose *moral* he increased. His position was one of difficulty. He held Isfahan, Shiraz and South-east Persia, but could hardly be said to administer the country. Indeed the Afghans were totally lacking in the art of administration Tahmasp was collecting a force in Mazanderan, Russia was determined to maintain her position, and Turkey had already seized Tabriz and Hamadan. Ashraf despatched an embassy to remonstrate at the action of a Sunni power uniting with Christians in hostile action against Persia, which was now governed by Sunni Afghans In spite of the feeling excited at Constantinople, the Turks declared war and an army captured Kazvin and marched on Isfahan The Afghan leader, who was a fine soldier, cut to pieces a Turkish detachment of two thousand men This success produced a considerable moral effect on the Turks and when Afghan *mullas* appeared in their camp and demanded of the Turkish Pasha how he dared to war on Muslims, who were obeying the divine law in subverting the power of the heretical Shiahs, there were serious desertions The Pasha determined to fight immediately and, although he outnumbered the Afghans by three to one, his sullen troops were defeated with heavy loss With consummate diplomacy Ashraf refused to pursue; moreover he released his prisoners and even restored their property to them This masterly moderation resulted in the Sultan making peace He recognized Ashraf as Shah of Persia, while the Afghan recognised him as Caliph Actually the Turks gained the provinces they had seized and Persia remained dismembered

Tahmasp and Nadir Kuli, 1727.—Ashraf was no sooner freed from the Turks than he was confronted with another serious danger. Tahmasp, at this juncture, was joined by Nadir Kuli leader of a robber band, who was destined to achieve fame as the conqueror of Delhi He brought with him some 5,000 of his Afshar tribesmen Tahmasp had previously collected some 3,000 Qajar Turks under their Chief, Fath Ali Khan, and recruits began to pour in who were determined to destroy the hated Afghans Nadir soon made away with the Qajar Chief and induced the Shah to secure Khorasan before attacking the Afghans This campaign was entirely successful, both Meshed and Herat being recaptured from the Chiefs who had occupied them

Expulsion of the Afghans, 1730.—Meanwhile Ashraf, who was seriously alarmed at the national revival, determined to attack before the Persian army became too strong The two armies met at Mehmandost in the vicinity of Damghan in 1729 The Afghans, whose *moral* was very high after their victory over the Turks, charged, but were met with a heavy musketry and artillery fire by Nadir, who then advanced and drove the Afghans from the field They stood again at Isfahan, and at Shiraz, but were finally crushed, and the survivors were hunted across Persia to the desert, where the Baluchis intercepted and killed Ashraf

The Afshar tribesman, Nadir Ḳuli, destined to restore the power and prestige of Persia, was born in a tent close to Mohammedabad in the district of Darragaz, in the province of Khorasan In the summer his father inhabited the village of Kupkan, situated on the route between Kuchan and Mohammedabad He died young, leaving his wife very poor and, when Nadir was eighteen, both he and his mother were carried off by a band of Uzbegs and sold as slaves Four years later, Nadir escaped and returning to Persia, entered the service of the Governor of Darragaz The times were troublous and Nadir soon won a reputation for bravery and so distinguished himself that his master gave him his daughter in marriage Upon his death Nadir succeeded to his post Summoned to Meshed by Malik Mahmud the ruler of Khorasan, he defeated a raiding force of Uzbegs but claiming what was considered to be an excessive reward, he was beaten and dismissed He soon reappeared on the scene at the head of a body of robbers But he aimed at higher things and capturing Nishapur, he occupied it in the name of Shah Tahmasp, whose service he entered

Turkish Campaigns.—Nadir fought three campaigns against the Turks at this period of his career. He lost one battle, but finally defeated the national enemy, and recovered the western provinces of Persia. The Russian Government, after the death of Peter the Great, decided to withdraw from Persia, and restored her Caspian provinces, in 1732. Three years later, war broke out between Russia and Turkey. Nadir took advantage of the situation to secure Baku and Derbent, by a threat to join Turkey unless these important fortresses were surrendered to him and Russia yielded Nadir had dethroned Tahmasp, who had made a disastrous treaty with the Turks, and his infant son had opportunely died Nadir had freed Persia from Afghans, Turks and Russians, and the Persian nation was profoundly grateful to him. At an assembly of the leading men in Persia, he was unanimously elected Shah.

D.—FROM NADIR SHAH TO THE REVOLUTION, 1736–1907

Nadir had settled accounts with Turkey and Russia, but the nation thirsted for vengeance on the Afghans, the recovery of whose country would restore to Persia all the territories ruled by Shah Abbas. Accordingly, in the year after his coronation, he led a powerful army 80,000 strong, towards Kandahar The city was ruled by Husayn, brother of the captor of Isfahan, who was quite unable to meet Nadir in the field, but decided to defend the city, trusting to its great strength. Nadir, who possessed no heavy guns, was reduced to a blockade, which operation he carried out with great thoroughness, building a wall, fortified with towers outside the perimeter of the city. For a year the blockade was continued with no decisive results Nadir then assaulted and captured some of the outworks, up which guns were dragged with great difficulty and Kandahar lay at his mercy. Having in mind further campaigns, the victor treated the Ghilzais with marked clemency, so much so that he enlisted a number of them in his army, and they served him loyally until his death.

Invasion of India, 1738.—During the tedious months spent outside Kandahar, Nadir prepared his plans for a campaign in India, which was the natural sequel to the recovery of the eastern provinces of Persia. The great Moghul dynasty had declined rapidly since the death of Aurungzeb, in 1707, and Mohammed Shah, his degenerate descendant "was never without a mistress in his arms and a glass in his hand." This despicable monarch and his effeminate troops were no match for virile Nadir and his warlike veterans. Treachery was also at work and more than one Indian noble had opened up relations with the Shah. With incredible folly, the Court at Delhi relied on Kandahar to repulse Nadir and, not only made no preparations for defence, but treated Nadir's requests that no fugitives should be granted asylum across the frontier with contempt.

After the capture of Kandahar, Nadir, whose prestige was greater than before, marched north, following in the footsteps of Alexander the Great, and captured Kabul, which was the key to the Khyber Pass, the main land-gate of India. There he secured a large sum of money, which enabled him to pay his troops, and also to arrange with the Afridis that his passage of the Khyber should not be opposed. Mohammed Shah was thoroughly alarmed by this time, but before the situation was really grasped by him or his councillors, Nadir had captured Peshawar and had crossed the Indus at Attock.

Battle of Karnal, 1738.—One of the historical battlefields of India is at Karnal, situated some sixty miles to the north of Delhi, on the right bank of the Jumna. There Mohammed Shah formed a strongly entrenched camp and supinely awaited the invaders. Nadir realised the strength of the Indian position and the fact that his men were unused to assault fortifications While he was considering the best course to pursue, Saadat Khan, a leading feudatory Prince, who had brought a reinforcement of 30,000 men, attacked a raiding party of Kurds Troops were brought up on both sides until the engagement became general. Nadir laid an ambush with complete success, Saadat Khan was taken prisoner and the panic-stricken Indians took refuge in their camp The Persians had killed 20,000 of the enemy; and part of the Indian artillery fell into their hands with rich spoils of every description Nadir wisely did not assault the Indian camp, but, he surrounded it, and prepared to bombard it.

Mohammed Shah realising that his troops would not fight again, decided to surrender before famine appeared among them He was received with courtesy by the victor, whose letter describing the battle and surrender have come down to us. Acting on the principle that Mohammed Shah was, like himself, of Turkoman descent, he commissioned his son Nasrulla to meet him outside the camp and when he entered his tent, "we delivered over to him the signet of our Empire " After paying this empty compliment, the victor, who marched in triumph into Delhi, determined to strip the people of all their portable wealth. In this he was successful and the value of his loot was estimated at £87,000,000 However that may be, it made Nadir a miser Had he employed this wealth wisely, it would have proved to be a blessing to impoverished Iran and the course of history would have run differently.

A rising in Delhi, suppressed with such pitiless severity that a "Nadir Shahi" is synonymous for a massacre in modern Delhi, and a marriage between Nasrulla and the daughter of the defeated Mohammed were the chief incidents of the stay at the capital Nadir, realising that he could not hold Delhi, restored it to Mohammed, who was, at any rate, utterly unwarlike. He, however, annexed the provinces on the right bank of the Indus, which, during the reign of Darius had formed part of the Persian Empire Thus, after a stay of only two months in India, he returned to Afghanistan with greater power, wealth and fame than any other Asiatic conqueror since Tamerlane It remains to add that he was the last great Asiatic conqueror

Campaign Against Bokhara, 1740.—During the siege of Kandahar, Nadir had despatched his eldest son and heir against Balkh, whose ruler had promised help to the Ghilzai Chief. Riza Kuli had proved himself worthy of the command, for his assault was so fierce and so continuous that the city was surrendered The young prince had then crossed the Oxus and defeated a strong army of Uzbegs Nadir, unwilling to attack Bokhara at this juncture, recalled his son and wrote to the Amir of Bokhara that he had ordered him "not to disturb countries ruled by descendants of the Turkoman." The situation was now entirely changed Nadir had not forgotten that he had been a slave at Khiva, and he realised that a campaign against the two Uzbeg states would form a natural corollary to the conquest of Northern India, and would protect Khorasan against raids for many years to come Finally, he anticipated rich spoils and little resistance Large quantities of grain had been collected at Balkh and loaded into boats, and the expedition commenced its march down the Oxus to Charjui, where a bridge of boats was constructed The Amir of Bokhara, realising that he could not resist Nadir's veterans, promptly submitted and proceeded to the Persian camp There, at first, he was treated with disdain, but he was finally restored to the throne on condition that the Oxus should again constitute the boundary of Persia, and that he should supply a contingent of troops for the Persian army The treaty, which was accompanied by the payment of huge sums of money, was cemented by a double marriage between the two monarchs

Conquest of Khiva, 1740.—After Bokhara it was the turn of Khiva. The Khan realised that Nadir depended entirely for his supplies on the boat-loads of grain and made a desperate effort to capture them. However, Nadir suddenly appeared on the scene and, although his men were suffering terribly from thirst, the charge he led was irresistible The army then advanced down the river, with the precious grain guarded by the entire force, but there was no further resistance and the Khan tamely surrendered Before the campaign he had put to death or mutilated the envoys of Nadir, who justly executed the barbarous ruler together with twenty of his councillors. Among the prisoners were two Englishmen, members of the staff of Jonas Hanway, the intrepid merchant, who attempted to trade with Persia and Central Asia across Russia, and has left us a most valuable account of the state of Persia at this period Nadir treated the Englishmen with kindness, giving them passports and a promise of redress for their losses One result of this campaign was the release of thousands

of Persian and Russian slaves. Many of the former were settled in Nadir's homeland of Darragaz, especially in a village which the Shah founded on the site of his birthplace.

The conquests of Nadir were now finished. He had restored the boundaries of Persia and made them wider than those of the Safavi dynasty. He had made Persia famous as a great fighting power and he had not only released the inhabitants of Khorasan who were slaves, but had ensured their safety in the future. Had he possessed any administrative capacity, he could have restored prosperity to Persia, but success and wealth had spoilt his character and made him a miser, and the remaining years of his life are a record of ever-increasing avarice and cruelty, which made him detested by his subjects.

Lesgian Campaign, 1741-1742.—There is a Persian proverb which runs, "If any Shah is a fool, let him march against the Lesgians." During the Indian campaign, these savage tribesmen of Daghestan had raided Shirwan and had killed Ibrahim Khan, Nadir's only brother. He was therefore bound in honour to invade their country and punish them severely. At first all went well and certain sections of the tribe, who inhabited the lower hills, submitted. But the main body of the Lesgians retreated into the dense forests until they were able to attack the Persian army and inflict heavy losses. Nadir refused to retreat until supplies failed when he was forced to make for Derbent, where the situation was only saved by the arrival of supplies shipped from Astrakhan. It was this bitter experience which induced Nadir to organise a fleet on the Caspian Sea. For the time being he retired from the scene baffled and sullen.

Like Shah Abbas, Nadir suffered from jealousy of his son, who was a distinguished soldier. He was shot at from an ambush by two Afghans and believed that the assassins were in the pay of his son. However that may be, he ordered him to be blinded and bitterly repented it when too late. Persians remember the remonstrance of the Prince: "It is not my eyes but those of Persia which you have put out."

The success of the Lesgians caused rebellions to break out in various parts of the empire, but they were suppressed with merciless severity. Nadir had unwisely attempted to reunite Islam by abolishing the Shiah sect and by substituting the *Imam* Jafar for Ali, the patron saint of Persia. At the time, there was no open opposition to the change by his subjects, who feared to oppose him, but the following decision was given by the religious leaders of Turkey: "The new sect is contrary to the true belief, and it is permitted to kill the people of Persia." This decision was followed by an enormous Turkish army, which was determined to avenge former defeats, but Nadir was as great a general as ever, and inflicted a crushing defeat, capturing the whole of the artillery and military stores of the enemy. Negotiations for peace followed, in which Nadir agreed to abandon his claims to found a new sect and released his prisoners. This was his last victory.

Assassination of Nadir, 1747.—As the years passed, Nadir put to death so many of his trusted officers that finally, in self-defence, he was attacked at night by his own body-guard and killed, fighting to the bitter end. Thus fell Nadir Shah, who, endowed with superb physique, a voice of thunder, dauntless courage and a genius for war, had hewn his way to the throne. Like Napoleon, with whom he may well be compared, success caused moral deterioration, and when he died, the nation which he had saved from the Afghans, the Turks and the Russians, received the news with intense relief. Had he died after the conquest of Khiva, he would have been the national hero for all time.

The assassination of Nadir Shah gave the signal for the break-up of his composite army. The Afghans under Ahmad Khan alone remained loyal, but being unable to avenge his fallen leader, he marched off to Kandahar and, aided by the capture of a treasure convoy, founded the kingdom of Afghanistan, which included most of the Indian provinces situated on the right bank of the Indus. Throughout, he remained loyal to the family of Nadir and when, after desperate contests for power, the son of ill-fated Riza Kuli was set on the throne of Khorasan and then blinded, Ahmad Shah, as he had proclaimed himself, avenged Shah Rukh and constituted Khorasan a separate kingdom for him under Afghan protection and suzerainty.

Rival Claimants in Persia.—Fath Ali Khan of the Qajar tribe, who was killed by Nadir when he joined Tahmasp, had a son, Mohammed Husayn Khan. After the death of Nadir Shah, he raised a force, with which he successfully opposed Ahmad Shah, and occupied the Caspian provinces. A second claimant was Karim Khan, a member of the Zand tribe of Fars. A man of humble extraction, he raised himself to power by sheer force of character and had a large following in South Persia. Finally there was Azad the Afghan general, who was in charge of Azerbaijan. A curious triangular contest ensued, in which each claimant at one period seemed to have won, but finally Mohammed Husayn was defeated and killed, and Azad surrendered, leaving Karim Khan supreme.

The Zand Dynasty, 1750-1794.—Karim Khan never aspired to the title of Shah, but termed himself *Vakil* or Regent. He made Shiraz his capital and adorned it with many fine buildings. Under his kindly rule, Persia gained a sorely needed rest, and began to recover something of her ancient prosperity. Upon his death, however, there was the usual fight for power among the members of his family. Meanwhile Aga Mohammed Khan, the eunuch chief of the Qajar tribe, collected a force and, winning over to his side Haji Ibrahim, the redoubtable Vizier of the Zand monarch, finally defeated Lutf Ali the heroic representative of the Zand dynasty, who was barbarously done to death by the cruel Qajar.

The Qajar Dynasty, 1794-1925.—Aga Mohammed was a good soldier and, after the final defeat of his rival, decided to attack Heraclius who, upon the death of Nadir Shah, had declared the independence of Georgia, and had annexed provinces up to the River Aras. He had also made a treaty with Russia, by the terms of which he was entitled to receive protection. Heraclius realised that he could not receive immediate help from Russia, yet he foolishly met the overwhelming Persian army in the field and was defeated. Tiflis was taken, the priests and infirm were massacred and the able-bodied of both sexes were enslaved. After Georgia, the Shah turned his attention to Khorasan. The wretched Shah Rukh was unable to offer any resistance, but Aga Mohammed required more than submission. He coveted with passion priceless jewels from Delhi, which he knew were in the possession of the blind monarch, and set his torturers to work. Day by day some valuable gem was produced. Last of all the famous ruby of Aurungzeb was extracted and Shah Rukh, worn out by the tortures, died cursing the Qajar eunuch. Shortly afterwards, the tale of his cruelties was brought to an end by the hands of two of his body-servants whom he had doomed to death, but yet permitted to attend him. Thus, in 1797, after only three years rule over the whole of Persia died the founder of the Qajar dynasty, who was rightly detested by all classes.

Fath Ali Shah.—Under his nephew, Fath Ali, Persia came within the orbit of European politics. The first step was taken by the British rulers in India. In 1798, Lord Wellesley received a letter from the Amir of Kabul in which he stated his intention of making an expedition into India. This would have upset British policy and Wellesley sent a Persian, who was acting Resident at Bushire, to induce the Persian Court to put pressure on the Amir. The task of the envoy was made easy by an Afghan demand for the cession of Khorasan, to which the young Shah replied that he intended to restore the eastern boundaries of Persia, as they were in Safavi days. He followed up this threat by despatching a force to help two Afghan pretenders, with the result that the Amir retired from Lahore to meet the threat in the west. The mission of the British Agent was thus entirely successful and paved the way for an accredited British Envoy, who was about to land on Persian soil.

French Threat to India.—The genius of Napoleon dominated his adversaries to such an extent that even his fantastic schemes caused them great alarm. Among these must be reckoned his plan of using the Shah as an instrument for the invasion of India in co-operation with French and Russian troops. To us, who have studied accurate maps and realise the barren nature of these

countries, the scheme was impracticable but, in 1800, it was seriously considered by Napoleon and Paul of Russia. Indeed, the latter actually ordered the Don Cossacks to march on India. The movement was begun, without supply-columns or maps, but it was stopped at the Volga upon the death of the Tsar, which was fortunate for all concerned. The British, determined to forestall the French, instructed their Agent, Captain John Malcolm to induce the Shah to bring pressure on the Amir of Kabul, to counteract the designs of the French, and to negotiate a political and commercial treaty. Malcolm's success was complete and he speedily gained all his objects. Moreover he established a high regard for British honour in Persia, which still exists.

The British foolishly withdrew Malcolm and left no permanent representative at Tehran. Napoleon took advantage of the favourable position and, in 1802, made definite overtures to Persia. These were followed up, in 1805, by the appearance at Tehran of a French envoy who, in view of the fact that the Emperor had declared war on Russia, offered to restore Georgia to Persia and to subsidise the Shah, who, in return, was to join France in an invasion of India. Fath Ali was most unwilling to become the ally of a nation which had put its monarch to death. However he could obtain no reply to his appeals from the British, who could not make up their minds what to do. Finally, therefore, he agreed to the French proposals. Fortune, however, favoured the British since, by the time that the Persians had agreed to the French proposals, Napoleon had made peace with the Tsar, and Persia lost all hope of recovering Georgia through his aid.

Treaty with Great Britain, 1814.—Outwardly a French Mission held the field and Malcolm, when he again landed in Persia, was affronted. In spite of this the situation was changing, the French Mission was dismissed and Sir Harford Jones representing the Crown, as apart from the Governor-General of Bengal, was given a magnificent reception and a new treaty was negotiated. In 1814, a definite treaty was signed, by the terms of which treaties or military co-operation with nations hostile to Great Britain was barred, Persia further pledging herself to use her influence with the states of Central Asia to adopt a similar policy. In return, Persia was granted a subsidy of £150,000 per annum, which was to be stopped if she engaged in an aggressive war. This treaty dealt with the French peril after it had passed. On the other hand, it was not realised by British statesmen that, so far as Persia was concerned, the annexation of Georgia and Karabagh by Russia had created an entirely new situation, that the treaty had not recognised the fact and was therefore likely to lead to trouble.

Struggle for Georgia.—Persia was bound to fight for Georgia and the campaigns that followed may be considered to fall into two distinct periods. The first ended with the defeat of Persia in 1812, peace being made in the following year by the Treaty of Gulistan. Thirteen years later, Persia again attempted to reconquer Georgia, and her final defeat is recorded in the Treaty of Turkomanchai, which was signed in 1828. The Persian army was commanded by the Heir-Apparent, who invariably lost his head on the battlefield, and rendered the efforts of a handful of British instructors nugatory. The first campaign opened with the siege of Erivan by a Russian force, which was so harassed by its lines of communication being cut, that the operation was abandoned. The campaign was ended, in 1812, by a decisive action fought at Aslanduz. A small Russian column surprised the Persian army in broad daylight. The British officers had drawn up their men when Abbas *Mirza* in a panic, ordered a hasty retreat, with the result that the force was annihilated.

After this disaster, the Shah, who was also panic-stricken, agreed to abandon all claims to Georgia; he also ceded Derbent, Shirwan and Karabagh. Russia, at this very time, was at the crisis of her fate owing to the invasion of Napoleon. Consequently Persia was to be blamed for abandoning her possessions and making no further effort against such a sorely embarrassed enemy. As was to be expected, Persian opinion regarded the Treaty of Gulistan as a national disgrace. It had been vaguely worded, so much so that the possession of three districts remained in dispute. Negotiations were being carried on but, before they were completed, Russia occupied the areas. Persian opinion was deeply stirred, recruits poured in, and the Shah was forced by public opinion to break the treaty. At first the Persians carried all before them, and occupied Shirwan and Talish in less than a month. But the Persians would not face Russian troops.

Defeat of Persian Army.—In an action fought near Ganja, although the Persians were numerically superior, their cavalry fled, demoralised by artillery fire. The Russian infantry then advanced and swept the Persians off the field. Fath Ali was a miser; he refused to pay the troops in the winter, and they perforce were disbanded. Realising the position, a small Russian force marched on Tabriz and captured not only the city but also the entire artillery park of the Persian army. Thus ignominiously hostilities were ended. By the Treaty of Turkomanchai, the Aras became the boundary of Persia. An indemnity was demanded and extra-territorial rights were included as well as a commercial treaty, by the terms of which there was a 5% tax on imports and exports. This treaty inaugurated a new era and became the basis on which other European nations conducted their intercourse with Persia. Great Britain recognised the changed position and, in view of the fact that Persia was the aggressor, declined to pay the subsidy. Persia was, however, in dire straits from lack of money to pay the Russians, and it was arranged that a single payment of £150,000 should be held to cancel all further claims on the subsidy.

Persia and Afghanistan.—Persia realised that her defeat by Russia was final. To salve her wounded pride, she decided to make strenuous efforts to recover Herat and other provinces that now formed the state of Afghanistan. This trend of policy was viewed with apprehension by the British Government, since Persia was under Russian influence and, if she reconquered Herat, Kabul and Kandahar, Russian agents would be established close to the Punjab. Actually her objective during this period was Herat, and Great Britain made strenuous and successful efforts to keep that province outside the influence of both Persia and Russia.

Abbas Mirza was more successful in Eastern Persia than against Russia. He gradually reconquered Khorasan until Sarakhs alone held out, encouraged by the presence of the Khan of Khiva. However the Khan, alarmed by the surrender of Kuchan, retired and Sarakhs was stormed, a feat which restored Persian prestige in Central Asia. Shortly afterwards, Abbas Mirza and then Fath Ali Shah died.

Mohammed Shah was the son of Abbas Mirza and, when he had defeated various pretenders and established himself on the throne, it was clear that he was determined to capture Herat. He had already, during his father's lifetime, commanded a force which was besieging that city, but had hastened to Tehran to secure his nomination as Heir-Apparent, upon hearing the news of his father's death. At this period a second British Military Mission reached Tehran, but it was received with marked coldness by the young Shah and was unable to serve any useful purpose.

Siege of Herat.—It is impossible to give any account of British policy in Afghanistan, and we must confine ourselves to the question of Herat. In 1837, the Shah opened his campaign, and the first prisoner that was captured, was bayoneted in his presence. Yar Mohammed, the able Vizier of the Prince of Herat, had made every preparation for a siege. The fortifications had been repaired and strengthened; supplies in large quantities had been stored, and all villages within twelve miles of the city had been burned. By a singular stroke of good fortune, an English artillery officer, Eldred Pottinger, arrived on the scene, and soon became the life and soul of the defence. In the spring of 1838, the British Envoy reached the Persian camp and nearly persuaded the Shah to break off the siege. However, at this juncture, the Russian Envoy offered the services of a Russian officer. Sir John McNeill was consequently flouted and quitted the Persian camp. Shortly after his departure, the Shah made his final effort. For six days the defences were battered, but the general assault failed. The Shah was utterly dejected and when he received a communication from the British Minister that his Government would view the occupation of Herat as a hostile act, and that the island of Kharak had been seized by British troops, he agreed to their demands and broke up the siege He died in 1848, leaving

Persia on the verge of revolution and bankruptcy.

Nasir-ud-Din began his reign well. He brought with him from Tabriz his adviser, *Mirza* Taki Khan, and appointed him his Vizier. He was the most remarkable Persian of his generation, being not only capable and hard-working, but also incorruptible. He set to work to abolish the sale of appointments and of justice; and the embezzlement of the soldiers' pay, the grant of pensions to favorites and many other abuses were all taken in hand. His reforms raised up a host of enemies, among them the mother of the Shah who persuaded her son that the Vizier was too powerful with the result that he was executed—a terrible blow to Persia. After this the Shah, generally speaking, ruled in the bad old way, although he was a more enlightened ruler than his predecessor, partly owing to his visits to Europe.

Religion of the Bab.—During the early part of Nasir-ud-Din's reign, an inhabitant of Shiraz preached a new religion. He proclaimed himself the *Bab* or "Gate," through which men might attain to knowledge of the Twelfth *Imam*. The *Bab* was the son of a grocer and, when he attempted to convert his fellow-townsmen, he was considered to be a madman and was imprisoned. His followers, however, increased to such an extent that the Shah finally ordered him to be executed at Tabriz. After his death, the doctrine spread far and wide, causing risings and an attempt on the Shah's life, which was met with pitiless persecutions. The religion founded by the *Bab* still exists and counts many followers, not only in Persia but, in the Levant, and in America.

Settlement of Afghan Question.—During the generation that followed her victories over Persia, Russia not only strengthened herself in that country by the creation of a naval base on the Persian island of Ashurada in Astrabad Bay but made great efforts to gain a footing in Central Asia and in Afghanistan. It was probably at her instigation that Nasir-ud-Din determined to win renown by the capture of Herat. Yar Mohammed, the capable Vizier had died, leaving the province to his son, who was mentally deficient, and whose first act was to open up negotiations with Persia. The British Government thereupon imposed a treaty on Persia, by the terms of which that power promised not to send troops into the Herat province, unless it was attacked from outside. The treaty caused intense irritation to Persia and was the main cause of relations being broken off between the two countries. Persia then gained possession of Herat through an Afghan nominee in 1856, and there was intense delight throughout the country. But Great Britain had to be reckoned with. In addition to paying a subsidy to the Amir, she declared war on Persia and landed an expeditionary force at Bushire. Under Outram, a march was made inland and a Persian force was defeated. The troops were then transferred to the mouth of the Karun River, where a second success was gained. Persia had already sued for peace and, by the terms of a treaty signed in Paris, in 1857, the Shah agreed to evacuate Herat and to recognise the independence of Afghanistan. No indemnity or concessions were demanded.

The Awakening of Persia.—Nasir-ud-Din was fated to see the advance of Russia across Central Asia until that Power entirely enveloped his northern frontiers in Asia. The khanates, as they were termed, were annexed one by one, until only the Turkoman was left. In 1881, after more than one failure, Skobeleff stormed the stronghold of the Tekke Turkoman at Geok Teppe, the other tribes gradually submitted and Russia forced Persia to accept a boundary that was most unfavorable to her, and gave her new neighbour a strangle-hold on Khorasan. We must now turn to the advance of the Indian empire. Baluchistan had relapsed into anarchy at the end of the eighteenth century and no immediate attempt would have been made to interfere with this state of affairs, but for the fact that it was decided to construct a telegraph line from England across Persia to India. Negotiations were opened with Persia, with the result that a boundary was finally drawn between Persian and British Baluchistan. This latter province may be said to have been the creation of that great frontier officer, Sir Robert Sandeman, through whose exertions law and order were gradually introduced into a "No Man's Land." From the Persian point of view these boundaries, which included the delimitation of her frontier with Turkey, completed her envelopment.

Constitutional Movement.—The desire for a constitution in Persia is quite recent. Persia was affected by the construction of telegraph lines and so forth, but her national pride in her own perfection was also strong. The Shah as a young man was in favour of progress, but the failure of the attempt at constitutional government in Turkey in 1876 frightened him, and his later policy trended towards keeping Persia free from dangerous new ideas. "I want ministers who do not know whether Brussels is a city or a cabbage," was his frank avowal and, although his point of view was selfish, the event has proved that Persia was not ripe for the new order. Nasir-ud-Din was assassinated in 1896. His successor, Muzaffar-ud-Din was a poor creature, who led Persia down the broad road to bankruptcy by borrowing large sums of money from Russia, which he wasted on his journeys to Europe and on his favorites. During his reign all fear of the Shah passed away, and, with it, the tribes robbed with impunity on the caravan routes, inflicting serious losses on all classes.

The movement in favour of a new order was led by Jamal-ud-Din, an agitator, who gained considerable influence in Turkey and Persia during the last years of Nasir-ud-Din. He was rather a Pan-Islamist than a constitutionalist, who vehemently denounced the corruption of the Persian Vizier. Another moving spirit was Prince Malkom, a clever Armenian with a French education. He was Persian Minister in London and, while holding this post, quarreled with the Vizier over a lottery, which the Shah had sold to him, but which the latter wished to cancel. In a paper which he published, Prince Malkom advocated a Parliament for Persia, while he never ceased to denounce his enemy the Vizier.

The weakening of the power of the Shah encouraged the reformers and, in 1905, a definite movement began in favour of a constitution. It commenced with a protest against the Vizier, who was held to be responsible for the costly journeys of the Shah, for the corrupt government and for the disorder in the country. A number of merchants followed a time-honoured custom and took *bast* or sanctuary at a mosque in the capital, where they were joined by some *mullas*. Driven from the mosque by orders of the Vizier, they proceeded to the shrine of Abdul Azim outside Tehran, where their numbers rapidly increased. In vain the Shah intervened by sending his favourite to induce them to disperse. Finally the Shah was obliged to dismiss the obnoxious Vizier and to promise to convene an *Adalatkhana* or "House of Justice"—it is to be noted that there was no demand for a constitution at this juncture. Upon receiving the royal promise, the *bastis* returned to their homes and the Shah took no steps to convene a House of Justice. In 1906, the Shah had a paralytic stroke and the Vizier decided to take strong measures against the reformers. This led to the Second *Bast*, which ended in the departure of the *Mujtahid* or "Doctors of the Divine Law" to Qum and the threat that they would lay the land under an interdict. Simultaneously thousands of citizens took *bast* at the British Legation and declined to leave it until a National Assembly had been granted by the dying Shah. This was, at length, conceded by Muzaffar-ud-Din, who opened the Assembly in October 1906, and died shortly afterwards.

The Revolution.—Mohammed Ali, who succeeded his father, was an Oriental despot of the worst type. He attempted to blind the reformers by twice pledging himself to adhere to the new constitution. However, he had no intention of keeping his solemn promises, for he resented any infringement of his absolute power to dispose of the revenues of Persia for his own purposes. The able Vizier of Nasir-ud-Din was recalled to office with secret instructions to overthrow the constitution. He set to work to gain the consent of the majority of the *Majlis* for the raising of a loan as the Shah had found the treasury empty, and could not buy partisans without money. It seemed as if the Vizier was achieving his purpose when he was assassinated. This black deed was glorified and the fortieth day after the suicide of the assassin was observed as a national holiday. Public opinion forced the Shah to appoint Nasir-ul-Mulk, who had been educated at Oxford, to be his Vizier. This honest statesman realised that it was essential to restore the finances of Persia but, before he could

carry through any of his reforms, the Shah, who had collected gangs of ruffians, called out his forces with the intention of closing the obnoxious *Majlis* and of arresting its leaders. But he suddenly hesitated and stayed his hand. The *Majlis* thereupon collected armed volunteers and sent telegrams to the provinces asking for support, which evoked a wave of enthusiasm.

The Shah yielded to the popular feeling and sent a Koran to the Assembly sealed with an oath that he would observe the constitution. This is the most solemn form of oath in Persia. Six months later, the Shah bombarded the building, in which the *Majlis* sat, arresting some of the leaders and regaining control of the government for the time being. The answer to this outrage was a rising at Tabriz. In vain the Shah despatched troops to crush the rebellion. They merely blockaded the city and, in the spring of 1909, the Russians broke up the blockade in the interest of their subjects. The defence of Tabriz gave time for national forces to be organised at Resht and Isfahan. These forces combined and entered Tehran, whereupon the Shah who was in camp a few miles from the capital, threw up the sponge and took refuge in the Russian Legation. He was deposed by the victors and left Persia. Thus with little loss of life, the Persian revolution was successfully accomplished.

Anglo-Russian Agreement, 1907.—For a century there had been keen rivalry in Asia between Great Britain and Russia, which, in 1885, had nearly led to war between the two empires owing to the famous Panjdeh incident. The military party in Russia, which desired to approach ever nearer and nearer to India, was averse from any settlement with Great Britain, but the disasters of the war with Japan had a chastening effect and made the Russian military party ready to come to terms. These feelings were warmly reciprocated by the British, and were embodied in an Agreement, which represented a comprehensive effort to settle all questions connected with Tibet, Afghanistan and Persia. Here reference will only be made to the Agreement, so far as it affected Persia. It began with a solemn declaration to respect the "strict independence and integrity of Persia," and then stipulated that each state binds itself to seek no concession of any kind in regions conterminous to the frontier of the other. To avoid misunderstandings, the commercial spheres were then defined. That of Russia included Northern and Central Persia, while Great Britain merely reserved the deserts of South-East Persia. It was a mistake not to have included the whole of South Persia, as there alone would commercial concessions be sought, and leaving it neutral was certain to lead to trouble. This was pointed out at the time, and the subsequent enormous development in oil proved that this view was correct. Persia naturally disliked the Agreement. She had based her policy on the rivalry of her two neighbours, and viewed with dismay the new order, by which, in her opinion, they had agreed to dismember her. British policy was honest and was entirely benevolent, so far as Persia was concerned. On the other hand, Russian officials considered that Northern Persia had been made over to them and, when the World War broke out, they were gradually annexing it. The Agreement has been annulled both by Great Britain and by Russia since the conclusion of the World War. (P. M. S.)

E.—HISTORY OF THE PERIOD, 1909–1929

This period, extending over two decades was destined to prove an epoch-making one in the history and evolution of Persia, and may be said to have commenced with the accession of the boy-King, Sultan Ahmad Shah and the re-establishment of constitutional government.

The first cabinet of the new government naturally included the two patrician heroes of the revolution, the Sipahdar (to be known later as Sipah Salar), as Premier, and the veteran Bakhtiyari chief Sardar Asad, as Minister of the Interior; but they soon found themselves mere figure-heads in the hands of the more extreme elements among the late revolutionaries, whose aim seemed to be to control the government without sharing its responsibilities. In these circumstances it was not long before the two ministers resigned their portfolios and took their seats in the Majlis as ordinary deputies, a new cabinet being formed under the presidency of a well-known figure in Persian politics, Mustaufi-ul-Mamalik, with a sprinkling of the most able of the Young Persian element. Nevertheless the first year of the revived constitution was marked by a continuation of cabinet crises and by the division of the Majlis into a number of conflicting factions.

After the nationalist occupation of Tehran, Yeprem Khan, the military leader of the revolutionaries, had promptly organised a vigorous police administration which gave the city immunity from any of those disorders which are so often experienced in such cases, and the lives and properties of foreigners were in no way molested. Nevertheless, on the plea that special measures were needed for the protection of their nationals, Russian troops were forthwith despatched to Kazvin, and having thus succeeded in effecting a temporary occupation, they altogether refused to withdraw, notwithstanding the earnest remonstrances of Great Britain, who advocated a policy of non-intervention in accordance with the spirit of the 1907 Convention. The lack of administrative experience on the part of the personnel of the new régime, soon made it apparent that the departments of the government could not be effectively reorganised without the assistance of foreign advisers, and when the subject came up for specific discussion Great Britain and Russia not unreasonably required that nationals of one or more of the minor Powers should be engaged, failing which they must press for the appointment of their own nationals.

The deliberations in this connection extended into the new year (1911) and eventually it was decided that Americans should be engaged for the supervision of finances and Swedes for police and gendarmerie. Action was taken accordingly and in due course, in the following May, an American citizen, Mr. Morgan Shuster, was engaged to serve as treasurer general for a period of three years, with a staff of 4 assistants, for the supervision, collection, and disbursement of the revenues of Persia.

Hardly had they got to work, when, on June 17, the recently deposed Mohammed Ali Shah unexpectedly landed at Gumesh Tepe on the Caspian, bent on an attempt to recover the throne; while at the same time his brother, Salar-ed-Dowleh, making a sudden appearance in Kurdistan, there too raised the standard of revolt, ostensibly on his brother's behalf. At first the menace to the capital from these two directions was undeniably serious, but the ex-Shah's effort was conducted with that incapacity and indecision which had distinguished all his activities, and ended in a complete fiasco. The credit for this result was mainly due to the redoubtable Yeprem Khan, and to Shuster's financial reforms which supplied his resources.

Meanwhile Shuster's financial programme had brought him into conflict with Russian interests. Finally the confiscation of the estates of the ex-Shah's brother, Shua-es-Saltaneh (who, it was claimed, was in debt to the Russian Bank) for the part he had played in his brother's abortive exploit, was held to afford sufficient grounds for the presentation of an ultimatum to the Persian Government, in which were included a demand for an indemnity and the dismissal of Mr. Shuster, failing which, it was announced, there would be an advance of Russian troops on Tehran. Great Britain made diplomatic protests at Tehran but they were of no avail and Russia persisted in her demands.

Anti-Russian Feeling.—Anti-Russian feeling now ran high in the capital; Russian goods were boycotted, and the Majlis having refused to sanction compliance with the ultimatum, some 3 to 4 thousand Russian troops were despatched to Kazvin from whence they were expected to march on Tehran at any moment. The position seemed desperate, until finally, on December 24, Nasir-ul-Mulk, who had become Regent on the death of the aged Kajar Azad-ul-Mulk, the year before, took charge of the situation and with the co-operation of the Cabinet and of Yeprem Khan dissolved the Majlis and then signified acceptance of the Russian demands. In pursuance thereof, on December 25, the contracts of Mr. Shuster and his colleagues were terminated and they left the country forthwith. Meanwhile chaos reigned in the provinces, the only bright spot in the picture being the comparatively satisfactory progress of the Swedish military mission in the direction of forming a gendarmerie.

From the time of the dismissal of the Shuster mission the financial administration of the country was carried on as best they could by the staff of the Belgian Customs Administration and with no small measure of success, but in the direction of constructive financial reform, little could be effected in the adverse circumstances then prevailing. During the World War, moreover, Persia, nominally neutral, became a mere field for the rival combatants (*see* PERSIA, CAMPAIGNS IN) On the conclusion of the war Persia was admitted as an original member of the League of Nations.

Post-war Foreign Relations.—In the matter of her foreign relations Persia found herself in a considerably altered position at the end of the war. The cabinet of Vossuq-ed-Dowleh concluded with Britain on Aug. 19, 1919 a Convention on the following basis:

(i) Categorical reiteration of undertaking repeatedly given by Great Britain in the past to respect absolutely the integrity and independence of Persia.

(ii) The lending of expert British advisers as necessary for the various departments of the Persian administration, military and civil.

(iii) The provision of a substantial loan for the purpose of financing the above schemes.

(iv) Co-operation on the part of the British Government in the promotion of Persian enterprises for the improvement of communications.

(v) The appointment by the two Governments of a joint Committee for the revision of the existing customs tariff on lines conducive to the interests and prosperity of the country.

This Convention though it was for a short while put into operation, lapsed on the fall of Vossuq-ed-Dowleh. His successor Sipahdah-i-Azim concluded a treaty with the Soviet providing for:

(i) Renunciation of the old Tsarist policy of force and a guarantee of non-intervention in the affairs of Persia

(ii) Denunciation of treaties concluded in the past between the Tsarist régime and other Powers in regard to Persia (*e g.*, the Anglo-Russian Convention of 1907).

(iii) The writing off of outstanding Russian loans to Persia

(iv) Cancellation of all concessions under which Russia had exercised control over Persian communications—with the clear proviso that they should not be passed on to the nationals of any other Power.

(v) Cancellation of all concessions granted by Persia to Russian subjects.

(vi) Abolition of the clause in the treaty of Turkmanchai under which no ships were allowed on the Caspian save those flying the Russian flag

(vii) The reciprocal right to appoint diplomatic and consular representatives where considered necessary.

(viii) Abolition of the ex-territorial rights of Soviet citizens

But the ink was hardly dry on this document when the capital became the scene of a most dramatic episode, in the form of a *coup d'état* organised by the nationalist newspaper editor, Saiyid Zia-ud-Din This young patriot had secured the co-operation of a native officer of the Cossack division, Sartip Reza Khan, under whose leadership a force of some 3,000 Cossacks from the Kazvin garrison marched on the capital Meeting with no opposition they proceeded to arrest all prominent personages, and the establishment of a government under Saiyid Zia-ud-Din was then announced Very soon after, Saiyid Zia-ud-Din found himself helpless before his colleague Sartip Reza Khan, who now, as minister of War, had sole control of all armed forces and was displaying great jealousy of foreign interference in any direction Feeling that the situation was passing out of his hands Saiyid Zia-ud-Din decided to leave the country and reached Baghdad at the end of May.

From this point the history of Persia is the story of the rising fortune of Reza Khan Pahlavi A native of the Savad Kuh district of Mazanderan, he had entered the Cossack Division as a trooper when about 25 years of age and at the time of his sudden appearance on the stage of Persian politics was a sartip in the division hitherto quite unknown outside it.

On the exit of Saiyid Zia (April 3, 1921) Reza Khan proceeded to set up a government of his own, with himself as minister of War and one of the old régime, Qavam-es-Sultaneh as prime minister. From that moment he practically ruled Persia. Fully alive to the importance of having some reliable troops at his back, attached alike to his person and interests, he set himself at once to reorganise the armed forces of the country and to make effective arrangements to ensure their regular pay. To this end he insisted on certain branches of the ministry of Finance being transferred to the Ministry of War. Having by this means gradually converted the miscellaneous contingents existing into a disciplined force of some 40,000 men, he concentrated his efforts on the subjugation of the distant and semi-dependent tribes, and his phenomenal success in this direction was soon reflected in the increased measure of security prevailing in the provinces.

In the autumn of the same year, as the result of negotiations with the U. S Government, which had been in progress throughout the summer, a strong financial mission arrived from America under the leadership of A. C. Millspaugh, and embarked on the task of reforming Persian finances.

In October 1923 the Shah fled to Europe, Reza Khan appointed himself prime minister and summoned the Majlis

Late in 1924, Reza Khan reduced to submission Shaikh Khazaal Khan, G C I E , K C S I , the semi-independent chief of Mohammerak, who had for years been in close contact with the British. Then on April 19, 1925, the Shaikh was arrested by Persian troops on board his yacht and forthwith removed to Tehran where he has since been detained as a political prisoner

In February 1925 Reza Khan demanded from the Majlis the grant of definite and comprehensive military powers only withdrawable by a vote of that body His request having been acceded to by the Majlis, he now became completely independent of the Shah's authority, and six months later he formally sought elevation to the crown of Persia The change of ruler and dynasty was effected with surprisingly little commotion, the deposition of the absent Sultan Ahmed Shah being executed by a simple declaration of the Majlis on Oct 31, 1925. A Constituent Assembly was then convened, which proceeded to elect "Reza Khan Pahlavi" as Shah of Persia, with right of succession to his heirs.

On December 15 the new Shah took the oath to defend the Constitution, and on the 16th he was publicly proclaimed amidst much popular enthusiasm. A few weeks later his eldest son, Shapur Mohammed Reza, was appointed crown prince On April 25, 1926, his majesty's coronation took place

The contracts of the members of Mr. Millspaugh's financial mission, to which reference has been previously made, having expired in August 1927, were not renewed After a short interregnum, during which the financial administration was carried on by the Belgian customs staff, a German financial expert, Dr Lindenblatt, was appointed (April 1928) to succeed Mr. Millspaugh, but with much reduced powers

Following the example of the rulers of Turkey and Afghanistan, the Shah gave notice to the Powers concerned, in 1927, of his intended denunciation of all treaties in which extra-territorial rights, commonly known as "capitulations," were conferred None of the said Powers having offered serious objections, the abolition was allowed to take effect from May 28, 1928 In the meantime negotiations had been opened for the conclusion of fresh treaties under which Persia's tariff autonomy was to be recognized and the legal position of the nationals of the Power concerned, under the new conditions, duly regulated.

Satisfactory relations have not yet been established between Persia and Iraq, Persia having so far refrained from according formal recognition to the new State. Meanwhile trade between the two countries pursues the even tenor of its ways.

After difficult negotiations extending over some months, an agreement has been reached (November 1928) for the establishment of bases in Persian territory for the air service to India.

At the session of the League of Nations in September 1928 Persia was elected to the Council of the League.

Progress in Persia.—The present position in Persia is dis-

tinctly better than under the Qajar dynasty. Like his great predecessors, Shah Riza realises the supreme importance of security. To ensure it, he has organised a well-trained force of all arms 40,000 strong and, using this instrument with courage and ability, he has disarmed the tribesmen, a feat that was entirely beyond the power of the previous dynasty. More than this, the Kashgais and Bakhtiaris are now ruled by military officers and their chiefs are either in prison or accept subordinate positions. The same policy is being pursued in the case of the smaller tribes and peace is assured. Total disarmament is really the crux of the whole matter as, once the tribesmen are rendered impotent for robbing, security of the roads is established, the sedentary population being most orderly.

Persia is indeed under military Government. For example, the whole of the country south of Isfahan is controlled by the general officer commanding the southern army, whose headquarters are at Shiraz. The *mullas*, like the nomad chiefs, have lost their power for evil and so far have changes gone that civil offices have been opened for marriages. Here, as in many other reforms, the policy of Turkey has been followed.

The Shah, once again like his great predecessors, has realised the importance of communications. Various routes were opened up and improved by the British during the World War, but were not kept up in the years that followed. A new policy has now been adopted, and steady progress is being effected under American engineers. The number of cars that use the routes is increasing at an amazing rate. Indeed, even the poor are beginning to travel, with the result that there is a wider outlook than in olden days. Nor must the marked improvement of the postal services be forgotten, both as regards the transport of mails and passengers. In this connection, in 1927, an agreement was concluded with a German air company for a weekly service between Tehran and Baku, to be followed by a similar service between the capital and the Iraq frontier. Wireless stations have also been established and, to some extent, are available for public use. The construction of a railway line from the Caspian to the Persian gulf is the dearest wish of the progressive Shah, whose enthusiasm has infected the entire nation. American engineers have examined the various routes and, in the autumn of 1927, the Shah cut the first sod of this great undertaking. Thanks to the royalties paid by the Anglo-Persian Oil Company, which constitute the anchor-sheet of Persian finance, and to a special tax on sugar and tea, it is possible that the money may be forthcoming for the construction, but, in view of the barren nature of Persia, the railway can hardly be worked at a profit.

Among the reforms that are being accomplished, is that of the judiciary which is being remodelled on French lines. Capitulary privileges were renounced by the Soviet Government and this probably encouraged the Shah to issue a decree that the capitulations would be abolished in May 1928. It would seem that this action is premature and it is probably a *ballon d'essai*, but it is noteworthy that the French Government has already accepted the position. Possibly the fact that there are practically no French subjects resident in Persia may have influenced this decision. (P. Z. C.; A. T. W.)

PERSIA, CAMPAIGNS IN. For many years before the World War Germany had been making strenuous efforts to increase her influence and interests in Persia. At Tehran a college was opened, staffed by German professors and subsidised by the Persian Government. In the Persian Gulf the firm of Wonckhaus began to deal in mother-of-pearl at Lingeh in 1896; in 1897 a German vice-consulate was opened at Bushire. In 1900 Germany attempted to purchase a site for the terminus of the Baghdad railway at Al Kuwait, but Sheik Mubarak had previously concluded a secret treaty with Great Britain agreeing, in return for protection, not to sell or lease any of his territory without her consent. Other German efforts, made in collusion with Turkey, members of Mubarak's family and the Wahabis, failed; but Turkey established and held posts on Mubarak's territory in Hor 'Abdullah, an inlet running from behind Bubiyan Island to within 30m. of Basra. In 1902 the firm of Wonckhaus attempted to gain control of the pearl fisheries around Hulul, then of the red oxide deposits of Abu Musa and finally of a piece of land along the river bank at Mohammerah. These attempts were foiled by Sir Percy Cox, the British Resident. In 1906 the Hamburg-Amerika Co. started a service to the Persian Gulf. At the outbreak of war Great Britain was engaged in negotiations with Germany which would have given that Power a strong position at Basra, the destined terminus of the Baghdad railway; and had acknowledged Turkey's suzerainty over Al Kuwait.

I. THE MENACE TO INDIA

In July 1914 the regency terminated with the coronation of the young Shah, who had hardly taken up his duties when hostilities commenced. His Majesty summoned the Majlis, and duly proclaimed the neutrality of Persia. The position was, however, a difficult one. The grandees were, in many cases, only anxious to receive money from one or both sides; the masses hated the Russians and mistrusted the British for being the friends of their enemies. There was sympathy in some quarters for the Turks, and "let the Christians devour one another" was frequently heard. But Persia was powerless. Her military forces included the Cossack brigade 8,000 strong, the Swedish gendarmerie 7,000 strong and the useless Persian Army.

German Policy in Persia.—At first sight it would seem unlikely that remote Persia should become a war theatre, but there is no doubt that Germany had prepared her plans for attacking the Indian Empire across Persia, using the Turkish Army as her instrument. Before Turkey declared war, the Government of India took the precaution of despatching a brigade of Indian troops to the Bahrein Islands. After the outbreak of hostilities this force, increased to a division, defeated the Turks at Sahil, and occupied Basra on Nov. 21, thus effectually protecting the oil refineries of the Anglo-Persian Oil Co. To protect the pipeline, 150m. long, running through Ahwaz to the oilfields at Maidān-i-Naftūn, which the tribesmen had breached and fired in several places, operations were undertaken, as a result of which Persian soil was cleared of a Turkish force that threatened Ahwaz; the local tribes then submitted to the Indian troops and the pipeline was repaired.

Germany hoped to embarrass Russia, and still more, Great Britain, by forcing Persia and Afghanistan into the War on her own side and creating disturbances in India and on her frontiers. If Persia would come in, the claim that Islam was on the side of the Central Powers might have brought in Afghanistan Germany was able to divert forces to Persia at a small cost; for India was weakly held, and the "Emden" was causing some uneasiness The chief German agent was Wassmuss, formerly consul at Bushire, who organised an anti-British confederacy at Tangistan, Dashti and Dashtistan, bought over the Swedish officers of the gendarmerie at Shiraz and secured control of their force The British vice-consul was murdered, the consul and entire colony arrested and taken to the coast, Qawam el Mulk, the chief of the Arab tribes, who was acting Governor-General, was driven out, and Wassmuss reigned supreme in Fars. In Kermanshah, Turks and Germans expelled the British in April 1915; at Isfahan the Germans were equally successful, and later at Yezd and Kerman. At the end of 1915 seven out of the 17 branches of the Imperial Bank of Persia (a British company) were in enemy hands, and the British colonies had been expelled from central and southern Persia, except the Gulf ports. In the north the position was different The Russians landed troops at Enzeli, which marched on Tehran. This action drove the enemy ministers to quit the capital.

One of the dangers to be guarded against was that of German missions to Afghanistan and Baluchistan. Efforts were made to intercept such parties, but it took time to make the necessary arrangements, and it was not until 1916 that the Eastern Persian cordon was in working order with the Russians patrolling the frontier as far south as Kain, from which centre the British, with some regular troops and a number of locally raised levies, were responsible to the borders of Baluchistan. Persia being a land of vast distances, it is not surprising that a German mission was able, by means of very long marches, to reach Herat in

safety. It was received with every honour, but displayed extraordinary lack of tact by openly decrying everything of Afghan manufacture, the arms manufactured at the arsenal at the capital, for instance, being criticised contemptuously. At Kabul too, the same behaviour brought the mission into trouble. The Amir, who had received it courteously, played for time by summoning a council representative of all the tribes and by lengthy meetings with the mission and his own advisers. The Germans gradually realised that, without a Turkish force, their efforts were wasted. They were finally dismissed, the Amir pointing out that he could hardly break with the British until a large, well-equipped army reached Kabul from the west. The mission broke up into small parties, most of which successfully evaded the cordon.

In 1916 the ebb and flow of the struggle were very marked. At first the Turks, shortly after the retreat of the British from Ctesiphon, occupied Kermanshah and pushed forward towards Hamadan. The Russians in their turn, advanced and drove the enemy off the plateau, while a second force swept the hostile Bakhtiaris out of Isfahan and brought back the British and Russian communities. The capture of Kut again transformed the military situation and, in the summer, the Turks, 16,000 strong with 54 guns, gradually drove back the Russians who could only oppose them with 12,000 men and 19 guns. Kermanshah was evacuated and then Hamadan, the retreat continuing as far as the Sultan Bulaq range which covered Kazvin and threatened a force marching on Tehran. This situation remained unchanged until December.

The South Persia Rifles.—In 1916 it was decided, in consultation with the Persian Government, to organise a force of Persian troops to restore order in Southern Persia and take the place of the Swedish gendarmerie. This force was to be 11,000 strong, and the Cossack brigade was to be raised to a similar strength. Brig.-Gen. Sir Percy Sykes, who had spent many years in Southern Persia, was appointed to undertake this task, and landed at Bandar Abbas in March, with three other British officers and a few Indian instructors. The state of affairs was most unfavourable as, apart from the defeat of Qawam, the British agent and his escort were assassinated at Lingeh, and two British officers were assassinated in Makran about the same time, and finally this terrible month of April saw the grave disaster of Kut al 'Amara. Many experienced officials expected a wave of fanaticism to sweep across Persia and there was certainly cause for deep anxiety, especially in Makran, but British coolness undoubtedly saved the situation. Recruiting operations at Bandar Abbas were started immediately after landing and, in spite of a strong anti-British party, men were rapidly enlisted, and, before the end of a month, the Persian flag was hoisted with ceremony over a camp. The force, handled with much tact and patience by its British and Indian instructors, never looked back, and was soon able to protect Bandar Abbas and an important section of the caravan route from the raiding tribesmen.

Qawam was aided by the British with money and munitions, and an exaggerated report of the means placed at his disposal led to the rebel Arab headmen kissing his feet. With their aid he defeated the Swedish gendarmerie, and was marching in triumph to Shiraz when he was killed by a fall from his horse. His son, a man of 28, was, however, able to restore Persian authority in Fars. The success of Qawam and the landing of the mission at Bandar Abbas made the position of the German parties at Kerman decidedly insecure. They fled to two parties, and after suffering some losses from attacks on the road, they were all captured by Qawam and imprisoned at Shiraz. The little band consisted of 60 Germans and Austrians, a dozen Turks and a few Afghans.

A small force of Indian troops, consisting of a section of mountain guns, a squadron of cavalry and 500 rifles, was sent to Bandar Abbas, and Sir Percy Sykes marched inland a distance of 280m. to Kerman, where he was received with much cordiality. The various pro-German elements who had created a state of insecurity fled, the bank and telegraph offices were reopened, and the normal state of affairs was quickly re-established. The column then marched to Yezd, where the British colony had just returned. News being received of the Turkish advance and of a probable attack on Isfahan, the column made a forced march to that city where it joined the extreme left of the Russian Army, represented by 600 Cossacks. The Turks, hearing of the arrival of the British at Isfahan, stopped at a village some six miles distant, and then retired. When it became evident that the danger had passed, the column marched south to Shiraz, which it reached in November, thereby completing a march of 1,000m. through the heart of Persia.

At Shiraz the question of the gendarmerie had to be settled. The Persian Government had not actually given its consent to its being incorporated in the South Persia Rifles, but it was unable to pay or equip the force. Spread over the route for a distance of 200m. from the borders of Fars in the north, to Kazerun in the south, and numbering some 3,000 men, the problem which confronted Sir Percy Sykes was one of extreme difficulty. He had no staff to administer or train such large numbers, and he was aware that it was this force which had seized the British consul only a year previously and that many of the officers were pro-German in sentiment. But he also realized that, if the gendarmerie broke up into well-armed bands of robbers and devastated the country, few supplies would reach Shiraz. He consequently decided to take over the entire body, and the force gradually developed and helped to restore order in South Persia. (*See* WORLD WAR; WORLD WAR: BIBLIOGRAPHY.)

II. THE BRITISH IN PERSIA

During the winter, the position in Mesopotamia entirely changed. Instead of weak, ill-equipped columns, severely handicapped by unfavourable climate conditions, failing before Kut al 'Amara, there was the pleasant picture of overwhelming forces under the inspiring leadership of Gen. Sir Stanley Maude recapturing Kut in February 1917 and following this up by the signal success of the capture of Baghdad. The position of the Turks in Persia became more and more difficult as the British advanced. On the day Baghdad was occupied they evacuated Kermanshah and, pursued by the Russians, reached the Persian frontier at Qasr-i-Shirin on March 31, worn out and hungry but not wholly demoralised. But during the succeeding winter, the Russian army disintegrated. Its collapse opened up to the enemy a completed line of northern advance across the Caucasus and the Caspian sea to 'Ashqabad, Merv (the junction for Kushk, within striking distance of Herat), Bokhara, Samarcand and Tashkent, the administrative centre of Rûssian Turkistan. In Sept. 1917 Georgia and Armenia decided to claim their independence, and a third state came into being under the title of the republic of Azerbaijan, with Baku as its capital. In connection with the efforts made to ward off the danger to India involved in the Russian collapse, British troops entered Western Persia.

The Dunsterville Mission.—It was out of the question to despatch large bodies of troops to support the Georgians or Armenians, as Baghdad was 800m. distant from Baku. The authorities therefore, decided to despatch a military mission to reorganise the sound elements of the country into a force that would prevent the Turks and their German masters from reaching Baku. It was hoped that these small States would fight for their homes, but the Armenians failed to do this. Maj.-Gen. L. C. Dunsterville was appointed to command this mission, and, in Feb. 1918, he started off from Baghdad with a party of officers in 40 cars to cross north-west Persia. Enzeli was his objective, and he hoped from that port to be able to proceed to Baku and Tiflis. He reached Enzeli only to find that the port and its shipping were in the hands of hostile Bolsheviks, while the neighbourhood was dominated by Mirza Kuchik Khan, an ambitious brigand who had recruited some 4,000 followers, nicknamed *Jangalis* or "Forest Dwellers," to the cry of "Persia for the Persians," and who robbed his countrymen if they refused to join him. Dunsterville quickly realised the situation, and, before his opponents had concerted their plans and had overcome their fear of the armoured motor-car, the mission had retired to Kazvin and Hamadan which latter city became its headquarters.

During this period, Dunsterville was brought into close

relations with the Russian generals Baratov and Bicherakov. The former had commanded the Russian troops in Northern Persia and was now helplessly watching their disintegration. The latter, on the contrary, had kept his command of 1,200 men practically intact. By March the last of Baratov's men had left, but Dunsterville had been able to keep Bicherakov's command at his side. Without its aid, the Jangalis, elated by the retirement of the mission, which was magnified into a great victory over a British army, would have been able to march on the capital. There they would probably have introduced a reign of anarchy and have forced Persia into the War on the side of the Central Powers, with whom Kuchik Khan had close relations; he also had German, Austrian and Turkish instructors well supplied with machine-guns. When the Jangalis marched on Kazvin, Bicherakov forestalled them, and drove them back to the forests with heavy losses. He then embarked at Enzeli. Dunsterville, who had received reinforcements consisting of a regiment of cavalry, a battery and two regiments of infantry, followed behind Bicherakov and took over the road. The Jangalis, under their European officers, attacked a detachment at Resht, but suffered heavy losses, and Kuchik Khan made terms and became a contractor for supplies. About this time the Bolshevik Government at Baku was overthrown and replaced by the Central-Caspian dictatorship, which asked for British assistance. Dunsterville took his force to Baku, held it for some weeks against overwhelming Turkish numbers, denying the use of the oil wells to the enemy, whom he also kept away from the Caspian Sea, and finally evacuated the town and returned to Enzeli, thus ending a very gallant episode of the War.

Investment of Shiraz by the Kashgais.—In the spring of 1918 the Persian Government, in reply to a British note, denounced the South Persia Rifles as a foreign force and a threat to Persian independence and integrity. It also expressed the hope that the British Government would withdraw its troops and allow Persia to commence her cherished reforms. The cabinet was under the impression that Germany was winning the World War or such a curt note would never have been penned. This reply was published all over Southern Persia; and the results were speedily shown in serious desertions from the South Persia Rifles and culminated in the formation of a confederacy under the Kashgai chief, Solat-u-Daulah, to annihilate the British in Southern Persia. He had at his disposal 4,500 Kashgais and 1,500 Kazerunis and this number was reinforced by contingents from Dashti, Dashtistan and elsewhere, and reached about 8,000 fighting men. The tribesmen were well armed with Mausers, had plenty of ammunition, and fought both bravely and cunningly. The British force at Shiraz was 2,200 strong, one-third being recruits. The South Persia Rifles slightly outnumbered the Indian troops and, owing to propaganda and the proclaimed hostility of the Persian Government, were a danger to the British. The detachments in the outposts mutinied and surrendered or deserted. Qawam had collected in and about Shiraz 2,000 Arabs, who were ready to attack the beaten side. On May 24 the column marched out 1,600 strong and defeated the Kashgais in the hilly country to the west of the city. About 10 days later the enemy returned in still larger numbers, and the Kazerunis occupied the garden quarter, which almost touched the fortified perimeter constructed by the British outside Shiraz. The inhabitants of Shiraz were incited against the British by the mullahs, some of whom preached *jihad* or Holy War.

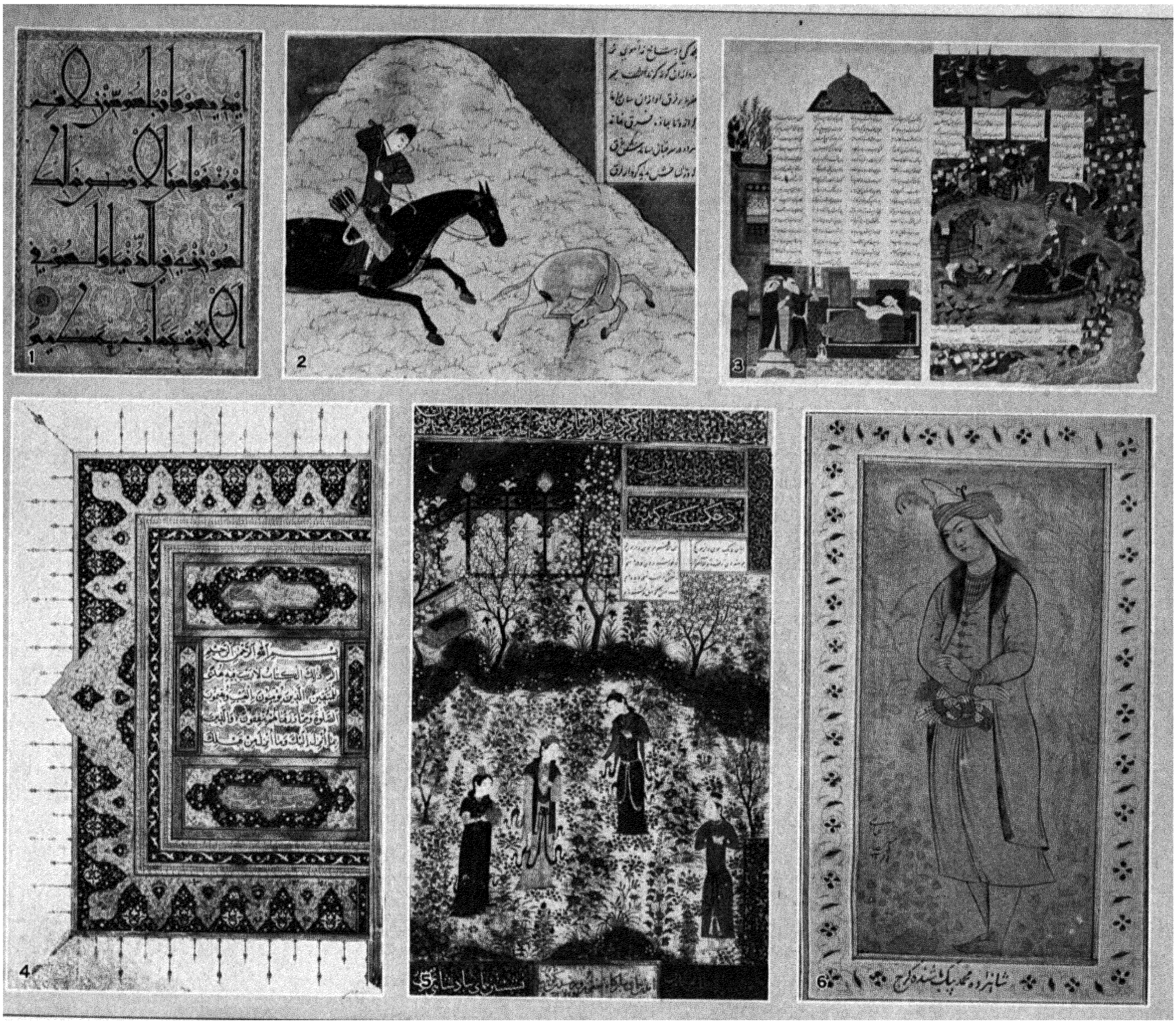
Sir Percy Sykes learned that the Kashgais were preparing to unite with the townspeople in a combined attack on June 17, and he determined to forestall them. Accordingly, on June 16, the column sallied out and again inflicted considerable losses on the enemy. On the following day Shiraz rose, its inhabitants attacking everyone suspected of being friendly to the British. But the Kashgais did not come to the support of the townspeople, who were overawed by the seizure at midnight of various key-positions by the British. The tide then turned. The governor-general appointed a new *Ilkhani* or "paramount chief" in place of Solat, whose followers began to break away, influenced by the heavy losses they had suffered. Qawam declared in favour of the new Ilkhani, and his example was followed by a brother of Solat and by perhaps one-quarter of the tribe. The column marched out again and Solat fled a broken man, pursued by Qawam, the new Ilkhani, and most of the Kashgai tribe. The expedition is described by L. C. Dunsterville, *The Adventures of Dunsterforce*, 1920. (P. M. S.)

PERSIAN ART, PAINTING AND CALLIGRAPHY. The share of Persia in the development of the art of book-production in the Islamic countries dates from even before the beginning of the Abbasid period. Towards the end of the 7th century, in the two oldest centres of culture in Iraq, Basra and Kufa, beautiful Koran mss. executed on broad parchment rolls were common, though at first they had no extraneous decoration, but produced their effect solely by the heavy lapidary style of the archaic character. In the 8th and 9th centuries this the most refined branch of Mohammedan art reached its first period of splendour under the powerful stimulus imparted by the caliphs of Baghdad; and the masters of the Cufic who flourished at that time (*c.* 800) include not only a number of Arabs, but also the Persian Khoshnâm of Basra. More important, however, was the part played by calligraphers of Iranian origin in the development of the various forms of the *naskhi*, the round character, which early began to take a high place beside the vertical script. The inventor of the decorative *thuluth*, which derived from this, is said to have been Ibrahîm Segzi of Sijistan, and his pupil Ustâd Ahwal Segzi has the reputation of having been the first, under the caliph Mamûn, to elaborate and discuss rules of calligraphy. He in turn was the teacher of the celebrated Ibn Moqla, who brought the *naskhi* into general use in place of the Cufic and is regarded as the greatest authority on all the principles of the art. Ibn Moqla's school produced, among other famous pupils Hasan es-Sirâfi (d. 979), who was of Mazdaic origin, and the Buyid prince Fenâ Khosrau (d. 983), a descendant of the Sassanian kings.

In painting the Persian element was stronger. Although no traces of frescoes or illuminations have come down to us from the Sassanian period, we know from other sources that in that great age of Iranian culture painting was another field of endeavour, and Herzfeld has traced to Sassanian models all the motifs (dancing-girls, huntresses, animal figures, floral decoration of various kinds) of the fragments of ornamental wall-paintings which came to light in the caliphs' palace at Samarra in the course of the excavations. At about the same time (9th century) illumination must have come into favour at Baghdad, probably through the Manichees. We have gained some knowledge of this through the discoveries made by the German expeditions to Turfan and by Sir A. Stein. (*See* ILLUMINATED MANUSCRIPT.)

The Baghdad School.—The first extant works of the Baghdad school of painting date from the 12th century, when the Seljuk period had already begun, but in their content and their artistic tendencies they go back unmistakably to older traditions, and continue with little change until the middle of the 13th century. They include scientific treatises translated from the Greek or based on ancient models, with explanatory illustrations; Arabic versions of the Bidpai fables which were imported from India; and the anecdotes of Harîri, then in great favour, in which the bold jests and witty conceits of Abû Saîd of Serrûj were illustrated. These three types of text were all equally well adapted to direct the artist to the study of nature and to emphasize the importance of problems of composition and colour, and the works of this school are veritably astonishing in their wealth of colour-shading and their forcible depiction of their subjects. To what extent Persian masters are represented we do not know; but the circumstance that the "minai" pottery of Raghes (*c.* 1200) borrowed the Baghdad style of painting suggests that the whole tendency had already spread from Mesopotamia to centres in Iran.

As early as about the 10th century, paper had supplanted parchment, not only in secular works but also in copies of the Koran and other religious texts, its manufacture having gradually spread from Samarcand to all the countries of Islam. Various places competed to produce perfect and costly types of paper, and the writing-material was often fetched from a distance, especially when commissioned by royal courts. Ornamental decoration of



PERSIAN MANUSCRIPTS AND MINIATURES

1. Leaf of a Koran in ornamental Kufic, 11th century
2. Bahram Gur hunting. From a Persian anthology made for the Library of Baisonqur, dated 1420
3. Persian miniature
4. Title page of a Koran written in Tabriz, A.D. 1463
5. Humay and Humayan in the Imperial Garden at Peking. Herat school, about 1450
6. Portrait of a young man, by Alî Rizâ Abbâsi, Isfahan

APPLIED ARTS IN PERSIA

1. Persian plate of the second half of the 17th century, showing elements of Chinese influence in the free and lavish floral decoration, combined with purely Persian elements in the border. 2. Blue glass bottle of the 17th or 18th century; one of a class with narrow necks designed for holding perfumes, illustrating Persian skill in handling the material. 3. An early bronze mortar of the 12th or 13th century; a primitive type showing Sassanian and Scythian elements. 4. Amber glass vase of the 17th or 18th century; its shape probably due to the influence of Chinese porcelains. 5. So-called Sultanabad plate, 14th century, illustrating the combination of freedom and balance characteristic of the best Persian design. 6. Pottery vase of the 17th century, with the typical informality and crowded richness of much later Persian ceramic ware. 7. Wall tile of the 13th or 14th century in underglaze blue and yellow lustre. The combination of Arabic letters with architectural motives and interlacing, conventionalized foliage is characteristic. 8. Water pitcher of engraved and inlaid copper, bronze and silver of the 19th century; a comparison with figure 3 shows the refinement of the later Persian work. The shape is probably due to influences from pottery. 9. Persian prayer rug of the 19th century; both border and field decorated with conventionalized floral motives. 10. Fourteenth century Sultanabad jar, like figure 5, characteristic of Persian pottery at its best. 11. Persian rug of the 16th century. *See* also *Rugs and Carpets*, Plates IV., V., VI.

manuscripts, from which for religious reasons figures were excluded, also made continual strides, and we soon find the craft of the illuminators and gilders breaking away from that of the calligraphers and painters and developing on its own lines. Cufic was now no longer used except in chapter-headings and title-pages; elsewhere the script employed was either one of the many variants of *naskhi,* or a decorative script representing a more graceful and stylistic development of the vertical character.

THE MONGOL PERIOD

The Mongol invasion in the 13th century proved unexpectedly fortunate for the art of book production in western Asia. Hulagu and his successors not only took pains to promote it in every possible way, but also brought it into contact with the highly-developed painting of the Far East, and directed it towards new subjects, with the important effect of immensely enlarging the painters' outlook. The main tendency was now to the pictorial representation of historic events and legendary episodes, in world histories conceived on a large scale, and the principal result of acquaintance with the works of the Chinese masters of the Sung period was to enhance the feeling for landscape. In manuscripts of the early 14th century we see the foreign stimuli combining with older traditions, until in course of time there developed a new Perso-Mongol style of painting which reached a high standard in the two capitals of the Ilkhâns, Baghdad and Tabriz. The captions were now no longer in Arabic, but generally in Persian, and the whole art of miniature painting was soon persianized when the great national epic of Firdûsi and other poems, such as those of Nizâmi and Khwadju Kirmâni, became increasingly common in illustrated copies. New and effective uses were here found for devices of composition, and, moreover, the arrangement of the verses in vertical columns, which could be broken up wherever desired, made possible a much more intimate and aesthetically satisfying conjunction of picture and text than had ever till then been known. Heroic scenes from the Shahnamah, sentimental themes from Khosrau and Shirin, Leila and Majnûn, etc., were then for the first time expressed in characteristic forms.

When Timur altered the whole political complexion of western Asia, there arose, beside the two centres already named, a third and highly productive centre—his capital of Samarcand, where, in addition to the miniature book-illustration in body-colour, the separate sheet bearing a light ink sketch, usually picked out in gold, came again into favour through the stimulus of Far Eastern example. Of Arabic texts there were at this period only the cosmography of Qazwîni and a few astrological treatises, which seem to have been produced with loving care in Western Turkestan. To the Baghdad school of calligraphy belongs the credit of having, about 1300, developed the lapidary style of the Cufic Korans into a rounded form, and brought this to the ripest degree of ornamental beauty in the majestic *tumar* variants. In the production of the magnificent Korans of the age of the Ilkhâns, with their large size and their few and incomparably imposing lines of script, Persian masters were certainly concerned; and they carried to Tabriz and Samarcand the new principles they had learnt in this school for the decoration of the holy book, especially the rich arabesque illumination. Timur's chief secretary, Emir Mohammed Bedr ed-Dîn of Tabriz, has an immense reputation as a master of all forms of writing, and two of the great Mongol emperor's grandsons, Ibrahîm Mîrzâ and Baisonqur Mîrzâ, were very famous calligraphers. The latter, who unfortunately met an early death in 1434, also earned much honour by founding the Academy of Artistic Book-Production at Herat in connection with his library; for years it employed 40 calligraphers, besides numerous illuminators and painters. In this academy the Persian texts were no longer written in *naskhi,* but in *nastaliq,* an offshoot of the old cursive character, invented by the celebrated Mir Ali of Tabriz. All the 40 masters of Herat were directly or indirectly his pupils, and towards the end of the century the style of calligraphy invented by him found its most splendid representative in Sultân Alî of Meshed (d. 1513), the protégé of the famous poet and minister Mir Ali Shîr Newâi and friend of the great poet, Jâm'i.

The preference that painters displayed for subjects drawn from the national literature, and the enthusiasm with which they steeped themselves in the magic of their native countryside, give to Persian painting of the Mongol period a romantic note which often chimes with the atmospheres we find in our own contemporary western Gothic. In the East, however, the purely decorative and impersonal character of the pictures continued, whereas in Europe they were gradually diverted from their original purpose by the influence of wall-painting and panel-painting. It was at this time that the harmony between picture and text reached the highest imaginable degree of perfection, and in turning the leaves of the extant manuscripts we are continually astonished at the skill with which the painters fitted their subjects into spaces allotted to them quite arbitrarily by the calligraphers. At the beginning of the 14th century the backgrounds were still carefully coloured red, but subsequently a rich blue became general, and it was not until the end of the period that a gold background came into favour, the other colours were predominantly bright and lively. The incidental landscape is generally of a steppe-like character, jagged rocks, isolated trees, and little brooks rippling among stones and bordered by growing flowers, are the essential features of almost all open-air scenes, and only occasionally is the mysterious atmosphere of the forest or the luxuriance of a flower-garden depicted. The highly effective motif of a tree in blossom, which is often used in smaller pictures, is obviously taken from Chinese models of the Ming period. We know that, particularly under the Timurids, contact with the Far East became increasingly frequent.

Behzâd of Herat.—An undeniable weakness of Perso-Mongol painting lies in the diagrammatical conventionalizing of the figures, the spiritless treatment of the heads, and the absence of expression in the movements. In this respect no progress is to be seen throughout the whole development of the art, which is in other directions so astonishing; and the appearance of a completely revolutionary personality was needed before a change could be brought about and new paths indicated. This personality was found in the genius Behzâd of Herat, who is rightly honoured as the greatest master of Persian painting. Behzâd understood how, even in his most populous compositions, to differentiate every single figure in countenance and bearing; his palette was extraordinarily rich, especially in warm, full tones, and this enabled him to individualize his portraits by the employment of numerous colour-nuances for costumes and even for flesh. He was also a reformer in the treatment of landscape, which appears more realistically in his pages than in those of his forerunners, and in the choice of subject a markedly realistic note is likewise seen. Moreover, it was he who revolted against the dictation of the calligraphers, and admitted no text at all, or only a few lines of verse in one corner, in the pages he illustrated; we have even a number of double-page miniatures by his masterly hand.

Behzâd, who was born before 1450 and died after 1520, represents the zenith of the Mongol and the opening of the Safawid period in Persian painting. He was head of the Herat Academy until 1506, when Shah Ismail took him to Tabriz, made him his chief librarian, and covered him with honours. Only a few extant works are indisputably by his hand. A characteristic early work is the *History of Timur,* illustrated in 1467, which was formerly in the Schulz collection and afterwards went to America; an edition of Saadi's *bustân* in the Cairo library is dated 1487, and the illustrations to Majnûn and Leila at Leningrad are among his last works. Both in Herat and in Tabriz he had many pupils, who carried his style far and wide in Persia, Western Turkestan, and India; and even in the 16th century his name was already so famous that his art was imitated on every side, while later on pages of the most various origins were furnished with his signature to enhance their value.

The Tabriz School.—The next generation of painters in Tabriz is dominated by the highly-gifted Sultân Mohammed, who exercised a commanding influence in the whole field of art at the court of Shah Tahmasp. In collaboration with other masters he illustrated *éditions de luxe* of the Persian epics, several of which have come down to us; but for the most part he preferred *genre* subjects and portraits, which were produced as single

sheets and were designed to be bound up in volumes with specimens of the handwriting of famous calligraphers. He opened new fields of activity to the painters by bringing lacquer bindings into fashion, and also by inducing them to design patterns for stuffs and knotted carpets to be made at the royal factories. Some of the studies for the celebrated hunting and animal tapestries of the 16th century were made in his studio, as were also a few velvets and silk brocades with figure subjects of the delicacy of miniatures.

Since the end of the 15th century an immense impetus had been given to Koran decoration at Tabriz. It was here that the picturesque division of the title-pages into star- or medallion-shaped fields and borders with a reciprocal pattern or a cartouche design was devised, and this, transferred to the knotting technique, brought about a revolution in the style of Persian carpet-making. The ornament grows richer and more complicated; to the arabesque are added slender floral twines in a bewildering profusion of lines, palmettes, rosettes and cloud patterns.

In Behzâd's time Shah Mahmûd of Nishapur came to eminence as a master of the *taliq* script, while later Mîr Alî of Herat, "the royal scribe" (d. 1559), held the foremost place. Sultân Alî el-Kâtib and many other calligraphers and illuminators heard the call of the Ottoman rulers and founded a school of book-decoration at Constantinople, which adhered closely to the tradition of Tabriz.

The Isfahan School.—Late in the 16th century, when all the artistic forces of Persia were once more being concentrated at the new capital, Isfahan, under the powerful impulse communicated by Shah Abbas the Great, there arose also in Isfahan a new and important centre for the art of book-production in all its various forms. Mîr Imâd el-Husni (d. 1618) and Alî Rizâ Abbâsi competed in calligraphy for the royal favour, while others sought to attract attention by animal figures ingeniously constructed out of pious mottos and similar subjects, or by a perfect mastery of the *shikeste,* a complicated script so full of flourishes as to verge on illegibility. In painting there is a link with the schools of Herat and Tabriz in the person of Ustâd Mohammedi, who was undoubtedly the first to put his observations of nature on to paper in the purest ink-wash technique without any reference to a text. His successor as head of the painters' gild at Isfahan was Rizâ Abbâsi, whose signature, genuine or doubtful, is frequently met with; it is still not established beyond dispute whether this artist is identical with the calligrapher mentioned above, and with Agâ Rizâ, who is thought to be of an older generation. Be that as it may, it was he who filled the albums of Persian and Indian collectors with his gay, sure-handed colour sketches and drawings in red chalk on the most every day subjects, and with carefully-executed pages in rich colour; and he ultimately became so much admired as almost to overshadow, for a time, the fame of Behzâd. He likewise gave a new impulse to the illustration of manuscripts, and his elegant, fashionable style gained him a great influence in the other decorative arts also; painted tiles and lacquered doors in the garden-palaces of Isfahan clearly show the mark of his atelier.

Rizâ's best pupil, and his bosom friend, was Muîn, one of whose extant works is a portrait of his master; the style created by the latter was still a living force at the end of the 17th century, in the works of Mohammed Qâsim, Mir Mohammed Ali, Mohammed Yûsuf and numerous others.

Later Persian painting is of little interest to the history of art. In the 18th century European paintings and engravings were slavishly copied, and Nadir Shah's expeditions to India introduced transitory influences of the Mogul school. At the beginning of the 19th century an enormous impetus was given to lacquer-painting, though only as an ordinary bazaar industry, which permeated the entire realm of writing materials and toilet accessories; decoration also took the form of large canvases, such wretched and barbarous productions as to demonstrate that Persian artistic taste, once so cultivated, had now become a thing of the past. Since the end of the 19th century the growing interest displayed by European and American museums and collectors in Persian miniatures has called into existence a considerable number of workshops for the production of fakes, where single pages and even complete manuscripts are concocted in the style of any old master that may be desired. This somewhat questionable development has at least the advantage of preserving skilled craftsmanship from decay and maintaining some contact with the masterpieces of the past.

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OTHER FORMS OF PERSIAN ART

A strain of decorative skill dating from the Mohammedan conquest permeates all the expressions of Mohammedan art generally known as Persian, but pre-Mohammedan influences are not absent. Such Sassanian motives as twinned animals facing each other appear constantly.

Architecture.—The progress of architecture from the Seljuk domination continues to a rich climax in the 16th to 17th centuries. The love of barrel-vaulted porches can be traced directly to Sassanian palaces and were the chief motives of the great mosques where they were flanked by twin minarets in the design of which appears that emphasis on height which is universally Persian. A second characteristic was the use of a dome with two shells, the outer onion-shaped and supported on a high drum, and the swelling slight in early examples but more pronounced later. Daring ingenuity of construction prevailed in all of these vaults and domes. The stalactite (*q.v.*) corbels, elaborate intersections of curved surfaces, delicate groined lines and scalloped forms were handled with extraordinary skill and these types differed widely from similar buildings in the rest of the Muslim world.

During the 18th century there developed rich and delicate wooden construction including slim columns, intricate cornices treated with lavish carving and inlays used frequently in the exquisite formal gardens so important to Persian life. The Mohammedan love of surface ornament led to dominance of plane surfaces covered with tiles so that walls, vaults, domes and minarets glowed with blue greens and turquoise, rose and yellow. In no other style has applied color become such an integral part of architectural design. (*See* Mohammedan Architecture; Mosque; Tile.)

Ceramics.—Springing from the most ancient Mesopotamian development of pottery Persian ceramics developed in about the 13th century into one of the most exquisite of all arts. The pottery body was coarse due to the available clay but the glazes were developed to a high degree of perfection and the coloration, more especially the blues ranging from turquoise to cobalt, became world-famous. Sassanian, Parthian and Byzantine influences lent vigour and charm. By the 14th century floral ornament became more important and the designs were freer and less formal. Vases were decorated in low relief and covered with monochrome blue glaze. During the 16th century the Chinese influence made itself felt and became strong in the 17th century not only in design but in methods of manufacture and at the same time Persian influences were felt in China. Tiles were of course an important phase of the ceramic industry. (*See* Pottery and Porcelain: *Near and Far East;* Tile; Mosaic.)

Textiles.—Church treasuries throughout Europe reserve textiles that are obviously of Asiatic origin showing the same Sassanian and Byzantine influences felt in Persian ceramics.

Lions, eagles and imaginary beasts enclosed in geometric patterns form the decoration on a material of woven silk and sometimes gold and silver. Prior to the 13th century these textiles came from different parts of the Mohammedan world but later from Turkey and Persia, the Turkish development appearing in conventionalized ornament and the Persian from the 18th century onward showing greater complexity in formality and realism, and influenced eventually by Chinese elements due to the Mongol domination.

Rugs are the most important of Persian textiles, the best of them, which date from the 16th and 17th centuries, displaying amazing delicacy in technique and great decorative skill in design with rich soft colours marvelously adapted to the texture. (*See* TEXTILES AND EMBROIDERIES; RUGS AND CARPETS; BROCADES.)

Metalwork.—The Persians were aesthetic craftsmen in metal and their delicate inlaying of silver and gold into copper and steel of intricate geometric and naturalistic ornament shows decorative genius and the greatest of technical facility. The motives in this work were similar to those used in ceramics and textiles. A rinceau or branching scroll ornamented with sharp pointed spear-like leaves was widely used. Much of this artistry was employed of course in the decoration of arms and armour and though there is a resemblance between the work of Turkey and Persia, the Persian far surpasses with its richness and delicacy. (*See* SILVERSMITHS' AND GOLDSMITHS' WORK: *Oriental;* DAMASCENING.)

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(T. F. H.)

PERSIAN BERRIES are the seed-bearing fruit of species of *Rhamnus* which are, or were, cultivated in France, Spain, Italy, the Levant and Persia. The Persian berry proper is derived from *R. amygdalinus*, *R. saxatilis* and *R. oleoides*. The berry, gathered when unripe, has a greenish-yellow colour, but when older it is black and gives an inferior result in dyeing. Though their use has declined, Persian Berries are still employed by calico printers for the production of "steam" orange, olive and green effects. In dyeing property they closely resemble quercitron bark and contain, as their main constituent, xanthorhamnin, $C_{34}H_{42}O_{20}$, a glucoside of rhamnetin, $C_{16}H_{12}O_7$. (A. G. P.)

PERSIAN GULF. The term Persian Gulf is, strictly speaking, restricted to the landlocked sea which extends in a south-easterly direction from the mouths of the Euphrates and Tigris rivers some 500 miles to the mountain mass of the promontory of Oman, terminating in Ras Musandam; but for the purpose of this article it will be considered to include the Gulf of Oman to which it is joined by the Strait of Ormuz, 29 m. wide in its narrowest part; it thus extends roughly from lat. 22° to 30° N., and from long. 48° to 62° E. The Gulf within the Strait of Ormuz has a maximum width in its southern part of about 200 m. and covers an area of about 97,000 sq.m. Its waters are comparatively shallow: the deepest soundings range from 40–50 fathoms, while in the Strait just off Musandam the depth is about 80 fathoms. The deep soundings lie much nearer the Persian than the Arabian shore, the 20 fathom line lying 100–105 m. off the coast of Bahrein, while it is only 10 m. off Lingeh on the Persian coast. The Gulf is tidal, spring tides rising about 9 ft. The salinity of the water, while somewhat higher than that of the Indian Ocean, is yet low for an inland sea subject to great evaporation. Within the Gulf proper, currents are scarcely observable, but at the Strait of Ormuz there is a distinct inward flow from the Indian Ocean during the south-west monsoon and a slight outward flow during the rest of the year.

By far the most important waters received by the Persian Gulf are those of the Euphrates and Tigris rivers, though until 1766 the Karun had direct access to the sea via Khor Musa, and at a much earlier date the Karkhah (which now disembogues into a marsh) joined the Karun below Ahwaz. The Shatt-el-Arab is now the main channel whereby all these rivers pour their waters into the Gulf and, with the exception of the Jarrahi and Hindiyan rivers to the east, all the other streams are insignificant and their water so salt as to be undrinkable. The Persian Gulf does not lack fine harbours, *e.g.*, Maskat, Elphinstone Inlet, Kuwait, Khor Musa and sheltered anchorages, *e.g.*, Chahbar, Jashk and Gwadur, but those principally used are mostly shallow and exposed.

The Gulf is dotted with numerous islands varying in size from the rocky pinnacles, such as the Quoins, to the extensive Qishm Island (close to the Persian coast and 70 m. in length), and Bahrein Island (off the Arabian shore, 30 m. by 10 m. and covering an area of 210 sq. miles). Some of these islands, *e.g.*, Kharag, Qishm and Shaikh Shu'aib are geologically similar to the main land of which they once formed a part: others, such as the Daiyinah group, Halul, Hormuz and Larak are salt plugs which have been thrust up from below, bringing to the surface boulders of the older rocks, such as may be seen on the shore at Henjam. Two extensive islands at the head of the Gulf, Abadan and Bubiyan Islands, are of deltaic formation.

The Persian Coast.—From the Indian Ocean the outer Gulf, or Gulf of Oman, is entered approximately where Persian territory begins in Makran at the small port of Gwatar, long. 61° 29′ E., whence the coastline, running W. first to the Strait of Ormuz, next along the north shore of the inner Gulf and finally to the mouth of the Shatt-el-Arab (the Perso-Iraq frontier) is nominally under the exclusive control of the Persian Government, falling in large part within the administrative district known as the "Gulf Port" of the province of Fars (*q.v.*). The sections of this coast named in order, from the neighbourhood of Jashk are: Biyaban, Minab, Shamil, Bastak, Lingeh, Shibkuh, Dashti, Tangistan, Dashtistan, Angali, Rud-Hilleh, Hayat Davud and Liravi. Then follows the coast of Khuzistan. The inhabitants of these coastal tracts are either Persians, or Arabs who by domicile and intermarriage with Persians have lost nearly all their racial and most of their social characteristics, but retain a dialect of Arabic as their mother tongue and are for the most part Sunnis and not Shi'ahs. The principal places along the coast are Chahbar, Jashk, Bandar Abbas, Lingeh, Bushire, Bandar Rig and Bandar Dilam.

The Arabian Coast.—The south coast of the Persian Gulf may be regarded as commencing from Ras el Hadd, the most easterly point of Arabia. Extending to Ras Musandam, this coast is part of the sultanate of Oman and is ruled by the sultan of Muscat (*q.v.*), and the principal towns, naming from east to west, are Sur, Muscat, Matra, Khabura and Sohar.

From Musandam, westward of the Muscat boundary at Tibat, the coastal tract now known collectively as the Trucial Oman, but formerly as the "Pirate Coast," is occupied by a number of independent sheikhdoms. The headquarters of the Trucial chiefs run east to west as follows: Ras al Khaima, Umm al Qaiwain, Ajman, Sharja, Dibai and Abu Dhabi. Further west is Qatar, a peninsula consisting of low barren hills projecting some 120 m. into the Gulf. Doha is the principal place and residence of the chief. The political position of Trucial Oman and Qatar is not easy to define briefly, but it is regulated in the main by two agreements signed individually by the five chiefs in 1853 and 1892. The first provided for the suppression of piracy and cessation of hostilities at sea among the signatories, and it imposed on the British Government the duty of enforcing peace; by the second agreement the Trucial chiefs bound themselves to enter into no treaty with a power other than Great Britain and not to cede, sell or mortgage any part of their territories, save to the British Government. Subsequently a treaty was made with the chief of Qatar whereby his position was assimilated to that of the Trucial chiefs; and the British Government undertook, in addition, to afford their good offices to all in the event of unprovoked aggression from within or without.

North-west of Trucial Oman and Qatar lies the extensive maritime tract of Al Hasa and Hofuf, over which, up to 1913, the Turks exercised authority, and claimed it also in Qatar and the

adjacent territory of Kuwait on the North. The emir of Nejd, Abd-ul-Aziz ibn Sa'ud, ejected them from the first-named district, and the World War put an end to Turkish claims elsewhere in the Gulf. Al Hasa is now entirely absorbed in the dominion of Ibn Sa'ud. The chief places on the coast are Uqair and Qatif, and Hofuf in the oasis of the same name.

Lying in a deep bay between Qatar and Al Hasa is Bahrein Island, with the smaller subsidiary island of Muharraq on the north. In 1892 the sheikh entered into an agreement with the British Government not to "cede, sell, or mortgage or otherwise give for occupation any part of his territory save to the British Government." North of Al Hasa, at the head of the Gulf, is situated the independent principality of Kuwait (*q.v.*) which has a low stretch of coastline some 200 m. in length. The chief town is Kuwait on Kuwait Bay. Between Kuwait and Persia is the narrow corridor which gives access to Iraq (*q.v.*).

Climate.—The prevalent winds in the Gulf follow the configuration of the coast, *i.e.*, north-west and south-east, and are known respectively as the *shamal* and the *qaus*. The former, often rising to a gale in a few hours and falling as suddenly, is foretold by no change in the barometer. With the qaus the reverse is the case, and this wind is much dreaded by native mariners, as it strikes nearly all the sheltered anchorages.

Meteorological observations systematically taken over periods ranging from eight to thirty-three years, give the following mean annual rainfalls for places round the Gulf: Basra 6·23 inches, Bushire 11·07, Jashk 4·17, Muscat 3·94 and Bahrein 2·47. Thus the rainfall is considerably greater on the Persian than on the Arabian coast. The influence of the south-west monsoon, though marked at Muscat, is scarcely noticeable in the Gulf proper, but upper-air investigations at Baghdad give some reason to think that the effect of the monsoon can be observed even there.

Mean temperature (Fahr.) varies as follows:—

Basra and Mohammerah	52° in Jan. to	91° in Aug.
Bushire	56° " " "	89° " "
Jashk	67° " " "	89° " "
Muscat	69° " " "	90° " "
Bahrein	61° " " "	91° " "

Absolute shade temperatures are:—

Basra and Mohammerah	24° in Jan. to	120° in Aug.
Bushire	32° " " "	115° " "
Jashk	42° " " "	112° " "
Muscat	58° " " "	114° " "
Bahrein	41° " " "	108° " "

Relative humidity is high throughout the Gulf proper, the maximum being experienced at Bahrein.

The Medical Conditions prevailing in the Gulf are largely determined by the peculiar climatic influences to which the inhabitants are exposed. The hot season is from May to Oct., and the Gulf had in the early part of the last century and during the World War an unenviable reputation, but the experience of the Anglo-Persian Oil Co., Ltd., who employ over a thousand Europeans and 25,000 Persians all the year round, largely in the open air, indicates that with good housing, sanitation and water supply, and under careful medical supervision, it is possible to maintain a higher general standard of health in the Persian Gulf and south-west Persia than in most parts of India and of the Far East. This has also been, in recent years, the experience of the British and Indian navies.

Earthquakes.—The latest movement to which the Gulf has been or is now being subjected is one of gradual elevation, evidences of which are found in recent sea-beaches, some as much as 450 feet above present sea-level, and in the flat ledge which surrounds Muscat harbour. Earthquakes are frequent and sometimes severe in the Persian Gulf proper, especially on Qishm Island and on the neighbouring mainland. In 1865, an earthquake levelled the villages of Darveh Asuh near Mugam in the Shibkuh section of the Persian coast; in 1880 an earthquake caused 120 deaths in Basra; in 1883, severe shocks were felt from Bushire to Tahiri (long. 52° 15′ E.); in 1884 an earthquake caused 132 deaths on Qishm Island, which was deserted for a time in consequence; in 1897 another destroyed Qishm town and caused over 1,000 deaths; further shocks were experienced at Qishm and Bandar Abbas in 1902 and 1905.

GEOLOGY

The Persian Gulf and its continuation, the alluvial plain of Mesopotamia, together form a depressed zone lying between the stable tableland of Arabia and the folded ranges of south-western Persia, the so-called Zagros system. It is a shallow sea, nowhere with depths of more than 60 fathoms, and is in no sense a "rift valley" such as the Red sea. The rocks forming its shores are of recent or young Tertiary age and are mostly sandstones, marls, limestones and gypsum. Locally Eocene and Upper Cretaceous limestones are exposed, and the Hormuz series, in part Cambrian, appears associated with intrusive salt bodies. Relics of raised beaches up to 150 ft. above sea-level are locally preserved.

The strike of the folds throughout the length of the Persian coast is parallel to the shore line. A number of anticlinal structures form prominent ranges, such as Kuh-i-Bang, Kuh-i-Mund, Shahin Kuh, etc. The greatest folding movement is of late Pliocene age. The marked swing of the strike between Lingeh, Bandar Abbas and Jashk shows the influence of Oman which projected as a buttress towards the advancing fold waves of the Zagros system. The headland of Oman, the Ruus el Jebel, consists of massive limestones of Permian to Lower Cretaceous age. These were strongly folded in middle Cretaceous time and the complex played a passive part during the later Pliocene folding of Persia. The inlets in the Ruus el Jebel are drowned valleys indicating a relative depression of the land of about 1,500 ft.

The Arabian coast of the Gulf is mostly very flat and featureless. Between Koweit and Qatif it is composed of an extended sheet of horizontal or very gently folded calcareous sandstones and limestones probably of Pliocene to Pleistocene age. Bahrein island and Qatar peninsula are elongated domes exposing Eocene limestones and marls. The water of the copious springs of Bahrein and of the wells of Qatar is artesian.

The numerous islands of the eastern half of the Gulf are formed of intrusive salt plugs. Salt is only exposed in a few islands, Qishm, Henjam, Hormuz, etc., but its presence under the other islands may be assumed. On the Persian mainland there are a great number of these plugs, which in some cases build great salt mountains rising to nearly 4,000 ft. above the surrounding plain, as at Kuh-i-Namak in Dashtistan. The salt masses are 4 to 6 m. in diameter and appear as intrusions.

Economic Geology.—Red oxide of iron is obtained from Hormuz island and smaller deposits are numerous elsewhere. The oxide is a concentrate from haematite-bearing rocks of the Hormuz series.

Copper.—Old copper workings are known in Oman and in Persia, north-east of Minab. The serpentines of the Hormuz series carry locally traces of copper.

Salt occurs in great quantities but it is only quarried for local markets.

Oil seepages or bitumen occur at Qishm, Khamir, Bahrein, etc. A boring by the Anglo-Persian Oil Co. on Qishm island was unsuccessful and has been abandoned.

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Minerals.—Though very careful search has been made for possible oil fields along the Persian littoral by the Anglo-Persian Oil Co., Ltd., and though seepages of oil, gas and asphalt are not uncommon, no potential field has yet been located near the coast. Experimental borings on Qishm failed to give results. Oil and asphalt shows occur likewise at Kuwait and Bahrein, but the prospects of oil being found in those territories in adequate quantities is slender.

Coal is found 30 m. inland from Sur, but apparently in pockets only, while some seams of good coal occur elsewhere in newer strata. Sulphur occurs in fairly pure state at Khamir and Bustaneh on the coast east of Lingeh, and on Qishm island. Copper, as copper glance and malachite, occurs in the interior of Oman, and ancient copper workings are not infrequently met with on the Persian coast. Some thousands of tons of red ochre have

been mined on Hormuz and occasionally on Abu Musa and other islands. Salt from deposits is obtained in abundance on Qishm and Hormuz, and by evaporation near Khor Musa, Fao and elsewhere on both sides of the Gulf. Iron, as haematite and pyrites, is widely found through the Ormuz series of rocks, but not in commercial quantity.

Agriculture and Livestock.—Fertile patches in the immediate vicinity of the Persian Gulf are exceedingly sparse: the only cultivated tracts of considerable extent are at Minab, east of Bandar Abbas; in the valley of the Mund river in Laristan; in the oasis of Hofuf in Hasa, and along the Batina coastal strip of Oman. Date plantations are extensive in the interior of Muscat at Minab, at Lingeh and along the banks of the Shatt-el-Arab. The Muscat date reaches maturity sooner than the Basra crop and forms a valuable article of export, being supplied chiefly to the United States markets. Camels are numerous on the Arabian side of the Gulf, but are much less common on the Persian coast. Horses are scarce in Oman, Bahrein and Al Hasa, but are in more common use in Qatar and Kuwait. Further details regarding agriculture are to found in the articles describing specific districts of the Gulf.

Sailing Craft.—The Persian Gulf is by tradition a home of sailing craft,—for their skill in handling which the Phoenicians afterwards became famous in the Mediterranean, and the Arabs in Indian waters. There are some 14 types of native craft which are more or less peculiar to the Persian Gulf proper. The same principle of construction applies to nearly all, and as a general rule these vessels are remarkable for the beauty of their lines. They sail well and fast and are weatherly craft. The principal boat-building centres are Kuwait, Sur and Lingeh. The craftsmen of the latter place are especially noted for their skill in building and repairing.

Fisheries.—Few seas are more prolific in fish than the Persian Gulf and the Gulf of Oman; most of the known species are edible, and many have a commercial value for the isinglass or oil extracted from them. Fish are extensively used for manure, especially around Muscat, where they are also fed to cattle with satisfactory results. Sharks are caught in enormous numbers with hook and harpoon: the flesh is regarded by some as having aphrodisiacal properties and is freely exported to the interior in sundried strips; while the dried fins and tails are exported to China, and the oil is used for smearing boats. Turtles are numerous, the carapace being exported as tortoiseshell. The narwhal whale is often seen in the Gulf of Oman and sometimes in the Persian Gulf, and porpoises and swordfishes are common.

Pearling Industry.—The temperature and shallowness of the Persian Gulf and its freedom from silt, except at the northwest end, appear to be favourable in a high degree to the growth of the pearl oyster, and the banks which are known and actually worked occupy a considerable area, chiefly upon the Arabian side. The pearling grounds of Bahrein lie in over six fathoms of water, mostly beyond the three-mile limit. The banks of the Persian side are found chiefly along the coast between Lingeh and Tahiri, and again in the neighbourhood of Kharag island. The largest and most important banks on the Arabian side are fished annually, while those of the Persian coast, poor and small, are worked at infrequent intervals. The total value of pearls exported was declared at £220,000 in 1925 and £192,000 in 1926, but the actual value is probably ten times as great, having regard to the large number of persons employed in and mainly dependent on the industry, not only in Bahrein but all along the Arab coast. The exports from Lingeh for the same years were £9,000 and £5,200. Mother-of-pearl was exported, before the World War, to the value of £20,000; after the war high freights and absence of demand from Hamburg, the principal market, killed the trade for the time being. Some 4,500 boats employing about 75,000 persons are engaged in the industry during the season, of three to four months, its length depending ultimately on the temperature of the water from a diving standpoint.

Commerce.—Commerce between East and West had from early times followed the Persian gulf route in preference to that of the Red sea, and when during the 15th Century Genoa and Venice successively lost their control of Oriental commerce, through the capture of Constantinople by the Turks and by the hostility of the Mamelukes of Egypt respectively, the country which most earnestly sought a new way to India was Portugal. Albuquerque in 1507 seized several towns on the coast of Oman, including Muscat, and soon afterwards established his authority on the island of Hormuz. Towards the end of the 16th century the Dutch made their appearance in Indian waters as rivals of the Portuguese, and in 1616 the first English "factory" of the East India Company was established at Jask. In 1622 the Portuguese were expelled from Hormuz by joint efforts of the British by sea and the Persians by land; in 1650 they were driven out of Muscat. In 1664 the French appeared, but did little trade, though in 1698 they took a share in the policing of the Gulf against pirates. The Dutch who had played no part in expelling the Portuguese, now became increasingly predominant, and the wars waged in Europe between England and Holland had their counterpart in the Gulf. In 1674 hostilities between the two countries ceased, but the position was still unsatisfactory in Indian waters owing to the prevalence of piracy, from which other nations as well as England suffered. About 1700 improved affairs in India began to have good effect on the East India Company's commercial position in the Gulf; by 1765 the Dutch trade there had ceased.

Henceforward the bulk of the trade was in British hands, but piracy was rife, the slave trade flourished, and the coast towns had fallen from their ancient prosperity to a low level. To restore and maintain this prosperity has, for a century past, been the mission of Britain in this region, the British Resident in the Gulf acting as the representative of the Government of India, being the arbiter to whom by long custom all parties on the Arab coast have appealed and who has, under treaty, been entrusted with the duty of preserving peace.

The following summary shows the import, export and total values of trade (in thousands of pounds sterling) in the Persian Gulf (excluding Iraq and Basra, *qq.v.*), in 1926 as compared with the pre-war year 1913–14:—

	1926			1913–14		
	Imports	Exports	Total	Imports	Exports	Total
Arabian side						
Muscat	448	226	674	408	272	680
Bahrein (Manama)	1,622	1,155	2,777	1,878	1,740	3,618
Kuwait	448	247	695	371	114	485
Total	2,518	1,628	4,146	2,657	2,126	4,783
Persian side						
Mohammerah	1,078	338	1,416	Not available		
Abadan	1,101	36*	1,137	Not available		
Bushire	2,099	1,899	3,998	826	602	1,428
Lingeh	170	66	236	180	126	306
Bandar Abbas	1,024	338	1,362	459	267	726
Total	5,472	2,677	8,149	..		..
Grand total	7,990	4,305	12,295	..	..	..

*Not including Anglo-Persian Oil Co.'s shipments of petroleum in 1926 = £11,494,000 (£St. = 47,34 krans).

The total tonnage of shipping passing up the Gulf to the various Persian ports amounted to nearly 8 million tons, in 1925–26, including A.P.O.C. shipping. Of this total about 220,000 tons only represented tonnage by local sailing craft. 95% of the shipping was British, the bulk of the remainder being Persian, German and Japanese. Figures for the Arabian side of the Gulf are not available, but Manama is the principal distributing port on that side.

The percentage of the total trade of each port, as shown in the above table, carried by sailing craft, in 1926, was as follows:—Muscat, 20%, Kuwait, 44%, Mohammerah, 38%, Bushire, 2%, Lingeh, 53%, Bandar Abbas, 7%.

The principal local products exported from the various ports of the Gulf in 1926 were as follows (values within brackets in thousands of pounds):—

From Muscat: Dates (138), Dry and Salted fish (60).
From Bahrein (Manama): Pearls (192), Dates (20), Specie (270), Misc. re-exports (600).
From Kuwait: Pearls (11), Dates (10), Hides, skins and wool (6).
From Mohammerah: Dates (114), Raw wool (104), Tobacco (14).
From Abadan: Petroleum (11,574), Fresh and dried fruits (10).
From Bushire: Opium (1,390); Carpets and rugs (160), Fresh and dried fruits (104), Gum (93), Tobacco (45).
From Bandar Abbas: Carpets (113), Dry and fresh fruits (65), Raw Cotton (63).

The peculiar interests of Great Britain, strategic, political and commercial, in the Persian Gulf have never been denied and they are intimately connected with the welfare of India, the security of its communication with the outside world, and its internal tranquillity. The considered policy of the British Government was embodied in 1903 in Lord Lansdowne's declaration in the House of Lords that "we should regard the establishment of a naval base or of a fortified port in the Persian Gulf by any other Power as a very grave menace to British interests, and we should certainly resist it by all the means at our disposal." This declaration was formally reaffirmed in 1907 by Sir E. Grey, in a despatch to the British ambassador at St. Petersburg, which further stated that "H. M. Government will continue to direct all their efforts to the observance of the *status quo* in the Gulf, and the maintenance of British trade; in doing so they have no desire to exclude the legitimate trade of any other Power." These declarations were never openly challenged, and in 1912–14 the British Government entered into far-reaching negotiations with the Turkish and German Governments with the object of regularizing the position in Mesopotamia. The resulting agreements had not, however, been ratified before the declaration of war, but in the result, the *status quo ante bellum* has been uniformly maintained throughout this region, except in Iraq (*q.v.*) and Nejd (*q.v.*).

Banks and Currency.—The Imperial Bank of Persia, in addition to others in Persia, has branches at Abadan, Bushire, Bandar Abbas and Mohammerah. The Eastern Bank has a branch at Bahrein. Persian currency alone is legal in Persia, but the rupee is current in Persian ports. On the Arabian coast the rupee is legal tender, and is almost exclusively used for commercial transactions, but the Maria Theresa dollar circulates freely and is preferred by the inhabitants of the interior.

Lights and Buoys.—In view of the difficulties attending navigation in the Gulf, and the impossibility of arranging with the various governments of the littoral for the provision of lights and buoys, except on terms which would have greatly hampered shipping; in view also of the great preponderance there of British shipping, the British Government has established since 1912 a very complete system of lights and buoys, at various ports and on certain islands. The cost is met (since Oct. 1925) by a levy on all vessels crossing the bar of the Shatt-el-Arab. There is a powerful lighthouse on one of the Quoins off Musandam and another on Tanb island farther west. There is a small shore light at Muscat harbour, but none on Ras el Hadd. Lightships are moored at Qais island and on the Shatt-el-Arab bar, the channel of which is very adequately buoyed and lighted throughout its length to Fao, where there is a fixed light. There is a beacon light at Ras al Arz (Kuwait bay); two lighted buoys at Manama (Bahrein); lighted buoys and a shore light at Bushire; and a shore light at Jask. The dredging of the bar of the Shatt-el-Arab to a maximum depth of 28 ft. along a channel 12 m. in length, was almost complete in 1928, the object being to maintain a good maritime approach to Iraq.

Mail Communications.—The Persian Gulf was at the end of the 18th century the most rapid route between Europe and India, and it was not until 1833 that the Red Sea route was adopted by the East India Company. From this date, until 1862, the Gulf fell into an extraordinary state of inaccessibility—letters from India being sent to Baghdad and Basra via Damascus, and correspondence from Bushire for Baghdad via Tehran. In 1862, the British India Steam Navigation company undertook their first mail contract for the Persian Gulf, and simultaneously the Euphrates-Tigris Steam Navigation company agreed to run a subsidized line of mail steamers from Basra to Baghdad. Since the World War the only steamship line running regular weekly services to the Gulf ports is still the British India Co. via Bombay and Karachi. Their direct mail steamers call only at Bushire and Mohammerah on their way to Basra, but there is a weekly subsidiary mail service which provides a service in each direction for every port in the Persian Gulf at least once a fortnight. The next line of importance is run by Messrs. F. C. Strick and Co. Ltd., who maintain a direct fortnightly service between the United Kingdom and the Persian Gulf (Basra). These steamers call at Bandar Abbas, Bushire and Mohammerah and, occasion requiring, elsewhere.

When merchandise has arrived at any port, the further transport to the hinterland is mostly effected by pack animal, except at Basra which has railway communication into Iraq, and at Bushire where transport by motor lorry is coming into use. Goods for the interior landed at Mohammerah are transhipped into barges which are taken by river steamers to Ahwaz and after further transhipment on to Shushtar.

Posts.—The reopening in 1862 of direct communications between India and the Persian Gulf gave rise to a demand for properly organized post-offices, and the Indian Postal Department accordingly opened branches in 1864 at Muscat and Bushire and later on at every port of importance. The Indian post-offices on Persian territory ceased to function in 1925 but those on the Arabian side are still maintained by the Government of India.

Telegraphs.—The inception of the Persian Gulf telegraphs, which formed the first links in an inter-continental chain, was dictated not by local interests, but by broad considerations of national advantage. The Crimean war brought home to the Porte the slowness of communication between the Persian Gulf and the outlying provinces of the Turkish Empire, while the Indian Mutiny taught the British Government a similar lesson in regard to India. In 1857, after some unfruitful negotiations, the Turkish Government agreed to the construction, on their behalf, of a telegraph line from Scutari to Baghdad; this was finished in 1861, and extended to Fao in 1864 when it was linked up with the cable from Karachi which had been laid meanwhile. The route of the cables has been several times altered. They now run from Karachi to Jask, whence a cable runs to Muscat; from Jask one cable runs to Hanjam, and thence to Bushire (Rishahr); another cable runs direct to Bushire. A double cable connects Bushire with Fao; and Hanjam is connected with Bandar Abbas. Jask is connected by land line to Karachi. Mohammerah is connected by land line with Abadan, and via Ahwaz with Bushire and with the inland Persian system. Kuwait is connected with Basra. The system is under the control of the Indo-European Telegraph Department, whose director-in-chief is responsible to the secretary of state for India. The Department, which also controls the principal international lines in Persia, is amply self-supporting. Bushire, Hanjam, Bahrein, Abadan, Basra and Jask are provided with wireless stations. Bushire and Bandar Abbas have their own telephone systems; and Abadan is connected by telephone with the Anglo-Persian oil fields at Masjid-i-Sulaiman (150 m.).

The Arms Traffic.—During the third Afghan War, the trade in modern arms and ammunition in the Persian Gulf attracted the attention of the British and Indian Governments for the first time. In 1880, the latter took preliminary steps to stop the traffic within its own borders. In 1881 the importation of arms and ammunition into Persia was made illegal, but with little effect. In 1890 the General Act of the Brussels Conference struck a blow at the trade in Africa, and diverted it to the Persian Gulf, which was not subject to the Act. The stream of arms flowing from Zanzibar continued to increase in volume until, in 1892, no less than 11,500 firearms were landed at Muscat, of which more than half were at once re-exported. The number was doubled by 1895 and trebled in 1897, and, in spite of prohibitions, imports into Persia continued on a large scale. Moved at last by the menace of the great quantity of military material that was being disseminated in the Gulf, the British Government urged the Persian Government to enforce the existing law, and to confiscate the large stores of arms which had accumulated at Bushire. Persia took strong action but with only temporary effect. Somewhat similar action was taken at Bahrein.

From 1898 to 1908 the attitude of the British Government

towards the question was one of constant attention without the power to intervene directly or effectively. In 1900, the consignment of arms and ammunition to the Gulf, through Indian ports, with or without transhipment, was made illegal. This was reinforced by Act of Parliament declaring illegal the export of arms to countries or to places where they might be employed against British troops or subjects. The trade, blocked at Persian and all Gulf ports except Muscat, continued, nevertheless, to flourish, in spite of a naval blockade of the Makran coast by the British in 1910–11. At length, in 1912, the sultan of Muscat issued a proclamation requiring all arms imported into his territory to be placed in an "arms warehouse," where they were registered and from which they could not be removed except on production of an import permit from the competent authority at the place of destination. This killed the trade at Muscat. The French Government who first held that the proclamation was inconsistent with the sultan's treaty engagements with them, accepted the accomplished fact after lengthy diplomatic negotiations. The trade was almost dead by 1913, except at the north end of the Gulf where it still persisted on a small scale. The traffic in arms has from first to last been responsible for much unrest among the tribesmen of the Middle East and indeed of Arabia; but for this phenomenon the European Powers, signatories of the Brussels Act of 1892, are largely to blame, from lack of foresight and to some extent of goodwill. The international conference on arms traffic held in 1925 under the auspices of the League of Nations rejected the Persian claim that the Gulf was "private waters" of Persia, declaring it part of the high seas.

Slave Trade.—On board the fleet which, in 1626, conveyed Sir Dodmore Cotton, British ambassador, with his staff from Surat to Bandar Abbas, there were more than 300 slaves bought by Persians in India, and the only remark which this scandalous circumstance suggested to Sir Thomas Herbert, his chronicler, was that "ships, besides the transporting of riches and rarities from place to place, consociate the most remote Regions of the Earth by participation of commodities and other excellencies to each other." In 1772 it was decided by the English courts that a slave as soon as he set foot on the soil of the British Isles became free; the slave trade, however, continued actively until 1807, when an Act was passed to prevent British subjects from dealing in slaves; in 1833 the status of slavery was abolished throughout the British Dominions. In defiance of her commercial interests and of her popularity with the Muslim population of the Gulf, Great Britain set herself the arduous task of suppressing the traffic in slaves, a task which involved great sacrifice of life and money.

The trade in the early days was carried on mainly at Muscat and Sur, notably the latter, a sheltered port conveniently placed for such a purpose, just north-west of Ras el Hadd. The source of supply was Zanzibar to which market the negroes captured in the interior of Eastern Africa were brought for sale. Other places of export were Kilwa and Juba. The destination of the "harvest" cannot be so clearly defined, but we are told that "we find the slave, after his final sale, as a pearl diver in the shallows of the green waters of Oman, as the familiar dependent and domestic of the Arab gentleman, or as the servant of the Persian merchant." In furtherance of her aims, Britain had to treat successively with several separate and largely independent political entities in the Gulf, and this made progress slow. Her first definite efforts were with the sultan of Muscat with whom, as a first step, a treaty was concluded in 1822, which prohibited the sale of slaves to Christian nations by the sultan's subjects, made the purchase of slaves a punishable offence, and empowered Britain to place an agent in the sultan's dominions of Zanzibar to watch the traffic and seize Omani vessels engaged in it. This agreement was amplified by further treaties in 1838–9 and 1845 and, in 1873, by final treaties with Muscat and Zanzibar separately. Treaties of a similar character were also made with the Trucial Chiefs and with the Sheikh of Bahrein. Persia agreed in 1851 to a Convention prohibiting the importation of negroes into Persia by sea, and this was amplified by a further convention in 1882.

The enforcement of the treaties, however, called for constant vigilance and involved the patrolling of the Gulf and Indian waters. Hundreds of slaves were rescued at sea and thousands otherwise released. By 1920 the last remaining traces of the nefarious traffic by sea had virtually disappeared. Domestic slavery, however, as an institution, continues in Muscat and in Central Arabia: it is important to distinguish between this—an institution recognised by Koranic law, which imposes many obligations and restrictions on the owners of slaves—and the commercialized slavery which disgraced Christendom in the 18th and the first half of the 19th Century, and was exposed with such courage and devotion by David Livingstone.

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(P. Z. C.)

PERSIAN LAMB, the skin of the young of Persian sheep, known generally as *astrachan*, which produces a valuable fur for commercial purposes. *See* FUR.

PERSIAN LANGUAGE: *see* IRANIAN LANGUAGES AND PERSIAN.

PERSIAN LITERATURE. We possess scarcely any documents on the intermediary stages of the Persian language between middle Persian and modern Persian. More than this, the first specimens of modern Persian are in verse; therefore the beginnings of the Persian language, as known to us, practically coincide with those of Persian literature. The origin of Persian poetry is associated with the rule of the Persian dynasties, which sprang up in the east as soon as the grip of the caliphs became less felt in the outlying parts of their empire. The earliest poets (9th and 10th centuries) were mostly natives of such extreme north-eastern provinces as Merv, Bukhara and Samaruand, but we may simply be less informed of the developments in the west. According to Ṭabari, the amīr of Marāgha (in Azerbaijān) Muḥhammad bin Ba'īth (d. A.D. 850) was the author of some poems in Persian.

Earliest Poets.—The earliest name mentioned by the Persian biographers is that of 'Abbās of Marv, who in A.H. 193 = A.D. 800 composed an ode in honour of Hārūn al-Rashīd's son Ma'mūn, noted for his strong pro-Persian feelings. Specimens of it, as quoted in the anthologies, are now regarded as spurious, but a Persian verse by a certain Abū Taqī al-'Abbās bin Ṭarkhān preserved by the Arabic geographer Ibn Khurdādhbih (towards A.D. 846) has a more genuine appearance; this Abū Taqī al-'Abbās may even be the same person as 'Abbas of Marv.

We know little more than the names of the poets who lived under the Tāhirids (A.D. 821–873) and the Ṣaffārids (A.D. 878–900), but the unification of the eastern provinces under the Sāmānids (A.D. 875–999) was marked by the rise of a great many Persian poets. Some of them were patronised by the princes of other contemporary Persian dynasties: the Buwaihids (932–1055), the Ziyārids (A.D. 928–1042, in Tabaristān and Gurgān) and the Farīghūnids (A.D. 980–1010 in the region west of Balkh). Even the surviving fragments of these poems, some of whose authors wrote also in Arabic, permit us to trace the principal literary forms developed later on,—such as the *qasīda*, or panegyric, the *ghazal*, or ode (love-ditty, wine-song or religious hymn), the *rubā'ī* or quatrain (in a special metre unknown to the Arabs), and the *mathnavī*, or double-rhymed poem (used for epic and didactic poetry). Many of these earliest specimens of Persian verse, first discovered in Europe by Dr. H. Ethé, are real gems of spontaneous poetic feeling not yet fettered by the later conventional forms of rhetoric.

The Sāmānid Times.—The Sāmānid Naṣr II. (913–943) particularly patronized arts and sciences. His court-poet was Rūdagī, the first Persian classic. (*See* RŪDAGĪ.) In 963 Bal'amī, vizīr of Manṣūr I. (961–976), abridged and translated from Arabic into Persian the famous *Annals* of Tabari. The same

Manṣūr employed the most learned theologists of Transoxiana for a translation of Tabari's second great work, the *Tafsir*, or commentary on the Koran, and accepted the dedication of the first Persian book on medicine, a pharmacopoeia by the physician Abū Manṣūr Muvaffaq b. 'Alī of Herat (edited by Seligmann, Vienna 1859) which forms a kind of connecting link between Greek and Indian medicine. Perso-Arabian medical science was soon after developed by the great Abū 'Alī b. Sīnā, or Avicenna (d. A.D. 1037), himself a Persian by birth and author of pretty wine-songs, moral maxims and a manual of philosophy, the *Danish-nāma-i 'Alā'ī*, in his native tongue.

Daqīqī and Firdausi.—Manṣūr's son Nūh II. (976–997), commanded from his court-poet Daqīqī a modern Persian version of the "Book of Kings" (in Middle-Persian *Khvātāy-nāmak*). Daqīqī, who openly professed in his ghazals his Zoroastrian sympathies, began the work but died in the prime of life. The great undertaking was carried on by Firdausi who in 1010 added the final touches to this work. (*See* FIRDAUSI.) The *Shāh-nāma* almost immediately found many imitators who chiefly exploited the minor episodes of the Seistān cycle (legends concerning Rustam's family and not belonging to the original *Khvātāy-nāmak*). 'Alī b. Aḥmed al-Asadī (the younger), author of the oldest Persian glossary *Lughat-i Furs* (ed. by Horn, Berlin 1897), completed in 1066, in upwards of 9,000 distichs, the *Garshāsp-nāma* (ed. by Huart, Paris 1927), a story of warlike feats and love adventures of Garshāsp, one of Rustam's ancestors. Other poets followed with their lengthy *Sām-nāma, Johāngīr-nāma, Farāmurz-nāma, Gushāsp-nāma* (story of Rustam's Amazon daughter) etc.

Later Epics.—Later epic poets turned their attention towards more recent historical events and produced rhymed chronicles interspersed with poetical pictures of battles and conquests. The historian Ḥamdullāh Mustaufi wrote a *Ẓafar-nāma* of 75,000 couplets narrating the events from the birth of the Prophet Mohammed down to the year 1331. Other poets sang the deeds of Tīmūr, of the Ṣafavi kings and of the later sovereigns. In India too this kind of poetry was very popular. One of the last productions in this style is the huge *Jārj-nāma, i.e.,* "George-nāma," which in 44,000 distichs gives a poetical history of India from its discovery by the Portuguese till the conquest of Poona by the British in 1817.

Heroic fiction, pure and simple, drew its inspiration from various sources: the apocryphal exploits of Alexander the Great were sung in numerous *Iskandar-nāmas*, of which the earliest and the most original was completed by Niẓāmī (*q.v.*) about 1202; the subjects of other poems were borrowed from the chivalrous times of the Bedouin Arabs; some were devoted to the heroic exploits of the saints of Islam, especially of the Caliph Ali.

Romantic Fiction.—Romantic fiction too was born in the time of Firdausi. Love episodes in the *Shāhnāma*, like that of Zāl and Rūdāba, are characterized by occasional transitions from the epic to the romantic note. Firdausi's second great mathnavi *Yūsuf-u-Zulaikhā* is entirely romantic. It represents the oldest poetical treatment of the Biblico-Moslem story of Joseph, which later on tempted many Persian poets, such as Jāmī. Some tales of the Sasanian times were likewise popular among the poets: the *Vīs-u-Rāmīn*, composed by Fakhr ad-dīn As'ad Jurjānī about 1048, is noteworthy for its resemblance to the legend of Tristan and Iseult. The highest triumph in Persian romantic poetry was scored by Niẓāmī (1141–1203).

Encomiasts.—Panegyrics, which form an important department of Oriental literatures, are less apt to interest an average reader, but Persian *qasīdas* merit the special attention of all Persian students, owing to a wonderful mastery of language and expression displayed by their best-known authors. This sort of literature could thrive only under the benevolent looks of the patrons (*mamdūh*) and it will suffice to enumerate the courts which chiefly attracted and encouraged the poets.

What was commenced by the poets of Sultan Maḥmūd's "Round table," such as 'Unsuri, Farrukhi, Minūchihri (whose *dīvān* has been edited by Kazimirski, 1886) and others, reached its perfection in the celebrated group of court-poets who gathered in Marv around the throne of the Seljuk Sultan Sanjar (1118–1157), viz., the "King of Poets" Amīr Mu'izzī, killed in 1147 by a stray arrow from his master's bow; Adīb Ṣābir, drowned in the Oxus (in 1151) by the order of the Khārizm-shāh Atsiz, whose designs against Sanjar he had discovered, and Auhad ad-dīn Anvari (d. about 1189), perhaps the most celebrated Persian *qasīda*-writer. Among Anvari's poems, the one entitled by the European translators "the Tears of Khorasan" (Browne, II., p. 386) is especially famous; it is a sort of message to Sanjar, then a captive of the Ghuz Turks, describing the sufferings of the people under the invader's yoke.

Of the poets patronized by Sanjar's rival Atsiz the best-known is Rashīd Vaṭvāṭ (the "Swallow," so nicknamed for his small stature), who died in 1182 and left besides a series of *qasīdas*, a valuable treatise on poetry.

Another group of famous *qasīda*-writers is that of Shīrvān (in Transcaucasia) and Azerbaijān. The most serious of Anvari's rivals was Khāqānī (d. 1199), court-poet to the Shīrvān-shāh. Khāqānī was well versed in many of the contemporary sciences and had a profound knowledge of Persian lexicology, which makes it particularly difficult to comment on his *qasīdas*.

Some other notable poets lived under the aegis of the noble Ṣā'idī family whose members held high offices in Isfahan. To this group belonged Sharaf ad-dīn Shafarva (d. 1204) and Jamāl ad-dīn (d. 1192). The latter's son Kamāl ad-dīn Ismā'īl, who enjoyed a still higher reputation, perished at the hands of the Mongols about 1237.

Satirists.—The first example of a bitter personal satire had been given by Firdausi in his famous invective against Sultan Maḥmūd. Anvari's sarcasms were pungent but not so reviling. A curious figure is that of 'Ubaid of Zākān, who lived under the Mongols and died in 1370. Many of his jokes are ribald and untranslatable, but his *Akhlāq al-ashrāf* or "Ethics of Aristocracy" is a clever social satire opposing the "adopted" morale to the old "abrogated" idea of virtue. Satirists of a special kind are Busḥāq of Shiraz (beginning of the 15th century), a sort of comic Brillat-Savarin singing exclusively of food, and his counterpart Maḥmūd Qārī of Yazd, author of sartorial poems.

Didactic and Mystical Poetry.—In didactic and mystical poetry too very high standards were reached in the 11th and 12th centuries. The origin of the former class can again be traced back to the times of Firdausi, as the *Shāh-nāma* abounds in moral reflections and wise maxims. The first Persian who employed poetry exclusively for the illustration of Ṣūfī doctrines (*see* ṢUFIISM) was Firdausi's contemporary, the renowned Shaikh Abū Sa'īd b. Abu'l-Khair of Maihana, of northern Khurasan (967–1049). (*See* Nicholson, *Studies in Islamic mysticism*, 1921.) Abu Sa'īd initiated the form of quatrains (*rubā'ī*) well adapted to a concise expression of religious and philosophic aphorisms. This literary form was further developed by the great free-thinker 'Omar-Khayyām (*q.v.*), who moulded in it his original sceptical and hedonistic ideas. The first Persian handbook of Ṣūfiism was composed by 'Ali b. 'Uthmān al-Jullābī al-Hujvīrī (d. probably after 1072); this *Kashf-al-maḥjūb* or "Revelation of Hidden Things" treats of various schools of Ṣufis, their teachings and observances (ed. by Zhukovsky, Leningrad, 1926; abridged transl by Nicholson, 1911). A great saint of the same period, Shaikh 'Abdullāh Anṣāri of Herat (1006–1089) further encouraged the mystical movement by his *Munājāt* or "Invocations to God," several prose tracts and an important collection of biographies (*Tabaqāt*) of eminent Ṣufis, based on the Arabic *Tabaqāt* by Sulami (d. 1021), and in its turn serving as ground-work for Jāmī's valuable *Nafahāt-al-uns* (completed in 1478, ed. in Calcutta by Nassau-Lees, 1859). One of the earliest ethical *mathnavis*, with a mystical tinge, is the *Hadīqat-ul-haqīqat* or "Garden of Truth" composed in 1130 by Hakim Sanā'ī of Ghazni to whom all the later Ṣufi poets refer as their master. The greatest heights of the pantheistic teaching of "Union with God" were attained about the time of the Mongol invasion. The author of the *Ṣifat al-ādāb* or "Rules of conduct," Najm ad-dīn Kubrā, was slain in 1221 during the sack of Khārizm (Khiva) by the troops of Jenghiz khan. The great Farīd ad-dīn 'Aṭṭār lost his life in his native Nishapur in A.D. 1230 at the age of 114 lunar years. This

ascetic shaikh composed very numerous Ṣufi works, partly in prose, as the *Tadhkirat ul-awliyā* or "Memoirs of the Saints" (ed. by Nicholson 1905–7), but mostly in verse. Among his *mathnavis* (some 20 in number), the best known are the *Pand-nāma* or "Book of Counsel" (published several times) and the *Mantiq uṭ-ṭair* or "Speech of the Birds" (ed. by Garcin de Tassy, Paris, 1857, 1863). In the latter, an allegoric poem, the final absorption of the Ṣufi in the Deity is illustrated by an ingenious parable. The greatest mystical poet of Persia Jalāl ad-dīn Rūmī (1207–1273) is a direct continuator of 'Aṭṭār. (*See* RUMI.)

Sa'di.—In strong contrast to the poetry of these pantheistic teachers are the works of Shaikh Sa'dī of Shiraz (d. 1292, *see* SA'DI). His *Būstān* and especially *Gulistān,* works of unsurpassed mastery, profess less lofty and more practical morals. Both these masterpieces have found comparatively few imitations (Jami's *Bahāristān* or "Spring-garden," Qā'ānī's *Parīshān*, etc.), whereas an innumerable host of purely sūfī compositions followed in the wake of the works of Sanā'ī, 'Aṭṭār and Jalāl ad-dīn Rūmī; *see* the books of reference mentioned at the end of the present article.

Lyric Poetry.—Lyric poetry has ever constituted one of the most conspicuous elements of Persian literature. One of the fullest anthologies, that compiled by 'Ali Quli Vālih in 1749, contains 2,594 biographical notices of Persian poets, mostly lyric. The first landmark on this field is Rūdagī (*q.v.*) who died in A.D. 900. Later Persian poetry, with all its refinement, never regained the natural tone of the Sāmānid poets. (*See* above.) As a peculiar phenomenon may be mentioned the curious figure of the dialect-poet Bābā Tāhir of Hamadan, who was still alive in A.D. 1055. His quatrains composed in a special metre are captivating by their freshness and sincere tone and still enjoy great popularity among all classes. (*See* Heron Allen, *The Lament of Bābā Tāhir,* 1902.)

Hafiz and his Epigons.—Speaking roughly, the second and highest stage in the Persian lyrics, corresponding with the post-Mongol epoch, is marked by Hāfiz (d. 1389). (*See* HAFIZ.) The influence of this *Lisān al-ghaib,* or the "Tongue of the Invisible," has been enormous. Hardly any Persian poet has escaped the spell of his sweet voice veiled by some placid yearning for things unearthly. But this predominant influence has been fatal for the epigons. As time went on, mannerism and tradition more and more asserted their right in Persian poetry.

More or less contemporary with Hafiz was Salmān of Sāva (1300–1378), the panegyrist of the Jalair Uvays, amusing in his irony, graceful and inventive in his conceits. To a still later Timurid epoch belongs the last Persian classic Jāmī, of Jām in Khurasan (1414–1492). Apart from his seven great *mathnavis* and numerous compositions in prose, he is the author of as many as three *dīvāns.* His lyric poems, though mostly in a mystical vein, are written in a clear and direct style devoid of artificial subtleties, but there is no great personal note in them.

Later Persian Poets.—Curiously enough, under the Ṣafavi dynasty, which gave a powerful impulse to such arts as architecture and painting, one finds in Persia proper very few poets of mark. One of the exceptions is the poet-laureate of 'Abbās II., Ṣā'ib of Tabriz (d. 1677), whose ghazals are full of vivid similes and original maxims. In the 18th century, the scarce poetical productions of Hātif of Isfahan (d. about 1784) are pleasant and fresh: in his celebrated *tarjī'-band* (a strophic poem) he ingeniously conveys the idea that a Unique Truth permeates all the Religions. Under the Qajar dynasty (19th century) lived Qā'āni of Shiraz (d. 1853), perhaps the most brilliant and melodious among the poets that Persia has ever produced, though rather indifferent in the choice of his subjects.

Persian Poets in India.—Persian poets who lived in India need special notice. The highest fame was gained by two poets of Delhi: Amīr Ḥasan (d. 1327) and especially Amīr Khusrau (d. 1325), who lived at the court of the Khilji kings. Amīr Khusrau composed no fewer than five *dīvāns* and nine large *mathnavis,* equally remarkable for the rich imagination and the graphic style of their author. Among the poets of the later Moghul times were Faiḍī (d. 1590); 'Urfī (d. 1590); Nau'i (d. 1610), and many others. Most of the Persian poets of the 16th and 17th centuries spent their lives in India. Thanks chiefly to the Emperor Akbar's (1556–1607) enlightened encouragement, many standard works in Sanskrit, such as the *Rāmāyana* and the *Mahābhārata,* the *Bhagavat-Gitā,* the numerous *Purānas* and *Upanishads* were translated into Persian. Indian folk-lore and fables (*Kalīla-va-Dimna, Sindbād-nāma, Ṭuṭi-nāma* or the "Tales of a parrot") have ever been popular in Persia.

History.—Persian prose literature presents manifold interest. The great importance of Persian historical works is now a recognised fact.

Only a passing mention may be made of the Persians who wrote in Arabic, like ad-Dīnāwari (d. A.D. 895), the famous Abū Ja'far Muhammad Tabari (d. A.D. 923), Hamza Isbāhāni (d. about 961), Abu Manṣūr ath-Tha'ālibi of Nishapur (b. A.D. 961), Abu Nasr 'Utbi, the historian of the years A.D. 975–1011, etc. Among the histories written in Persian are Gardizi's *Zayn al-akhbār* (about A.D. 1050), with some important items on the Turks and India (partly ed. Berlin, 1928); *Tarikhi Baihaqi* by Abū'l-Faḍl Muḥammad Bayhaqi (d. A.D. 1077), a vivid picture of the times of the Ghaznavid Mas'ūd; the anonymous *Mujmal attavārikh* (written A.D. 1126) valuable for the early history of Persia and the Turkish tribes; the *Rāhat as-Ṣudūr* by Muḥammad b. 'Ali ar-Rāvandi written about A.D. 1203, a history of the Seljuks (ed. by the *Gibb Memorial*). A particularly brilliant period of Persian historiography is that of the Mongol domination of Persia: 'Aṭā Malik Juwaini's *Jahān-gushā,* completed A.D. 1260 (ed. by the *Gibb Memorial*), is perfect both in style and in the accuracy of the author, who held a high office under the Mongols; Minhāj-i Sirāj Jūzjānī was also a personal witness of the Mongol invasion, and his *Tabaqāt-i Nāṣiri* is especially interesting for the events which occurred in Afghanistan; the *Tārīkh-i Waṣṣaf* completed in A.D. 1312 by 'Abdullāh of Shīrāz continues the authentic record of an important period but its usefulness is somewhat marred by the tedious redundance of its style. The *Jāmi'-ut-tawārīkh* (published in part by Quatremère, Berezin and Blochet) of the famous Rashīd ad-dīn (d. A.D. 1318), is a vast historical encyclopaedia, such as no single people possessed in the Middle Ages. Rashīd ad-dīn utilized the Mongolian archives and in the composition of special chapters was assisted by a Kashmiri hermit, by two learned Chinese and probably by some European monks. Ḥamdullāh Mustaufi's *Tārīkh-i Guzīda* (ed. *Gibb Memorial*), written in 1330, is a useful compendium, containing many valuable details of contemporary events. Among the historians of the Tīmūrid epoch the best known (though largely dependent on their predecessors Niẓām ad-dīn Shāmī and Ḥāfiz-i Abrū) are Sharaf ad-dīn 'Ali Yazdi, author of the *Ẓafar-nāma* or "Book of victories" (A.D. 1424), and 'Abd al-Razzāq Samarqandi (d. A.D. 1482) whose *Matla' as-sa'dain* is very valuable for the history of Timur's successors and contains interesting episodes, like the author's journey to India. A younger contemporary of 'Abd al-Razzāq was the well-known Mīrkhond (*q.v.*). Khondamīr, Mīrkhond's grandson, abridged his grandfather's history and wrote his own *Habīb as-Siyar,* documentary for the time of Ismā'īl I., the founder of the Ṣafavi dynasty. Among the numerous historians of the latter, Iskandar-munshi enjoys a merited fame; his *'Ālamārā* (history of 'Abbās the Great) is full of authentic data on Persia and her neighbours at that memorable time. There exist special histories of Nādir-shāh, Karīm khan Zand and the Qajars. The Bābī movement and the revolution of 1907 have also had their historians, several of whose works have been published by E. G. Browne. Of great value are special local histories of the provinces of Iran (Seistan, Herat, Tabaristan, Gilan, Kurdistan, Fars, Shushtar, etc.). Unique in their importance are numerous histories of India, most of which have been described and partly translated in the eight volumes of Sir H. M. Elliot's *History of India* (1867–1878).

Geography.—Many of the Arabian geographers of the 9th and 10th centuries were Persians but the oldest geography in Persian seems to be the *Hudūd al-'Ālam* (the so-called "ms. Tumansky"), written by an anonymous author of the court of the Farighūnid, Abu'l Hārith of Jurjan (d. soon after A.D. 998). Nāṣir-i

Khusrau left a curious account (Safar-nāma) of his journey (A.D. 1046–1052) from Merv across Persia, Mesopotamia and Palestine to Egypt and back to Balkh. Of special importance is the geography of the Mongol epoch which forms a part of Hamdullah Mustaufi's cosmographic work called *Nuzhat al-Qulūb* (written in A.D. 1430). Towards A.D. 1420 Hāfiz-i Abrū completed for Shāhrokh his rare geography (nameless) in which the description of some Persian provinces is accompanied by an epitome of their history. Many valuable additions to *Nuzhat al-Qulūb* are found in Amīn Aḥmad Rāzī's important geographico-biographical encyclopaedia *Haft Iqlīm* (A.D. 1594). In the year 1831 Zain al-'Ābidīn Shīrvānī wrote the final draft of his geographical dictionary *Bustān as-siyāḥat* which is based on personal observations. Towards the end of the nineteenth century Muḥammad Hasan khan Ṣanī' ad-daula started the publication of a historico-geographical dictionary *Mir'āt al-buldān* (4 volumes); more independent is the same author's *Matla' ash-shams,* describing, with an archaeological commentary, his journey to Khurasan. Not devoid of importance are the diaries of Nāṣir ad-dīn Shah's journeys, written under his name in a clear and simple style.

Theological.—Very numerous are the religious and philosophical works in prose and verse of the celebrated preacher of the Ismā'īlī (Assassin) doctrines, Nāṣir-i Khusrau (b. 1003, d. after 1065), *q.v.* They were imitated by the representatives of numerous other Persian sects (Ḥurūfi, Ahl-i Haqq, Bābī, etc.). In 1092 Abu'l-Ma'ālī Muḥammad composed the *Bayān al-adyān* in which are explained the tenets of different religions and sects. To the end of the seventeenth century belongs a similar *Dabistān al-madhāhib* (transl. by Shea and Troyer) written in India by Shaikh Muhsin Fānī whose identity is still dubious.

The names of numerous works on theology, astronomy, politics, mathematics, ethics, medicine, lexicography, etc., will be found in the standard catalogues of the great European and Asiatic libraries.

The Drama.—Persian drama is still at the spontaneous and popular stage of semi-religious performances during the month of Muḥarram, in the style of the mediaeval "mysteries," or the present-day Oberammergau Passion-plays. These *ta'ziya* (*see* DRAMA: *Persian*) originated in the public lamentations in memory of the tragic fate of the house of the Caliph 'Alī, such as were introduced in Baghdad as early as A.D. 963 by the Buwaihid Mu'izz ad-Daula. The librettos of the *ta'ziyas* belong to little known playwrights. Since the reign of Nāsir ad-dīn Shah a few plays, mostly comedies, have been translated and written in Persian. Quite popular farces are the so-called *shab-bāzī* or "night plays." The marionette-theatre is also known in Persia under the name of *Kachal-Pahlavān* or "The Bald Hero."

The Persian Press.—A very important rôle in the Persian literary movement has been played by the press. The first Persian paper in Tehran appeared in the reign of Fatḥ 'Ali Shāh. Some organs founded abroad enjoyed real political influence, such as: the *Akhtar* or the "Star," Constantinople 1875–1895; the *Qānūn* or the "Law," started in London in 1890 by a former Persian Minister at the court of St. James, Malcom-khan, who advocated for Persia a constitutional form of government; the *Habl al-Matīn,* which has been published in Calcutta since 1893; and the *Kāva* (in its first phase, 1916–1920) published in Berlin by the deputy of the first Majlis Taqizada. Great impetus was given to the Persian press by the revolution of 1905–08. Speaking from a merely literary point of view, the press has rendered the language more pliant, simple and popular. Daily papers have revealed such talents as 'Alī Akbar Dakhau, good poet and excellent publicist imitating in his satirical feuilletons the humorous bazar-speech; the poet Malik ash-shu 'arā Bahār, and several others. To the class of magazines belong the *Kāva* in its last phase (Berlin 1920–21); the *Irānshahr,* Berlin 1922–25, whose editor was Kāẓim-zāda, and three periodicals published in Tehran after 1918: the *Dānish-kada* or the "Temple of Knowledge" (ed. Malik ash-shu 'arā), the *Armaghān* or the "Gift," the *Āyanda* or the "Future." These last have been the centres round which gathered the young Persian poets and writers, nationalists yet admirers of European culture.

Latest Persian Literature.—The possibility of seeing their work printed without the intervention of a rich patron has been a great encouragement to the Persian authors of recent times. Among the poets of the older generation are: Adīb-i Pīshāvarī (b. 1844), a learned author, who during the war indulged in the composition of a *Qaisar-nāma,* meaning the "Book of the Kaiser," written in the style of Firdausi; Adīb al-Mamālik (d. 1917), a poet of civic tendencies; Īraj-mīrzā (d. 1926), a man of remarkable feeling and talent, who is also known as a champion of the Persian woman's emancipation. To a younger generation belong Malik ash-shu 'arā, already mentioned, and some others whose lyres are tuned on a vast scale, from the romantic admiration of the great past (Pur-i Davud) to the modern revolutionary war-cries (Lāhūtī).

Promising attempts have been made to create the national novel. In 1922 Jamāl-zāda published in Berlin a remarkable volume of realistic tales *Yakī būd, yakī nabūd,* or "Some of it was, some of it was not"; other authors are transplanting on Persian soil the European *genres* of sentimental and didactic novel, as well as of "roman de boulevard."

Several able works have been written by the young Persian economists, literary critics and historians. A very conspicuous figure is that of Muḥammad khan Qazvīni (b. 1877, resident in Europe since 1904), the learned editor of Juvaini's history and of other important works on history and philology.

BIBLIOGRAPHY.—A scientific and systematic study of Persian literature in its general lines was made by Dr. H. Ethé, whose *Neu-persische Literatur* published in Geiger und Kuhn's *Grundriss der Iranischen Philologie* (Strassburg, 1906), II., p. 212–368, enumerates and resumes all the previous works of the same author and gives a complete bibliography of the subject. Of capital importance are also E. G. Browne's *A Literary History of Persia from the Earliest Times until Firdawsi,* first ed. I. (1902); idem, *A Lit. Hist. of Persia from Firdawsi to Sa'di,* first ed. (1906); idem, *A History of Persian Literature under Tartar Dominion* (A.D., 1265–1502) (1920); idem, *A Hist. of Pers. Lit. in modern times* (A.D., 1500–1924) (1924). *See* also J. Darmesteter, *Les origines de la poésie persane* (1887); P. Horn, *Geschichte d. persischen Literatur* (Leipzig, 1901); I. Pizzi, *Litteratura persiana* (Milan, 1887) (208 pages), *Storia della poesia persiana* (Turin, 1894), 2 vol. (350+425 pages) with numerous translations; Krymski, *Istoriya Persii, yeya literatury i dervisheskoi theosofii,* 3 vols., single parts several times re-edited (Moscow, 1906–1917) (detailed bibliography); A. V. W. Jackson, *Early Persian Poetry* (1920); Shibli Nu 'mānī, *Sh'r al-'Ajam,* 5 vols. (Lahore, 1907–1924) (in Urdu) contains an important account of the whole Persian poetry; C. A. Storey, *Persian Literature, a bibliographical survey* (1927) (Section I. Qur'anic literature); *The Encyclopedia of Islam* (published at Leyden from 1908) has special articles on the principal Persian writers. For the recent developments *see* E. G. Browne, *The Press and Poets in Modern Persia* (1914), and K. Chaykin, *A short sketch of the most recent Persian Literature* (in Russian) (Moscow, 1928). As only a few manuscript copies exist even of very important works in Persian, of extreme importance are the detailed descriptions of single collections of mss. A list of such catalogues will be found in C. A. Storey's book (*see* above); the most valuable among them is the *Catalogue of the Persian manuscripts in the British Museum* by Rieu (4 vols., 1879, 1881, 1883, 1895); *see* also *A catalogue of the Persian printed books in the British Museum,* by E. Edwards (1922), where most of the Oriental editions are mentioned. For European critical editions and translations of Persian poets *see* the works of Ethé and Browne.

Many important prose works have appeared in the "E. J. W. Gibb Memorial" series (histories and geographies of Ibn-Balkhi, Ibn Isfandiyār, Rāvandi, Niẓāmī-i 'Arūḍi, Juvaini, Rashīd ad-dīn, Hamdullāh Mustaufi, etc.); in the *Persian Historical Texts,* Leyden: 'Aufi, 'Aṭṭār, Daulat-shāh; in the *Recueil de textes relatifs à l'histoire des Seldjoucides,* Leyden; in the *Publications de l'Ecole Nationale des Langues Orientales,* Paris, and in single publications of the Russian Academy (histories of the Caspian provinces, of the Kurdish dynasties); etc. For Persian Languages *see* IRANIAN LANGUAGES AND PERSIAN. (V. F. M.)

PERSIGNY, JEAN GILBERT VICTOR FIALIN, DUC DE (1808–1872), French statesman, was born at Saint-German Lespinasse (Loire) on Jan. 11, 1808, the son of a receiver of taxes. A strong Bonapartist, he planned the attempt on Strasbourg in 1836 and that on Boulogne in 1840; he took a prominent part in securing the election of Louis Napoleon to the presidency.

Persigny plotted the restoration of the empire, and was a devoted servant of Napoleon III. He succeeded Morny as minister of the interior in January 1852, and later became senator. He resigned office in 1854, being appointed next year to the London

embassy, which he occupied with a short interval (1858–1859) until 1860, when he resumed the portfolio of the interior. The growing influence of Rouher provoked his resignation in 1863, when he received the title of duke. A more dangerous enemy than Rouher was the empress Eugénie, whose marriage he had opposed and whose presence in the council chamber he deprecated in a memorandum which fell into the empress's hands. He sought in vain to see Napoleon before he started to take over the command in 1870, and the breach was further widened when master and servant were in exile. Persigny returned to France in 1871, and died at Nice on Jan. 11, 1872.

See *Mémoires du duc de Persigny* (2nd ed., 1896), edited by H. de Laire d'Espagny, his former secretary; an eulogistic life, *Le Duc de Persigny* (1865), by Delaroa; and Emile Ollivier's *Empire libéral* (1895, etc.).

PERSIMMON, the name given in the United States to the fruit of *Diospyros virginiana.* The tree which bears it belongs to the ebony family, Ebenaceae, and is usually from 30 to 50 ft. in height, with large oval entire leaves and greenish unisexual flowers. The fruit-stalk is very short, bearing a subglobose fruit 1 in. to 2 in. in diameter, of an orange-yellow colour, and with a sweetish astringent pulp and oblong, flattened seeds. The fruit is extensively eaten in the Southern States where several varieties are cultivated. The wood is heavy, strong and very close-grained and used in turnery. The tree is very common in the South Atlantic and Gulf States, and attains its largest size in the basin of the Mississippi. It was brought to England before 1629 and is cultivated, but rarely if ever ripens its fruit. The Chinese and Japanese cultivate another species, *D. Kaki*, which is now grown commercially in southern California. The fruits are larger than those of the native American kind, but have similar qualities; they are used as a sweetmeat when dried. *D. Lotus* is the date-plum.

PERSIS (mod. Fars, *q.v.*), the south-western part of Iran (Persia), named from the inhabitants, the Iranian people of the Pārsa (Fars); their name was pronounced by the Ionians *Persai*, with change from *a* to *e*, and this form has become dominant in Greek and in the modern European languages. The natural features of Persis are described very exactly by Nearchus, the admiral of Alexander the Great (preserved by Arrian *Indic.* 40 and Strabo xv. 727). The country is divided into three parts, of very different character and climate: the coast is sandy and very hot, without much vegetation except date palms; it has no good harbours, and the climate is very unwholesome; the population is scanty. About 50m. from the coast rise the chains of the mountains, through which some steep passes lead into the interior valleys (called κοιλὴ Πέρσις, Strabo xv. 729), which lie about 5,000ft. above the sea. Here the climate is temperate, the country watered by many rivers and lakes, the soil fertile, the vegetation rich, the cattle numerous. These regions, which were thickly populated, form the real Persis of history. "This land Persis," says Darius, in an inscription at Persepolis, "which Ahuramazda has given to me, which is beautiful and rich in horses and men, according to the will of Ahuramazda and myself it trembles before no enemy." The third part is the north, which belongs to the central plateau, still much higher, and therefore rough and very cold in the winter. Towards the north-west it borders on the Median district of Paraetecene (about Isfahan); towards the north and north-east it soon passes into the great desert, of which only the oasis of Yezd (*Isatichai* in Ptolem. vi. 4, 2) is inhabitable. In the east, Persis proper is separated by a desert (Laristan) from the fertile province of Carmania (Kerman), a mountainous region inhabited by a Persian tribe. To Carmania belonged also the coast, with the islands and harbours of Hormuz and Bander Abbasi. In the west Persis borders on the mountains and plains of Elam or Susiana. For the ancient topography *cf.* Tomaschek, "Beiträge zur historischen Topographie von Persien," in *Sitzungsber. der Wiener Akademie, phil. Cl.* cii. cviii. cxxi.

The Persians are not mentioned in history before the time of Cyrus; the attempt to identify them with the Parsua, a district in the Zagros chains south of Lake Urmia, often mentioned by the Assyrians, is not tenable. Herodotus i. 125, gives a list of Persian tribes: the Pasargadae (at Murghab), Maraphii, Maspii, Panthialaei (in western Carmania), Derusiaei, Germanii (*i.e.* the Carmanians) are husbandmen, the Dahae (*i.e.* the "enemies," a general name of the rapacious nomads, used also for the Turanian tribes), Mardi, Dropici, Sagartii (called by Darius *Asagarta,* in the central desert; *cf.* Herod. vii. 85) are nomads. The kings of the Pasargadae, from the clan of the Achaemenidae, had become kings of the. Elamitic district Anshan (probably in 596, *cf.* CYRUS). When, in 553, Cyrus, king of Anshan, rebelled against Astyages, the Maraphians and Maspians joined with the Pasargadae; after his victory over Astyages all the Persian tribes acknowledged him, and he took the title of "king of Persia." But from then only the inhabitants of Persia proper were considered as the rulers of the empire, and remained therefore in the organization of Darius free from taxes (Herod. iii. 97). Carmania, with the Sagartians, the Utians (called by Darius *Yautiya*), and other tribes, formed a satrapy and paid tribute (Herod. iii. 93); the later authors therefore always distinguished between Carmania and Persis. Names of other Persian tribes, partly of very doubtful authority, are given by Strabo xv. 727,[1] and Ptolem. vi. 4 and 8.

The Persians of Cyrus (*see* PERSIA: *Ancient History*) were a vigorous race of husbandmen, living in a healthy climate, accustomed to hardship, brave and upright; many stories in Herodotus (especially ix. 122) point the contrast between their simple life and the effeminate nations of the civilized countries of Asia. They were firmly attached to the pure creed of Zoroaster (*cf.* Herod. i. 131 sqq. and the inscriptions of Darius).

When Darius had killed the usurper Smerdis and gained the crown, a new usurper, Vahyazdata, who likewise pretended to be Smerdis, the son of Cyrus, rose in *Yautiya,* but was defeated in two battles by Darius's generals and put to death (Behistun inscription). Cyrus had built his capital with his palace and tomb, in Pasargadae (*q.v.*). Darius founded a new city about 30m. farther south on the left bank of the Pulwar, near its confluence with the Kur, with a large terrace, on which his magnificent palace and that of his son Xerxes were built. As Pasargadae was named after the tribe in whose district it lay, so the new capital is by the Persians and Greeks simply called "the Persians"; later authors call it Persepolis (*q.v.*), "the Persian city."

Both in Persepolis and Pasargadae large masses of gold and silver from the tribute of the subject nations were treasured, as in Susa and Ecbatana. But Persis lies too far off from the centre of the Asiatic world to be the seat of government. Like Arabia and similar countries, it could exercise a great momentary influence in history and produce a sudden change throughout the world; but afterwards it would sink into local insignificance. So the Persian kings fixed their residence at Susa, which is always considered as the capital of the empire (therefore Aeschylus wrongly considers it as a Persian town and places the tomb of Darius here). After the reign of Xerxes, Persis and Persepolis became utterly neglected in spite of occasional visits, and even the palaces of Persepolis remained in part unfinished. But the national feeling of the Persians remained strong. When Alexander had won the victory of Arbela, and occupied Babylon and Susa, he met (in the spring of 330) with strong resistance in Persia, where the satrap Ariobarzanes tried to stop his progress at the "Persian gates," the pass leading up to Persepolis. Here Alexander set fire to the cedar roof of the palace of Xerxes as a symbol that the Greek war of revenge against the Persians had come to an end. Our best information tells us that he soon had the fire extinguished (Plut. *Alex.* 38); the story of Thais is a pure fiction, and we may well believe that he repented the damage he had done (Arrian. vi. 30, 1).

Alexander had planned to amalgamate the former rulers of the world with his Macedonians; but his death was followed by a Macedonian reaction. Peucestas, the new satrap of Persis, followed the example of Alexander, and thus gained a strong hold on his subjects (Diod. xix. 48); nor did Seleucus, to whom the

[1]To the Pateiskhoreis belongs the lance-bearer of Darius, "Gobryas (Gaubaruva) the Pātishuvari," mentioned in his tomb-inscription; they occur also in an inscription of Esarhaddon as Patushara, eastwards of Media, in Choarene at the Caspian gates; the Kyrtii are the Kurds.

dominion of the east ultimately passed (from 311 onwards), disdain the aid of the Persians; he is the only one among the Diadochi who retained his Persian wife, Apame, daughter of Spitamenes. Seleucus and his son Antiochus I. Soter tried to introduce Hellenism into Persis. Of Greek towns which they founded here we know Alexandria in Carmania (Plin. vi. 107; Ptol. vi. 8, 14; Ammian. Marc. 23, 6, 49), Laodiceia in the east of Persis (Plin. 6, 115), Stasis, "a Persian town on a great rock, which Antiochus, the son of Seleucus, possessed" (Steph. Byz. *s.v.*), Antiochia in Persis, founded apparently by Seleucus I. and peopled by Antiochus I. with immigrants called together from all Greece, as we learn from a *psephisma* passed by "boule and demos" of this town in 206 in honour of Magnesia on the Maeander. But at the same time we find in the centre of Persis in the district of Istakhr (the town which succeeded Persepolis) a local dynasty with Persian names (Bagdat, Vahuburz, Astakhshatr, Vatafradat), and the still unexplained title Fratadara. On their coins in Aramaean Pehlevi which begin about 250 B.C., they have Persian features and wear the headdress of the satraps; on the reverse is the fire-altar with the image of Ahuramazda hovering above it and the standard of the empire. They must have been recognized as vassals by the Seleucids; but a story preserved by Polyaenus (vii. 30) narrates, how one of them, Oborzos (Vahuburz), allured 3,000 settlers (evidently Greek settlers) into a fertile plain and annihilated them at night. Another story (Polyaenus vii. 39) relates, how in the same way a general of Seleucus (evidently Seleucus II. 247–225), destroyed 3,000 Persian rebels with his Macedonian and Thracian troops. Thus the Seleucid supremacy was restored, but the dynasty of the Fratadaras was suffered to continue. When in 221 Molon, the satrap of Media, rebelled against Antiochus III., his brother Alexander, satrap of Persis, joined him, but they were defeated and killed by the king. Persis remained a part of the Seleucid empire down to Antiochus IV. Epiphanes, who at the end of his reign restored once more the authority of the empire in Babylonia, Susiana and Persis; perhaps a battle, in which the satrap Numenius of Mesene (southern Babylonia) defeated the Persians on the shore of Carmania on sea and land (Plin. vi. 152), belongs to this time. But after the death of Antiochus IV. (164) the Seleucid empire began to dissolve. While the central provinces, Media and northern Babylonia, were conquered by the Parthians, Mesene, Elymais and Persis made themselves independent.

Persis never became a part of the empire of the Arsacids, although her kings recognized their supremacy when they were strong (Strabo xv. 728, 736). From the periplus of the Erythraean sea 33–37 we learn that their authority extended over the shores of Carmania and the opposite coasts of Arabia. On their coins they now wear Parthian dress and have the title of King (written *malkâ,* pronounced *shâh*). Among their names we find Darayav (Darius), probably the founder of a town, Darabjird, in eastern Persia, his son Artaxerxes (according to a fragment of Isidore of Charax in Lucian, *Macrob. 15,* murdered by his brother Yosithros at the age of 93 years), Narses, Manocihr and others. From the traditions about Ardashir I. we know that at his time there were different petty kingdoms and usurpers in Persis; the principal dynasty is by Tabari called Bāzrangi. The coins demonstrate that Hellenism had become quite extinct in Persis, while the old historical and mythical traditions and the Zoroastrian religion were supreme. There can be no doubt that at this time the true form of Zoroastrianism and the sacred writings were preserved only in Persis, whereas everywhere else (in Parthia, in the Indo-Scythian kingdoms of the east and in the great propagandist movement in Armenia, Syria and Asia Minor, where it developed into Mithraism) it degenerated and was mixed with other cults and ideas. So the revival of Zoroastrianism came from Persis. When Ardashir I. the son of a king of Istakhr began to subdue the other Persian dynasts and in A.D. 224 defeated and slew the Parthian king, Artabanus, his aim was religious as well as political. The new Sassanid empire which he founded enforced the restored religion of Zoroaster (Zarathustra) on the whole of Iran.

The new capital of Persis was Istakhr on the Pulwar, about 9m. above Persepolis, now Hajjiabād, where already the predecessors of Ardashir I. have resided. It was a great city under the Sassanids, of which some ruins are extant. But it shared the fate of its predecessor; when the empire was founded the Sassanids could no longer remain in Persis but transferred their headquarters to Ctesiphon. (ED. M.)

PERSIUS, in full AULUS PERSIUS FLACCUS (A.D. 34–62), Roman poet and satirist. According to the *Life* contained in the mss., Persius was a native of Volaterrae, of good stock on both parents' side. When six years old he lost his father, and his stepfather died in a few years. At the age of 12 Persius came to Rome, where he was taught by Remmius Palaemon and the rhetor Verginius Flavus. Four years later began a close intimacy with the Stoic Cornutus. In this philosopher's pupil Lucan, Persius found a generous admirer of all he wrote. Still in early youth he became the friend of the lyric poet Caesius Bassus, whilst with Thrasea Paetus (whose wife Arria was a relative) he had a close friendship of ten years' duration and shared some travels. Seneca he met later, and was not attracted by his genius. The perusal of Lucilius revealed to Persius his vocation, and he set to work upon a book of satires. But he wrote seldom and slowly; a premature death (*vitio stomachi*) prevented the completion of his task. He is described as possessed of a gentle disposition and girlish modesty and personal beauty. To his mother and sister he left a considerable fortune. Cornutus suppressed all his work except the book of satires in which he made some slight alterations and then handed it over to Bassus for editing. It proved an immediate success.

The scholia add a few details—on what authority is, as generally with such sources, very doubtful. The *Life* itself, though not free from the suspicion of interpolation and undoubtedly corrupt and disordered in places, is probably trustworthy. The mss. say it came from the commentary of Valerius Probus, a contemporary scholar. The mere fact that the *Life* and the *Satires* agree so closely does not of course prove the authenticity of the former. One of the points of harmony is, however, too subtle for us to believe that a forger evolved it from the works of Persius. It requires indeed a thoughtful reading of the *Life* before we realize how distinct is the impression it gives of a "bookish" youth, who has never strayed far, at least in spirit, from the domestic hearth and his women-folk. And of course this is notoriously the picture drawn by the *Satires.* So much better does Persius know his books than the world that he draws the names of his characters' from Horace.

The chief interest of Persius's work lies in its relation to Roman satire, in its interpretation of Roman Stoicism, and in its use of the Roman tongue. The influence of Horace on Persius can, in spite of the silence of the *Life,* hardly have been less than that of Lucilius. Not only characters, as noted above, but whole phrases, thoughts and situations come direct from him. The resemblance only emphasizes the difference between the caricaturist of Stoicism and its preacher. Persius strikes the highest note that Roman satire reached; in earnestness and moral purpose rising far superior to the political rancour or good natured persiflage of his predecessors and the rhetorical indignation of Juvenal, he seems a forerunner of the great Christian Apologists. Like Seneca, Persius censures the style of the day, and imitates it. Indeed in some of its worst failings, straining of expression, excess of detail, exaggeration, he outbids Seneca, whilst the obscurity, which makes his little book of not 700 lines so difficult to read and is in no way due to great depth of thought, compares very ill with the terse clearness of the *Epistolae morales.*

Persius's satires are composed in hexameters, except for the scazons of the short prologue above referred to, in which he half ironically asserts that he writes to earn his bread, not because he is inspired. The first satire censures the literary tastes of the day as a reflection of the decadence of the national morals. The theme of Seneca's 114th letter is similar. The description of the *recitator* and the literary twaddlers after dinner is vividly natural, but an interesting passage which cites specimens of smooth versification and the languishing style is greatly spoiled by the difficulty of appreciating the points involved and indeed of distributing the dialogue (a not uncommon crux in Persius). The remaining satires

handle in order (2) the question as to what we may justly ask of the gods (*cf.* Plato's second *Alcibiades*), (3) the importance of having a definite aim in life, (4) the necessity of self-knowledge for public men (*cf.* Plato's first *Alcibiades*), (5) the Stoic doctrine of liberty (introduced by generous allusions to Cornutus' teaching), and (6) the proper use of money. The *Life* tells us that the *Satires* were not left complete; some lines were taken (presumably by Cornutus or Bassus) from the end of the work so that it might be *quasi finitus.* This perhaps means that a sentence in which Persius had left a line imperfect, or a paragraph which he had not completed, had to be omitted. The same authority says that Cornutus definitely blacked out an offensive allusion to the emperor's literary taste, and that we owe to him the reading of the mss. in *Sat.* i. 121,—"auriculas asini *quis non* [for *Mida rex*] habet!" Traces of lack of revision are, however, still visible.

AUTHORITIES.—The mss. of Persius fall into two groups, the one represented by two of the best of them, the other by that of Pithoeus, so important for the text of Juvenal. Since the publication of J. Bieger's *de Persii cod. pith. recte aestimando* (Berlin, 1890) the tendency has been to prefer the tradition of the latter.

The important editions are: (1) with explanatory notes: Casaubon (Paris, 1605, enlarged edition by Dübner, Leipzig, 1833); O. Jahn (with the scholia and valuable prolegomena, Leipzig, 1843); Conington (with translation; 3rd ed., Oxford, 1893); B. L. Gildersleeve (New York, 1875); G. Némethy (Buda-Pesth, 1903); (2) with critical notes: Jahn-Bücheler (3rd ed., Berlin, 1893); S. G. Owen (with Juvenal, Oxford, 1902). Translations into English by Dryden (1693); Conington (*loc. cit.*); Hemphill (Dublin, 1901); Ramsay (Loeb, 1918), etc., in Martha, *Les Moralistes sous l'empire romain* (5th ed., Paris, 1886); Nisard, *Poètes latins de la décadence* (Paris, 1834); Hirzel, *Der Dialog* (Leipzig, 1895); Saintsbury, *History of Criticism*, i. 248; Henderson, *Life and Principate of the Emperor Nero* (London, 1903); and the histories of Roman literature (especially Schanz, §§ 382 *sqq.*). *A Bibliography of Persius*, by M. H. Morgan (Cambridge, U.S.A., 1893); Villeneuve, *Essai sur Perse* (Paris, 1918).

PERSON, OFFENCES AGAINST THE. This expression is used in English law to classify crimes involving some form of assault or personal violence or physical injury, *i.e.*, offences affecting the life, liberty or safety of an individual: but it is also extended to certain offences which cannot technically be described as assaults, such as criminal libel. The bulk of the offences thus classified, so far as their definition or punishment depends upon statute law, are included in the Offences Against the Person Act 1861, in the Criminal Law Amendment Acts, and in the Children Act 1908. The classification in these statutes is not scientific. The particular offences dealt with by the acts above named are discussed under their appropriate titles, *e.g.*, abortion, assault, bigamy, homicide, rape, etc. In the Indian penal code most of the offences above referred to fall under the head "offences against the human body." In his *Digest of the Criminal Law* Sir James Stephen includes most of these offences under the title "offences against the person, the conjugal and parental rights and the reputation of individuals."

United States.—In the United States, such crimes as fall under the classification of offences against the person in England, are crimes by common law or statutes in the different States, but sometimes without any such general classification in the statutes.

PERSONAL ACCIDENT INSURANCE: *see* ACCIDENT INSURANCE, PERSONAL.

PERSONALITY. What is new in the philosophical treatment of Personality is the recognition of its supreme place in the interpretation of value. To meet the modern form of the ancient subjective explanations of "good" ("Man is the measure of all things," including good and evil), or the modern theory that the only account to be given of good or value, is that it is what is desired, a new form of idealism arises; viz., personal idealism. If "There's nothing either good or bad but thinking makes it so," what is the nerve or soul of the thinking which penetrates into the essence of life, giving it a character of value or disvalue? The philosophy of personality conceives value as correlative to person, person being something unique in every human being, which he brings with him to experience, and which urges him in all activities to seek value.

In earlier modern discussions, the question of *knowledge* was chiefly investigated. MacTaggart for instance, in his article in *Encyclopaedia of Religion and Ethics,* examines the problem whether the self, which he regards as equivalent to Personality, can be known as an object. He concludes that the self can perceive itself as an object of awareness. He holds also that self-consciousness is not essential to selfhood. With this James Ward (*Realm of Ends*) would clearly agree. For his Pan-psychism or doctrine that the nature of things consists, as in Leibniz's *Monadism,* of psychical units, rather mental than physical in kind, supposes even the unconscious monads, or psychic atoms of nature to be "conative, that is feeling and striving subjects, or persons, in the widest sense." This wide use of the term person is inadmissible, since it is required for a principle which is indispensable for the understanding of human experience in its most individual character. Ward admits the difficulty of conceiving a psychic being without memory. And without a realization of the part played by memory, actively bringing to the events of life the results of all experience of value, it seems impossible to understand the essence of personality, in its incommunicable character. Here Leibniz's theory that the world for each individual is "perspective" or known only from his unique point of view, in its further elaboration by modern thinkers, falls in with the new insight in regard to the creation by the individual mind of all the meaning through which his world is real for him. In Prof. Wildon Carr's *Theory of Monads* the perspective view of knowledge is carried farthest, and the monad appears to do almost all the work of creating its own world.

Some thinkers explain the significance of personality, by giving it the highest place in a philosophy of "emergence," according to which there is a hierarchy of orders, or stages of evolution in the universe, gradually following upon one another. Thus Gen. Smuts (*Holism and Evolution*) conceives Personality as the culmination of a series, and, whilst holding with Bergson that all evolution is "creative," finds in the personality of every human being a "unique creative novelty." Dr. William Brown's view (*Mind and Personality*) that consciousness is creative is based on psychology, especially psycho-analysis, whilst his philosophical standpoint is in harmony with this result. "So far as the mind is a conscious mind," it is always producing something new. The individual has produced in himself a "final differentiation," and "superimposed it on all he has inherited." Such an interpretation seems confirmed, when we turn from the subtle and microscopic analyses of the individual consciousness, and sub-consciousness in which lies the genius of modern psychology, to the large-scale impressions of human nature presented in biography, history and literature. Thucydides' dictum that human nature will remain the same, gives one side of the truth, but the original individuality of each person's struggle to realize his own idea of good, even though it may take a poor form, is the more impressive side. This becomes more intelligible if we conceive the distinctive character of personal mind, as that which cannot survive, but will disappear in sinking to a lower level, unless it finds some minimum of worth in its experience. The conception that value is correlative to personality is presented impressively by Dr Max Scheler ("Formalismus"—"Formalism in Ethics, and a Material Ethic of Value"). Personality he conceives as a new type of being, emerging in humanity, at some stage of its development, together with a new type of values and acts. The philosophy of "Personalism" in its American form emphasizes the creativity of the person in the spheres of knowledge and of value. Borden P. Bowne (*"Personalism, Common-Sense and Philosophy"*) insists on the necessity for the understanding of knowledge, of recognizing that "we are in a personal world from the start."

The greatest problem which arises for this type of philosophy, is whether that principle which is found to be essential to the interpretation not of knowledge alone, but of human activity in all its reality and meaning, can be attributed to the whole of things. Is the Universe personal? That it is, is the conviction of Professor Clement Webb, who argues (*God and Personality*) that "The thought of the Universe as a whole," primarily presents itself as a religious thought, and for the religious emotion, our relation to the universe must be conceived as "essentially of the same nature as our relation to a person" Similarly Bowne (*Theism*)

in view of the fact of the incompleteness of personality in our experiences, finds it necessary to posit a complete personality, which he identifies with the Infinite. And Professor Flewellyn (*Creative Personality*) assumes that the source of personality must be the "Absolute Personality" which is the Whole. MacTaggart's arguments, in the article cited above seem conclusive against the logical validity of this conception. It may be added that the notion that the Whole, within which all spiritual life falls, can be personal, is inconsistent with the idea of personality in the deepest sense. For this involves distinction and relations between persons, possessing each at least some degree of an independent quality to constitute him a term or subject of a spiritual relation. The mystical loss of personality in communion with the Supreme Being implies a distinct personality to be lost and to be found again. Neither the part nor the whole is personal where all is One. This is understood by the Neo-Hegelians, who consistently recognize that in holding nothing to be in the end real, except the Whole, they must give up personality. With other values it suffers a change or is "transcended" in the Absolute. This view, of which Bernard Bosanquet and F. H. Bradley were the most distinguished English exponents, would render unintelligible the profoundest experiences of personality, feeling itself to be in contact with reality. That this feeling corresponds with truth, is a conviction which seems confirmed when the problem is considered in the light not only of theory of knowledge and of logic, but of history and practical experience.

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PERSONAL PROPERTY, one branch of the main division of the English law of property, the other being "real property." The division of property into real and personal represents in a great measure the division into immoveable and moveable, incidentally recognized in Roman law and generally adopted since.

Personal estate is divided in English law into *chattels real* and *chattels personal;* the latter are again divided into *choses in possession* and *choses in action* (*see* CHATTEL; CHOSE).

Interest in personal property may be either absolute or qualified.

There are several cases in which, by statute or otherwise, property is taken out of the class of real or personal to which it seems naturally to belong. By the operation of the equitable doctrine of conversion money directed to be employed in the purchase of land, or land directed to be turned into money, is in general regarded as that species of property into which it is directed to be converted. An example of property *prima facie* real which is treated as personal is an estate *pur autre vie,* which, since 14 Geo. II. *c.* 20, s. 9, 1740–41 (now replaced by the Wills Act 1837, s. 6) is distributable as personal property in the absence of a special occupant. Examples of property *prima facie* personal which is treated as real are fixtures, heirlooms, such as deeds and family portraits. (*See* further SUCCESSION.)

The terms *heritable* and *moveable* of Scots law in a general sense correspond with the real and personal of English law. Moveable or personal property is, in Scots law, subdivided into corporeal and incorporeal moveables. Corporeal or physical things, not being land or attached to land, are moveable property. Incorporeal things, or rights, are said to form moveable property when they do not affect land, and are not similar to rights affecting land in having a tract of future time. By the Titles to Land Consolidation (Scotland) Act 1868, s. 117, heritable securities are moveable as far as regards the succession of the creditor, unless executors are expressly excluded. They still, however, remain heritable *quoad fiscum,* as between husband and wife, in computing legitim, and as far as regards the succession of the debtor. Annuities, as having *tractum futuri temporis,* are heritable, and an obligation to pay them falls upon the heir of the deceased. At common law an obligation to pay money was, after the term of payment, considered heritable in the person of the creditor as having a tract of future time. Bonds containing such obligations, except where the creditor's executors are excluded, are now moveables in the creditor's succession. See the Scots Act of 1661 cap. 32 and the Conveyancy (Scotland) Act 1924 s. 22 (1).

The law in the United States agrees in most respects with that of England. Chattels real include all estates in land less than freehold. Legislation in some States has, however, made terms for years and estates *pur autre vie* real property. Title-deeds are generally regarded as personalty inasmuch as their importance is less than in England, due to the Land Registration Acts. Shares in some of the early American corporations were, like New River shares in England, made real estate by statute, as in the case of the Cape Sable Company in Maryland (Schouler, *Law of Personal Property,* i.). Otherwise, shares of stock, like other choses in action, are regarded as personalty.

PERSONATION, in English and American law, a form of fraud consisting in a false representation by one person (by words or conduct) that he is another person living or dead. It is not an offence by the common law unless the representation is made on oath under circumstances constituting the offence of perjury, or unless the representation if not made on oath is made under circumstances amounting to a common law cheat. (*See* also FALSE PRETENCES; ELECTORAL SYSTEMS.)

PERSPECTIVE, deals with the phenomena of appearance; usually applied to the construction of drawings intended to represent objects as seen from some definite point of view. In appearance an object may seem very unlike what it is known to be in reality. A railway track is of the same width throughout its length, yet in appearance the rails seem to approach one another as they recede, Plate I., fig. 2. A cube is known to have 12 edges all equal in length and to have a perfect square for each face, but when viewed the edges do not appear to be equal, nor do the faces appear to be squares, Plate I., fig. 6.

Isometric Drawing.—A method of representing objects is sometimes used in which dimensions in three directions are shown in their true size to the scale of the drawing. A cube constructed by this method is given in fig. 1. Every line in the direction of *ab,* of *ac,* or of *ae,* is drawn at its true scale. Thus all the edges of the cube as shown are of equal length. Such a drawing is known as an *isometric.* It is useful in indicating the size of an object, as three dimensions at right-angles to one another can be shown upon a single plane surface. It is a purely arbitrary method of representation, however, gives a distorted picture of the object, makes no pretence of reproducing its appearance, and should never be confused with true perspective.

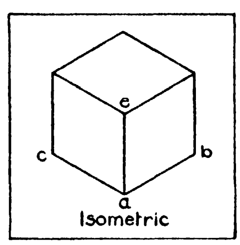


FIG. 1.—AN ISOMETRIC PRESENTATION OF A CUBE. ALL EDGES HAVING SAME DIMENSIONS AS ACTUAL

True Perspective.—In true perspective three lines at right-angles to one another cannot all appear in their true lengths. Lines and forms seem to change in size and shape as they occupy different positions in the picture. Colours and lightings seem to change as well. In the foreground objects appear brilliant with distinct details, clear colours, dark shadows and strong contrasts. As one looks farther into the distance objects seem less brilliant, contrasts less marked, colours gradually lose their clearness and tend to merge into a purplish monotone. This is caused in part by minute specks of dust or moisture held in the atmosphere which reflect a soft hazy light into the picture. These lighting effects are outside the scope of the present article. The apparent changes in form, however, are dealt with as an exact science known as *linear perspective,* by means of which it is possible to construct, from the actual dimensions of an object, its apparent shape and size at any point in space.

The camera is an instrument by means of which perspective views can be produced mechanically. On Plate I., figs. 2 and 6 are so produced. Rays of light reflected from any object, as *ab,* fig. 2, pass through the lens of the camera and fall upon the

sensitive plate forming an image which will represent the appearance of the object to one who views the photograph.

The human eye, fig. 3, is, in effect, a little camera with a lens, *o,* and a sensitive surface, the retina, which receives the image, *fe.* If a transparent plane, *PP,* be placed between the object and the observer's eye, the rays of light coming from the object will pass through the plane and project upon it an image, *cd,* of the object The image on the plane would be a *perspective* of the object and would represent to the observer its appearance

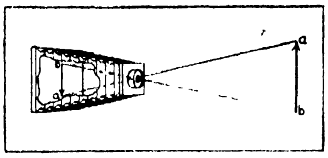


FIG 2 —PERSPECTIVE PROJECTION PRODUCED PHOTOGRAPHICALLY

Wherever one looks he sees a perspective view An expert draftsman before a group of objects might record on paper exactly what he saw. The result would be a perspective drawing reproducing the appearance of the objects and might conceivably be made without any understanding of the laws of perspective Some of the ancient peoples, the Chinese for example, developed an interesting technique in drawing, and their pictures often showed a strong sense of perspective Whether they understood the underlying science or merely copied what they saw is open to argument It was probably not until the early part of the 15th century that the governing principles of the science began to be understood by western civilization The names of Brunelleschi, Alberti, Ucello, Leonardo da Vinci, Piero della Francesca and Albrecht Durer are all connected with its development To Francesca has been attributed the conception of the vanishing point which is the key to modern perspective construction

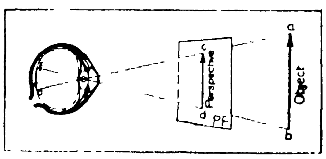


FIG 3 —THE HUMAN EYE AS A CAMERA

FUNDAMENTAL PRINCIPLES

Apparent Diminution in Size.—The complete theory of perspective can be developed from a single basic phenomenon; viz , the apparent decrease in size of an object as it recedes from the eye A railway train moving over a straight track furnishes an example As the train becomes more distant its dimensions apparently become smaller Its speed also seems to diminish, for the space over which it travels in a given time appears to be shorter and shorter as it is taken farther and farther away Plate I , fig 8, is another example, showing posts of equal height and with equidistant spaces between

The reason for the apparent diminution in size is readily understood from fig 4 The size of any object is estimated by comparing it with some standard As the observer looks along the line *ba* at the top of the first post, the top of the second post is invisible It is apparently below the top of No 1, and in order to see it he must lower his direction of sight until he looks along *bd.* He now sees the top of No 2, but No 3 is still invisible and in order to see No 3 he must lower his gaze still further until he looks along *bf* Considering the bottoms of the posts he finds the same apparent shrinkage. Compared with No 1, No 2 seems to have a length only equal to *km,* No 3 only equal to *op,* and so on. The posts thus appear relatively smaller and smaller as they are taken farther and farther from the eye If the line of posts could be extended an infinite distance, the last post would evidently appear incalculably small or of zero length.

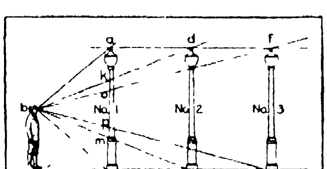


FIG 4 —CAUSE OF APPARENT FORESHORTENING

Similarly the two parallel lines, *adf* and *ceg,* running respectively along the tops and bottoms of the posts must, owing to the apparent decrease in the lengths of the posts, appear to approach one another as they recede Could they be of infinite length they would evidently appear to meet in a point at an infinite distance from the observer This imaginary point which parallel lines seem to approach is called a *vanishing point.* Plate I , fig 3, shows a perspective of the interior of an aqueduct in which the parallel lines of the stone courses can easily be imagined to meet in a vanishing point.

Systems of Lines.—If any object bounded by planes, *e g ,* a cube is examined, its edges can be grouped into several series or systems of parallel lines. Each system will have its particular vanishing point. In fig 5 there are three such series, one apparently converging or *vanishing* toward the right, one toward the left, and a vertical system It is important to be able to locate the imaginary vanishing point of any system of lines This can always be done by looking along one of the lines or *elements* of the system Whatever the position of the observer, every element of a given system appears to converge towards the vanishing point of that system and, if extended indefinitely, to meet the vanishing point Hence if the observer looks along any element, he will be looking directly at the vanishing point of the system The line along which he sights will be seen endwise, as a point, exactly covering the vanishing point toward which all other elements of the system will appear to converge Thus, an observer might sight directly along one of the course lines in Plate I , fig 3, and discover the vanishing point for the other course lines directly in front of his eye

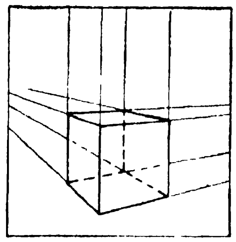


FIG 5 —SYSTEMS OF LINES

This principle is further illustrated by the model shown in Plate I , fig 1, which consists of a series of rods representing straight lines and arranged in a parallel system Let the observer look directly along any one of the rods, as the one at the lower left corner This rod will appear as a dot, and apparently cover the imaginary infinitely distant vanishing point of the system All the other rods or elements will appear to converge toward the vanishing point which the observer has located Again if he sights along the centre rod, Plate I , fig 4, he will see it as a dot covering the imaginary vanishing point towards which the other elements of the system appear to converge Let him choose which rod he will the result will evidently be the same The line along which the observer sights is called the *visual element* of the system Plate I , fig 9, shows the use of this method to locate the vanishing point of the horizontal lines in the view that are parallel to the curbing The observer sights along the fence rail which being parallel to the curb leads his gaze to the desired vanishing point All other horizontal lines in the view belonging to this system seem to converge towards the infinitely distant vanishing point covered by the fence rail

It is evident that the view of the scene as well as the apparent position of any vanishing point must change with every new position of the observer. Therefore a perspective drawing can only attempt to represent the view as it will appear from one point of view This is a limitation inherent in every perspective drawing

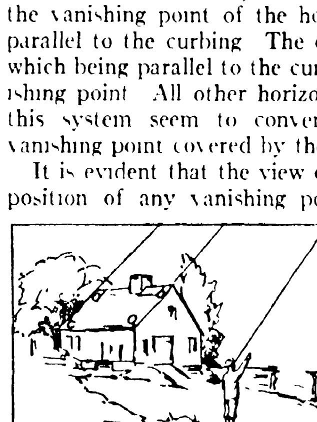


FIG 6 —LOCATING A VANISHING POINT

Instead of sighting along an actual element, the observer can look in a direction parallel to an element The direction in which he looks may be considered as an imaginary element which will lead his eye to the desired vanishing point In fig 6 the observer is looking in a direction parallel to the two edges *ab* and *cd* of the roof plane These two edges appear to him to converge towards a point infinitely distant from him in the direction of his gaze

Rule A.—From the method of locating a vanishing point it follows that if a system is horizontal its vanishing point must appear to be on a level with the eye If a system vanishes upward its vanishing point will be located above the eye; if downward below the eye; if toward the right, to the right of the eye; or if toward the left, to the left of the eye

Theoretically every system of lines has 'two vanishing points, for, if the observer can locate one by looking along an element in one direction, he can also locate a second by looking along the same element in the opposite direction. For any given position of the observer one of these vanishing points will usually lie before and the other behind him. The one lying in the direction of his gaze is the only one considered, except in certain special problems.

Systems of Planes.—Plane surfaces which are parallel appear to approach one another as they recede. This will be evident from fig. 7. Since the horizontal edges of the cube appear to converge, the top and bottom planes must appear nearer together at *cd* and *gh* than at *ab* and *ef,* and must seem to approach one another as they extend into space. Parallel planes extended an infinite distance appear to meet in a straight line known as the *vanishing trace* of the planes. Each system of planes will have its own vanishing trace which can be located by looking along any one of the planes. The plane will appear edgewise, as a line, and cover the vanishing trace which every plane of the system will appear to approach.

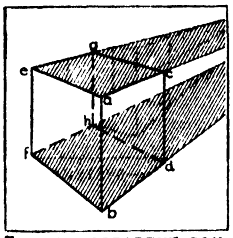


FIG. 7.—APPARENT CONVERGENCE OF PARALLEL PLANES

The method of locating a vanishing trace is illustrated in Plate I., figs. 5 and 7. The plane along which the observer looks is known as the *visual* plane of the system. It appears as a straight line and the other planes of the system seem to approach it. The vanishing trace of the system of horizontal planes will evidently be a horizontal line on a level with the observer's eye. To this vanishing trace is given the special name of *horizon.* The visual plane of a horizontal system is called the *horizon plane.*

If the observer while locating a vanishing trace should slowly turn completely around still looking along the visual plane, at every instant he would see the vanishing trace as a straight line directly in front of him. The vanishing trace therefore may be considered as a circle of infinite radius which is theoretically the same thing as a straight line. In practical work so small a field is usually visible that a vanishing trace is always treated as a straight line.

Axioms.—The foregoing discussion may be summarized in five axioms and one rule.

Axiom 1. Parallel lines appear to converge as they vanish, and to meet at an infinite distance from the observer in an imaginary point called the vanishing point of the system.

Axiom 2. Parallel planes appear to approach one another as they recede from the eye, and to meet at an infinite distance from the observer in an imaginary straight line known as a vanishing trace.

Axiom 3. A line lying in a plane must have its vanishing point in the vanishing trace of the plane. This is evident from the manner of locating the vanishing point of a line and the vanishing trace of a plane.

Axiom 4. The vanishing trace of a plane must contain the vanishing points of all lines which lie in the plane. This is the converse of number 3.

Axiom 5. A line which forms the intersection of two planes, since it lies in both, must have its vanishing point at the intersection of the vanishing traces of the two planes.

Rule B. To locate the vanishing point of a system of lines, look along any real or imaginary line of the system.

APPLICATION TO PERSPECTIVE DRAWING

The Picture Plane.—The five axioms just formulated apply to conditions which are apparent but which do not really exist. In a perspective drawing these apparent conditions in space must be represented by actual conditions on paper. The perspectives of parallel lines are represented by converging lines which actually meet at a point which is the perspective of their vanishing point. Fig. 8 illustrates this. An observer stands before an object. Between him and the object is a plane called the *picture plane.* The object becomes visible to him by rays of light known as *visual rays* reflected into his eye from each point on its surface. Each point is projected upon the picture plane by its visual ray and the result is a perspective view.

Rule C. The perspective of any point is where the visual ray from the point intersects the picture plane.

A perspective is really a *conical projection* of the object on the picture plane, the projecting cone being made up of visual rays. In order to locate the imaginary vanishing point of the roof

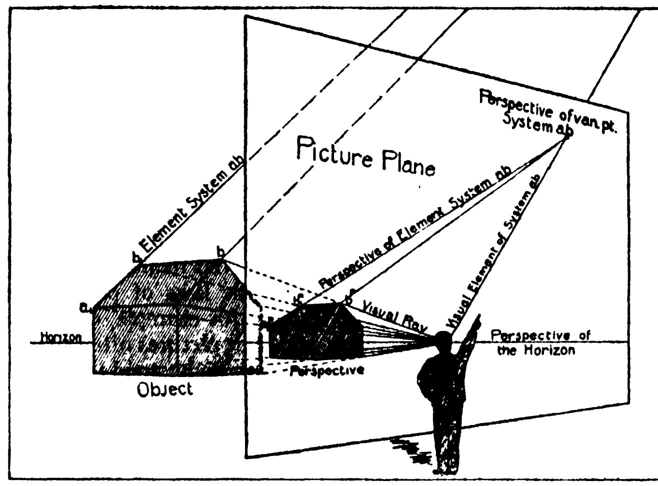


FIG. 8

lines *ab* and a_1 b_1, the observer looks in a direction parallel to *ab* and a_1 b_1 (Rule B). The direction in which he is looking becomes the visual ray passing between the imaginary vanishing point and his eye. The point in which this visual ray intersects the picture plane is the perspective of the vanishing point (Rule C), and to this perspective vanishing point the perspectives of the roof lines *ab* and a_1 b_1 actually converge.

Rule D. To find the perspective of the vanishing point of any system of lines, pass a line parallel to the system through the observer's eye and find where the line pierces the picture plane.

Planes of Projection.—In making a perspective drawing three planes are used: first, a vertical plane, the picture plane, which receives perspective view; second, a horizontal plane, the horizon plane which must always contain the observer's eye; third, a second horizontal plane called the ground plane on which the object always rests, fig. 9. Since the horizon plane always contains the observer's eye, or *station point,* and the object always rests upon the ground plane, the relation between these two planes determines the kind of view to be produced. If the distance between them equals the height of a man (to the scale of the drawing) the view obtained will be as though seen by an observer standing on the ground plane. Increasing this distance is equivalent to raising the observer's eye, and if the distance is great the result is a bird's eye view. The ground plane may be taken above the horizon plane and the resulting view will show the object as though the observer were looking up at it. The picture plane and the horizon plane are known as the *co-ordinate planes of projection* and on them is performed all the work of constructing the perspective view.

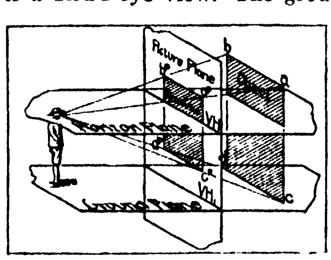
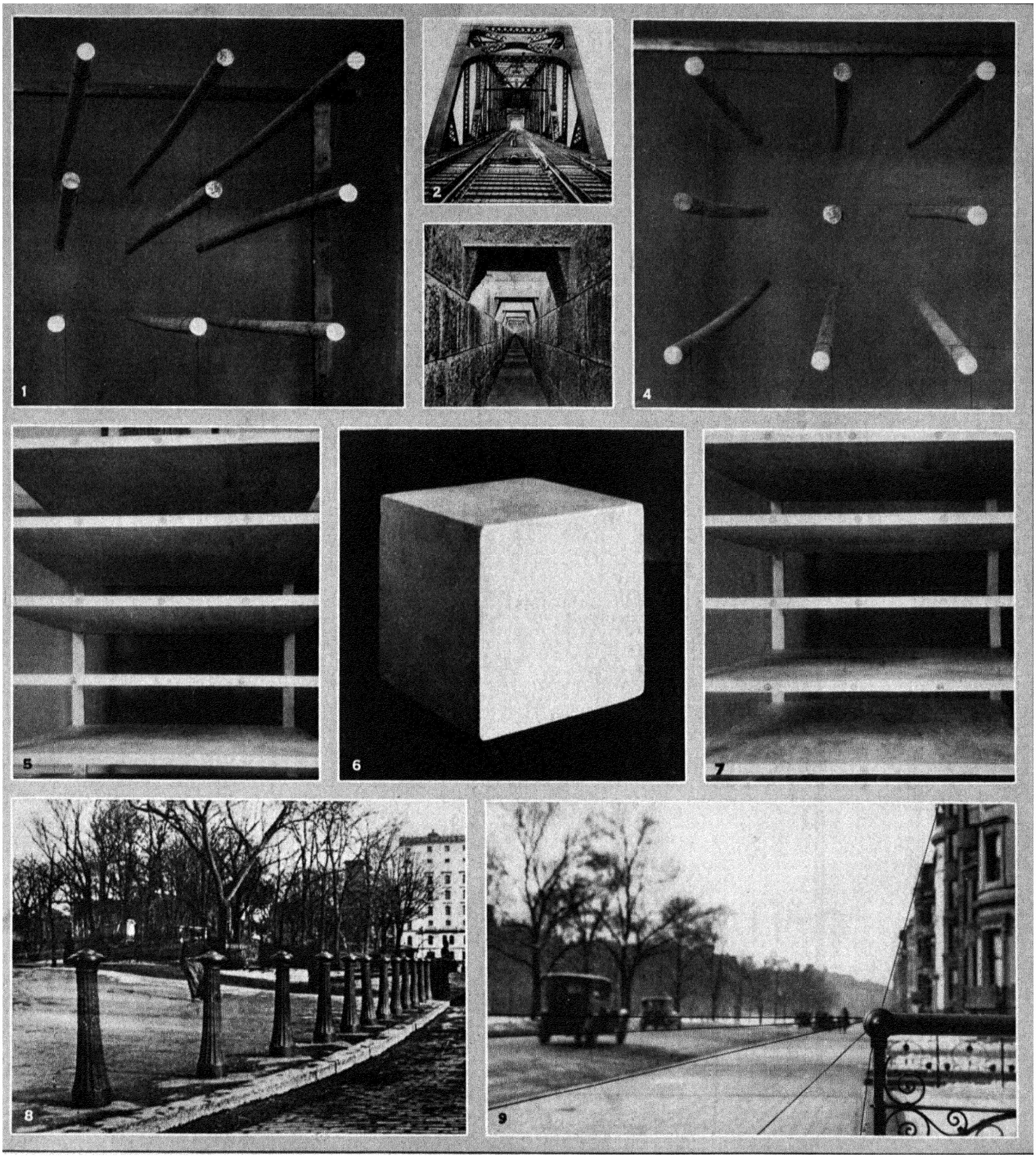


FIG. 9

Orthographic Projection.—As already stated the perspective view is a conical projection on the picture plane. This conical projection is in practice not found from the actual object in space, but from a plan and an elevation of the object. The plan is essentially a top view and the elevation a front view or sometimes a side view.

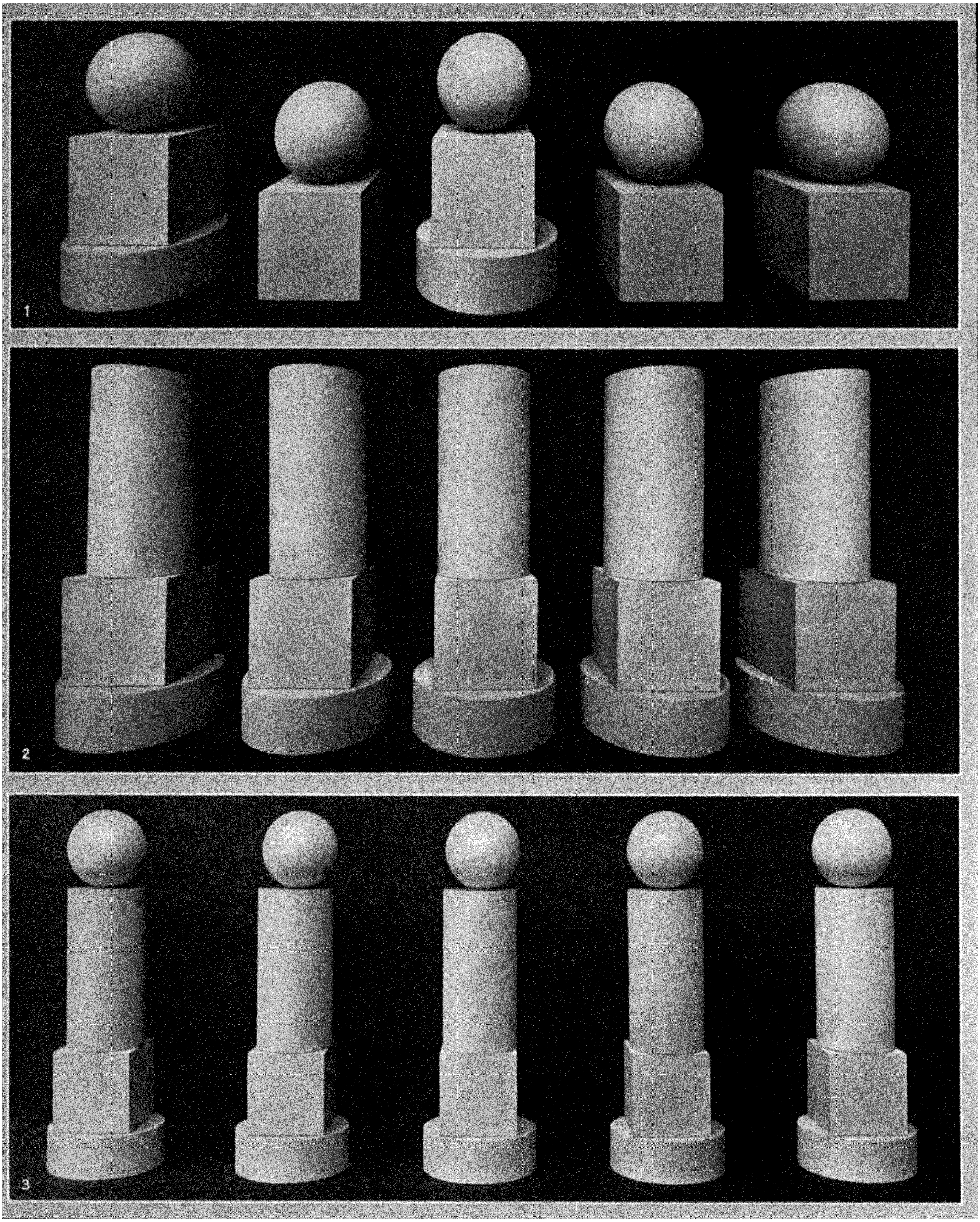
A plan is constructed by projecting each point in the object to a horizontal reference plane by lines or projectors which are perpendicular to the horizontal plane. An elevation is constructed by projectors perpendicular to the vertical plane. Such views are known as orthographic or right-line projections in contrast to the



ILLUSTRATIONS OF PERSPECTIVE

1. Method of locating a vanishing point
2. Apparent convergence of parallel lines
3. Apparent vanishing point of parallel lines
4. Element at centre used to locate vanishing point
5. Method of locating vanishing trace
6. Appearance of object contrasted with reality
7. Plane at centre used to locate vanishing trace
8. Apparent diminution in size with increasing distance
9. Location of vanishing point

PERSPECTIVE



ILLUSTRATIONS OF PERSPECTIVE

1. Example of apparent distortion
2. Example of apparent distortion
3. Effect of increased distance between object and picture plane

conical or perspective projection, and are the ordinary means of representing objects on paper (*see* DRAWING, ENGINEERING). Fig. 10 shows a conical and an orthographic projection. Fig. 11 illustrates the construction of a plan and an elevation. Fig. 12 shows the two views as they are represented on paper. Each point in the object, has two projections, both being necessary to locate accurately the relations of the point to the two planes. Thus the point *a* is above the horizontal reference plane, a distance equal to *am* as indicated in elevation, and in front of the vertical reference plane a distance equal to *an* as shown in plan. The elevation shows vertical distances, the plan shows horizontal distances. The object in space may be above the horizontal plane as in figs. 11 and 12, or it may be below the horizontal plane as in fig. 13. It may be behind or in front of the vertical plane, or it may lie partly behind and partly in front of the vertical plane or partly above and partly below the horizontal plane.

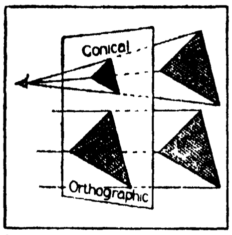


FIG. 10.—COMPARISON OF CONICAL AND ORTHOGRAPHIC PROJECTIONS

Any point in space may have three different but related projections, a plan or horizontal projection, an elevation or vertical projection, and a conical or perspective projection. This is illustrated in fig. 14 where two points in space *a* and *b* are shown, each with its vertical, its horizontal and its conical projection. The horizontal projection is indicated by an index *h*, the vertical projection by an index *v*, and the perspective projection by an index *p*. The point *a* is shown behind the picture plane and above the horizon plane. The point *b* is shown in front of the picture plane and below the horizon plane. The conical projection or perspective is always on the vertical or picture plane.

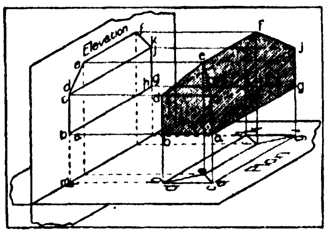


FIG. 11.—CONSTRUCTION OF PLAN AND ELEVATION

Fig. 15 shows the planes of projection with the ground plane indicated by its intersection (VH_1) with the picture plane. The point *a* is shown in space behind the picture plane and below the horizon plane, with its horizontal projection (a^h) and its vertical projection (a^v). The station point is represented by its two orthographic projections just as every point in space. Since it always lies in the horizon plane its horizontal projection, SP^h, must always coincide with the point itself. Its vertical projection will be directly in front of SP^h, on the picture plane as SP^v. SP^v must always lie in the line *VH* which represents the vertical projection of the horizon plane.

Just as a point in space has a horizontal projection and a vertical projection, so the visual ray which passes from the point *a* to the observer's eye has two projections, one on each plane. Its projection is seen on the horizon plane passing through a^h and SP^h. Its vertical projection is seen on the picture plane passing through a^v and SP^v. The visual ray pierces the picture plane at a^p which is the perspective of the point *a* (Rule C).

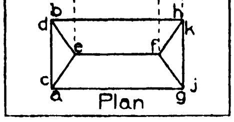


FIG. 12.—PLAN AND ELEVATION, ORTHOGRAPHIC PROJECTIONS

Rule E. The intersection of a visual ray with the picture plane must always lie upon the vertical projection of the visual ray, and must be directly in line with the point where the horizontal projection of the visual ray crosses the horizontal projection (*HPP*) of the picture plane.

In practice both the picture plane and the horizon plane must be represented on one sheet of paper. One can imagine the picture plane to be revolved about its intersection with the horizon plane in the direction indicated by the arrows s_1 and s_2, fig. 15, until the two planes lie coincident as shown in fig. 16. In this position the group of projections on the picture plane will overlap the group on the horizon plane. To avoid the resulting confusion the two planes can be pulled apart as shown in fig. 17. After these movements of the planes the horizon plane will still contain all of the horizontal projections, which will remain undisturbed in all aspects of their relations to one another.

HPP is the horizontal projection of the picture plane and is the reference line for all horizontal projections. Similarly the picture plane will contain all of the vertical projections. *VH* is the vertical projection of the horizon plane, and is the reference line for all vertical projections. VH_1 represents the intersection of the ground plane with the picture plane. The distance between *VH* and VH_1 shows the height of the observer's eye above the plane on which the object rests.

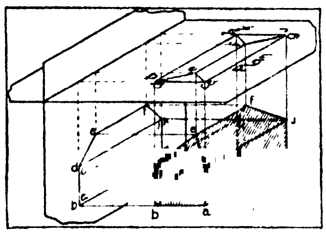


FIG. 13.—CONSTRUCTION OF PLAN AND ELEVATION

The two groups of projections are usually represented as in fig. 18. The only relation between the two groups is that the two corresponding orthographic projections of any point as a^h and a^v, *or* SP^h and SP^v, must always be vertically in line with one another. Horizontal projections show distances back and front. Vertical projections show distances up and down. Distances are never measured between a horizontal and a vertical projection. The relation of a^h to *HPP* shows the point *a* to be behind the picture plane. The relation of a^v to *VH* shows it to be below the plane of the horizon. The two projections of the visual ray through the point *a* are shown (R^h and R^v). By Rule E, the point *p* can be determined.

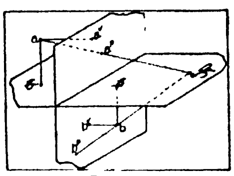


FIG. 14

Measure Lines.—Fig. 19 shows a rectangular block resting upon the ground plane in plan and elevation. The perspective of each point has been found by Rule E. Connecting these points by straight lines, the perspective of the block is determined. Since the object lies some distance behind the picture plane, as seen by comparing the plane with *HPP*, the perspective is smaller than the object. Any line which lies in the picture plane will show its true length in the perspective view, and is called a *measure line*. It can be drawn at once to scale and used to determine the dimensions of other parts of the object which do not lie in the picture plane and consequently appear larger or smaller than their real dimensions, according to whether they are in front of or behind it. Any vertical plane if extended will intersect the picture plane in a vertical line. The intersection will be a measure line on which true vertical dimensions may be scaled. Thus, in fig. 19, the left vertical face of the block can be extended forward until it intersects the picture plane in a measure line on which the distance $a^v m$ will show the true height of the block The right vertical face if

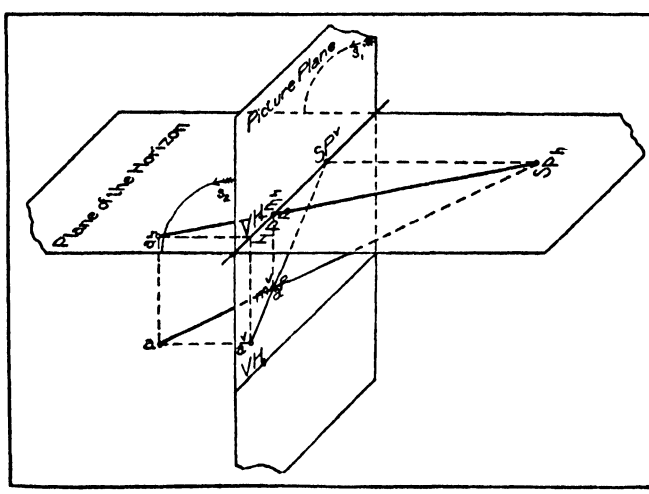


FIG. 15

extended will also give a measure line, on which $b'n$ shows the true height

The Construction of a Perspective Projection.—Fig. 20 illustrates the fundamental method of constructing a perspective from which all other methods are derived A plan and elevation are given on the left, an end view on the right *HPP* determines

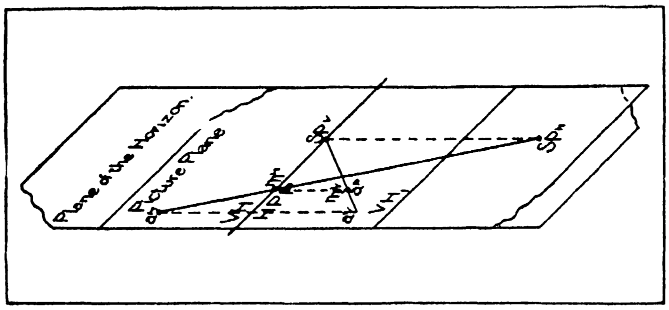


FIG 16

the picture plane in horizontal projection. *VH* determines the plane of the horizon in vertical projection. VH_1 determines the plane of the ground on which the object is to rest The observer's eye, *SP*, is given in vertical and horizontal projections The resulting perspective is to show the house with the vertical corner *ae* lying in the picture plane, and with the face *aefb* making an angle of 45° with it This position is indicated by the

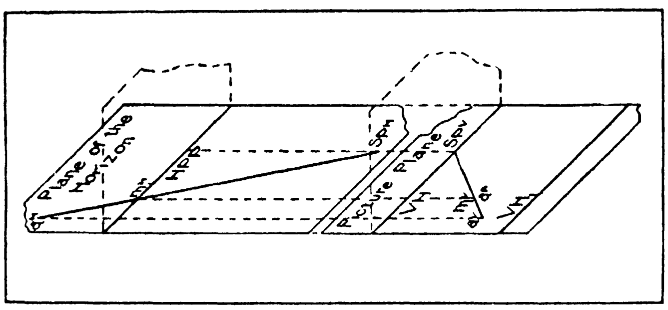


FIG. 17

diagram, which is a plan of the house revolved about a vertical axis until the side *aefb* makes the specified angle of 45° with *HPP*, and placed with the corner *ae* touching *HPP* in accordance with the specification The point *a* will thus lie both in the picture plane and on the plane of the ground Its perspective must be at a^p on VH_1 and directly under the point *a* in the diagram As the front corner lies in the picture plane it will be a measure line and its true height taken from the elevation can be laid off directly from a^p, determining e^p as indicated Next, by Rules D and E establish the vanishing point for the system of lines parallel to *ab*, as follows the horizontal projection of the visual ray will pass through SP^h parallel to *ab* in the diagram, and will cross *HPP* at the point 10 Since *ab* is a horizontal system the vertical projection of the visual ray will pass through SP^v and coincide with *VH* The desired vanishing point must be on *VH* directly below 10, at V^{ab}.

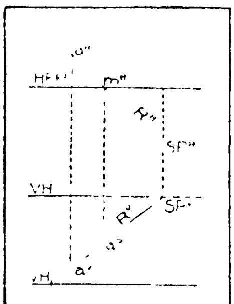


FIG 18 —ELEMENTARY PROBLEM IN PERSPECTIVE

Similarly the vanishing point for the horizontal system parallel to *ad* will be found on *VH* at V^{ad}. The upper and lower edges of the right face run from e^p and a^p respectively and vanish at V^{ab}. The observer sees the rear edge of the right face projected on the picture plane directly below the point where a visual ray from *fb* in the diagram crosses *HPP* As the perspective of a vertical line upon a vertical picture plane is always a vertical line, the rear edge will be found at b^pf^p. In a similar way the upper and lower edges of the left face vanish at V^{ad}, and the rear edge of this face is found at d^ph^p. The rectangular portion of the house is completed by lines running from b^p and f^p vanishing at V^{ad}, and from d^p and h^p vanishing at V^{ab}, establishing by their intersections c^p and g^p.

To find the roof of the main house, extend the ridge (*lk*) in the diagram until it intersects *HPP* in the point 12. Imagine a vertical plane to pass through the ridge It will intersect the picture plane in a vertical line dropped from the point 12. This will be a measure line for the ridge and the true height of the ridge above the ground, 2–1, taken from the elevation, can be laid off on it. A horizontal line through *l* vanishing at V^{ad} must contain the ridge which will be located on this line at k^pl^p directly below the points in which visual rays through the extremities of the ridge in the diagram, intersect *HPP* From k^p, lines to e^p and f^p respectively, and from l^p, lines to h^p and g^p respectively will complete the roof.

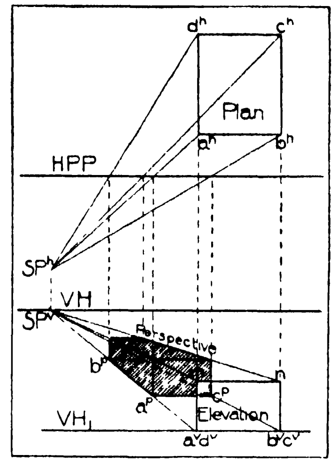


FIG 19 —MEASURE LINES

The chimney can be located in a similar manner Extend the front face through *p* in the diagram until it intersects *HPP* in 13 The plane of this face will intersect the picture plane in the vertical line dropped from 13, which will be a measure line for this face Lay off on this measure line the true height of the top of the chimney 8–7, and the true height of the bottom line of the front face, 8–9. Through 7 and 9 lines vanishing at V^{ad} will contain the top and bottom edges of the front face which will be located vertically below the points where visual rays from the front face of the chimney in the diagram intersect *HPP*. The construction of the rest of the chimney is obvious from the drawing.

A measure line for the right vertical face of the porch is found by extending this face in the diagram until it intersects *HPP* and dropping a vertical 3–4 On this vertical shows the true height front face, 8–9 Through 7 and 9 lines vanishing at V^{ad} will contain the upper and lower edges of the right hand face The points r^p and m^p can be located by visual rays drawn through *r* and *m* on the diagram 5–6 shows the true height of the ridge of the porch laid off on the measure line for the ridge A line through 5 vanishing at V^{ab} will contain the ridge. Points s^p and n^p on this ridge can be located by visual rays through *s* and *n* in the diagram. The construction of the remainder of the porch can be readily understood from the drawing

The heights of the tops and bottoms of the windows can be taken directly from the end view and laid off on a^pe^p which is the measure line for the right hand face of the main house Horizontal lines through these heights will establish the top and bottom lines of the windows The vertical sides can be located vertically below where visual rays from the windows in the diagram cross *HPP*. In this way the entire perspective can be completed

Vanishing Points of Oblique Lines.—The vanishing points for the inclined lines in the roof *ek, kf, lg, lh*, etc, are not absolutely necessary for the construction of the perspective. The method of determining them, however, should be understood as in some problems the vanishing points of oblique lines form an important part of the solution. The construction for their determination is shown on fig 20

First consider *ek* A line drawn through the station point parallel to *ek* will establish the vanishing point by its intersection with the picture plane (Rule D). The horizontal projection of such a line will pass through SP^h parallel to *ek* in diagram, and will cross *HPP* at 14 The vanishing point will be vertically in line with 14 and on the vertical projection of the line through SP^v parallel to *ek* (Rule E). But since the diagram containing *ek* has been revolved from the original position of the given plan, no vertical projection is given which corresponds to the revolved direction of *ek*. The line *ek* must therefore be revolved back into its original direction, *i e*, parallel to e^hk^h in the given plan, in

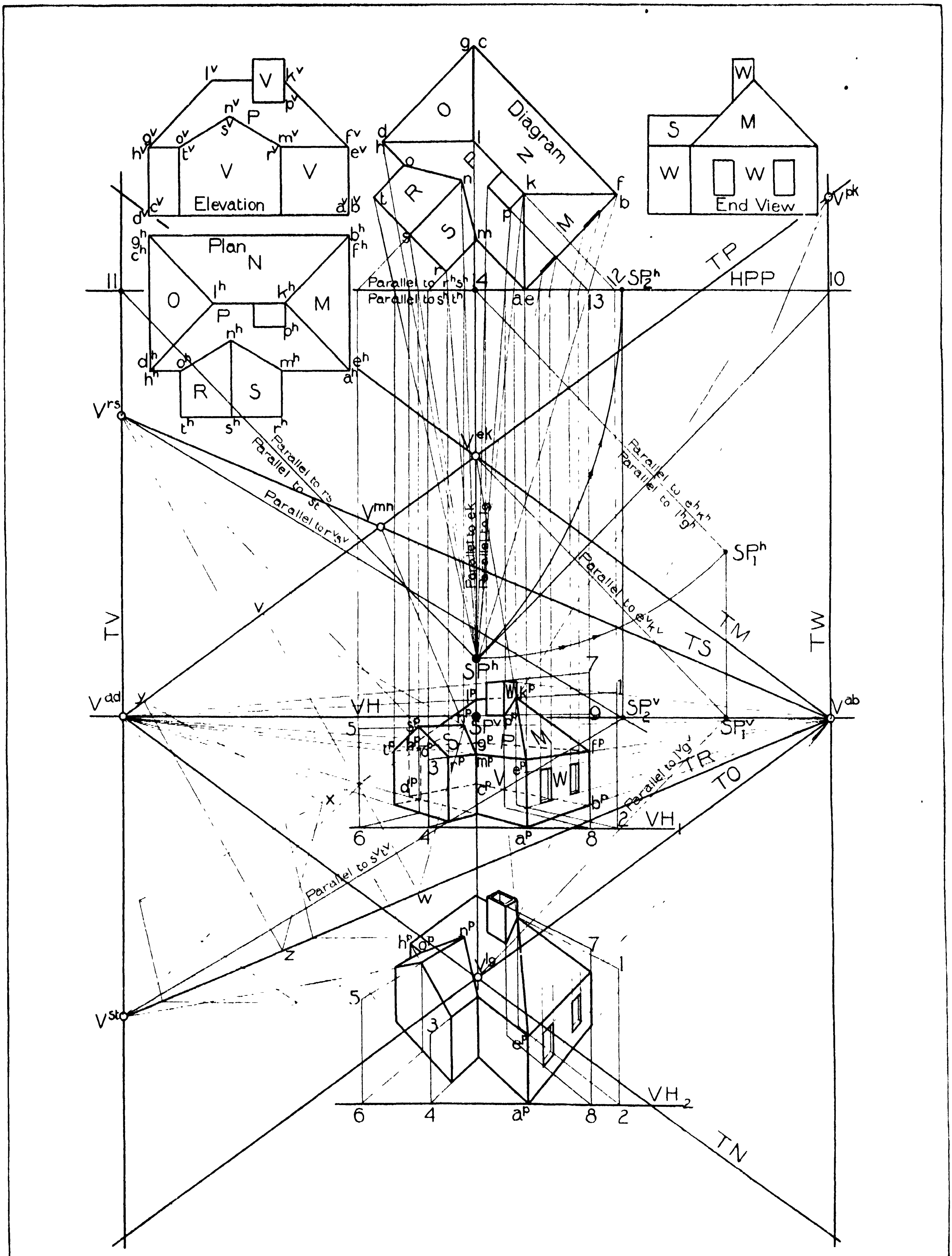

Elevation
Plan
Diagram
End View
HPP
VH
VH_1
VH_2
TV
TW
TP
TM
TS
TR
TO
TN
Parallel to r^hs^h
Parallel to s^ht^h
Parallel to rs
Parallel to st
Parallel to r^vs^v
Parallel to ek
Parallel to lg
Parallel to e^hk^h
Parallel to l^hg^h
Parallel to e^vk^v
Parallel to l^vg^v
Parallel to s^vt^v

FIG. 20

order that the given vertical projection e^vk^v may be used to establish its vanishing point. As the vanishing point must lie in the vertical through 14, the vanishing point will not be disturbed if the vertical line through 14 is used as the axis about which the revolution takes place. During the revolution, the horizontal projection of any point in the line, as SP^h, will describe a circle with the point 14 as its centre. The vertical projection, SP^v, of the same point in the line, will move in a horizontal path along VH, and at any instant during the revolution will be found directly under SP^h. The revolution will be continued until the horizontal projection of the line is parallel to e^hk^h in the given plane. The line will now be in its original direction, SP^h will have moved to $SP_1{}^h$, SP^v will have moved to $SP_1{}^v$, and the given elevation e^vk^v can be drawn through $SP_1{}^v$, determining by its intersection with the vertical through 14, the desired vanishing point V^{ek}. Since the line *ek* slopes upward as it recedes, V^{ek} is found to be above VH (Rule A).

In a similar manner the vanishing point for *lg* can be found. The line through SP^h parallel to *lg* coincides with the one parallel to *ek*. This is swung back about a vertical axis through 14 until parallel to l^hg^h, in which position it will coincide with the line parallel to e^hk^h, and SP^h will have revolved to $SP_1{}^h$, $SP_1{}^v$ will be on VH directly below $SP_1{}^h$ and a line parallel to the given elevation l^vg^v, drawn through $SP_1{}^v$ will, by its intersection with the vertical through 14, determine V^{lg}. Since the line *lg* slopes downward as it recedes, its vanishing point is found below the horizon (Rule A).

To find the vanishing point for *rs* draw a line parallel to *rs*, in the diagram, through SP^h, crossing HPP at 11. V^{rs} will be found somewhere on a vertical through 11. Swing the line about a vertical axis through 11 until parallel with r^hs^h in the given plan. SP^h will revolve to $SP_2{}^h$ and $SP_2{}^v$ will be found on VH vertically in line Through $SP_2{}^v$ draw a line parallel to r^vs^v in the given elevation which will determine by its intersection with the vertical through 11, the vanishing point *rs*. This will be found above VH as *rs* vanishes upward. A similar series of steps will determine the vanishing point for *st* at V^{st} below the horizon.

Vanishing Traces.—With the vanishing points that have now been determined it is possible to locate a vanishing trace for each plane in the object. The roof planes have been lettered on the diagram. The vanishing trace for the plane *M* will be a line lettered *TM* containing V^{ab} and V^{ek} (Axiom 4). Similarly *TO*, the vanishing trace of the roof plane O, must contain V^{ab} and V^{lg}. *TN* must contain V^{ad} and V^{lg}, *TP* must contain V^{ad} and V^{ek}, *TS* will pass through V^{ab} and V^{rs}, and *TR* will pass through V^{ab} and V^{st}. The vanishing trace of a vertical plane must always be a vertical line and can therefore be determined by a single vanishing point. *TW* will be a vertical line through V^{ab} and *TV* a vertical line through V^{ad}. A vanishing trace is thus found for each plane in the object and, by virtue of Axiom 5, the vanishing points for the remaining oblique systems can now be located. Thus *mn* being the intersection of the planes *S* and *P* will have its vanishing point, V^{mn}, at the intersection of *TS* and *TP*. Similarly *pk*, the intersection of the right hand face of the chimney with the roof plane *P* will have its vanishing point at the intersection of *TW* and *TP*.

V^{no} must be situated at the intersection of *TP* and *TR*, but these two vanishing traces do not intersect within the limits of the paper. A line may be drawn through n^v to meet *TP* and *TR* at their intersection in the following manner. Draw any triangle as n^vvw with its apex at n^v and its base, *vw*, stretching between *TR* and *TP*. Draw any other triangles as *xyz* with its sides respectively parallel to n^vvw and its base *vz* stretching between *TR* and *TP*. A line from n^v through *x* will meet *TR* and *TP* at their intersection.

Lines Parallel to the Picture Plane.—It has been stated that the perspectives of vertical lines on a vertical plane are always vertical and not convergent. The reason for this follows directly from Rule D. If a vertical line is drawn through the observer's eye it cannot pierce a vertical picture plane within finite limits. The perspective of the vanishing point of such a system will theoretically be vertically over SP^v at an infinite distance. As the perspectives of all vertical lines must meet at the perspective of their vanishing point they cannot meet within a finite distance and must be drawn parallel and vertical. The parallel vertical lines drawn in perspective are themselves, however, subject to the laws of appearance, as are all lines in space, and, though actually drawn vertical, will appear to the observer to converge in just the right degree as they recede in the picture from his eye. This is true not only of vertical lines but of all lines which are parallel to the picture plane; *i.e.*, all lines whose projections in the diagram are parallel to *HPP*. From this truth three additional and very useful axioms may be deduced.

Axiom 6. Lines in space which are parallel to the picture plane will have their perspectives drawn parallel to one another and not convergent.

Axiom 7. Any line parallel to the picture plane must have its perspective drawn parallel to the vanishing trace of every plane in which it lies.

Axiom 8. If the line in which two planes intersect is parallel to the picture plane, the vanishing traces of the two planes must be parallel to one another.

These axioms are exemplified in the vertical lines in the drawing and also in the lines *kf* and *lh* whose projections in the diagram show them to be parallel to the picture plane. *kf* being the intersection of *M* and *N*, *TM* and *TN* should be parallel to

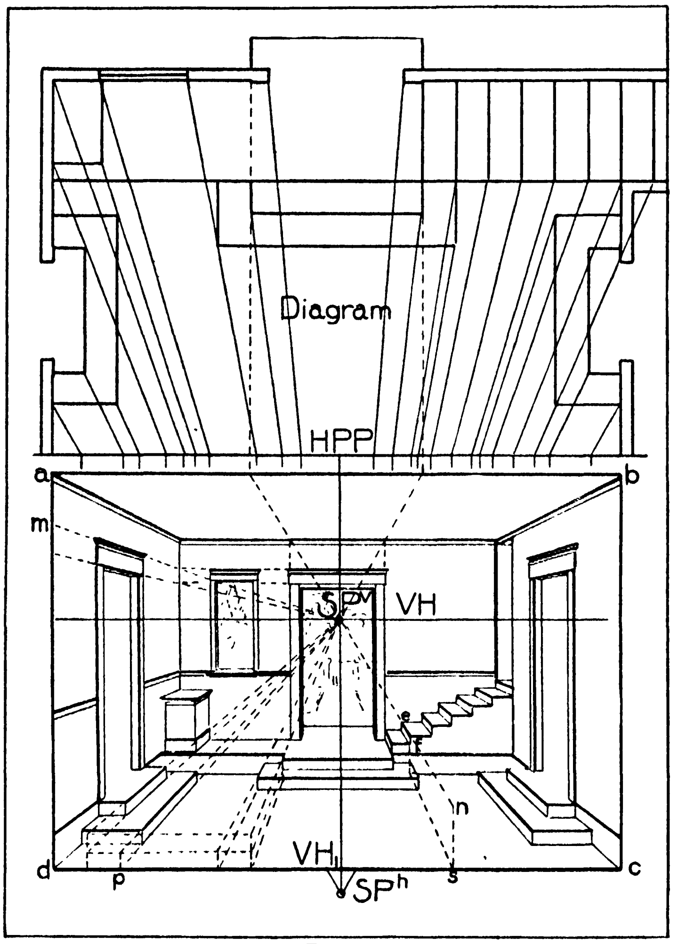
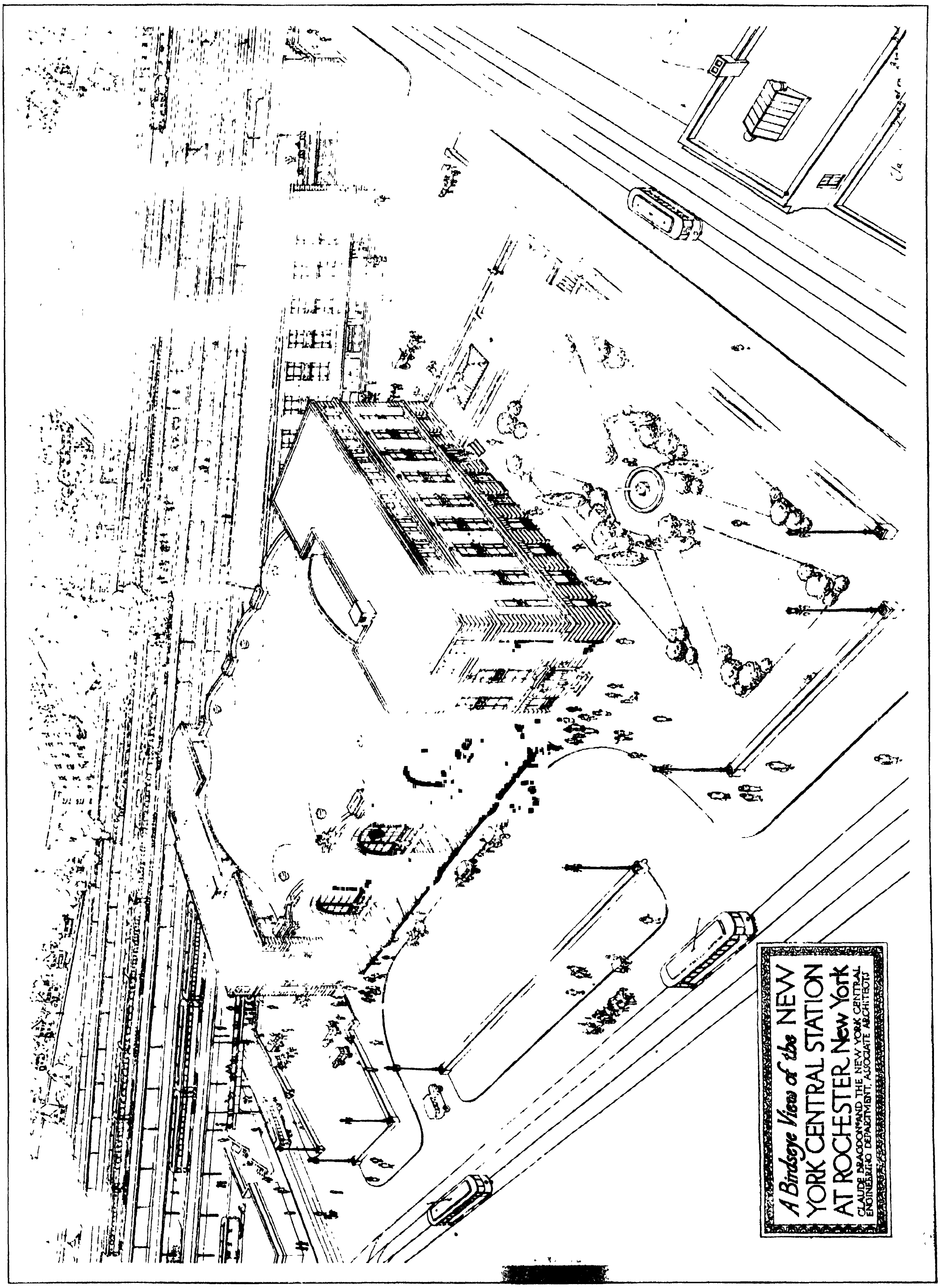


FIG. 21

one another (Axiom 8) as they are found to be, and *kf* should be drawn parallel to *TM* and *TN* (Axiom 7). Similarly *lh* is drawn parallel to *TO* and *TP*, and these two vanishing traces are parallel to one another.

Vanishing Point Diagram.—The more or less geometrical figure composed of the vanishing traces of the planes, the vanishing points of the lines, *VH*, *HPP*, and the projections of the station point form the vanishing point diagram. This vanishing point diagram is quite independent of the particular location of the revolved plan, provided the directions of the lines in the



AN ARCHITECTURAL DRAWING IN AERIAL PERSPECTIVE

A rendering by Claude Bragdon showing an interesting use of aerial perspective

volved plan are not changed. It would serve to determine the ›rspective of the house were it placed to the right or the left its present position, or it might be brought forward or moved ıckward in relation to the picture plane. It might also rest on ground plane higher or lower than the one used, provided always at the lines in the object do not change their direction. The ınishing point diagram would therefore serve for a number of nilar objects placed at different positions but always having the me angular relation to the co-ordinate planes. As an illustration this a second perspective projection has been drawn in Plate III. ı a ground plane represented by VH_2 some distance below VH_1. he same vanishing point diagram serves for both perspectives. ıould, however, the angular relation between the diagram and e picture plane be changed it would be necessary to construct new vanishing point diagram.

Parallel Perspective.—Sometimes instead of the diagram ›ing turned with its principal horizontal lines oblique to the cture, it is placed with one of its principal systems of horizontal ıes parallel and the other perpendicular to the picture plane, in fig. 21. The result is often referred to as a *parallel* perspec- ve and is frequently used in showing interior views. The picture ane may be taken coincident with the nearest wall of the room. he horizontal system perpendicular to the picture plane will ıve its vanishing point coincident with SP^v (Rule D). The hori- ɪntal system parallel to the picture plane will, in perspective, ıow as true horizontal lines (Axioms 6 and 7). This is simply special case under the general method already explained, and volves no new principles. The vertical and horizontal edges of ıe room, *ab*, *bc*, *cd* and *da* being lines in the picture plane will › measure lines and true lengths can be laid off on them directly, *dm* the height of the door and *dp* the projection of the lower ep from the wall; or any line as *ef* can be extended forward to the picture plane where it will show its true height *sn,* above ıe ground plane.

CURVES

As must be evident from the foregoing discussion, linear per- ›ective is essentially a science of straight lines. When curves ›pear in the plan or elevation their perspectives are usually con- ructed by reference to straight lines. If the curve is of regular ›rm it can be enclosed in a polygon, usually a rectangle, the per- ›ective of the rectangle found and the ırve then constructed within the perspec- ve rectangle. Fig. 22 shows a curve so ıclosed, the perspective of which has ›en found. The diagonals of the perspec- ve rectangle locate its centre. Lines ·awn through the centre respectively par- lel to the adjacent sides give by their tersections with the sides, points at hich the curve is tangent. The sides of the rectangle give the rections of the curve at the points of tangency. Fig. 23 is an- .her illustration of curves of regular form constructed in per- ›ective. If the curve is not regular in form the enclosing rec- ngle can be subdivided into smaller rectangles, as shown in fig. ı, as a further aid to locating the curve.

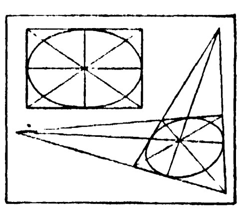


FIG. 22

Although methods can be devised for constructing the exact per- ›ective of any curved object, they are complex and seldom used ı practice. A few important points are usually located and the ıtline sketched in freehand, if in a position corresponding to ıat in the picture.

Apparent Distortion.—It is evident from the statement in ›nnection with Plate I., fig. 3 that an object in space is exactly ›presented by its perspective prospective projection, or in other ords, no distortion or exaggeration can exist in correctly con- .ructed perspective projection. Notwithstanding this fact, very isagreeable effects and very apparent distortions are often noticed ı perspective projections, the accuracy of which cannot be ques- oned. A few examples will suffice to show what is meant. Plate I., fig. 1, is a true perspective. It is supposed to represent a umber of perfect spheres of equal size. The view as seen does ›t convey this impression. A sphere in space always appears as perfect circle and never as the oval-shaped areas seen near the edges of the photograph. Again, Plate II., fig. 2, is a correct per- spective of five circular cylinders all having the same diameter. The ones farthest to the right or left should appear smaller than the nearest one at the centre. In the photograph just the opposite is true and the farther from the eye the larger they appear. The explanation of these seeming anomalies is as follows: Before any perspective projection is constructed the position of the ob- server's eye is definitely fixed, and, in order that the perspective shall represent the view in space, the observer must close one eye and place the other exactly in the predetermined position. It is seldom that an observer looks at a drawing with one eye only, or places either eye even approxi- mately in the correct relation to the drawing. This limitation of a perspective view and the failure to understand it is the cause of all apparent distortion. In Plate II., figs. 1 and 2, the station point has purposely been chosen so close to the paper that it is impossible for the observer to see the view from the correct position. Should either of these views be enlarged so that the distance from the paper to the station point became considerably greater, and should the observer examine the enlarged view with one eye only, placed exactly at the station point, the elliptical projections of the outside spheres would be foreshortened by the obliquity of his line of vision and would appear as perfect circles, representing to him perfect spheres. The cylinders would also appear in their proper relations.

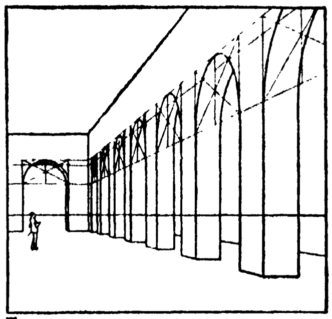


FIG. 23.—SEMI-CIRCLES ENCLOSED IN RECTANGLES

When the eye is not in its proper position all parts of the draw- ing show more or less distortion. This is most noticeable in reg- ular curved forms or in the human figure, especially when these are located near the edges of the drawing. The disagreeable effects are much more pronounced when the station point is taken too near the picture plane. Thus the apparent distortion seen in a cor- rectly constructed perspective is due, not to inaccuracies in the perspective theory, but to an unwise choice in the station point, a faulty arrangement of the view, and the failure of the observer to recognize the limitations of a perspective projection. In making a perspective, the station point should always be chosen in such a position that the observer will naturally place his eyes approxi- mately at the chosen point when viewing the drawing. An arbi- trary rule sometimes given is to assume the station point directly in front of the centre of the drawing, at the apex of an equilateral triangle the base of which just covers the width of the view. The station point may be chosen farther away than this without much danger but not nearer, and never nearer than eight or ten inches. Curved forms of regular shape and human figures or animals should be kept as near the centre of the drawing as possible. Plate II., fig. 3, shows a view of the same cylin- ders and spheres seen in the two previous figures but with the station point much far- ther from the picture plane. The result is a vast improvement in the view obtained, though the spheres on the outskirts of the picture still appear slightly elliptical. After all precautions have been taken, if disa- greeable effects still persist in the drawing it is customary to introduce certain so-called corrections such as making the perspective of the spheres in Plate II., fig. 1, all perfect circles. These are really not corrections but actual transgressions of the rules of perspective which alter the view so that it will not be exactly correct at any point, yet it may not be noticeably dis- agreeable from any position likely to be taken by the observer.

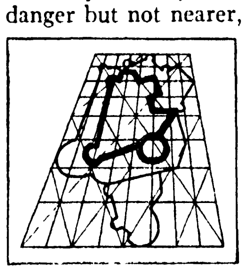


FIG. 24.—IRREGULAR CURVES REFERRED TO RECTANGLES

BINOCULAR PERSPECTIVE

Finally, mention should be made of the most perfect form of perspective representation, the binocular. When a single per- spective drawing is viewed with both eyes the image on the retina

of each eye is practically the same When, however, an object in space is viewed with both eyes two slightly different images are received, one by the right and one by the left eye It is the fusion of these different views which gives to the observer the impression of relief or solidity

In binocular perspective two slightly different views are made of the same scene from two slightly different points of view some 2¾ in apart, to correspond with the views seen by the two eyes This is most easily done with a camera having two lenses, known as a stereoscopic camera The two views are then presented to the observer in such a way that the right eye sees only the view taken by the right-hand lens and the left eye only the view taken by the left-hand lens An instrument designed for showing these double pictures is called a stereoscope (*see* BINOCULAR INSTRUMENT, *Stereoscope*), and gives a result that is startling in its realistic reproduction of distance and relief (*See* ART; ARCHITECTURE; DRAWING, ENGINEERING)

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PERSPIRATION, the excretion of sweat from the sweat-glands of the skin Sweat is a clear colourless neutral or slightly alkaline fluid containing 2% of solids Under pathological conditions, sugar, urea and other substances are found The secretion of sweat is constantly going on, the activity of the sweat-glands being under control of the central nervous system The only function of sweat is the regulation of the heat discharge from the body The chief morbid conditions of the sweat-glands are excessive sweating (*Hyperidrosis*) and foetid sweating (*Bromidrosis*) Excessive sweating is a symptom observed in various diseases, such as tuberculosis and rheumatic fever, but it may exist apart from such conditions, and either be general, affecting the whole body, or confined to a part, such as the axillae, head, hands, feet, or, as in some rare instances, the one half of the body Excessive perspiration may often be prevented by the cold bath, and by tonics, such as iron, quinine, strychnia, etc Locally, the use of astringent lotions of vinegar or a weak solution of lead or atropin will also be of service Foetid sweating most frequently affects the feet, and is apparently due to rapid bacterial decomposition in the perspiration which has saturated the stockings, these should be frequently changed and the feet washed several times a day, dried carefully, and dusted with some antiseptic powder

PERTAB (or PARTAB) **SINGH,** Sir, Maharaja of Idar (1844–1922), native Indian soldier and statesman, belonging to the Rahtor Rajputs of the Jodha class, was born in 1844, being the son of Maharaja Takht Singh, ruler of Marwar (or Jodhpur) In 1878 and again in 1879 he was chief minister of Jodhpur In the following year he accompanied the British mission to Afghanistan, and on his return he carried out many judicious reforms and administered Jodhpur with remarkable success He visited England to take part in the celebration of the 1887 Jubilee of Queen Victoria's reign He served on the staffs of Sir William Lockhart and General Elles in the Tirah and Mohmand expeditions in 1897–98, was slightly wounded, was mentioned in despatches, and promoted to the rank of full colonel He won the reputation of being one of the keenest sportsmen and the best riders that even Rajputana has produced When it was decided to send a force from India to China in 1900 to relieve the foreign embassies besieged in Peking, Sir Pertab Singh at once offered the services of the Jodhpur Lancers, and himself accompanied them His father rendered good services to the British Government in the Mutiny, and Pertab Singh always cherished the memory of the protection given to Jodhpur by the East India Company in 1818 His services to the empire in India were universally recognized. From Queen Victoria he received the honour of knighthood and the Bath and the Star of India; from King Edward VII the distinction of "aide-de-camp"; and the University of Cambridge gave him the degree of LL D From his own State of Jodhpur he obtained the title of Maharaja-Dhiraj In 1901 he succeeded to the rulership of the state of Idar

He relinquished his position as Maharaja of Idar in 1911 in favour of his adopted son Daolat Singh, in order to resume the regency of Jodhpur which he had previously held on the death of his brother in 1895, but this time for his grand-nephew Summair Singh, then 13 years of age When the World War broke out Sir Pertab, in the words of Lord Hardinge the Viceroy, "would not be denied his right to serve the King-Emperor in spite of his 70 years " He came to France for service in the field with his young ward, then only 16, and commanded the Jodhpur Lancers In the later stages of the war he served with them in Egypt and Palestine Sir Summair Singh died in 1918, two years after receiving ruling powers, and Sir Pertab again became regent, assisted by a council. He died on Sept 4, 1922

PERTH, EARLS AND DUKES OF. The Scottish title of earl of Perth was bestowed upon James, 4th Lord Drummond (d 1611) in 1605 His ancestor Sir John Drummond (d 1519) had been created Lord Drummond in 1488

JAMES, 4th earl and 1st duke of Perth (1648–1716), opposed Lauderdale, and after his retirement in 1680 he was one of the committee of seven which managed Scottish affairs He was made justice-general and extraordinary lord of session in 1682, and was lord chancellor of Scotland from 1684 to 1688 As a convert to Roman Catholicism after the death of Charles II, he stood high in the favour of James II Perth, who is credited with the introduction of the thumbscrew, was very unpopular with the Scottish people, and during the Revolution of 1688 he was imprisoned at Stirling Released from captivity in 1693 he joined James II at St Germain, and was made duke of Perth, a titular dignity only after the exiled king's death in 1701 His son JAMES (*c* 1675–1720) and his grandson JAMES (1713–1746) fought for the Stuarts at Sheriffmuir and at Culloden respectively The titular dukedom became extinct at the death of the 6th holder in 1760

The 1st duke's brother, JOHN (*c* 1650–1715), earl of Melfort, rose to favour under Charles II about the same time as his brother, like him, too, he became a Roman Catholic in 1686 In 1684 he was made secretary of State for Scotland, in 1686 he was created earl of Melfort by James II, and during his reign he took a leading part in Scottish affairs He died in Paris on Jan 25, 1715 In 1853 George (1807–1902), nominally 6th duke of Melfort, obtained a reversal of the various attainders, and his own recognition as earl of Perth and Melfort The succeeding earl (the 15th) was his kinsman, William Huntly Drummond, Viscount Strathallan (1871–)

See Sir R Douglas, *The Peerage of Scotland;* and *Histories of Noble British Families*, vol. ii, ed H Drummond (1846)

PERTH, the capital of Western Australia, is situated in the south-west of the State (lat 31° 57′ S; long 115° 50′ E) on ground rising from the Swan river (alt 200 ft) about 12 miles from its mouth where lies its port Fremantle (*v inf*) Established in 1829 and for a long time slow of growth, Perth was constituted a city in 1856 and the metropolitan area now extends over 20 miles east and west along the northern side of the river, though the southern side also (South Perth and Victoria Park) is being increasingly occupied The climate is of "Mediterranean" type, warm to hot and sunny, with occasional hot winds from inland, and winter rains (Av ann temps 73·1°–55·3° F, with occasional days over 100° F; 2,783 hours sunshine; av ann rainfall 34·3 in falling during 120 days, mainly May–Oct inclusive) Fortunate in its site and in its river, which, exhibiting throughout its lower course alternating features of both subsidence and recent elevation, broadens in front of it into a large lake (Perth Water), Perth has during recent years been largely rebuilt, and its environs, including the lower course of the Swan river, improved, in keeping with the State's rapid growth During the last 10 to 15 years nearly £5,000,000 have been devoted to this end and land values have approximately doubled Thus though many of the streets are still narrow, the old, and very plain, city is disappearing and Perth counts amongst its attractions some of the finest terraces, avenues and buildings in Australia (*e.g.*, St. George's Terrace and Forrest Place) A good supply of water is derived from the Darling "Ranges," from some 13 artesian bores (450–2,000 ft) and this is now (1929) being augmented by the enlargement

of the Mundaring Weir to permit of a daily supply of 10,000,000 gallons. The gas and electric tram and lighting and public services generally are upon up-to-date and efficient lines and the city owns some 5,700 ac. of public lands devoted partly to parks, recreation grounds, etc., and including the fine King's Park (1,018 ac.) overlooking the Swan river west of the city. The public buildings include Government House, Houses of Parliament, two Cathedrals, besides numerous fine business and educational buildings (such as the University). The population of Perth and suburbs (including Fremantle) is *c.* 185,000, 48·64% of the total population of the State. Besides being the political and administrative centre, Perth, with Fremantle, is by far the most important centre for trade, commerce, banking, etc., in the State, the natural terminus and departure port for the principal railway routes of a wide hinterland which stretches far inland to the eastern goldfields.

Fremantle is the leading seaport of Western Australia, the first normal port-of-call for liners from Europe, and the terminus of the transcontinental railway. Its position relative to the State's chief wheat and wool producing areas, and to Indian Ocean, South African and European trade routes, lends added significance. Two moles prolonging the course of the Swan river seawards provide a safe approach 5,000 ft. long and 450 ft. wide and lead in to a harbour having over 10,000 ft quay space, 36 ft. depth (low-water), accommodation for large modern vessels and excellent cargo facilities. It is thus one of the most convenient ports in Australia but its rapid growth has outdistanced improvements and large-scale developments upstream and in Freshwater Bay are possible and are contemplated. Fremantle is one of the oldest settlements in Australia (founded 1825). Its population (1928. 32,600) is rapidly growing and the town, which is to attain the dignity of a city in June 1929, is extending along both banks of the river. Activity centres mainly on shipping and railway transportation but a varied industrial activity is also developing. Fremantle with a total trade valued (1927–28) at £30,628,000 conducts 65–70% of the total trade of the State and is visited by shipping of 3,300,000–3,500,000 tonnage annually Its exports in 1927–28, including 55,341,000 lb. of wool, were valued at £13,624,000.

PERTH, city, royal, municipal and police burgh, and county town of Perthshire, Scotland, 32 m N. by W of Edinburgh by the L M S., and 47¾ m. by the L N.E railway, via the Forth bridge and Kinross junction, the two companies using one station. Pop (1921) 33,208 It is situated on the right bank of the Tay, between the meadows of the North Inch and those of the South Inch, both laid out as public parks. The river is crossed by St. John's bridge of nine arches; by Victoria bridge, connecting South street with Dundee road; and farther south (at the end of Tay street) by a footway alongside the viaduct belonging to the railway. On the left bank of the river lie the suburb of Bridgend and Kinnoull hill (729 ft.). To the south are the wooded heights of Moncrieffe hill, Magdalenes hill, Kirkton hill and Craigie wood In the river are Friarton or Moncrieffe islands and the Stanners.

Notwithstanding the importance of Perth in former times, almost the sole relic of the past is the church of St. John the Baptist. The original building is believed to have been erected in the time of Columba, but the transept and nave of the existing structure date from the early part of the 13th century, the choir from the 15th. It was previously divided into three churches, but was in process of complete restoration in 1927. In May 1559 John Knox preached in St John's his famous sermon in denunciation of idolatry. The Dominican, Carthusian, Franciscan and Carmelite monasteries, the castle, palace and fortress, have all disappeared. The tombstone of James I. and his queen, who were buried in the Charterhouse, was afterwards removed to St. John's East church. During the period between the beginning of the 12th century and the assassination of James I. in 1437, many of the Scottish parliaments were held in Perth. The building in which they met stood off High street and was only cleared away in 1818, its site being occupied by the Freemasons' hall. The house of Catherine Glover, the "Fair Maid of Perth," still stands in Curfew Row. James VI.'s hospital, founded in 1569, which occupies the site of the Carthusian monastery, has been converted into workmen's dwellings. A replica of the old market cross (removed in 1765) has been erected opposite the new City Hall (1911). Among modern public buildings the principal are St. Ninian's Episcopal cathedral (1890); the municipal buildings (1881); the Marshall Memorial hall, housing the public library and the museum; the Perthshire natural history museum; the Sandeman public library, founded by a bequest of Professor Sandeman of Owens college, Manchester. The general prison for Scotland, south of South Inch, was originally erected in 1812 as a dépôt for French prisoners. North-west of the city are the military barracks built in 1793–94. The Burgh Grammar school, supposed to date from the 12th century, has been amalgamated with the Perth academy (1807), and Sharp's institute (1860).

The city has long been famous for its dyeing. Perth is under the jurisdiction of a town council, with a lord provost and bailies.

History.—During the time that it was occupied by the Romans, a period estimated at 320 years, the city was called Victoria; its present name probably derives from the Celtic Abertha ("at the mouth of the Tay") On the conversion of the original Pictish inhabitants and the dedication of the first church to St. John the Baptist, the town was designated St. Johnstoun, and it continued to be known indifferently by this name and that of Perth down to the 17th century. Perth is stated to have been a burgh in 1106 and was made a royal burgh by William the Lion in 1210. During the Scottish wars of Independence its fortifications were strengthened by Edward I. (1298). Robert Bruce several times ineffectually attempted to seize it, but in 1311 he succeeded in scaling the walls during a night attack This was the fourth and most brilliant of the seven sieges which the city has sustained. Taken by Edward III. in 1335, it was recaptured in 1339. In 1396 the combat between the Clan Chattan and the Clan Quhele, described in Scott's *Fair Maid of Perth*, took place on the North Inch in presence of Robert III and his queen, Annabella Drummond. The Blackfriars' monastery was the scene of the murder of James I. by Walter, earl of Atholl, in 1437. In consequence Perth lost its status as capital, in which it had succeeded to Scone, and the Parliament Courts were transferred to Edinburgh in 1482 Gowrie palace was the scene of the mysterious "Gowrie" conspiracy against James VI. in 1600. The town was taken by Montrose in 1644, by Cromwell in 1651, and was occupied by Viscount Dundee in 1689. In 1715 the Old Pretender was proclaimed king at the Mercat cross, and the chevalier himself appeared in the city in the following January, only to leave it precipitately on the approach of the earl of Argyll.

PERTH AMBOY, a city of Middlesex county, New Jersey, U.S A., at the mouth of the Raritan river, on Raritan bay and Staten Island sound. It is served by the Baltimore and Ohio, the Central of New Jersey, the Lehigh Valley and the Pennsylvania railways and by boats to New York; and is connected with Tottenville, at the southern end of Staten island, by the Outerbridge Crossing, a highway bridge built by the Port of New York Authority (opened 1928), and with South Amboy, across the Raritan, by the Victory bridge (opened 1926), a State memorial to the men of the World War. Pop. (1920) 41,707 (36% foreign-born white); 1928 estimate 50,100. Perth Amboy has a good harbour, with ship-yards and dry docks, and is a port of entry. Its manufacturing industries are varied and important, with an output in 1925 valued at $232,061,673. Chief among them are huge copper and silver refineries, which produce 37,000,000 oz. of silver annually and 28% of the world's output of copper. The assessed valuation of property for 1927 was $47,494,300. There are many old buildings of historic interest still standing in and near the city, including the Government house, built by the colonial proprietors in 1760; Franklin palace (1764–74), the home of William Franklin, a natural son of Benjamin Franklin and the last royal governor of New Jersey; the Barracks (1759); the Parker house (1729), a Loyalist centre during the Revolution; and Kearney cottage (1730), the home of "Madam Scriblerus." Perth Amboy was founded in 1683 and incorporated as a city in 1718. At first it was called by the Indian name Amboy, but the proprietors named it Perth, after one of their number, the Earl of Perth, and later the two names were combined. From

1686 until the end of the proprietary government in 1702 it was the capital of East Jersey and under the royal government it alternated with Burlington as the seat of government.

PERTHES, JOHANN GEORG JUSTUS (1749–1816), German publisher, was born at Rudolstadt on Sept. 11, 1749. In 1785 he founded at Gotha the business which bears his name (Justus Perthes). In this he was joined in 1814 by his son Wilhelm (1793–1853). On the death of Justus at Gotha on May 2, 1816, Wilhelm took entire control of the firm He laid the foundation of the geographical branch of the business by publishing the *Hand-atlas* (1817–23) of Adolf Stieler. The business passed to his son Bernard Wilhelm Perthes (1821–57), who was then associated with August Petermann and Bruno Hassenstein (1839–1902); and subsequently to his son Bernard (1857–1919). In 1863 the firm first issued the *Almanach de Gotha,* a statistical, historical and genealogical annual (in French) of the various countries of the world; and in 1866 the elaborate *Geographisches Jahrbuch* was produced under the editorship of Ernst Behm (1830–84), on whose death it was continued under that of Prof. Hermann Wagner. A new edition of Stieler's atlas (ed. H. Haack) was published in 1925.

PERTHSHIRE, inland county, Scotland, bounded north by the shires of Inverness and Aberdeen; east by Angus; south-east by the Firth of Tay and the counties of Fife and Kinross; south by the shires of Clackmannan and Stirling; south-west by the counties of Stirling and Dumbarton; west by Argyllshire and north-west by Inverness-shire. It is the fourth largest county in Scotland, having an area of 1,595,802 ac. (excluding water). By far the greater part is mountainous belonging to the highland area of Dalradian schists and metamorphosed rocks, with granite masses and numerous volcanic dikes. Including the hills on the confines of Inverness-shire and Argyllshire, there are at least 50 mountains exceeding 3,000 ft. in height. Of these the most familiar are Ben Lawers (3,984 ft.) near Loch Tay, Ben More (3,843) east of Crianlarich, Ben Lui (3,708) on the Argyllshire border, Schiehallion (3,547) south of Loch Rannoch, Ben Vannoch (3,125) west of Loch Lyon, and Ben Chonzie (3,048) near the head of Glen Almond. Of the immense number of hills of lesser altitude there may be mentioned four made famous through the *Lady of the Lake*—Ben Ledi (2,875) and Uam Var (2,179) near Callander, and Ben Venue (2,393) and Ben A'an (1,750), guardians of the Trossachs. The rocks of most of the remainder of the county are of Old Red Sandstone age, this formation being cut off from the Dalradian schists by the great fault which crosses the, county north of Aberfoyle and Crieff. The Ochils divide Perthshire from the shires of Clackmannan, Kinross and Fife

The chief river is the Tay, which rises on the Argyllshire frontier and discharges into the North sea off Buddon Ness, after a course of 117 m , being thus the longest river in Scotland. Its head-waters are the Fillan and Dochart, and among its affluents are, on the right, the Bran, Almond and Earn and, on the left, the Lyon, Tummel, rising in Argyllshire and receiving the Garry on its left, and Isla. The Earn flows out of Loch Earn and enters the Firth of Tay 6½ m. below Perth. The Forth, the principal natural boundary of the shire on the south, properly belongs to Stirlingshire, in which it rises, but its leading left-hand affluents are Perthshire rivers, namely, the Teith, the Goodie, issuing from the lake of Menteith, and the Allan, rising in the Ochils near Sheriffmuir.

All the lakes are narrow, scarcely one exceeding a mile in width. Loch Ericht, belonging partly to Inverness-shire, is 14½ m. long. Loch Tay (14½ m. long), situated about the centre, is the largest lake in the county. In the south are the series of lakes which the *Lady of the Lake* has rendered famous—Loch Vennachar (4½ m. long), Loch Achray (1¼ m. long), Loch Katrine (about 8 m. long); to the west of Aberfoyle is Loch Ard (3 m. long) and to the east Lake Menteith (1½ m. long). Nearly all the glens possess striking natural features, among them, from south to north, being Glens Artney, Almond, Dochart, Ogle, Lochay, Lyon, Garry, Shee, Bruar and Tilt; while the Trossachs, Killiecrankie, Birnam and Leny are the loveliest passes in the Highlands. The low-lying country is represented mainly by Strathmore, Strath Gartney, Strathallan, noted for its annual "gathering" or games, Strathearn, Strath Bran, Strath Tay and Strath Fillan, but more particularly by the fertile alluvial belts of the Carse of Gowrie, a raised marine platform on the northern shore of the Firth of Tay and the Carse of Stirling.

Agriculture and Industries.—The arable land is chiefly in the drier regions of the east and south-east, the soil for the most part being fertile. Light soils prevail in the lower undulating districts; clay and alluvial land occur in the Carse of Gowrie, the Carse of Stirling and the lower reach of Strathearn below and above Bridge of Earn. The best heavy carse land is very rich and productive, but requires to be thoroughly worked, limed and manured, being well adapted for wheat. The number of holdings is slightly in excess of 4,000 and of these over one-third are under 50 ac. each. Perthshire, with Argyllshire, carries the heaviest flocks of sheep in Scotland. Blackfaced is the principal breed in the Grampians, but there is also a large number of Cheviots and South Downs. In Breadalbane and Menteith there are remains of the ancient Caledonian forest, but little of the county is under wood, though considerable afforestation was carried out during the 19th century by large landowners. The lochs and rivers abound with salmon and trout, while hardly any of the streams have suffered pollution from industries or manufactures. The deer forests, of which the four largest cover some 90,000 ac , are frequented by red deer and roe deer, and on the extensive moors and in the woods are found grouse, pheasants, partridge, capercailzie, woodcock, ptarmigan and hares.

The shire is famous for its dyeing and bleaching works, which are situated in Perth and its vicinity; but, apart from these, there are flax and jute mills at Rattray and Blairgowrie, and cotton mills at Stanley, Deanston and Crieff; woollens, linen, jute and tartans are woven at Dunblane, Alyth, Coupar-Angus, Auchterarder and Crieff.

The L M S railway main line to Aberdeen enters the county near Dunblane and runs in a north-easterly direction via Perth. At Crieff junction it sends off a branch to Crieff and at Perth branches to Dundee and Lochearnhead. The Stirling to Oban line of the same company crosses the shire from Dunblane to Tyndrum. The main line to Inverness runs northwards from Perth, and has a branch at Ballinluig to Aberfeldy. Branches of the L N E railway reach Perth from Mawcarse in Kinross-shire and Ladybank in Fifeshire, and Aberfoyle from Buchlyvie, part of the branch from Buchlyvie on the Forth and Clyde line runs to Aberfoyle. The West Highland branch skirts the west of the shire.

In 1921 the population was 125,503; 16 persons spoke Gaelic only. The chief towns are Perth (pop. 33,208), Crieff (5,877), Blairgowrie (3,072), Dunblane (2,931), Auchterarder (2,263), Coupar-Angus (1,976), Rattray (1,740), Callander (1,874). Among lesser centres may be mentioned Aberfeldy (1,569), a favourite resort on the Tay, well known for the falls of Moness, mentioned in Robert Burns's song "The Birks of Aberfeldy"; Abernethy, the seat of an early bishopric, retaining one of the three ancient round towers in Scotland; Alyth (1,710), Comrie, a holiday resort on the Earn, and Pitlochry. Of old the county was divided into hereditary jurisdictions, which were abolished in 1748. The county forms a sheriffdom with a sheriff-substitute at Perth. For parliamentary purposes it is divided into an eastern and western division (the latter including Kinross). The shire is under school-board jurisdiction, and there are secondary schools at Perth and Crieff, and Trinity college in Glen Almond is a well-known public school on the English model.

History.—In 83 Agricola explored the lands beyond the Forth and in the following year penetrated to the Grampians, defeating the Caledonians under Galgacus with great slaughter. The site of this battle is disputed. The Romans did not pursue their victory, and the Picts were left undisturbed for a considerable period. At this time, according to Ptolemy, the territory now known as Perthshire was occupied by three tribes—the Damnonii, the Venicones and the Vacomagi. The growing lawlessness of the southern Picts and their frequent raids in the more settled country in the south at last compelled the attention of the emperor Severus. He arrived in Britain in 208, but though he led

a strong army to the shores of the Moray firth, he was unable effectually to subdue the tribesmen. The road he constructed ran from Stirling to Ardoch (where there are notable remains) and thence by Strageath, near Muthill, where it branched north-westwards to Dalginross and Buchanty, and north-eastwards to Perth and so to the Grampians.

When the Romans finally withdrew from Britain, the Picts established their capital first at Abernethy and then at Forteviot. Abernethy was the centre of the Celtic church after the conversion of the natives by Ninian, Palladius and other missionaries in the 5th and 6th centuries. On the burning of Forteviot by the Norsemen in the 8th century, the seat of Pictish government was removed to Scone. In the latter half of the 9th century Dunkeld—to which Kenneth Macalpine had brought some of the relics of Columba from Iona—became the scene of monastic activity, the abbot succeeding to the position of the abbot of Iona, and exercising great influence for nearly 100 years. The Danes periodically harried the land, but a crushing defeat at Luncarty in 961 put an end to their inroads in this quarter. In 1054 Macbeth was defeated at Dunsinane by Siward, earl of Northumberland, who had invaded Scotland in the interest of his kinsman, Duncan's son, who, on the death of the usurper three years later, ascended the throne as Malcolm III., called Canmore.

With Malcolm's accession the Celtic rule of the monarchy of Scone came to an end. Perth became the capital at the beginning of the 12th century; from that time the history of the shire is merged in that of the county town, with the exception of such isolated incidents as the removal of the Coronation Stone from Scone to Westminster in 1296, the defeat of Robert Bruce at Methven in 1306, the battle of Dupplin in 1332, the victory of Dundee at Killiecrankie in 1689 and the indecisive contest at Sheriffmuir in 1715. Among archaeological remains may be mentioned the hill-fort on Dunsinane; the ship-barrow of the vikings at Rattray, weems (or earth-houses) in the parishes of Monzie, Alyth and Bendochy; standing stones near Pitlochry, and an extraordinary assemblage of sculptured stones at Meigle.

PERTINAX, PUBLIUS HELVIUS (A.D. 126–193), Roman emperor, the son of a charcoal-burner, was born at Alba Pompeia in Liguria. From being a teacher of grammar he rose through many important offices, both civil and military, to the consulate, which he held twice. Chosen, at an advanced age and against his will, on Jan. 1, 193, to succeed Commodus, he was himself assassinated in a mutiny of the soldiers, on March 28, 193.

PERTZ, GEORG HEINRICH (1795–1876), German historian, was born at Hanover on March 28, 1795, and studied at Göttingen. Baron Stein engaged him in 1820 to edit the Carolingian chroniclers for the newly-founded Historical Society of Germany. After a prolonged tour through Germany and Italy in search of material Pertz was placed (1823) in charge of the publication of *Monumenta Germaniae historica*, texts of all the more important historical writers on German affairs down to the year 1500, as well as of laws, imperial and regal archives, and other valuable documents, such as letters, falling within this period. In 1823 he had been made secretary of the archives, and in 1827 principal keeper of the royal library at Hanover; from 1832 to 1837 he edited the *Hannoverische Zeitung*, and more than once sat as a representative in the Hanoverian second chamber. In 1842 he was called as chief librarian to Berlin, where he shortly afterwards was made a privy councillor and a member of the Academy of Sciences. He resigned all his appointments in 1874, and on Oct. 7, 1876, died at Munich.

The *Monumenta* began to appear in 1826, and at the date of his resignation 24 volumes folio (*Scriptores, Leges, Diplomata*) had appeared. This work for the first time made possible the existence of the modern school of scientific historians of mediaeval Germany. In connection with the *Monumenta* Pertz also began the publication of a selection of sources in octavo form, the *Scriptores rerum germanicarum in usum scholarum;* among his other works are an edition of Leibnitz, and a life of Stein (*Leben des Ministers Freiherrn vom Stein* (6 vols., 1849–1855); also, in an abridged form, *Aus Steins Leben* (2 vols., 1856).

PERU, a republic on the Pacific coast of South America. It extends in a general south-easterly direction from 3° 16′ S. to 18° S., with a sea-coast of more than 1,400 miles. Its area is estimated at 522,689 sq.m., an approximate figure, however, since much disputed territory is occupied by neighbouring States, with boundaries as yet undetermined.

Boundaries.—Beginning at the Estero de Machala on the Pacific (3° 16′ S.), the boundary with Ecuador runs south to the Chira river, then east to the confluence of the Canchis and Chinchipe. So much is agreed upon. From the Chinchipe, pending settlement of the dispute with Ecuador, Peru still claims all the territory east of the cordillera as far north as the boundary which has now been established between Peru and Colombia. In a treaty of 1922, ratified by Colombia in 1925, and by Peru in 1927, those countries came to an agreement. Their common boundary now runs from the confluence of the Cuembi with the Putumayo down the Putumayo to the mouth of the Yahuas; thence by a straight line to the mouth of the Atacuari in the Amazon; and from there down the main channel of the Amazon to the Brazilian boundary. By this treaty, the Apaporis-Tabatinga line, defined by treaty in 1851 as the boundary between Brazil and Peru, is now part of Colombia's boundary with Brazil. Furthermore, Colombia is given a corridor to the Amazon (the area between the Yahuas-Atacuari and the Apaporis-Tabatinga line) and has been guaranteed freedom of navigation in perpetuity on that river. The Peruvian frontier from Tabatinga on the Amazon is fixed. It ascends the Yavarí to its source, running south along the divide between tributaries of the Ucayali and those of the Yuruá to 9° 24′ 36″ S., where it crosses the Yuruá, thence to the Purús, which it crosses at the mouth of the Santa Rosa, running south, then east, to the source of the Acre and following it to the Yaverija. Boundaries between Brazil, Peru and Bolivia were defined in this region by the treaty of Sept. 8, 1909. From the junction of Acre and Yaverija the boundary runs south-east to the junction of the Heath with the Madre de Dios. It ascends the Heath in a southerly direction to its source, continuing by an irregular line to the shore line of Lake Titicaca, crossing the lake in a south-easterly direction to the Desaguadero. From this point south to the Chilean frontier the boundary between Peru and Bolivia is undemarcated. The *de facto* boundary with Chile is the Sama river in the department of Tacna. (*See* TACNA-ARICA.)

GENERAL VIEW SHOWING A STREET IN THE BUSINESS DISTRICT OF LIMA

Description.—Peru is traversed throughout its length by the Cordillera de los Andes, which runs roughly north-north-west and south-south-east, dividing the country longitudinally into three sharply contrasted regions: (1) coastal zone, 50–100 m. wide by over 1,400 m. long; (2) mountainous areas (*sierra*) consisting of stupendous chains commonly called cordilleras, high plateaux and deep, narrow valleys; (3) and beyond the *sierra*, heavily forested slopes which lead to the vast, low-lying Amazonian plains (*montaña*). The coastal zone of hills and plains is crossed by about 50 intermittent streams. South of Punta Pariñas it is a desert, except for irrigated valleys. Imperceptibly this zone merges with the foot-hills and spurs of the cordillera. A transition zone, without clearly defined boundaries, is called Las Cabezas de los

Valles (valley-heads), where, in steep-sided, dry, stony *quebradas* (gorges), the stream-beds narrow as they steepen. Most of the streams shrivel as they approach the coast, because of evaporation and loss of water by irrigation.

The *sierra* extends from the lower limit of summer rains on the west to the upper limit of tropical forest on the east. It is approximately 200 m. wide at the south, and less than half that at the north. On the east is the Cordillera Oriental, on the west the Cordillera Occidental, the continental divide. No other mountains are continuously so lofty (some over 20,000 ft.) near a coast which drops off to such abyssal depths (20,000 ft.). The highest peaks are covered with perpetual snow. Wide undulating plateaux with a mean altitude of about 12,000 ft. between eastern and western cordilleras are called *puna* in the south, and *jalca* north of 8° S. Longitudinal valleys with their tributaries make a labyrinth of ramifying wild gorges on an immense scale.

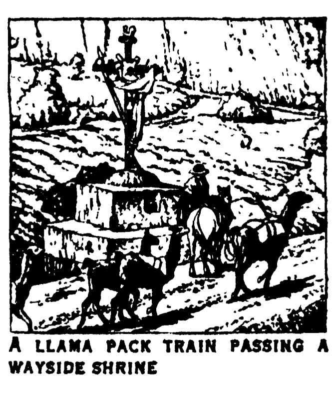
Between *sierra* and *montaña* lies a second transitional zone, *ceja de la montaña* (eye-brow of the *montaña*). The contrast between *sierra* and *montaña* on the east, in rock structure, topography, climate and vegetation is one of the most abrupt and spectacular on earth. The *sierra* is dry and cold. The *montaña* is covered with tropical forest, impenetrable except for rivers and a few short trails to gold or rubber camps.

Geology.—The conception of the structural geology of the Andes has been revolutionized during the past few years. Instead of the notion of three separate, structurally unlike chains, Oriental, Central and Occidental, of which the eastern was the oldest, the Andes of Peru are now considered a single broad plateau, a peneplain uplifted to 13,000–15,000 ft., whose original character has been largely destroyed by erosion. Deep canyons cut by streams tributary to the Amazon divide the plateau in a general way into three longitudinal strips, designated in the past as Eastern, Central and Western Cordilleras, and still popularly so-called. Crest-lines and major valleys trend with the axes of the mountain folds, showing that the streams follow broader structural depressions and that residual mountain masses survived because of greater resistance. Isolated volcanic peaks in southern Peru are not survivals, but are superimposed on the plateau surface. Erosion of these peaks has played an important part in levelling mountain basins, many of which are the result of drop-faulting accompanying the general elevation. The Cordillera Oriental has a central core of granite and gneiss, flanked by shales, slates and schists, with infolded limestones and sandstones. The surface of the plateau, where not covered by volcanic extrusives or alluvium, is sedimentary, largely limestone and sandstone deposits dipping west. The same formations in the Cordillera Occidental have been so deformed and metamorphosed by igneous intrusions, andesite, porphyry and diorite, as to be almost unrecognizable. In places they are covered by volcanic lavas and ash, and are much dissected by entrenched streams. The coast area consists of sedimentaries and late volcanic products; most traces of sub-strata are obscured except in river valleys. The maturely dissected coast range between 14° and 16° S. is composed of granitic rock of uncertain age. Other outcrops exist at frequent intervals along the coast. As the zone has been recently uplifted, the sea-cliffs are largely composed of stratified conglomerate, sands and clays, with broken shells and detrital material from igneous rocks interbedded with sand. The eastern lowlands do not resemble the structure of adjacent mountains, being unlike the western lowlands in this respect. The foot-hills are composed of upturned beds of sandstone rising above the level of the plain. Surface conglomerates are somewhat dissected and covered by present river gravels (*see* ANDES).

Coast Zone.—The coast zone varies in width and topography. At the north it is a plain more than 100 m. wide, gently sloping toward the sea, where it terminates in a bluff. At the south it is a more elevated plain, separated from the coast by a range of low hills, differing in topography and climate from the rest of the coast. Here fog prevails much of the year, causing intermittent vegetation, enough at times for pasture. Though excellent crops, such as olives and grapes, are raised in the deeply entrenched valleys, comparatively little is exported, as there are few ports. Mollendo, the largest, serves only the *sierra*. Valleys north of Lima are given over to industrial crops, mostly sugar and cotton. They monopolize the water, have eliminated food crops and restricted pasture. Dispossessed Indians take refuge in the valley-heads. Valleys near Lima are intensively cultivated in order to supply the capital with food; its white towers are surrounded by market-gardens and plains of alfalfa with grazing cattle. The coastline is remarkably straight, usually steep, with occasional stretches of beach and but few real harbours; those which are most sheltered are too shallow or too far from productive areas. A thick mantle of wind-blown sand covers the desert surface, forming in some localities crescent-shaped sand-dunes (*médanos*). The islets are barren and rocky. From north to south the more important are Lobos de Tierra and Lobos de Afuera; San Lorenzo (1,050 ft. high, 1 by 4½ m. in extent), which protects the harbour of Callao, and near Pisco bay rugged San Gallán and the three Chincha islands, famous for their guano.

Sierra.—The southern Cordillera Oriental, a grandiose wilderness of craggy peaks and ridges, mostly snow-covered, loses its high-mountain character north of Cerro de Pasco; the extensive *puna* has no parallel in the north, and the volcanic cones of the Cordillera Occidental, so marked a topographical feature in the south, are entirely absent north of Lima.

Sections of the *sierra* may be briefly summarized as follows: In southern Peru the *puna*, or *altiplano*, is overshadowed on the east by the Cordillera Oriental (Real) and on the west by the Cordillera Occidental. It is a vast intermontane basin, roughly 500 by 100 m., sloping gently to the south, very high, cold and dry. Upon it, ranges of low hills alternate with alluvial tracts, salt swamps and many lakes, the largest of which is Titicaca. At an altitude of 12,466 ft., Lake Titicaca is 130 by 41 m., with an average depth of 100 ft. (maximum about 1,000 ft.). Well defined on the east, the bordering scarps of this great tectonic depression are concealed on the west by thick lava-flows. Near the lake, crops of barley, *quinoa* and potatoes are grown, while the western part of the plain is pastoral, covered with grass and occasional stretches of bushy growth. Puno is the only large town. Seen from the western slopes of the Cordillera Occidental, the even sky line of the lava plateau is broken by a series of volcanic peaks, some eroded, some symmetrical. They are isolated, snow-capped, dormant or extinct, 19,000 to 20,000 ft. in height (Coropuna, 21,703 ft.). Earthquakes are frequent throughout this area. The bordering scarps of the *altiplano* converge on the north at the Nudo de Vilcanota (14° 26′ S.). In the valley of the Huatanay, 11,000 ft. high, is the ancient city of Cuzco. In this beautiful, luxuriant valley enclosed by mountains the Incas founded their great empire. Between 12° and 14° S. the heart of the *sierra* is a wilderness of gorges with cliffed sides, some over 6,000 ft. deep. Into these it is usually impossible to descend. The valley of the Apurimac is spectacular, its highly-coloured walls with tufts of cactus reaching from fever-ridden floor to snowy peaks. Between 10° and 12° S. the *puna* is called the Pampa of Junín. It has many lakes, the largest of which is Lake Junín (Chinchaicocha), 20 by 7 m., altitude 13,415 ft. From it the Mantaro flows south across the plain—a deep, silent, swift-flowing stream. The chief activities in Junín are mining and pastoral, the only crops, potatoes and *quinoa*. North of the Pampa of Junín is the Cordillera de Huayhuash as the Nudo de Cerro de Pasco is now called, a desolate mining region. North of this, the western chain is divided in two Cordillera Negra, toward the west, and Cordillera Blanca, so called because of its snow-caps. The latter (8° 43′ and 9° 53′ S.) is about 70 m. long, its average height 15,000 ft., and its highest peak, Huascarán (22,180 ft.), a laccolith of granodiorite. Inhabitants are few, Indians living on slopes and valley moraines in



A LLAMA PACK TRAIN PASSING A WAYSIDE SHRINE

small groups of huts like animal burrows. The Cordillera Negra (8° 43′ S. and 10° 11′ S.) is about 100 m. long and about 14,000 ft. high (maximum 16,000 ft.). The bare, dark-grey rocks and even skyline contrast with the sharp peaks of the Cordillera Blanca. It is an unbroken wall without practicable passes. Between the two ranges lies the fertile valley of the Huaráz, averaging 25 m. in width, one of the most thickly settled parts of the *sierra*. The river flows north through a series of basins each with its town—Recuay, Huaráz, Yungay, Caráz, Huaylas, strung like beads upon a thread, responding to the presence of good soil, water and favourable climate. Temperate zone crops are raised in upper reaches of the valley and tropical in the lower, known as the Callejón de Huaylas. At 8° 40′ S., the Huaráz, now called Santa, cuts the Cordillera Negra at right angles and crosses the desert to the Pacific. Two great rivers. Marañón and Huallaga, rise on the northern slopes of the Cordillera de Huayhuash. The valley of the Marañón, 500 m long, (4° 30′–10° 20′ S.) and for most of that distance more than a mile deep, is east of the Cordillera Blanca and parallel to it. In the rainy season the Marañón is impassable. It cuts the Cordillera Oriental at the Pongo de Manseriche (4° 25′ S.) and flows toward the Atlantic. The valley of the Huallaga, farther east than the Marañón, is more open and populated Huánuco, in the upper valley, communicates by a good road with Cerro de Pasco. The Huallaga cuts the eastern chain at the Pongo de Aguirre (6° 30′ S.). North of 8° S the cordilleras gradually subside. There are no more snowy peaks The *jalca*, 7,000 to 9,000 ft. high, is covered by dense steppe vegetation with little seasonal variation, and much dissected by youthful valleys, some being canyons with vertical walls and narrow floors The ancient town of Cajamarca is the agricultural centre of the northern *sierra*

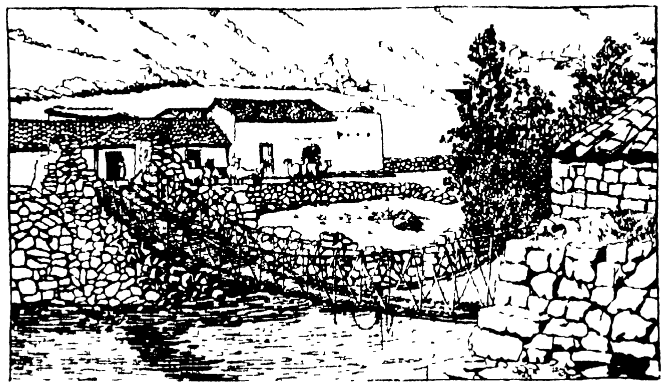
Throughout the length of the Peruvian Andes there are 27 practicable passes, most of which are over 12,000 ft high The highest in use, between Antabamba and Cotahuasi, is 17,400 ft., the lowest in the far north at Huarmaca (Piura), 7,085 ft. high

Montaña.—The heavy precipitation on the eastern slopes of the eastern cordillera results in some of the profoundest erosion in progress to-day The soil on the valley bottoms is a rich, alluvial fill, adapted to tropical crops Sides of lower valleys, as well as slopes of mountains and foot-hills, are covered with impenetrable forest shrouded in mist

The steaming equatorial basin below is an endless blue-green lowland with ranges of low hills, and here and there a glimpse of the windings of shining rivers which disappear in the mists of the horizon These plains at the foot of the Cordillera Oriental are less than 1,000 ft. above the sea, usually much less Topographically Amazonia is monotonous but botanically it is most diversified.

Climate.—Though there are three major climatic controls in Peru, latitude, ocean and the Cordillera de los Andes, the last is by far the most important. Change of climate is sought not by travelling north and south, but up and down, from west to east A frigid zone can be reached in a few hours of ascent from tropical lowlands. Rainfall, which is heavy on the east, increases up to a certain height, decreasing from east to west across the *sierra*. The south-east trades sweep across the warm lowlands of Amazonia, filled with moisture. Confronted by the Andes, they are forced to rise, are chilled and heavy rains result The annual rainfall on the lower eastern slopes of the Peruvian Andes is 150 in or more Swollen streams give rise to the world's greatest river-system The trades cross the mountains and in descending do not again reach sea-level until 50 to 100 m off shore. The Humboldt or Peruvian current, a mass of cold water about 150 m. wide, sweeping up from the south along the coast brings cool, moist south and south-west winds, which, meeting the warm air over the land, cause fogs (*garúas*) along the southern coast. They are about 1,500 ft. thick and extend about 5 to 15 m. inland. North of 8° S. there are none whatever, but a summer rainfall of a few inches occurs every few years, as in 1925. There are no electrical storms on the coast.

Climatic provinces are distinguished chiefly by variations in rainfall. From east to west, *montaña* and *ceja de la montaña* have precipitation throughout the year, heaviest in summer. *Sierra* rainfall, confined to summer, diminishes both in quantity and in length of season toward the south. The rainfall of the higher western slopes resembles that of the *sierra*, the amount of precipitation diminishing with altitude, disappearing entirely at altitudes which vary with latitude and exposure. (1) The immedi-



ANCIENT SUSPENSION BRIDGE OF NATIVE CONSTRUCTION IN CENTRAL PERU. A HERD OF LLAMAS IS STANDING ON THE FARTHER SIDE

ate coast zone, though desert, has a cool, damp climate with small annual and diurnal variability Mean annual temperatures at the north average about 10° F warmer than those at the south (Paita 75° F, Mollendo 65° F). The western slopes below 4 to 6,000 ft, though averaging about the same, have greater diurnal ranges of temperature This uniformity, interrupted by no storms and no sudden changes of temperature, is very monotonous, especially since the skies, as far north as 8° S, are covered with clouds during more than half the year, though the total annual rainfall is under 2 inches. (2) The summer-rain zone is an extremely complex province. It includes, besides the western slopes above the rainless zone already described, the summit region above 15,000 ft., desolate, high plateaux, intermont basins and deep canyons, whose climates range from equatorial to frigid Climates in Peru depend primarily on altitude, deep valleys are tropical to semi-tropical, depending on depth, valley-trend, slope and exposure Mean annual *puna* temperature averages about 50° F, with greater diurnal than annual range With an average relative humidity of 50%, the mean annual rainfall is 25 in at the south, where it is confined to summer, reaching 40 in in the north, where precipitation occurs in spring, summer and autumn, overlapping the equatorial rainfall type Snowfall occurs south of about 7° S above 12,000 to 13,000 feet. Because of aridity the snow-line is very high. Heat in deep *sierra* valleys is so great and rainfall so slight, that often the narrow floors are semi-desert; while 4,000 to 6,000 ft above those same floors rainfall may exceed 80 inches Similarly, high-level basin stations have less rainfall than surrounding mountains, and irrigation is often necessary. (3) Maximum rainfall is on the eastern slopes between 4,000 and 8,000 ft elevation. Rainfall may be different on opposite sides of a single valley, so that the eastern walls may be grassy, the western forest-covered It probably averages 150 in or more, except where the slopes are protected by foot-hills The mean annual temperature is about 72° to 75° F, with a negligible range (4) Constant evaporation takes place above the great Amazonian wilderness (the area of which equals half that of Europe) and this moisture is again precipitated, to be once more vaporized and condensed With two permanent lows, one near the mouth of the Amazon, into which both north-east and south-east trades flow, and one near the boundary between Bolivia and Argentina, excessively high relative humidity is maintained throughout the year. It is so great that salt dissolves and matches will not ignite unless kept in air-tight boxes Rainfall averages well over 100 in. with winter minimum. The mean annual temperature probably averages 78° F, with a range of 3° F

Hydrography.—The Cordillera supplies three systems of drainage. The first flows toward the Pacific, the largest of these streams (Santa) is the only one to cross the Cordillera Occidental

The second flows toward the Atlantic, including such vast tributaries of the Amazon as Marañón, Huallaga, Mantaro and Apurimac. These clear, quick-flowing streams pass through narrow *pongos* (gateways) and then join the sluggish jungle streams of Amazonia, whose branches spread out over half a continent before reaching the Atlantic, nearly 3,000 miles away. The third is that of Lake Titicaca, an inland system, complete in itself, fed by perpetual snow. *Via* the Desaguadero river, a shallow stream, it empties into Lake Aullagas (Poopó), thence into a series of *salars* (salt swamps) to the south, where its waters eventually evaporate.

Flora and Fauna.—The coast desert seems to be without vegetation except cacti, *Furcraea* and occasional clumps of gnarled *algarroba* trees (*Prosopis juliflora*), the sweet pods of which are used for cattle food. South of 8° S., however, *garúas* are followed by a sparse, fugitive plant cover upon the hills. It springs up as if by magic, growing more luxuriant up to about 3,000 ft., following the mists so closely that it indicates the limit of their distribution. On the other hand, all streams are lined with vegetation—acacia, willow, pacay, pepper-trees, thorny Leguminosae, bushes and tall reeds. Where irrigation is possible there are crops and orchards including such delicious native fruits as *chirimoya* (*Anona cherimolia*), and *palta* (*Persea gratissima*).

The fauna of the coast zone is poor, consisting of rodents, armadillos, bats, scorpions, lizards and poisonous vipers in the sugar fields. There are owls, vultures and birds of prey. Otters live in some of the streams. In contrast is the teeming ocean which abounds in fish and bird life.

In the valleys of the western slopes, xerophytic vegetation may reach as high as 10,000 ft. with geranium, heliotrope, floripondio, fruit trees and temperate zone crops, where irrigated. The zone of seasonal grass-steppe and small perennial plants begins at about 8,000 feet. Above 12,000 ft., the treeless *puna* has hard grasses, mostly *ichu* (*Stipa jarava*). Clumps of *yareta* (*Bolax globaria*) are used as fuel. On low-lying damp lands, distichia moors form a continuous carpet. Lichens and mosses and some Compositae climb to 16,000 feet. Near Lake Titicaca grows the *totora* (*Scirpus riparius*), reeds which in bundles serve to make boats for the Indians. This bleak height is the original home of the potato, *oca* (*Oxalis tuberosa*), *ulluco* (*Ullucus tuberosus*), and *quinoa* (*Chenopodium quinoa*), a grain peculiar to Peru, which heads at high altitudes, and is a staple Indian diet. Barley is the only other cereal which will head at these altitudes. In valleys there is elder, alder and *Cantua buxifolia*, the *cantu* shrub of the Incas, with leathery leaves and large red flowers. There are great stands of *queñuar* (*Polylepis racemosa*), gnarled old evergreen trees 15 to 20 ft. high, and *quisuar* (*Buddleia incana*) on the valley walls, together with a fibrous plant 12 to 18 ft. high, (*Pourretia gigantea*), of which the prickly leaves and thorns are the bane of shepherds. If deep enough, the valley floors have xerophytic vegetation like that of coast valleys (Marañon). Tropical crops are grown in lower valleys, sugar up to about 6,000 feet.

The Camelidae are the most important animals of the *sierra*, llamas, alpacas, huanacos and vicuñas. Two rodents, viscacha and chinchilla live among the rocks. There are quantities of water and game-birds on the clear lakes and several species of fish. The condor (*Sarcoramphus gryphus*) is seen in the loneliest places.

The tropical rain-forest of the *montaña* extends up the eastern slopes to 8,000 ft. or more, even crossing the divide north of 8° S. It is a dense mass of vegetation, with occasional openings of soft, short grass which increase in extent above 6,000 feet. Nowhere is nature more prodigal. Cabinetwoods, dyes, aromatic plants and spices, rubber, vegetable-ivory—the list of beneficent plants is inexhaustible. Animal life is identical with that of Brazilian Amazonia. (*See* AMAZON: *Flora and Fauna.*)

Population.—Though the exact population of Peru is unknown, it is estimated at 5,000,000. More than half are *sierra* Indians, and of the rest, the majority are half-breeds (*mestizos*), the others, whites, negroes and Asiatics. The original Spanish stock numbers less than 500,000, mostly members of the governing and professional classes. There are three types of Indians, *Quechua*, (the majority), *Colla* or *Aymará* (in the Titicaca basin), and *Chuncho*. The *sierra* Indian is very strong, silent and apathetic and stolidly endures hardship. He resists cold and is able to carry great weights for long distances. His homespun clothing has altered little since the conquest. His house is a thatched stone hut with a door for its only opening. His food is dried mutton, salt beef or llama meat, maize, *oca*, frozen potatoes and cakes of *quinoa*. The universal beverage is maize *chicha*. His implements are few and simple. Only *coca* and alcohol induce him to toil for more than bare necessities. His occupations are live stock raising, primitive agriculture, mining and driving pack-trains. He travels day and night, if necessary, following his flock of llamas with hoarse cries, throwing his sling, climbing rocks, fording streams, crossing the puna, sleeping anywhere at night in spite of snow and hail-storms. The life of an Indian consists of two parts, drudgery and orgies on feast days. Indians of the *montaña* (*Chunchos*), divided into scores of tribes speaking as many languages, differ greatly in habits and customs. These tribes, isolated and independent, are all in a low state of culture (*see* BRAZIL). Coast Indians, mostly half-breeds, have special terms for all degrees of colour and race. Negroes, introduced as agricultural slaves shortly after the conquest, live only on the coast. They were emancipated in 1855. The first Chinese coolies were brought under contract for the extraction of guano in 1849. Most of them went to the Chincha islands, and after the guano boom subsided, became agricultural labourers, or artisans and small shopkeepers. In Lima there is also a Japanese colony; about 2,000 arrived in 1926–27. Foreign population is chiefly concentrated in Lima and Callao. Several hundred eligible colonists arrived in the eastern valleys in 1926–27, mostly Poles. Spanish is the official language of Peru.

SIERRA INDIAN BEFORE THE DOOR OF HIS THATCHED STONE HUT

Public Health.—Common diseases are malaria, tuberculosis and bubonic plague. Permanent commissions for the study of malaria and tuberculosis were appointed by the Government in 1926. Yellow fever, which used to sweep the coast, has been stamped out, largely by the efforts of the International Health Board of the Rockefeller Foundation. The source of *verruga peruana* (Carrion's disease), peculiar to Peru on the upper, western slopes of the cordillera, has been traced. Hospitals can accommodate only a fraction of the ill. The Government is constructing hospitals, prisons, markets and other public buildings. A most comprehensive undertaking is that of city sanitation. Thirty-two cities are being supplied with water and sewage systems.

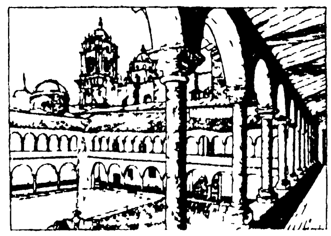
Education.—A new education law was put into effect in 1921. Primary instruction, which is free and compulsory between the ages of 6 and 14, covers 5 years. Vocational training is given in both common and special schools. In 1926, 262,267 pupils were enrolled in 3,330 public primary schools, with 5,487 teachers. Secondary schools (*colegios nacionales*) have an attendance of about 5,326. Convent instruction is traditional for girls. In spite of an excellent system, there is still much illiteracy.

There are four universities, of which the largest and most famous is the Universidad Mayor de San Marcos in Lima. It was founded by a grant from Charles V. in 1551, and is the oldest university in the New World. The University of Cuzco was founded in 1598, Arequipa in 1821 and Trujillo in 1824. There are about 2,000 university students.

A School of Civil and Mining Engineering was established at Lima in 1876. There are in addition, military, naval, agricultural and commercial schools and several agricultural experimental stations. The Government maintains academies of medicine, music and the fine arts, a national museum, national archives, meteorological and magnetic observatories and many learned scientific bodies. The national library, founded in 1821, was pillaged

by Chileans during the War of the Pacific. After the evacuation of Lima by Chile, Ricardo Palma devoted his life to the recovery of the scattered books and manuscripts. The Geographical Society of Lima (1888), is the chief centre of scientific study, while the Historical Institute of Peru (1905) and the Athenaeum (1877) are also important organizations (*see* LIMA).

Science and Literature.—Peruvian literature does not antedate the Spanish conquest. The Quechua drama, *Ollanta,* which purports to be pre-Spanish, was really written about 1770. The earliest accounts of Peru and its inhabitants were chronicles written by eye-witnesses. Chief among them are the *Comentarios reales* by Garcilaso de la Vega (1539–1616), whose mother was of the Inca blood-royal, *Crónica del Perú* by P. de Cieza de León (1553) and *Historia natural y moral de las Indias* (1590), by José de Acosta Several chronicles, including the *Royal Commentaries,* have been translated into English by Sir Clements R. Markham, and published by the Hakluyt Society of London The bulk of 17th and 18th century literature is history, accounts of exploration or raids of British pirates Many scientific investigations during the last half of the 18th century are embodied in *El Mercurio Peruano,* a periodical founded by Hipólito Unánue in 1791 Dr Unánue wrote a book on the climate of Lima, founded the *Anfiteatro Anatómico* in 1792, and the Colegio de Medicina de San Fernando in 1811 The most prolific writer of the colonial period was Pedro de Peralta Barnuevo (1663–1743), who was not only poet-laureate of the viceroy, but wrote more than 60 astronomical and mathematical works. In the late 18th century there were many scribblers of light, humorous verse and pleasant romances; devotional writings in both verse and prose and dramas for instructional purposes Mariano Melgar (1791–1815) wrote plaintive love-songs and patriotic odes After Peruvian independence (1821), both science and literature gained new life Mariano Eduardo Rivero with J J. von Tschudi published *Antiguedades Peruanas* in 1851, one of the earliest scientific studies of pre-hispanic culture in Peru. *Geografía del Perú* by Mateo Paz Soldán appeared in 1862; his *Diccionario estadístico y geográfico del Perú* in 1877. The most important works during this period were those of the Italian savant, Antonio Raimondi (1825–90), embodied in *El Perú: estudios mineralógicos,* etc., Lima (1874–1902) and of Manuel de Mendiburu (1805–1885), *Diccionario histórico-biográfico del Perú* (1890)



COURTYARD OF THE UNIVERSITY AT CUZCO, AN INSTITUTION OF LEARNING FOUNDED IN 1598

Political satire in verse and prose, eulogies of liberty and odes to civilization characterized the literature of the revolution. About 1830 this artificiality gave way to romanticism. Felipe Pardo y Aliaga (1806–68) and Manuel Ascensio Segura (1805–71), who wrote comedies about the established order, are the founders of the national theatre. Among writers since their day three are pre-eminent. Ricardo Palma (1833–1919) recreated anecdotes of the colonial period in six volumes of *Tradiciones Peruanas,* a treasure house of Peruvian history and culture. Manuel Gonzáles Prada (1848–1918) was a poet, radical philosopher and essayist. José Santos Chocano (1875–), the poet, belongs to a new literary school. His inspiration is the geography, history, flora, fauna, legends and mythology of Peru. Literature since the declaration of the republic has been studied by José de la Riva Agüero in *Carácter de la literatura del Perú independiente* (1904) and by Ventura García Calderón in his anthology, *Del Romanticismo al Modernismo* (1910). Francisco García Calderón is internationally known for essays on contemporary history, philosophy and literature (*Le Pérou contemporain,* 1907, and *Démocraties latines de l'Amérique,* 1912). There is (1928) a host of younger writers in Peru, some of whom, like Luis Alberto Sánchez (1901–), have already attained fame. Among contemporary men of learning may be mentioned Julio C. Tello and Luis E. Valcarcel (archaeology); H. H. Urteaga and Carlos Wiesse (history); Victor M. Maúrtua (jurisprudence); Federico Villarreal (mathematics); and Oscar Miró Quesada (philosophy). A recently developed type of architecture (neo-Peruvian) combines Inca and Spanish colonial characteristics. There are several artists of international reputation, such as Carlos Bacaflor. Among composers, J. Valle-Riestra has written several operas, the most famous of which, *Ollantá,* was inspired by the Indian music of the *sierra.*

Religion.—The Roman Catholic Church is protected by the Government. There are ten dioceses: Lima, (an archbishopric), Arequipa, Puno, Cuzco, Ayacucho, Huánuco, Huaraz, Trujillo, Cajamarca and Chachapoyas Each diocese has its seminary for the education of the priesthood, that of Arequipa being renowned for its influence in church affairs The church owns 3,552 monasteries, churches, and other buildings. There is a Catholic university in Lima The city of Lima has produced two saints, St. Toribio, archbishop from 1578 to 1606, and Santa Rosa, patron of Lima (1586–1616) Nine strictly religious festivals are public holidays. There are Anglican Churches in Lima and other cities.

Political Divisions.—Under the Spaniards the country was divided into *intendencias,* renamed "departments" by the republic (1821). Departments are sub-divided into provinces, and provinces into districts. There are at present 20 departments (including Tacna Libre), two littoral provinces and the constitutional province of Callao. The departments, with their areas, capitals and estimated populations are as follows.—

Departments	Area square miles	Population estimated	Capitals
Amazonas	13,947	70,876	Chachapoyas
Ancachs	14,705	386,463	Huaráz
Apurimac	8,189	177,387	Abancay
Arequipa	21,052	229,007	Arequipa
Ayacucho	18,190	302 469	Ayacucho
Cajamarca	12,541	442,412	Cajamarca
Callao (province)	14	53,258	Callao
Cuzco	55,731	438,646	Cuzco
Huancavelica	8,300	223,796	Huancavelica
Huánuco	15,430	145,309	Huánuco
Ica	9,799	90,962	Ica
Junín	22,820	394,303	Cerro de Pasco
Lambayeque	4,615	124,091	Chiclayo
Libertad	10,209	250,931	Trujillo
Lima	15,052	423,729	Lima
Loreto	163,283	100,506	Iquitos
Madre de Dios	58,842	16,000	Maldonado
Moquegua (province)	5,550	42,604	Moquegua
Piura	15,239	213,909	Piura
Puno	26,140	537,345	Puno
San Martín	17,450	70,361	Moyobamba
Tacna Libre	3,100	15,700	
Tumbez (province)	1,501	8,602	Tumbez

Cities.—There are but five cities with over 15,000 inhabitants: Lima, Callao, Arequipa, Cuzco and Cerro de Pasco. On the coast, the largest settlements are not ports, but towns in the fertile valleys a few miles inland. Ports usually consist of offices and warehouses near the landing-stage on an open roadstead and a cluster of adobe houses. Towns in the *sierra* coincide with agriculturally productive areas, intermont basins (Cajamarca, Cuzco), or rich valleys (Huaráz, Huancavelica), except for mining communities In the *montaña* there are river ports, but only one town of importance (Iquitos). Towns are all built on the same plan—a quadrangular plaza surrounded by public buildings. The church is often a fine example of Spanish colonial architecture The condition of the plaza is an index of the prosperity of the community. Streets, crossed by others at right angles, extend from it in parallel lines. The houses, usually of adobe, are built around courts, and are one or two storeys high, the second with a balcony encircling the patio Windows overlooking the street are covered with iron grilles Flat roofs characteristic of the coast are replaced in the *sierra* by high-pitched tile roofs.

Communications.—At the fall of the Inca dynasty there were two longitudinal highways from Cuzco to Quito, each about 2,000 m. long, one in the *sierra,* one along the coast, and many cross-roads. But as these were destroyed or allowed to fall into decay

by the Spaniards, Peru has been for the last 400 years practically without roads. The programme of construction authorized by Congress in March 1920 is of first importance in a country where the natural resources of adjacent regions are so unlike that they are mutually dependent. This plan included the construction of two longitudinal trunk-lines, one in the *sierra*, one along the coast, and a series of cross-roads, thus reverting to the plan of the Incas. More than £P400,000 was voted for road construction in 1926, and £P700,000 in 1927. Every citizen must give direct or indirect road service. In 1926 there were 6,600 m. in use, and 5,398 m. under construction. The coast road from Zarumilla to Mollendo is actually in use throughout a distance of 1,500 m., including the environs of Lima, where more than 100 m. of modern asphalt and concrete paving has already been laid. The *sierra* road is much less advanced. Finished sections include those in the Huaráz valley, Huánuco to Huancayo and Pampas, and Cuzco to Desaguadero, more than 400 m. in all. Transverse roads ascending the rocky *quebradas* from the coast end either at *sierra* towns or cross to river ports of the *montaña*. Of the latter, the most important unites the port of Paita with Yurimaguas on the Huallaga, which is in constant communication with Iquitos and the Atlantic.

The first South American railway, between Lima and Callao, was opened in 1851, the first line of penetration, between Mollendo and Arequipa, in 1869. The next few years were the golden age of construction. The War of the Pacific put an end to this activity in 1879. In 1926, there were 2,523 m. of railways of various gauges, 80% of which were under the management of the Peruvian Corporation, Limited. The two most important systems are the Central (259 m.) and Southern (569 m.). The Central Railway runs from Callao to Oroya, thence south to Huancayo and Huancavelica. Between Lima and Oroya, there are 65 tunnels and 67 bridges and the divide is crossed at 15,665 feet. It is the highest standard-gauge railway in the world; its construction, begun by Meiggs, was a famous engineering feat. (*See* CERRO DE PASCO.) The Southern railway runs from Mollendo to Lake Titicaca, 326 m., and connects with steamers to Bolivia. The highest point is Crucero Alto (14,666 ft.). A branch from Juliaca runs to Cuzco (210 m.). The Peruvian Corporation operates several lines from seaports to towns a few miles inland. £P633,070 were spent on construction in 1926 as against £P484,900 in 1925. Power for electric traction and light for Lima is supplied by the Rimac.

The most important means of communication in the *montaña* is river transportation. There are 3,000 to 4,000 m. of navigable tributaries to the Amazon. The chief port is Iquitos on the Marañón, 2,653 m. from the Atlantic. Two British lines of steamers, the Booth and Red Cross lines, ply between Iquitos, England and New York. On the Huallaga is Yurimaguas, about 500 m. upstream from Iquitos, connected with it by a regular line of steamers. A railway from Yurimaguas to the Pacific coast is under contract. On Lake Titicaca steamers ply regularly between Puno and the Bolivian port of Huaqui, a distance of about 50 miles. This line is one of the highest in the world.

The Marconi Wireless Telegraph company administers (1928) the postal and telegraph services. The telegraph dates from 1864 and there are 10,557 m. of lines; but the cost of construction in the *sierra* is so great that the Government is substituting wireless telegraphy. First established in 1908, there are now about 15 stations. A national telephone company operates the system of Lima and surrounding districts, with about 8,000 telephones and about 11,000 m. of lines. There is an army air service and naval aviation service. Two submarine cables connect with London and New York. The Compañía Peruana de Vapores is the only national steamship line operating on the coast. The Peruvian merchant marine consisted in 1925 of 23,000 tons. There are ten first class ports: Talara, Lobitos, Paita, Pacasmayo, Pimentel, Salaverry, Callao, Pisco, Mollendo and Iquitos. Most importing is done through Callao (*q.v.*); but the petroleum port of Talara nearly equals it in exports. Several foreign steamship lines carry coastwise traffic. There are (1927) 21 lighthouses on the coast, five of which have a visibility of more than 20 m.

Commerce.—During the colonial period foreign trade was confined to Spain; export was mainly silver. After independence (1821), export of guano and nitrate became the chief source of revenue; from 1851–72, guano worth more than £75,000,000 was exported. The War of the Pacific took the nitrate provinces from Peru in 1879 and trade was paralysed. Until 1914 it recovered slowly. European demand for Peruvian products as a result of the World War brought a period of fresh prosperity. Large North American investments and Peru's need for manufactured products have increased trade with the United States. Countries whose trade with Peru amounted in 1926 to over £P1,000,000 are as follows:—

	Imports	Per cent of total imports	Exports	Per cent of total exports
	£P.		£P.	
United States	9,037,094	46·2	8,258,009	34·5
United Kingdom	3,052,752	15·6	6,841,246	28·5
Argentina	95,761	·5	2,641,401	11·0
Canada	212,570	1·1	1,375,029	5·7
Chile	427,466	2·2	1,992,206	8·3
Germany	1,927,319	9·9	384,707	1·6

While the total foreign trade in 1913 was £P6,088,777 (imports) and £P9,137,181 (exports); in 1927 it was £P18,735,421 (imports) and £P28,931,507 (exports). The chief exports of Peru are petroleum, cotton, sugar, copper, mineral concentrates, wool, silver, gold, hides and skins. Wild rubber, until recent years a large item of export, is now unimportant. The chief articles of export in 1926 were as follows: Petroleum and derivatives, 1,198,756 tons (£P7,421,128); cotton, 50,234 tons (£P4,593,939); copper, 44,805 tons (£P4,247,986); sugar, 329,779 tons (£P3,604,995). Imports are mostly machinery and manufactured goods from the United States and the United Kingdom, in 1926 those from the United States being nearly three times those from the United Kingdom, its nearest competitor. In 1926 the chief imports were cotton textiles, manufactured metal articles, wheat, lumber, agricultural and mining machinery and woollen textiles.

BY COURTESY OF THE MUSEUM OF THE UNIVERSITY OF PA.

INDIAN OF SOUTH-CENTRAL PERU GUARDING A FRAME ON WHICH BALATA (CHICKLE GUM) IS DRYING

Agriculture.—Under the Inca empire agriculture achieved a perfection never equalled since. During this period the potato was developed from the wild, bitter tuber, and other plants as well. Total lands cultivated at present are estimated at about 4,000,000 acres. The chief vegetable products are cotton and sugar. Cotton is indigenous and has been cultivated since pre-Columbian times. Most of the crop is grown in northern irrigated coast valleys: Peruvian cotton (*Gossypium Peruvianum*), full rough and semi-rough, grown in Peru only, chiefly in Piura; Egyptian (*Gossypium herbaceum*), the "upland cotton" of the United States; *mitafifi*, a variety of *Gossypium barbadense; tangüis*, a native blend of rough and smooth, which although of recent origin, now constitutes four-fifths of the entire crop. Production is steadily increasing, export having reached 8,000 tons in 1900 and 50,234 in 1926. Sugar-cane has been cultivated in Peru since 1545, total production, 375,963 tons in 1926. The principal centres of production are the valleys of Libertad and Lambayeque. About 50,000 tons of sugar and 6,000,000 litres of pure alcohol are consumed annually in Peru. Wheat has been grown in the *sierra* since the conquest; annual production averages 80,000 tons, about one-half national requirements. Rice was introduced in the colonial period and about 35,000 tons are produced annually. Maize is the staple food everywhere. There are many fruits, but beyond local market demands, their commercial production is limited to grapes and olives from southern coast valleys. Wheat, barley, oats, *quinoa*, alfalfa, maize, *oca* and potatoes are the principal *sierra* products. Potatoes and *quinoa* are the only crops above 13,000 feet. Cattle

have been raised ever since Spanish occupation. They are commonly small and hardy. Sheep are bred chiefly for their wool, and goats are raised for their skins and fat. Swine-breeding for lard is important in some coast valleys. Horses are bred on a small scale, also mules for mountain travel. The llama is used as a pack animal, and the alpaca for wool, hides and meat. Wild vicuña wool is highly prized and its export prohibited. The llama was the only beast of burden before the conquest and it is still indispensable on difficult trails. Most of the world supply of alpaca wool comes from Peru. The export of wool in 1926 was 4,161 tons, valued at £P518,192. *Montaña* and *ceja de la montaña* crops include sugar, tobacco, sweet potatoes, cacao, vanilla, coffee, bananas and yucca. The export of Peruvian bark (*Cinchona officinalis*) is no longer important. The Peruvian supply is practically exhausted by destructive methods employed in collecting the bark. Quinine, extracted from it, is now imported in manufactured form. Coca (*Erythroxylon coca*) is a product peculiar to the eastern slopes of Bolivia and Peru; it is a medium of exchange in the *sierra*, the Indian's cure-all. By masticating the leaves he is able to perform incredible tasks with little food. Guano exerted a profound influence on the economic and political life of Peru during the past century. Though used by pre-historic peoples, it was not exploited until 1841–79, when it became the chief source of revenue. The birds which deposit it are so numberless that they cover the islands with a living carpet and fill the air with clouds that obscure the sun. Among them are cormorants, pelicans, gannets, penguins, gulls and terns. The actual deposits are now protected by law, since "mineral" deposits, over 3,000 ft. thick, were largely exhausted during the boom. About nine-tenths of the total output is now used for domestic agriculture. In 1926–27, 98,196 tons were extracted. The prime requisite of agriculture on the Peruvian coast and in parts of the *sierra* is irrigation. Pre-Hispanic Indians built aqueducts, some of which are still in use. The Government has returned to vigorous support of irrigation projects. About 640,000 ac., an area which yields almost half the agricultural produce of the country, are at present irrigated. The most important project under construction is that of diverting the Huancabamba river to the Pampa of Olmos. It includes drilling 18 m. of tunnels through the continental divide and constructing two hydro-electric dams 150 ft. high.

Mining.—Peru is the classic land of gold and silver. Its yield has been so great that it smacks of legend. The conquerors enslaved the Indians and by forced work in the mines filled the coffers of the Spanish kings. This was responsible for wholesale destruction of the Indian population. Up to 1603, the "King's Fifth" from the mines had amounted to £60,000,000, largely silver. With the republic, mining declined, chiefly because guano could be easily exploited. But after the establishment of the National School of Mines (1876) the industry revived. Large North American investments have resulted in an increase in export value from £P610,000 (1896) to over £P12,000,000 (1926). Petroleum, copper and silver constitute 80% of mineral output. Gold, silver, copper, mercury, lead, zinc, nickel, iron, manganese, tungsten, vanadium, antimony, bismuth, molybdenum, mica and coal are found in the *sierra*. On or near the coast are coal, salt, sulphur, borax, nitrates and petroleum. The total value of mineral production in 1926 was £P22,453,627 as against £P4,495,753 in 1913, most of which, except coal for smelting, was sent to the United States. First in importance is petroleum. The producing area lies between 3° 40′ S. and 5° S. near the coast, and has been worked at intervals since 1880. There are now 1,384 producing wells with an average annual output of 1,500,000 tons, most of which is exported (*see* PIURA). Second in mineral export value is copper. In the Andes silver, argentiferous lead and copper are the most numerous metalliferous deposits and are found and mined together, though primitive silver mines are scattered throughout the *sierra*. Total production was 668,734 kilos in 1926. Copper has become more important than silver, its production steadily increasing (13,474 tons in 1902, to 46,958 in 1927) (*see* CERRO DE PASCO). Gold is found throughout Peru in lodes and alluvial deposits. Sandía and Carabaya (Puno) are the most important centres of production and may have been the source from which the Incas derived most of their store. Total production in 1926 was 2,910 kilos. Vanadium, mined in Junín, is 90% of the world's requirements; 11,927 tons of zinc were produced in 1926. The present coal industry is merely subsidiary, about 150,000 tons annually (*see* CERRO DE PASCO). Mercury is obtained in Huancavelica (*q.v.*). There are numerous unexploited iron deposits. Sulphur is mined in Piura and borax at Salinas (Arequipa). Salt, in all of its forms, is a State monopoly (29,121 tons in 1926).

Manufacture.—In spite of many new enterprises, the country as a whole can hardly as yet be said to have reached the industrial stage of development. The largest plants are copper smelters, oil refineries, cotton and sugar mills. Besides cotton-seed crushing mills and oil refineries, 11 cotton textile mills manufacture the cheaper grades of cloth (about 33,000,000 yd. annually). The output of woollen goods is much less. Eighteen tanneries export about 3,000 tons of hides. Eight shoe factories manufacture 200,000 to 250,000 pairs annually. About 20,000 gal. of castor oil are produced annually, and about 50,000 gal. of olive oil. In Huánuco and Trujillo are cocaine factories. Since 1909 tobacco has been a Government monopoly (over 2,000,000 lb. of cigars and cigarettes produced annually). A Swedish company has a monopoly on the sale of matches. There are chocolate factories and flour mills. The rubber industry, dependent on the exploitation of wild rubber in the *montaña*, is fast disappearing because of unsupervised and primitive methods. About 5,000 doz. straw hats ("Panama") woven of palm leaves (*Carludovica palmata*) are exported annually. It is an historic industry. (*See* LIMA; CALLAO; AREQUIPA.)

Government.—The supreme law is the Constitution of Jan. 18, 1920. Every male citizen over 21, or under, if married, who can read and write, is entitled to vote. There is no woman suffrage. Laws protect and bind everyone equally. Legislation is by a national Congress, a senate of 35 senators and a chamber of 110 deputies; both are elected for five years by direct, popular vote and may be re-elected. They must be native-born Peruvians in full enjoyment of civil rights. The government of departments, provinces and districts is by prefects, sub-prefects and governors; the first two are appointed by the executive, the governors by the prefects. There are three regional legislatures, in the north, centre and south of the republic, with deputies elected by the provinces

THE RUINS OF AN INCA FORTRESS IN THE ANDES
Some of the stones weigh 800 tons and all were put in place without the use of any known machinery

at the same time as national representatives. These legislatures sit annually for a period of 30 days.

The chief executive is the president of the republic. He is elected by direct, popular vote for a period of five years and may be re-elected. He must be 35 years of age, a Peruvian by birth, and ten years a resident of the republic. He names a council of ministers, whose number is designated by law. If he dies or resigns, Congress chooses a new president within 30 days, the council of ministers governing in the meantime. There is also a council of State composed of seven members, appointed by the council of ministers, with approval of the senate. It acts in an advisory

capacity. The ministries are as follows: Interior and Police; Foreign Affairs; Justice, Worship and Education; Finance and Commerce; War; Navy; Public Works. Peru is a member of the League of Nations.

The judiciary is composed of a supreme court in Lima, superior and first instance courts in departments and provinces, respectively, and justices of the peace. Justices and State's attorneys of the supreme court are selected by Congress from ten names submitted by the executive. Justices of the superior court are appointed by the president from a list submitted by the supreme court, and justices of first instance from one made by the respective superior courts. The supreme court has authority over all other courts. No member of the judiciary may hold political office, but justices of the supreme court may be ministers of State.

Army.—The strength of the regular army is 1,006 officers and 6,416 men, that of the national police, 420 officers and 6,380 men. There are no other armed forces. It is estimated that about one-half of the strength of the national police would be available in emergency, to serve as a body. The regular army is organized into four skeleton divisions and a garrison for the *montaña*. Each division has two regiments of infantry, one regiment of cavalry, one regiment of field artillery. For administration and mobilization the republic is divided into five areas. Four of these are divisional regions, with headquarters in Piura, Lima, Arequipa and Cuzco, the fifth is the region of the *montaña*, with headquarters at Iquitos. Military affairs are directed by a general staff. Service is compulsory, but not universally enforced, for all males between 19 and 50. There is a military high school, a staff school and engineering, agricultural and military aviation schools.

Navy.—The navy, practically annihilated in the war with Chile, has cruisers (two light, one auxiliary), a destroyer, six submarines and four gun-boats on the Amazon. In 1920 an American naval mission began reorganization. In 1927 there were 200 officers and 2,000 men. The Naval academy is at La Punta (Callao) and a school of hydro-aviation is at Las Palmas near Lima. Naval aviation has air-mail and passenger services between Iquitos and San Ramón. It comprised 20 officers and 110 men (1927). There is a submarine base at San Lorenzo island (Callao).

Finance.—The present budget system dates from 1922. While revenues in 1896 were only £P1,128,714, they had risen to £P10,219,547 in 1926, when expenditures were £P10,518,689. Although actual expenditures exceeded actual collections by approximately 3% in 1926, in both years revenues actually exceeded the original estimates. Budgetary estimates of receipts and expenditures for the year 1928 are £P11,113,650. Internal taxes are collected by a Tax Collecting company which makes payments to the Caja de Depósitos y Consignaciones, so long as any bonds of the Peruvian National Loan (1926) are outstanding. Fiscal agents of the New York banking house which floated the loan are represented on the board of directors.

The foreign debt began with a small loan of £1,200,000 in London in 1822. Lavish expenditures in spite of ample (guano) revenue had raised the total to £49,000,000 in 1872, on which the annual interest amounted to about £2,500,000, a sum wholly beyond the resources of the treasury. Then came the War of the Pacific (1879–83). By 1889 the total foreign debt, including arrears of interest, was nearly £56,000,000. On Jan. 11, 1890, a contract was made whereby the Peruvian Corporation, Ltd. was formed and the entire external indebtedness of the republic was cancelled in return for certain concessions. Among these were operation for 66 years of State railways, free use of certain ports, right of navigation on Lake Titicaca, exploitation of the remaining guano deposits up to 3,000,000 tons and 33 annual payments of £80,000 each. This contract in modified form is still in force.

On June 30, 1927, the total national debt of Peru amounted to £P20,856,522 of which £P16,030,864 was external, loans chiefly in the United States and United Kingdom. Proceeds of recent loans are applied to railway construction, irrigation and sewage systems and the refunding of loans bearing higher service charges. In 1922 the Banco de Reserva del Perú was established; in addition to its rediscounting functions it regulates the currency. It alone issues notes, secured by a gold reserve. On Oct. 31, 1927, the ratio of gold to paper currency in circulation was over 83%. In Jan. 1928, the Mortgage Bank of Peru and its subsidiary, the Agricultural Intermediate Credit Bank, were established. The capital of the former is £P1,500,000, of the latter £P500,000, held entirely by the parent organization. They facilitate both the placing of mortgages and the extending of agricultural credit.

Currency.—The single gold standard was established in 1897, silver and copper being used for subsidiary coinage. The monetary unit is the Peruvian pound (*libra*, abbr. £P) uniform in weight and fineness with the British pound sterling. Half and fifth pounds are also coined. There are gold notes beginning with ½ *libra*. Silver coinage consists of *sol* (100 *centavos*), half *sol* (50 *centavos*), silver and nickel pieces of 20 (*peseta*), 10 and 5 *centavos* and copper coinage of one and two *centavos*. The change from the double standard was effected without any noticeable disturbance in commercial affairs, but this was in part due to the precaution of making the British pound sterling legal tender in the republic and establishing the legal equivalent between gold and silver at 10 *soles* to the pound. Intrinsically they are still equivalent. Since 1919, however, no gold has been available in payment of notes and none is in circulation, so the currency depreciated in 1928 but recovered early in 1929.

Weights and Measures.—The legal standard is the French metric system. It is in use in the custom-houses and in foreign trade, but the old units are still commonly used among the people. These are the ounce (1·014 oz., avoirdupois); Spanish *libra* (1·014 lb. avoirdupois); Spanish *quintal* (101·43 lb. avoirdupois); *arroba* (25·36 lb. avoirdupois); wine *arroba* (6·70 imperial gallons); *galón* (·74 of an imperial gallon); *vara* (32·91 in.) and the square *vara* (·835 sq.yd.).

History.—Ruins of vast edifices at Tiahuanaco just south of Lake Titicaca, at Cuzco and at Ollantaitambo appear to have been erected by sovereigns with unlimited command of labour. Of their origin nothing is known, for they are entirely unlike the later Inca structures. Settlement of the Cuzco valley by the Incas or "people of the sun" probably took place in the 13th century. They already possessed a considerable civilization. The Peruvian empire dated from the victories of Pachacutec Inca about a century before Huayna Capac, the Great Inca, who died in 1526, one year before Pizarro first appeared. The consolidated empire extended from the river Ancasmayo north of Quito to the Maule in Chile. (*See* INCAS.)

In March 1526, a contract for the conquest of Peru was signed by Francisco Pizarro, Diego de Almagro and Hernando de Luque. In 1527 Pizarro landed at Tumbez. The next year he went to Spain, and in 1531, with his brothers returned to Tumbez. The civil war between Huascar and Atahualpa, sons of Huayna Capac, had been fought out in the meanwhile, and the victorious Atahualpa was at Cajamarca, whither Pizarro with 183 men made his way. On Nov. 15, 1532, after a friendly welcome from the Inca, Pizarro treacherously seized him. In Feb. 1533 Almagro arrived with reinforcements. In spite of fulfilling an agreement to provide a vast ransom in gold and silver, the Inca Atahualpa was murdered on Aug. 29, 1533; in November, Pizarro entered Cuzco. He allowed Manco, the legitimate son of Huayna Capac, to be solemnly crowned. Almagro then undertook an expedition to Chile, and Pizarro founded the City of Kings (Lima), on Jan. 18, 1535. A dispute arose between Francisco, Juan and Gonzalo Pizarro and Almagro as to the limits of their respective jurisdictions; Almagro was defeated near Cuzco in 1538 and executed. His adherents recognized his young half-caste son, a gallant youth generally known as Almagro the Lad, as his successor. Bitterly discontented, they conspired at Lima and assassinated Francisco Pizarro on June 26, 1541. Meanwhile Vaca de Castro had been sent out as governor by Charles V. On Sept. 16, 1542, he defeated Almagro the Lad and beheaded him at Cuzco.

Civil Wars.—The "New Laws" code was enacted in 1542 whereby grants of estates (*encomiendas*) on which the inhabitants were bound to pay tribute and give personal service, reverted to the Crown on the death of the holder. Blasco Nuñez de Vela was sent out in 1544 as first viceroy of Peru to enforce the "New

Laws." Their promulgation aroused a storm among the conquerors. Gonzalo Pizarro rebelled and entered Lima on Oct. 28, 1544. The viceroy fled to Quito, but was followed and killed in Jan. 1546. The "New Laws" were revoked. Pedro de la Gasca, first president of the court of justice of Peru, arrived in 1547, and in April 1548 defeated and executed Gonzalo Pizarro near Cuzco. La Gasca made a redistribution of *encomiendas* to the loyal conquerors, which caused great discontent, and left Peru before his scheme was made public in Jan. 1550 Don Andrés Hurtado de Mendoza, marquis of Cañete, entered Lima as viceroy on July 6, 1555, and ruled with an iron hand for six years. All leaders in former disturbances were sent to Spain. Magistrates were ordered to execute all turbulent individuals. Unemployed persons were sent on distant expeditions. The viceroy came to an agreement with Sayri Tupac, son and successor of the Inca Manco, and granted him a pension. Schools and towns were founded, wheat, vines, olives and European domestic animals introduced. From this time there was a succession of viceroys until 1824 The splendour of their entourage was unexcelled. Meanwhile, in the *sierra,* Indians were being exterminated in an extravaganza of destruction.

Viceroyalty.—Don Francisco de Toledo (viceroy 1569–81), fearing that the little court of the Inca Tupac Amaru might prove rebellious, beheaded the last of the Incas at Cuzco in the year 1571. Toledo's *Libro de Tasas* fixed taxes on the Indians, exempting all under 18 and over 50 In addition to the tribute, there was the *mita,* or forced labour in mines and farms; he enacted that one-seventh of the male village population was subject to paid conscription for this service, but they were not to be taken beyond a specified distance from their homes. This system has become so ingrained that even now, though the Indian is theoretically free, he is incapable of grasping the fact and continues to regard the patron as lord of the land The Spanish authorities, although desiring to protect the people, were unable to restrain distant officials and the country was depopulated by the illegal methods of enforcing the *mita* Moreover, the colonies suffered from strict trade monopoly of Spain, and from arbitrary proceedings of the Inquisition Between 1581 and 1776, 59 heretics were burned at Lima, and there were 29 *autos da fe.* A descendant of the Incas, who assumed the name Tupac Amaru, rose in rebellion in 1780. The insurrection lasted until July 1783; wholesale slaughter followed his defeat

Peru Independent.—Meanwhile the Creoles (American-born Spaniards) had long been shut out from all important official positions Peru was still the centre of Spanish power in South America, though New Granada (Colombia) in 1740 and Río de la Plata (Argentina) in 1776 had been created independent viceroyalties. As military strength was concentrated at Lima, the more distant provinces, Chile and Buenos Aires, were first to declare themselves independent, in 1816 and 1817 But destruction of the viceroy's power at Lima was essential to their continued independent existence A fleet fitted out at Valparaiso, officered by English, convoyed the Argentine and Chilean army under command of the Argentine general, San Martín, to the coast of Peru in Sept 1820 San Martín was enthusiastically received, and after the viceroy had withdrawn, the independence of Peru was proclaimed at Lima (July 28, 1821). On Sept 20, 1822, San Martín resigned his protectorate, and on that day the first Congress of Peru became the sovereign power. It elected Don José de la Riva Agüero first president, in Feb. 1823 He was energetic but unsuccessful; the aid of the Colombians under Simón Bolívar was sought, and Agüero deposed

Bolívar arrived at Lima in Sept. 1823, and organized an army to attack the Spanish viceroy and his forces in the interior. On Aug. 6, 1824, the cavalry battle of Junín was fought near Chinchaicocha. It was decided by a gallant Peruvian charge under Capt. Suárez. Soon afterwards Bolívar left the army and the final battle of Ayacucho (Dec. 9, 1824) was won by his aide, Gen. Sucre Spanish power in Peru was at an end. Gen Bolívar then ruled Peru with dictatorial powers. Upper Peru was given the name of Bolivia and declared an independent republic in 1825 Bolívar left Peru in Sept 1826

Early Presidents.—Gen. José de La Mar, who commanded the Peruvians at Ayacucho, was elected president in Aug. 1827, but was deposed and Gen. Agustín Gamarra, chief of staff in the patriot army at Ayacucho, was elected third president in Aug. 1829. From 1829 to 1844, Peru painfully experimented with independence. The officers who fought at Ayacucho were all-powerful and settled political differences by the sword. Three men during that period are conspicuous: Generals Agustín Gamarra, Felipe Santiago Salaverry and Andrés Santa Cruz. Gamarra never accommodated himself to constitutional usages, but attached to himself many loyal and devoted friends. Born at Lima of pure Basque descent, Salaverry joined the patriot army before he was 15 and displayed audacious valour in many a hard-fought battle. Feeling the guilt of civil dissension, he wrote poems which became very popular. Andrés Santa Cruz was an Indian, his mother a lady of high rank, and he was very proud of his descent. Unsuccessful as a general in the field, he nevertheless possessed remarkable administrative ability and for nearly three years (1836–39) realized his dream of a Peru-Bolivian confederation. But the strong-handed intervention of Chile on the ground of assistance rendered to rebels, ended in the defeat and overthrow of Santa Cruz After this, except for administrations of Gen Ramón Castilla (1845–51 and 1855–62), revolution succeeded revolution for the spoils of office. In 1849 regular payment of interest on the public debt was begun, steam-lines established along the Pacific coast and a railway built from Lima to Callao. Income from guano and nitrate was amounting to several million pounds a year. In 1868 Col. José Balta became president With the vast sums of money at his disposal, he began the construction of public works, principally railways, on a gigantic scale—an orgy of expenditure. He was succeeded in 1872 by Don Manuel Pardo, an honest and enlightened statesman, who tried to compensate for the reckless policy of his predecessor He promoted education, encouraged literature and regulated Chinese immigration to the coast valleys, which from 1860 to 1872 had amounted to more than 50,000. But in general, conditions went from bad to worse. In 1876 Gen Mariano Ignacio Prado was elected president

War of the Pacific.—Peru and Bolivia, alarmed at continued Chilean encroachments in the desert of Atacama, signed on Feb. 6, 1873, a treaty of defensive alliance. On Feb. 14, 1879, Chile, in the course of a dispute over Bolivia's right under treaty to levy an export tax on nitrates, occupied the Bolivian port of Antofagasta, and on April 5 declared war on Peru (*see* CHILE-PERUVIAN WAR) President Prado having left the country to obtain aid, Nicolás de Piérola assumed a dictatorship, and was elected president in Dec 1879 The United States made several efforts to mediate, first in Oct 1880, without success. Chile refused to deal with President Piérola A provisional government under Francisco García Calderón was set up with Chile's approval in 1881, but when that, too, failed to meet their demands, they removed him to Chile; Lima was occupied by Chilean troops, and a reign of terror followed The university was looted and the national library destroyed Occupation continued for over two years. With Chilean support, Gen. Iglesias was elected president in 1883 and on Oct. 20, 1883, a treaty of peace was signed at Ancón Though the invading army left shortly after, Chile maintained a strong force in Lima until July 1884, when the treaty was ratified. The chief conditions imposed by Chile were: Cession in perpetuity and unconditionally of Peru's nitrate province of Tarapacá; possession for a period of ten years of the provinces of Tacna and Arica, at the expiration of which time a plebiscite should decide whether the territory was to remain under the dominion of Chile or continue to form part of Peruvian territory. There was violent dissatisfaction in Peru with the terms of the treaty and President Iglesias was forced to abdicate in 1885; Gen. Cácares succeeded him. The country was in a desperate plight, politically and financially. Not only had many of the ablest leaders been killed, but there was no money for war debts. Morales Bermúdez, elected president in 1890, died in 1894, just before the expiration of his term of office. Disputes as to his successor culminated in a year's fighting. In 1895 Nicolás Piérola became president. He initiated several unpopular reforms and in

Sept. 1899, abdicated in favour of Eduardo de Romaña, the people's choice. The chief problem was still that of Tacna and Arica. Though 15 years had passed, the Chileans still continued in possession. Following the term of Dr. José Pardo (1904–08), Don Augusto B. Leguía was elected president (1908–12); attempted reforms were ineffectual because of shortage of funds. Dr. Pardo entered upon a second term in July, 1915. The World War created a demand for sugar, cotton and copper and Peruvian industry had the greatest boom (1916–18) in the history of the country. (Diplomatic relations with Germany had been severed in 1917.) National finances, however, did not sufficiently profit by the boom. Leguía again became president on July 4, 1919. On July 10 a Constituent Assembly was authorized to alter the Constitution of 1860. The new one, promulgated on Jan. 18, 1920, affects almost every phase of government. From that time to the present (1929)—for President Leguía was re-elected in 1924 for another term, now of five years—there has been steady progress. Efforts of the United States to mediate in the Tacna-Arica dispute are dealt with in another article (*see* TACNA-ARICA).

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PERU, a city of La Salle county, Illinois, U.S.A., on the north bank of the Illinois river, immediately west of La Salle and 100 m. S.W. of Chicago. It is on Federal highway 51 and is served by the Burlington Route, the Illinois Traction (electric), and the Rock Island railways. Pop. 8,869 in 1920 (20% foreign-born white); estimated locally at 10,000 in 1928. There are coal mines within the city limits, and the manufacturing industries include the largest alarm-clock factory in the world and large zinc works. The city was founded in 1830 and incorporated in 1845.

PERU, a city of Indiana, U.S.A., 75 m. N. of Indianapolis, on the Wabash river; county seat of Miami county. It is on Federal highways 24 and 31, and is served by the Chesapeake and Ohio, the Nickel Plate, the Wabash, and other railways. Pop. (1920) 12,410 (95% native white), estimated locally at 15,000 in 1928. Peru is headquarters of three large circuses, and during the winter is the home of more wild animals than any other city in the world. Peru was founded about 1834 and was incorporated as a city in 1867.

PERUGIA (anc. *Perusia*), a city and archiepiscopal see of Italy, the capital of the province of Perugia in Umbria situated 1,444 ft. above sea-level. Pop. (1921) 37,701 (town); 72,971 (commune). The town is finely situated upon a group of hills nearly 1,000 ft. above the valley of the Tiber. Its outline is very irregular; from the centre of the town, at the junction of several ridges, parts of it extend for a considerable distance along their summits, being divided from one another by deep valleys. This is the extent enclosed by the mediaeval walls; within them are considerable remains of the lofty terrace walls of the Etruscan period. The so-called Arco di Augusto is a town gate with a Decorated superstructure of the Etruscan period, bearing the later inscription *Augusta Perusia;* above this again is a Renaissance loggia. Five other gates of the Etruscan period can still be traced.

The citadel was erected by Pope Paul III. in 1540–46, after the plans of Antonio da Sangallo the younger, and demolished in 1860. On one side of the Piazza del Duomo stands the cathedral of San Lorenzo, a Gothic structure of the 14th and 15th centuries, in the plan of a Latin cross; on the other the Palazzo Comunale with two fine Gothic façades (1297, completed in 1429–43), with the figures of the Perugian griffin and the Guelph lion above the outside stair; and in the centre the marble fountain constructed in 1277–80 by Arnolfo di Cambio, and adorned with statues and statuettes by Niccolo and Giovanni Pisano. In the Palazzo Comunale is the Pinacoteca Vannucci, with an important collection of Umbrian pictures, of ceramics, and illuminated mss. On the decoration of the Sala del Cambio, close by, Perugino put forth the full force of his genius. San Domenico, a Gothic edifice originally designed by Giovanni Pisano but rebuilt in 1614, contains the monument of Pope Benedict XI., and in its east front a large Gothic window with 15th century stained glass. San Pietro de' Cassinensi (outside the Porta Romana) is a basilica with nave and aisles, founded at the end of the 10th century, remarkable for its conspicuous campanile, its ancient granite and marble columns, its walnut stall-work of 1535 by Stefano de' Zambelli da Bergamo and its numerous pictures (by Perugino, etc.). The oratory of S. Bernardino has an early Renaissance polychrome façade, richly sculptured, of 1457–61, by Agostino d'Antonio di Duccio of Florence. S. Severo contains Raphael's first independent fresco (1505). The circular church of S. Angelo, with antique columns in the interior, probably dates from the 5th century. The university dates from 1307, and has faculties of law, science and medicine; it had 346 students in 1925–26. It contains an important museum of Etruscan and Roman antiquities. Three miles to the S.S.E., lay the Etruscan necropolis. The large tomb of the Volumni (2nd century B.C.) hewn in the rock, with its carved cinerary urns, is interesting. (*See* E. Galli, *Il Museo Funerario del Palazzone all' Ipogeo dei Volunni,* 1921.)

The ancient Perusia first appears in history as one of the 12 confederate cities of Etruria. It took an important part in the rebellion of 295 B.C. and was reduced, with Vulsinii and Arretium, to seek for peace in 294. In 216 and 205 it assisted Rome in the Hannibalic war; in 41–40 B.C., L. Antonius took refuge there, and it was reduced by Octavian after a long siege. A number of lead bullets used by slingers have been found in and around the city. The city was burnt, we are told, with the exception of the temples of Vulcan and Juno—the massive Etruscan terrace-walls, naturally, can hardly have suffered at all. It must have been rebuilt almost at once, but is hardly mentioned except by the geographers until the middle of the 6th century.

In the 9th century, Perugia passed under the popes; but for many centuries the city continued to maintain an independent life, warring against many of the neighbouring lands and cities. It remained true for the most part to the Guelphs. On various occasions the popes found asylum within its walls, and it was the meeting-place of the conclaves which elected Honorius II. (1124), Honorius IV. (1285), Celestine V. (1294), and Clement V. (1305); but when papal legates sought to coerce it by foreign soldiers, or to exact contributions, they met with vigorous resist-

ance. In the 15th century power was at last concentrated in the Baglioni family. Gian Paolo Baglioni was lured to Rome in 1520 and beheaded by Leo X.; and in 1534 Rodolfo, who had slain a papal legate, was defeated by Pier Luigi Farnese, and the city, captured and plundered by his soldiery, was deprived of its privileges. The citadel was begun six years later "ad coercendam Perusinorum audaciam." In 1797 Perugia was occupied by the French; in 1832, 1838 and 1854 it was visited by earthquakes; in May 1849 it was seized by the Austrians; and, after a futile insurrection in 1859, it was finally united, along with the rest of Umbria, to Piedmont, in 1860

See G. Conestabile, *I Monumenti di Perugia etrusca e romana* (Perugia, 1855); M. Symonds and L Duff Gordon, *Perugia* ("Medieval Towns Series") (1898); R. A. Gallenga Stuart, *Perugia* (Bergamo, 1905); W. Heywood, *Hist. of Perugia* (1910). (T. A.)

PERUGINO, PIETRO (*c.* 1450–1524), whose family name was VANNUCCI, Italian painter, was born at Città della Pieve in Umbria, and belongs to the Umbrian school of painting. The name of Perugino came to him from Perugia, the chief city of the neighbourhood. Pietro was one of several children born to Cristoforo Vannucci, a member of a respectable family settled at Città della Pieve. Before he had completed his ninth year the boy was articled to a master, a painter at Perugia Who this may have been is very uncertain; the painter is spoken of as mediocre, but sympathetic for the great things in his art Fiorenzo di Lorenzo may possibly have been the man. Pietro painted a little at Arezzo, where he may have worked under Piero della Francesca; thence he went to the headquarters of art, Florence It appears to be sufficiently established that he studied in the atelier of Andrea del Verrocchio, where Leonardo da Vinci was also a pupil. The date of this first Florentine sojourn is not settled. In 1475 he was back at Perugia and employed on work in the town hall, which is no longer extant. One of his earlier works now in existence is the fresco, dated 1478, in the church of Castel Cerqueto, near Perugia. Though much ruined it displays a beautifully modelled figure of St. Sebastian. Another early work is the small panel with the "Annunciation" of Conte Ranieri in Perugia, where the influence of Fiorenzo di Lorenzo is apparent. Soon afterwards Perugino proceeded to Rome. His fresco of the Virgin in the apse of St. Peter's was destroyed at the rebuilding of the church. From 1480–82 he worked in the Sixtine chapel. The painting of that part of the chapel which is now immortalized by Michelangelo's "Last Judgment" was assigned to him by the pope; he covered it with frescoes of the "Assumption," the "Nativity," and "Moses in the Bulrushes." These works were ruthlessly destroyed to make space for his successor's more colossal genius, but other works by Perugino still remain in the Sixtine chapel: the "Baptism of Christ" and "Christ giving the Keys to Peter." Pinturicchio accompanied Perugino to Rome, and executed the greater part of the "Baptism of Christ." "Christ giving the Keys to Peter" is the first great work of the master that has survived, and it shows him as a mature artist who had assimilated the Florentine traditions, while keeping the character of the native Umbrian school.

Perugino must have left Rome after the completion of the Sixtine paintings. He visited Perugia and in 1486 was in Florence Here he figures by no means advantageously in a criminal court In July 1487 he and another Perugian painter named Aulista di Angelo were convicted, on their own confession, of having in December waylaid with staves someone (the name does not appear) in the street near S. Pietro Maggiore. Perugino was fined ten gold florins.

Between 1486 and 1499 Perugino resided chiefly in Florence, making one journey to Rome and several to Perugia In 1490 he completed the altarpiece for Cardinal Guiliano della Rovere, now in the Villa Albani. This is one of his most charming creations. Other notable works of this period are the half-figure of "the Madonna" in the National Gallery (*c.* 1480); the tondo of "the Madonna with Saints and Angels" in the Louvre (*c.* 1490); and the "Crucifixion," now in the Uffizi (*c.* 1490). One of his most celebrated pictures, the "Pietà" in the Pitti gallery, belongs to the year 1495. From 1496 to 1498 he was employed on the great altarpiece for S. Pietro of Perugia, consisting of 15 panels. The greater part of these were taken by the French in 1797 and are now at Lyons, Nantes, Rouen, and in St. Gervais, Paris. Others are in the Vatican gallery Only five small panels have remained at Perugia. In 1499 the gild of the cambio (money-changers or bankers) of Perugia asked him to undertake the decoration of their audience-hall. This extensive scheme of work, which may have been finished within the year 1500, comprised the painting of the vault with the seven planets and the signs of the zodiac (Perugino doing the designs and his pupils most probably the executive work) and the representation on the walls of two sacred subjects—the "Nativity" and "Transfiguration"—the Eternal Father, the four virtues of Justice, Prudence, Temperance and Fortitude, Cato as the emblem of wisdom, and (in life size) numerous figures of classic worthies, prophets and sibyls. On the mid-pilaster of the hall Perugino placed his own portrait in bust-form. In Sept. 1493, Perugino married Chiara, the daughter of Luca Fancelli, architect and engineer. He was made one of the priors of Perugia in 1501. About 1500 he produced the *chef-d'oeuvre* of the "Madonna and Saints" for the Certosa of Pavia The six constituent parts of this noble work have now been sundered. The only portion which remains in the Certosa is a figure of God the Father with cherubim. Three compartments—the Virgin adoring the infant Christ, St. Michael, and St. Raphael with Tobias—are among the choicer treasures of the National Gallery, London. Two portions representing the Annunciation have disappeared.

Pope Julius II. had summoned Perugino to paint the Stanza in the Vatican, now called that of the Incendio del Borgo; but he soon preferred a younger competitor, that very Raphael who had been trained by the aged master of Perugia; and Perugino, after painting the ceiling with figures of God the Father in different glories, in five medallion-subjects, retired from Rome, and was once more in Perugia from 1512. Among his last works one of the best is the extensive altar-piece (painted between 1512 and 1517) of S. Agostino in Perugia

Perugino's last frescoes were painted for the churches S. Maggiore at Spello, S. Maria della Lagrime at Trevi; and S Agnese at Perugia; and in 1523 for the church of Castello di Fontignano hard by. This, his last work, representing "The Adoration of the Shepherds," is now in the National Gallery, London. He was still at Fontignano when the plague broke out and he died in February or March 1524. He was buried in unconsecrated ground in a field, for, on the sudden outbreak of the plague, the panic-stricken local authorities ordained that all victims should be at once interred without waiting for any religious rites. Perugino left three sons With him the ideal and mystic tendency of the Umbrian tradition prevailed. Perugino is, however, open to the charge of mannerism. He employed many assistants and frequently repeated the same motive in his works. Among his pupils were Raphael, Giovanni lo Spagna and Mannia. He was, after Raphael, the greatest representative of the Umbrian school His fame spread, and he received commissions from princes and churches all over Italy. His figures are graceful, gentle and pure; his landscapes bathed in glowing evening lights, and he excelled in compositions with graceful flowing lines.

Among the very numerous works of Perugino a few not already named require mention Towards 1496 he painted the "Crucifixion" in S. Maria Maddalena dei Pazzi, Florence. "The Marriage of Joseph and the Virgin Mary" (the "Sposalizio"), now in the museum of Caen, was painted about 1503 and served indisputably as the original, to a great extent, of the still more famous "Sposalizio" which was painted by Raphael in 1504, and is now in the Brera gallery in Milan. In the chapel of the Disciplinati of Città della Pieve is an "Adoration of the Magi," a square of 21 ft. containing about 30 life-sized figures; this was executed in 1504; about this time he finished, after much persuasion from Isabella d'Este, a panel for her study representing the struggle between chastity and sensuality, now in the Louvre In 1507, when the master's work had for years been in a course of decline, he produced, nevertheless, one of his best pictures—the "Virgin between St Jerome and St. Francis," now in the National Gallery

London. In S. Onofrio of Florence is a much-lauded and much-debated fresco of the "Last Supper," a careful and blandly correct but not inspired work painted before 1500. Perugino painted a few portraits. The most noted is that of Francesco dell' Opera (1494) in the Uffizi. It is painted with great minuteness and recalls the Flemish portraiture. The sitter holds a scroll in his hand with the inscription *Timete Deum.*

See Crowe and Cavalcaselle, *History of Painting in Italy* (edit. Tancred Borenius, 1914); G. C. Williamson, *Perugino* (1903); Walter Bombe, *Geschichte des Peruginen Malerei* (1912); *Perugino* (Klassiker der Kunst, 1914).

PERUZZI, BALDASSARE (1481–1536), Italian architect and painter of the Roman school, was born at Ancajano, near Volterra, on March 7, 1481, and passed his early life at Siena. Peruzzi went to Rome about 1503, under the patronage of the Sienese banker, Agostino Chigi, and there studied architecture and painting. The choir frescoes in Sant' Onofrio, on the Janiculan hill, show the influence of Pinturicchio. However, he soon fell under the influence of Raphael, and he learnt much from the study of the antique. The first work which brought renown to the young architect was the villa on a bank of the Tiber, now known as the Farnesina, built for Agostino Chigi. This villa is best known for the frescoes painted there by Raphael and his pupils. One of the loggie has frescoes by Peruzzi's own hand—the story of Medusa. In 1516 he painted the frescoes in the Capella Pozzetti at S. Maria della Pace. On account of his success, Peruzzi was appointed by Leo X., in 1520, architect to St. Peter's at a salary of 250 scudi; his design for its completion was not, however, carried out. In 1522 he was invited to Bologna to design a façade for the church of S. Petronio. In 1525 he built the Ossoli palace in Rome. During the sack of Rome in 1527 Peruzzi escaped with his life to Siena, where he was made city architect, and designed fortifications for its defence. A little court of the oratory of S. Caterina, the frescoes in Castel Belcaro and in the church of Fonte Giusta, date from this time. In 1529 he was made *capo maestro* of the cathedral. Here he designed a magnificent wooden-organ case, the high altar, and the Cappella del Battista. He then returned to Rome and in 1535 began the famous Palazzo Massimi. He died on Jan. 6, 1536, and was buried by the side of Raphael, in the Pantheon.

Peruzzi was an eager student of mathematics and was also a fair classical scholar, a most able architect, a fair painter, and a scientific engineer. The National Gallery has an interesting drawing of the "Adoration of the Magi." The Uffizi and the library at Siena contain a number of Peruzzi's designs and drawings, many of which show ancient buildings which have been destroyed since the 16th century.

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PERVIGILIUM VENERIS, the vigil or nocturnal festival of Venus, a short Latin poem. The occasion, author, date and place of composition are unknown. The poem probably belongs to the 2nd or 3rd century A.D. It describes in admirable if slightly florid poetry, the spring-time awakening of the world through the goddess. It consists of 93 trochaic septenarii, divided into groups of unequal length by the refrain:

Cras amet qui nunquam amavit, quique amavit cras amet.

A famous imaginative reconstruction of the manner of its writing can be found in Pater's *Marius the Epicurean.*

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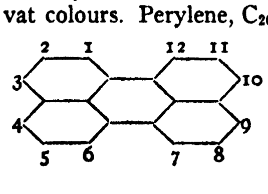
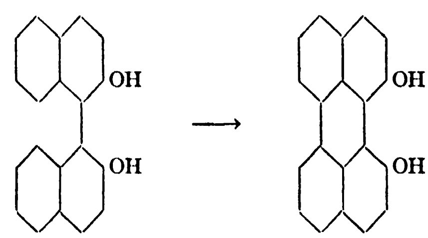
PERYLENE, a hydrocarbon whose preparation was described in 1910, since when the subject has become of importance in view of its application to vat colours. Perylene, $C_{20}H_{12}$,



does not appear to have been detected in coal tar. The hydrocarbon itself was first obtained by the union of two naphthalene nuclei, but it is more conveniently prepared by heating β-dinaphthol with a mixture of condensing and reducing agents. It is also formed on distilling dihydroxyperylene over zinc dust in hydrogen, or by dry distillation of calcium perylenetetracarboxylate. In organic solvents perylene exhibits a blue fluorescence, whilst in sulphuric acid a rich violet develops. On crystallization of the crude product, glistening bronze plates melting at 264–265° C are obtained, but when purified through its picrate, perylene melts at 273°–274° C.

Nitration of perylene yields mono- to tetra-nitro-derivatives: these compounds form vat dyes on treatment with aluminium chloride. The most important halogen derivatives are those in which positions 3:9- or 3:10- are occupied by chlorine or bromine. Higher halogenated compounds are also known. Perylene derivatives have also been obtained by the condensation of substituted 1:1′-dinaphthyls, such as 4:4′-diamino-, 4:4′-dicyano-, 4:4′- and 2:2′-dihydroxy-dinaphthyl, by means of aluminium chloride:—

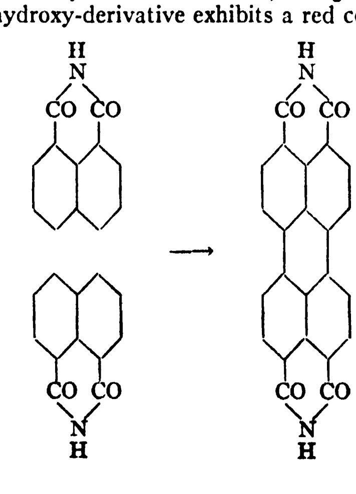


The dihydroxy-derivatives of perylene are specially important. Of the 21 theoretically possible, 12 should be capable of forming quinones; three of the latter have been isolated.

1:12-Dihydroxyperylene, prepared from β-dinaphthol, has been isolated as yellow leaflets. On passing air through an alkaline solution of dihydroxyperylene the crude quinone separates. The latter on treatment with lead peroxide and benzene crystallizes in reddish-brown needles, melting at 287° C, dissolving to a brown solution in sulphuric acid. The vat is yellow with green fluorescence and dyes cotton in yellow to brown shades.

3:9-Dihydroxyperylene, obtained by oxidation of 3:9-dichloroperylene by concentrated sulphuric acid and reduction of the product, crystallizes as yellow-orange needles. The corresponding quinone could not be isolated, but instead a compound, $(C_{20}H_{10}O_2)_2,H_2O$, was obtained. The sulphuric acid colour is red, becoming green on addition of water. The vat is orange-red with a yellow-green fluorescence, dyeing cotton orange-red which in air changes through brown to olive green.

3:10-Perylene quinone can be obtained by direct oxidation of perylene by aqueous chromic acid, by oxidation of 3:10-diaminoperylene or 3:10-dichloroperylene or *via* the dihydroxy-compound, by the action of aluminium chloride on α-dinaphthol. It crystallizes in bright yellow needles, melting above 350° C, and giving in sulphuric acid a blue-red colour and intense fluorescence. The cherry-red vat dyes cotton carmine, changing to light yellow in air. The dihydroxy-derivative exhibits a red colour in sulphuric



acid; the dibenzoate melts at 295–6°. Nitro-, amino-, and halogen derivatives of this quinone have been prepared.

A new class of vat dyestuff, containing the perylene nucleus and two carboxylic imide groups, has appeared in patent literature. The simplest dyestuff is formed on fusing naphthalimide or acenaphthenequinoneoxime with caustic alkali. *See* p. 636.

Hydrolysis of this product by concentrated sulphuric acid yields the parent tetracarboxylic anhydride which, on treatment with aliphatic or aromatic primary amines, forms *N*-substituted imide dyestuffs; the same products may be obtained by alkali fusion of *N*-substituted naphthalimides. These substances are remarkable for the colours and fluorescences they exhibit in solution. The anhydride dissolves in alkali forming a yellow solution which shows a brilliant green fluorescence on dilution: in sulphuric acid the colour is bright pink with yellow-red fluorescence. The parent dyestuff, the di-imide, dissolves to a reddish purple with scarlet fluorescence, whilst the *N*-phenyl derivatives show a purple colour with less fluorescence. The dyestuffs form cherry-red vats and dye cotton violet changing to red in air: as the molecular weight of the substituent increases, the colour tends to blue. Nitro- and chlorinated derivatives of these dyestuffs have been prepared.

Corresponding dyestuffs, also containing the perylene nucleus, have been prepared by alkali fusion of imides of anthracene 1:9-dicarboxylic anhydride; these dye cotton in green shades. The perylene nucleus is also present in violanthrone, isoviolanthrone and many other products derived from benzanthrone, dibenzanthrone and similar substances, by alkali fusion.

See A. E. Everest, *The Higher Coal Tar Hydrocarbons* (1927).

(J. G. M.)

PESARO, a city and seaport of the Marches, Italy (anc. *Pisaurum*), the capital of the province of Pesaro and Urbino, situated on the coast of the Adriatic 37 m. N.W. of Ancona by rail, on the right bank of the Foglia, the ancient Pisaurus. The ground on which it is built is only from 10 to 40 ft. above the sea, but it is surrounded by hills. Upon the Coles S. Bartolo stands the Villa Imperiale, the foundation stone of which was laid by the emperor Frederick III., built by the Sforza, and decorated with fine stucco ceilings and wall paintings and pavements of majolica plaques. A new palace was begun in 1530 by the Genga for Eleonora Gonzaga, but never finished. (*See* B. Patzak, *Villa Imperiale in Pesaro,* 1908.) The city walls were in 1830 transformed into a public promenade. The cathedral of the Annunciation has a 4th century mosaic pavement under the present one. There are a number of smaller churches with Gothic portals. The most conspicuous buildings are the prefecture (a palace originally erected in 1455–1465 for the Sforza, and restored by Francesco Maria della Rovere in the 16th century, which contains various antiquities, a picture gallery and a fine collection of majolica [the best in Italy] from the old Urbino and other manufactories) the fortress of Rocca Costanza (built by Costanzo Sforza in 1474, Laurana being the architect) and the large lunatic asylum. The composer Gioacchino Rossini, who was a native of Pesaro, left all his fortune to found a musical school in the city. The Museo Mosca, left by its owner to the town, contains collections of faience, furniture, etc. Pesaro is the centre of a rich agricultural district and is also a sea bathing resort. Pop. (1921), 22,663 (town); 29,899 (commune).

Destroyed by Vitiges the Goth, the town was restored and strengthened by Belisarius, and afterwards along with Ancona, Fano, Senigallia and Rimini formed the Pentapolis Maritima. In the course of the 13th century Pesaro was sometimes under the government of the popes, sometimes under that of the emperors; but the Malatesta family, which first took root in the city about 1285, gradually became the real masters of the place. In 1445 they sold their rights to Francesco Sforza; and in 1512, through the influence of Julius II., the Sforza were supplanted by his nephew Francesco Maria, duke of Urbino. Pesaro became the residence of the dukes of Urbino till the death of Francesco Maria II. in 1631, when it reverted to the States of the Church.

PESCADORES (*i.e.,* fishers), a group of islands (called by the Japanese *Hōkō tō* or *Hōko Guntō*) lying 30 m. west of Formosa, from which they are separated by the Pescadores Channel, about the tropic of Cancer. The islands number 48 (21 inhabited), have a coast-line of 98·67 miles, a total area of 85·50 sq.m., and a population of about 70,000, principally Chinese. Meteorological observations taken by the Japanese during a period of three years show that the annual average number of stormy days is 237. The anchorage is at Mako (Makyū or Makun) on the principal island of Penghu. The chief industry is fishing.

PESCARA, FERNANDO FRANCESCO DAVALOS, Marquis of (1489–1525), Italian *condottiere,* was born at Naples, of Spanish origin. At the age of six the boy was betrothed to Vittoria Colonna (*q.v.*), and the marriage was celebrated in 1509. In 1512 he commanded a body of light cavalry on the Spanish side at Ravenna. When Francis I. invaded Italy in 1524 Pescara was appointed as lieutenant of the emperor to repel the invasion. There was much discontent in the ill-paid army, but the tenacity, patience and tact of Pescara triumphed over all obstacles. On Feb. 24, 1525 he defeated and took prisoner Francis I. by a brilliant attack. He destroyed the superior French heavy cavalry by assailing them in flank with a mixed force of harquebusiers and light horse. He died at Milan on Nov. 4, 1525.

Bibliography.—The life of Pescara was written in Latin by Paolo Giovio, and is included in the *Vitae illustrium virorum,* printed at Basle (1578). Giovio's Latin *Life* was translated by L. Domenichi (1551). *See* also Mignet, *Rivalité de François Ier et de Charles Quint* (1875), which gives references to all authorities.

PESCARA, a river and town of Italy. The river is formed by the confluence of the Gizio and Aterno, flowing into the Adriatic at the town of Pescara (pop. [1921] 5,543), the capital of the province of that name. This town occupies the site of the ancient Aternum, the terminus of the Via Claudia Valeria. The railway from Sulmona follows the Pescara valley and joins the coast line to Brindisi at Pescara. In this valley, 22 m. from the sea, was the site of the ancient Interpromium, a town belonging probably to the Paeligni; and not far off is the very fine Cistercian abbey church of S. Clemente di Casauria, founded by the emperor Louis II. in 871. The present building belongs to the 12th century. The sculptures of the portals, the pulpit, the Paschal candelabrum, etc., and the bronze doors of this period are important.

PESCHIERA SUL GARDA, a fortress of Venetia, Italy, in the province of Verona, on an island in the Mincio, 77 m. by rail E. of Milan. It occupies the site of the ancient Arilica, a village of boatmen and fishermen. It was one of the famous fortresses of the Quadrilateral, the chief bulwark of the Austrian rule in Italy until 1866 (Mantua, Legnago and Verona being the other three) and has played a prominent part in all campaigns conducted in north Italy, more especially during the Napoleonic wars, but now has no military value. It was taken by the Piedmontese from the Austrians, in 1848.

PESELLINO, IL (1422–1457), name given to Francesco di Stefano Giuochi, a Florentine painter of the early Renaissance. He was brought up by his grandfather, the painter Giuliano il Pesello (1367–1446) and worked as his assistant until his death, when he became associated with Fra Filippo Lippi, and in 1453 with Piero di Lorenzo di Pratese, a little known painter. During this partnership he began, for the church of S. Trinità at Pistoja, the altarpiece of the Trinity now in the National Gallery, London. It was left unfinished at his death on July 29, 1457.

He excelled in the execution of paintings on a small scale, and is famous for his "cassone pictures," intended for the decoration of marriage chests in which he illustrated, in charming tapestry-like designs, some old legend or tale. Two such cassone pictures representing the story of David and Goliath are in the collection of Lady Wantage. The Museum of Bergamo has the "Story of Griselda" and a "Judgment Scene."

Two predella pieces, now in the Louvre, and three, now in the Florence academy, once formed together the predella which Pesellino painted for an altarpiece of Fra Fillippo in the church of S. Croce, Florence. Other works are an "Annunciation," in the Uffizi, Florence, and a "Madonna Enthroned with Angels and Saints," in the museum at Empoli. His works are exceedingly rare and precious; the miniature altarpiece of "The Madonna and Six Saints" was sold at the Holford sale in 1927 to Messrs. Knoedler

for 16,000 guineas. Drawings by the master are in the Louvre and the Uffizi.

PESETA. The monetary unit of Spain. It is divided into 100 centimos. It is a coin of 5 grammes of silver ·835 fine, and is thus equivalent at par to the franc.

The history of the peseta since 1914 is in many ways a curious one. During the war, Spain escaped the huge losses incurred by the Allies, but was involved in the general economic dislocation. Nevertheless, she preserved her currency and exchange system intact. At the beginning of 1919, the pound was quoted at Ptas. 23·67, and a year later at Ptas. 19·72. At this latter date, the Peseta was at a premium of 33 per cent, or was alternatively worth 12·2 pence against its par value of 9·5 pence.

Internally, the note-issue had expanded from Ptas. 1,931 millions in 1913 to Ptas. 4,326 in early 1921, but the Bank of Spain's "cover," or reserves, had risen from Ptas. 1,390 millions to Ptas. 3,031 millions, of which Ptas. 2,456 millions were gold.

The weak spots were the budget, the foreign trade balance, the American exchange and the internal price-level. For 1920–21 the budget had a deficit of Ptas. 633·5 millions. In 1920 the adverse trade balance was Ptas. 406 millions, which was not abnormal in relation to 1913 and the intervening rise in prices. But for 1921, it rose to Ptas. 1,252 millions, and remained there or above until 1924. In New York, the peseta fell from its parity of cts. 19·295 to cts. 13·53 for 1921, while between 1920 and 1921, internal wholesale prices only fell by 14 per cent., whereas in America they fell by 35 per cent, and in England by 36 per cent.

The fact is that, whereas in 1921 England, Sweden, Holland and the United States were well embarked on the path of deflation and reconstruction, Spain was delayed by her war in Morocco, and by wasteful and inefficient Government administration at home. After the revolution of 1923 matters began to improve. The budget deficit was gradually reduced, until, in 1927, a small surplus was actually realized. The adverse trade balance was similarly contracted and the ratio of legal cover to notes was maintained at the pre-war figure.

The result was a steady improvement in the peseta, so much so that during 1927 there were constant rumours of its impending stabilization at Ptas. 25·22 to the pound. The Spanish Government, however, made it clear that stabilization would not be hurried. Subsequent events were to reveal the wisdom of this decision since, as with other countries, successful stabilization depended upon internal economic and political stability. In early 1929 political events in Spain caused a fall in the peseta exchange serious enough to undo the improvement of many previous months. Its subsequent fluctuations at rates running over 30 to the pound showed that the restoration of political stability must precede currency stabilization.

PESHAWAR, a city of British India, the capital of the North-West Frontier Province, giving its name to a district. The city is situated near the left bank of the river Bara, 11 m. from Jamrud at the entrance of the Khyber Pass, the railway station being 1,588 m. north-west of Calcutta; pop. (1921), 104,452. Two miles west of the city are the cantonments, forming the principal military station of the North-West Frontier Province. To Peshawar for many centuries the *Povindahs,* or Afghan travelling merchants, have brought their caravans from Kabul, Bokhara and Samarkand every autumn. They bring horses, wool, woollen stuffs, silks, dyes, gold-thread, fruits, precious stones, carpets and poshtins (sheepskin clothing), fighting and buying their way to the British border where, leaving their arms, they are free to wander at will to Delhi, Agra and Calcutta.

The District of Peshawar has an area of 2,607 sq.m.; pop. (1921), 622,349. Except on the south-east, where the Indus flows, it is encircled by mountains which are inhabited by the Mohmand, Utman Khel and Afridi tribes. The inhabitants are Pathans.

In early times the district of Peshawar seems to have had an essentially Indian population, for it was not till the 15th century that its present Pathan inhabitants occupied it. Under the name of Gandhara it was a centre of Buddhism, and especially Graeco-Buddhism. Rock-edicts of Asoka still exist at two places; and a *stupa* excavated in 1909 was found to contain an inscription of Kanishka, as well as relics believed to be those of Buddha himself. The Mogul emperors always found difficulty in maintaining their authority over the Afghan border tribes. Peshawar was a favourite residence of the Afghan dynasty founded by Ahmed Shah Durrani, and here Mountstuart Elphinstone came as ambassador to Shah Shujah in 1809. A few years later Ranjit Singh crossed the Indus, and after much hard fighting Sikh authority was firmly established under General Avitabile in 1834. In 1848 Peshawar passed to the British. During the Mutiny, after the sepoy regiments had been disarmed, Peshawar was a source of strength rather than of danger, though Sir John Lawrence did at one time contemplate the necessity of surrendering it to the Afghans, in order to preserve the rest of Northern India.

PESHITTA or **PESHITA** (*i.e.,* "simple"), the Syriac version of the Bible. Long supposed to be the original Syriac version, it is now generally recognized as a revision made by Rabbula, bishop of Edessa, early in the 5th century, to standardize the Syriac text much as Jerome had done for the Latin in his Vulgate. (*See* Bible: *Old Testament, Texts and Versions.*)

PESHWA, the title of the head of the Mahratta confederacy in India. The word is Persian for "leader." Originally the peshwa was only prime minister, but afterwards he supplanted his master, founding an hereditary dynasty, with the capital at Poona. The last peshwa, Baji Rao, came into collision with the British, and was dethroned in 1818. His adopted son, Nana Sahib, took a leading part in the Mutiny of 1857.

PESO. The monetary unit of certain Central and South American countries; divided into 100 centavos. Its value varies between country and country, as shown below:—

Argentina: 100 pesos paper = 44 pesos gold	= $42.45.
Chile: 1 peso	= 12·166 cents.
Colombia: 1 peso gold	= 97·331 cents.
Guatemala: 1 peso	= 1·666 cents.
Mexico: 1 peso or dollar	= 49·85 cents.
Uruguay: 1 peso	= 103·425 cents.

The most important of these six pesos is that of Argentina.

PESSIMISM, a word of modern coinage, denoting an attitude of hopelessness towards life, a vague general opinion that pain and evil predominate in human affairs (from Lat. *pessimus,* worst). It is the antithesis of "optimism," which denotes the view that on the whole there is a balance of good and pleasure, or at least that in the long run good will triumph. Between optimism and pessimism is the theory of "meliorism," according to which the world on the whole makes progress in goodness. The average man is pessimist or optimist not on theoretical grounds, but owing to the circumstances of his life, his material prosperity, his bodily health, his general temperament. Perhaps the most characteristic example of unsystematic pessimism is the language of Ecclesiastes, who concludes that "all is vanity."

Pessimism and optimism have, however, been expressed in systematic philosophical forms, a brief summary only of which need here be given. Such systems have been elaborated chiefly by modern thinkers, but the germs of the ideas are found widely spread in the older Oriental philosophies and in pre-Christian European thought.

Oriental pessimism, at least as understood by Europeans, is best exemplified in Buddhism, which finds in human life sorrow and pain. But all pain and sorrow are incidental to the human being in his individual capacity. Let who will cast aside the "Bonds," the "Intoxications," the "Hindrances," and tread the Noble Eightfold Path (*see* Buddhism) which leads to Nirvana, and attain the ideal, the "Fruit of Arahatship," which is described in terms of glowing praise in the Pali hymns. This, the original doctrine of the Buddha, though not adopted in the full sense by all his followers, is in fact at least as optimistic as any optimism of the West. To call it "pessimism" is merely to apply to it a characteristically Western principle according to which happiness is impossible without personality. The true Buddhist on the contrary looks forward with enthusiasm to this absorption into eternal bliss. However, Western Christian mysticism has never been a stranger to this concept.

Passing over the Italian Leopardi we may notice two leading

modern pessimists, Schopenhauer and von Hartmann. Schopenhauer emphasizes the pessimistic side of Hegel's thought. The universe is merely blind Will, not thought; this Will is irrational, purposeless and therefore unhappy. The world being a picture of the Will is therefore similarly unhappy. Desire is a state of unhappiness, and the satisfaction of desire is therefore merely the removal of pain. Von Hartmann's doctrine of the Unconscious is in many respects similar to Schopenhauer's doctrine of the Will. The pessimism of Schopenhauer and Hartmann does not, however, exclude a certain ultimate mysticism, which bears some analogy to that of Buddhism.

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PESSINUS (Πεσσινοῦς, Πεσινοῦς), an ancient city of Galatia in Asia Minor, situated on the lowest southern slope of Mt. Dindymus. The ruins, discovered by Texier, lie round the village of Bala-Hissar, 8 or 9 miles S.E. of Sivri-Hissar. Originally a Phrygian city, it became the capital of the Gallic tribe Tolistobogii and the chief commercial city of the district. It contained the most famous sanctuary of the mother of the gods (Cybele), who here went by the name of Agdistis, and was associated with the god Attis, as elsewhere with Sabazius, etc. Her priests were also princes, who bore rule not only in the city (the coinage of which, beginning about 100 B.C., was for long issued by them) but also in the country round, deriving a large revenue from the temple estates; but in the time of Strabo (A.D. 19–20) their privileges were much diminished. Some time before the year 164 B.C. Pessinus fell into the power of the Gauls, and the membership of the priestly college was then equally divided between the Gauls and the old priestly families Like Ancyra and Tavium, Pessinus was Romanized first and Hellenized afterwards. Only about A.D. 165 did Hellenic ways and modes of thought begin to be assumed; before that we find a deep substratum of Celtic feeling and ways, on which Roman elements had been superimposed without filtering through a Hellenic medium Christianity was introduced late; it cannot be traced before the 4th century. When Galatia was divided into two provinces (A D 386–395) Pessinus was made the capital of Galatia Secunda or Salutaris, and it became a metropolitan bishopric. After the 16th century it disappears from history.

PESTALOZZI, JOHANN HEINRICH (1746–1827), Swiss educational reformer, was born at Zürich on Jan. 12, 1746. His father died when he was young, and he was brought up by his mother At the university of Zürich he was associated with Lavater and the party of reform. His earliest years were spent in schemes for improving the condition of the people. The death of his friend Bluntschli turned him however from politics, and induced him to devote himself to education. He married at twenty-three and bought a piece of waste land at Neuhof in Aargau, where he attempted the cultivation of madder. Pestalozzi knew nothing of business, and the plan failed. Before this he had opened his farm-house as a school; but in 1780 he had to give this up also. His first book published at this time was *The Evening Hours of a Hermit* (1780), a series of aphorisms and reflections. This was followed by his masterpiece, *Leonard and Gertrude* (1781), an account of the gradual reformation, first of a household, and then of a whole village, by the efforts of a good and devoted woman. The French invasion of Switzerland in 1798 brought into relief his heroic character. A number of children were left in Canton Unterwalden on the shores of the Lake of Lucerne, without parents, home, food or shelter. Pestalozzi collected a number of them into a deserted convent, and spent his energies in reclaiming them. During the winter he cared for them personally, but in June 1799 the building was required by the French for a hospital, and his charges were dispersed. In 1801 Pestalozzi gave an exposition of his ideas on education in the book *How Gertrude teaches her Children.* His method is to begin with observation, to pass from observation to consciousness, from consciousness to speech. Then come measuring, drawing, writing, numbers, and so reckoning. In 1799 he had been enabled to establish a school at Burgdorf, where he remained till 1804. In the year 1805 he removed to Yverdon on the Lake of Neuchâtel, and for twenty years worked steadily at his task. He was visited by all who took interest in education—Talleyrand, Capo d'Istria, and Mme. de Stael. He was praised by Wilhelm von Humboldt and by Fichte. His pupils included Ramsauer, Delbrück, Blochmann, Carl Ritter, Froebel and Zeller. About 1815 dissensions broke out among the teachers of the school, and Pestalozzi's last ten years were chequered by weariness and sorrow. In 1825 he retired to Neuhof, the home of his youth; and after writing the adventures of his life, and his last work, the *Swan's Song,* he died at Brugg on Feb. 17, 1827. For his far-reaching influence on educational methods *see* EDUCATION.

Pestalozzi's complete works were published at Stuttgart in 1819–26, and an edition by Seyffarth appeared at Berlin in 1881. Volumes on his life and teaching have been written by De Guimps (1889), Barnard (1862) Krüsi (1875) and Pinloche (1901) *See* also J. A Green, *Life and Works of Pestalozzi* (1913); P. Matorp, *Der Idealismus Pestalozzis: eine Neuuntersuchung der philosophischen Grundlagen Seiner Erziehunglehre* (Leipzig, 1919), W. O. Nicolay, *Pestalozzis Stellung zu Religion und Religionsunterricht* (Langensalza, 1920).

PESTS: *see* ENTOMOLOGY.

PÉTAIN, HENRI PHILIPPE BENONI OMER JOSEPH (1856–), French soldier, was born on May 24, 1856 at Cauchy la Tour (Pas de Calais). He was commissioned from St. Cyr 1878, passed in due course through the École de Guerre, filled various staff appointments, including that of instructor at the École de Guerre, and was promoted colonel in 1910 At the outbreak of the World War he was commanding an infantry regiment, but he was immediately given a brigade and then a division, and acquitted himself so well during the opening weeks of the struggle that he was advanced to the command of the XXXIII. Army Corps in Artois on Oct. 25, 1914 He greatly distinguished himself on the occasion of the French offensive near Arras in May 1915, where his corps completely broke through the German position, though exploitation proved to be impossible for want of reserves On June 21, 1915 he was given command of the II. Army, which under his orders carried out on Sept. 25, 1915 the great attack in Champagne. After this action Gen. Pétain wrote a remarkable *Rapport sur les opérations de la IIe. armée en Champagne et enseignements à en tirer.* This contained the principles of a new tactical doctrine, and was published in the *Archives de la Grande Guerre,* No. 10, pp 5–30

After the battle of Champagne, the staff of the II. Army was withdrawn from the front, and was thus available at the moment when the Germans were attacking Verdun on Feb. 21, 1916. It was then that the task of stopping the advance of the German crown prince was entrusted to Pétain.

His first task was to organize the battle zone. He fixed a line of defence from Bras to Douaumont: this line had to be held at all costs, and under cover of it he divided up the ground to be held in sections which were duly laid out and equipped. It was largely owing to the system and energy of Pétain that Verdun was saved (*see* VERDUN, BATTLES OF). On May 1, 1916 he was given the command of the centre army group, of which the IV. Army, on the left, took part in the great offensive of April 16, 1917 On April 28 he was appointed chief of the general staff at the Ministry of War in Paris; and on May 15 he replaced General Nivelle as Commander-in-Chief of the armies in the field.

The French army at that time was faced with a grave crisis, not excluding mutinies. Pétain did his utmost to remove the special causes of discontent, such as the irregularity of leave, and the inequality between units in their tours of duty in the trenches. He also saw to it that soldiers on leave were not exposed to dangerous influences or neglect, and he renewed the confidence between the combatants and their leaders. By means of reforms

rather than measures of repression, he succeeded from the month of June onwards in having the army completely in hand. In *directive* No. 1 he informed the army group and army commanders that they must limit themselves provisionally to preparing attacks with only limited objectives with the object of wearing out the enemy reserves. In *directive* No. 2, which was issued in the second fortnight of June, he reconstructed the training of the troops. In *directive* No. 3, at the beginning of July, he laid down the method of distribution in depth. The key-note of the limited operations outlined by his *directive* No. 1 was to be thoroughness of organization and high proportion of fire-power, so as to give the maximum result with the minimum risk. Such were the characteristics of the action of the I. Army in Flanders, July 15–31; the II. Army before Verdun, Aug. 13–25 (*see* VERDUN, BATTLES OF) and of the VI. Army at Malmaison, Oct. 17–26.

Late in 1917 it became apparent that owing to the defection of Russia a formidable German offensive would be launched in the spring of 1918 on the western front. With this in view, Pétain studied the possibilities of surprise by placing reserves within reach of the threatened points. On Feb. 22, 1918 he and Sir Douglas Haig agreed to give each other mutual assistance.

On March 21 when the Germans had just attacked General Gough's Army with great violence, Pétain hurried forward the V. Corps which was in reserve behind his left wing. On the 22nd Haig having requested the intervention of the French army, Pétain pushed forward the extreme left or 125th Division of the VI. Army towards the field of battle, where it arrived during the night March 22-3. Other French units were speedily added in order to assist the British, and these formed successively the III. Army and then the I.

Meanwhile, on March 26 at Doullens, General Foch had been entrusted with the mission of co-ordinating the efforts of the Allied armies. Pétain therefore had only to carry out on the lines of the *directives* issued by Foch those operations which had been assigned to the French armies. He withstood the German attacks of May 27, June 9 and July 15, and as a tactical counter to the enemy's offensives, he planned in a note of June 24 new tactics of elastic defence under which the second line trench system became the main position of resistance.

It was now the moment to pass to the counter-offensive. On June 27 Foch had asked Pétain to draw up a *directive* for an offensive. This was the *directive* No. 5, July 1. The operation itself as originally planned was to consist of a move by General Mangin's army on Soissons. On June 14 Foch had ordered preparations to be made for an offensive against this town. On June 16 Pétain issued the same order to General Fayolle, the commander of the army group. On June 20 Mangin, who was entrusted with its execution, drew up the plan of action, which consisted of preliminary operations which were to be followed by the occupation of the heights in front of the town. This plan was approved on June 27 and the first phase was carried out between June 28 and July 3. The preliminary successes led Mangin to think that the action could be further developed. On July 7 Pétain and Foch discussed this point; and next day Pétain sent Fayolle a letter in which he expressed approval of Mangin's plans. But on July 9 Foch conceived the idea of an action on a larger scale in which two other armies should take part. With this end in view Pétain on July 12 issued to the army group commanders instructions which were approved by Foch on July 13. On July 14 Foch went to see Pétain, and an agreement was reached between them as to the time when the offensive should be launched. This was planned for the 18th.

Pétain, under similar conditions, prepared the great offensives of Aug. 8 and Sept. 25, 1918 and he was also responsible for pushing the Germans back to the Ardennes. On Nov. 21 Pétain received at the hands of the president of the republic at Metz the baton of *Maréchal de France;* he was also the recipient of many high honours from the Allied Governments. He subsequently held the position of vice-president of the *Conseil Supérieur de la Guerre;* and it was in this capacity that he went to Morocco in the summer of 1925 to supervise the arrival and employment of the reinforcements which were sent out to carry on the campaign against Abdel Krim.

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PETALITE, a mineral species consisting of lithium aluminium silicate $LiAl(Si_2O_5)_2$. The monoclinic crystals approach spodumene (*q.v.*) in form, which is also a lithium aluminium silicate with the formula $LiAl(SiO_3)_2$. There is a perfect cleavage parallel to the basal plane, and the mineral usually occurs in platy cleavage masses; on this account it was named, from Gr. πέταλον (a leaf). The hardness is 6½ and the specific gravity 2·4 (that of spodumene being 3·16). The mineral is colourless or occasionally reddish, varies from transparent to translucent, and has a vitreous lustre. It was discovered in 1800 as cleavage masses in an iron mine on the island of Utö near Stockholm, where it is associated with lepidolite, tourmaline and spodumene.

PETALUMA, a city of Sonoma county, California, U.S.A., at the head of navigation on the Petaluma river, 35 m. N.N.W. of San Francisco. It is served by the North-western Pacific and electric railways, and (for freight) by boats and barges to points on San Francisco bay. Pop. (1920) 6,226 (80% native white); 1928 estimate, 8,250. It is famous for its poultry industry, which occupies 3,000 families and sent 42,480,000 dozen eggs to market in 1927. Dairying is also important, and the city has numerous manufacturing industries, including incubator factories and the first silkthread mill established west of the Rockies. The town was plotted in 1852, incorporated in 1858, and chartered as a city in 1911. The poultry industry was introduced by Lyman C. Byce, a young Canadian, in 1878.

PETCHENEGS or **PATZINAKS** [Latin *Bisseni*], a nation which played a considerable part in the mediaeval history of Eastern Europe. The Petchenegs were a Turkish race, akin to the Cumans (*q.v.*), whose language, according to Anna Comnena, they spoke. They were probably a federation formed of the earlier Bukuk and Kangaris. In the 9th century A.D. they were living between the Volga and the Urals, having as their neighbours the Burtas on the west, the Khasars south-west, and the Ghuz south-east. About 860 the Khasars and Ghuz combined and drove them west, a remnant only remaining in their old territory, which was now occupied by the Ghuz. The remainder drove the Magyars, who were the western neighbours of the Khasars, over the Dnieper, themselves settling near the Don. In the year 889 they again drove the Magyars westward into Moldavia, arriving on the Dnieper 895. In this or the following year they allied themselves with Khan Symeon of the Bulgars, inflicted a third and crushing defeat on the Magyars, and drove them into their present homes in Hungary. The Petchenegs made their own headquarters on the two banks of the Dnieper, where for a century they harassed Kiev and the trade route between that state and Constantinople, lurking near the rapids at which convoys disembarked, then charging them on horseback and raining arrows on them. In addition, they ravaged Wallachia, Bulgaria, and the lands of the eastern Roman empire, perhaps the most formidable of their many incursions being that of 934, when, allied with the Magyars, they destroyed Varander. In 972 they had slain Sviatoslav of Kiev; but in 1036 Prince Yaroslav defeated them so heavily that they ceased to trouble Russian territory. Their incursions westward grew correspondingly more severe. Between 1020–1030 they invaded Bulgaria almost every year, and from 1048–1056 were at war with Byzantium without intermission. At the close of this campaign the Emperor granted them lands for settlement in north-east Bulgaria, but their depredations continued. The great westward raid of the Ghuz in 1064 passed clean through their territory, and many Petchenegs were probably then slain or absorbed by the Ghuz. Others fled into Hungary, where King Ladislaus defeated them in 1067. Colonies of the survivors were settled as guards on Hungary's western frontiers. In 1080 the emperor Alexius again defeated them, and their power was finally

broken in 1091 by the crushing defeat which they suffered at Lebunien. Remnants of them, however, still lurked about the Balkans, and one band, imitating their old tactics on the Dnieper, attacked Peter the Hermit's party of Crusaders north of Belgrade in 1096. After this they fade out of history; but the "Sops" in the plain of Sofia to-day are believed to be their descendants.

The Petchenegs were ruled by a Khan and organised in 8 hordes and 40 minor units, each under its khan of lower degree. They were purely nomadic; on their raids they took their women and children with them, forming their camps out of rings of wagons. They wore long beards and moustachios, and were dressed in long kaftans. The food of the wealthy was blood and mares' milk; of the poor, millet and mead. They were originally "magicians," *i e*, fire-worshippers; but a form of Islam early became current among them and the nation was temporarily converted to Christianity in 1007–1008. They were the most dreaded and detested of all the nomads; Matthew of Edessa calls them "the carrion-eaters, the godless, unclean folk, the wicked, blood-drinking beasts." Other anecdotes are current of their shamelessness, and many of their cruelty; they invariably slew all male prisoners who fell into their hands The modern Sops are despised by the other inhabitants of Bulgaria for their bestiality and stupidity but dreaded for their savagery. They are a singularly repellent race, short-legged, yellow-skinned, with slanting eyes and projecting cheek-bones. Their villages are generally filthy, but the women's costumes show a barbaric profusion of gold lace.

See J. Marquart, *Osteuropaische und Ostasiatische Streifzuge* (1903), where the main original sources are given. *See* also under RUSSIA, BULGARIA, and ROMAN EMPIRE, LATER. (C. A. M.)

PETER, ST., the Apostle who is referred to in the New Testament by several names. Most commonly he is called Peter, but we also find Simon, Simon Peter, Cephas, and once Symeon We may infer that the Apostle's name was the common Hebrew "Symeon" (שִׁמְעוֹן) which was generally rendered by the Greek "Simon" (Σίμων); he also received the title "Cephas" (כֵּיפָא) which was Graecized according to the sense of "stone" or "rock" into "Peter" (Πέτρος). There is no certain evidence that either "Cephas" or "Peter" was already in use as a proper name. The bestowal of the name Cephas is mentioned by Mark in connection with the sending forth of the twelve (iii. 16), by Matthew in connection with Peter's confession at Caesarea Philippi (xvi. 18), and in the fourth gospel in connection with the first call of Simon near the scene of John's baptizing (i 42)

Prominence of St. Peter.—The gospels agree in representing St. Peter as the most prominent of the disciples during the ministry of Jesus He is mentioned by Mark 23 times, by Matthew 24 times, by Luke 27 times, by John 39 times, and 182 times in the whole of the New Testament. Together with the sons of Zebedee, he formed an inner circle among the disciples, and was constantly in the company of the Master. Thus he is mentioned as present on several notable occasions such as the raising of Jairus' daughter (Mark v. 22 *sqq.* and parallels), the Transfiguration (Mark ix. 2 *sqq.* and parallels), and in the Garden of Gethsemane (March xiv. 32 and parallels). Early tradition (Papias) makes Peter the ultimate source of the Marcan narrative, to which Matthew and Luke were indebted. If so, the frequency of Peter's appearances may be partly explained; but it is Matthew rather than Mark who exalts Peter, and there is no reason to doubt that he was indeed the leader of the Twelve.

Early History.—Of his earlier history nothing is known. In Matthew xvi. 17 he is called "Simon Barjona" (*i.e.*, Simon Son of Jonas), whereas in John i. 42 and xxi. 15 he is referred to as "Simon son of John." Jonas and John are quite distinct names, but among Greek-speaking Christians the confusion would not be difficult. He was married and lived in a house at Capernaum with his brother Andrew and his mother-in-law (Mark i. 29). His occupation was that of a fisherman, and Luke says he was in partnership with James and John.

Call of St. Peter.—The synoptic gospels describe the call of Peter to discipleship as taking place by the Lake of Galilee (Mark i. 16 *sqq.*, Matt. iv. 18 *sqq.*, Lk. v. 1. *sqq.*). No explanation is given of the suddenness of the call or of the ready response which it evoked. But the fourth gospel represents the earliest disciples of Jesus as previously disciples of John the Baptist and as leaving John to follow Jesus. One of these disciples was Andrew, who brought his brother Simon to Jesus with the announcement, "We have found the Messiah," and Jesus received him with the words "Thou shalt be called Cephas," which is by interpretation Peter. It is difficult to accept this account wholly as it stands, for the synoptic gospels make it plain that the disciples did not at first regard their Master as the promised Messiah; but it may embody a genuine tradition that the disciples had been connected with John's work, and thus explain why on a later occasion Peter was so ready to obey the call of Jesus. On the other hand it is possible that the account of the fourth gospel is coloured by a desire to minimize the importance of the Baptist save as a forerunner of the Christ. It is not improbable that a rival sect of the Baptist persisted to the end of the first century (Acts xviii. 25), and it was for that reason that the author of the fourth gospel omitted to mention John's independent work, and represented him as surrendering his disciples to Jesus.

Mark and Matthew agree closely in their accounts of the call of Simon and Andrew, and both quote the saying, "I will make you fishers of men" Luke has a good deal of non-Marcan material, and his account differs considerably. He places the visit to Capernaum and the healing of Simon's mother-in-law before the call to Simon, and he connects the call with the story of the miraculous draught of fishes which appears in the fourth gospel after the resurrection (John xxi) If the story of the miraculous draught arose from the prophecy that Peter should catch men, Luke's arrangement is in a sense justified. According to John the catch numbered 153—probably men of every race whom Peter was to attract by his teaching.

Confession of St. Peter.—Of the incidents during the ministry in which Peter played a prominent part it is only possible here to deal with one in detail Critics attach considerable importance to the account of Peter's confession at Caesarea Philippi (Mark viii. 27 *sqq*, Matt. xvi. 13 *sqq*, Luke ix 18 *sqq*). According to all three synoptic gospels, at a comparatively late date in the history of the ministry Peter, in answer to a question of Jesus, acknowledged him to be the Messiah Jesus then spoke of his coming passion, and Mark and Matthew add that Peter brought upon himself a severe rebuke by protesting against such an unwelcome development. The gospels make it clear that this was a turning-point in the history of the ministry and in the education of the Twelve Matthew emphasizes the importance of the occasion by the insertion of a remarkable paragraph concerning Peter. "And Jesus answered him, Blessed art thou Simon Barjona, because flesh and blood did not reveal it to thee, but my Father in Heaven. And I say to thee that thou art Peter and upon this rock I will build my church, and gates of Hades will not prevail against it. I will give thee the keys of the kingdom of the heavens, and whatsoever thou shalt bind on earth shall be bound in the heavens, and whatsoever thou shalt loose on earth shall be loosed in the heavens." Here difficulties multiply, but two points seem clear. (1) Peter is to have unique importance in the future corresponding to the unique insight which he has displayed; he is the rock on which a new *ecclesia* will be founded to triumph over death. (2) Peter will have unique authority to admit to the new *ecclesia* and to legislate for its members We must consider these points in greater detail. (1) Peter has received a definite revelation from Heaven, and his confession does not reflect the opinion of men (*cf* Gal. i 16). In virtue of this insight he is to become the foundation of "my church," that is, of an *ecclesia* comparable with the old Israel which is frequently referred to in the Old Testament as "the congregation" (Heb. קָהָל LXX. ἐκκλησία).

C. Taylor (*Sayings of the Jewish Fathers*) quotes a remarkable rabbinic parallel. When the Holy One wanted to create the world, he passed over the generations of Enoch and of the flood as unsound; but when he saw Abraham who was going to arise he said, Lo I have discovered a rock (petra) to build and to found the world upon. Therefore he called Abraham "rock" (צוּר), as it is said, "Look unto the rock whence ye are hewn." In what sense Peter is to be the foundation of the new *ecclesia* is perhaps

explained in the following words: "Peter will bear witness to the resurrection, and against the Church thus encouraged to face death the gates of Hades (Death, not Hell) will not prevail."

(2) Peter will receive the keys of the kingdom and will have unquestioned authority to bind and to loose, that is to legislate for the community. As to the keys, Is. xxii. 20–23 should be studied, and, for a Christian parallel, Rev. iii. 7. Two ideas seem to be combined: a chief steward bears the keys of a house as the sign of his authority, and a teacher of truth has the means of admission to the kingdom of Heaven (*cf.* Luke xi. 52 where the lawyers are blamed for taking away the key of knowledge). St. Peter will have authority in the new church such as Eliakim had in the old; and, as the ideal Scribe, St. Peter will admit many to the kingdom by his teaching. It is remarkable that in Matt. xviii. 18 a similar power of binding and loosing is bestowed upon all the disciples. (B. T. D. Smith, *St. Matthew*, pp. 151, *sqq.*)

Opinions differ as to the authenticity of this saying addressed to Peter. The use of *ecclesia* for the Christian Church as a whole seems to reflect later usage (*cf.* Matt. xviii. 17 where the word means a local congregation); and the whole passage implies a reverence for St. Peter such as might be felt by the second generation of Christians, especially by some community (? the Church of Antioch) which regarded him as its founder. John vi. 68 records another confession of Peter which is perhaps the Johannine equivalent of the synoptic "Thou art the Christ."

St. Peter and the Resurrection.—The New Testament implies that St. Peter was specially famous in the early church as a witness to the resurrection of Jesus. St. Paul (I. Cor. xv. 5) mentions an appearance to Cephas first among the evidences of the resurrection. The "young man" of Mark xvi. thus instructs the women at the tomb, "Go tell his disciples *and Peter* that he goeth before you into Galilee and there ye shall see him"; from which we may infer that Mark intended to relate an appearance in Galilee at which Peter was specially prominent. Luke testifies to a belief in an early appearance to Simon (xxiv. 34), although he does not describe it and it does not fit easily into his scheme. It is very strange that the description of this appearance has dropped out of the synoptic tradition, for it seems to have belonged to a very early stratum. The omission may be variously explained. The original ending of Mark is almost certainly lost. Luke and John adopted the belief that the disciples stayed in Jerusalem after the crucifixion, and both were therefore bound to omit a story of an early appearance in Galilee. Matthew seems to have deliberately preferred an account of an appearance to all the disciples on a mountain, perhaps because he thought it evidentially superior. But it is very probable that the appendix to St. John (ch. xxi.) reproduces a late version of the half-forgotten story; and, so far as we can judge, the apocryphal gospel of Peter ended with a similar account. In the Johannine narrative Jesus appears to seven disciples, and Peter is prominent. The apocryphal account begins, "And I Simon Peter. . . ." It has been suggested that the story of Jesus' walking on the water (Mark vi. 48 and parls.) is another version of the same incident, for Matthew represents Peter as acting in a similar way on that occasion, jumping out of the boat to meet Jesus. (Matt. xiv. 29, *cf.* Joh. xxi. 7.)

Later History and Death.—The last chapter of the fourth gospel is important as containing what is certainly the earliest reference to the death of St. Peter. Three times Jesus tests his love which three times he had denied, and three times entrusts to him the pastoral duty to "feed my sheep." The sheep (or lambs, *v.* 15) are doubtless members of the early Church dependent upon Peter's teaching for their spiritual food. So we have a further testimony to the Apostle's great reputation as a teacher, and a suggestion that his life was devoted to pastoral rather than to missionary work. The reference to his death is to us obscure, though probably it was clear enough to the original readers of the gospel. "Verily verily I say unto thee, when thou wast young thou didst gird thyself and walkedst whither thou wouldest; but when thou shalt be old thou shalt stretch forth thy hands and another shall gird thee, and bear thee whither thou wouldest not. Now this he spake signifying by what manner of death he should glorify God." The inference seems to be that the life of St. Peter was prolonged to an age at which he was unable any longer to attend to himself, that he lived under some kind of restraint, and that his death was somehow connected with these circumstances. To the Church it was a martyrdom by which he glorified God, but the words do not necessarily imply more than that Peter died of old age, bearing bravely its infirmities and indignities. Clement of Rome (*Ep.* 5 Πέτρος μαρτυρήσας) perhaps implies more than this, but the tradition that Peter was crucified rests upon a misunderstanding of the words "thou shalt stretch forth thy hands" (*i.e.*, to allow another to gird thee), and has nothing but a respectable antiquity (Tertullian and Origen) to commend it.

The first part of the Acts is largely a record of Peter's doings, and from these chapters it appears that for some time after the Ascension he was the acknowledged head of the Jerusalem church. His prominence brought him into collision with the Jewish authorities, and twice he was arrested by the priests (iv. 3, v. 18, possibly a doublet). Accompanied by John he made a journey to Samaria to see the results of Philip's preaching, and thus he was concerned in the earliest expansion of the Church (viii. 14 *ff.*). At a later date he travelled further afield, visiting Lydda, Joppa and Caesarea. At Caesarea he baptized Cornelius, and thus it was Peter who admitted the first Gentile to the Church, though Cornelius was no heathen (x. 1 *ff.*). Returning to Jerusalem Peter met criticisms of his policy by relating his experiences, and he was successful in convincing his critics; but it must not be assumed that either St. Peter or the other authorities had as yet any idea of dispensing with circumcision as generally necessary to salvation. There followed (at what interval we do not know) a persecution by Herod in which Peter was arrested, and a famine in which the Jerusalem church, weakened economically by socialistic experiments, suffered severely.

The famine probably continued after Herod's death, and Peter may have been present throughout, for "another place" to which he departed (xii. 17) may mean no more than another house. If he was present during the famine he must have met Saul and Barnabas when they brought relief from Antioch (xi. 30), and this may be the meeting described in Gal. ii. 1 *ff.* at which an agreement was reached between Paul and the senior Apostles on the question of preaching to the Gentiles. This is the view of Sir William Ramsay, and it has the great advantage that it acquits St. Paul of the charge that in writing to the Galatians he omitted to mention one of his visits to Jerusalem.

Peter's last appearance in Acts is in connection with the Council of Jerusalem where he stands up to champion a liberal policy towards the Gentiles. The veracity of the author of Acts has been questioned here, for in Gal. ii. 11 St. Paul discloses the fact that even after the agreement reached at Jerusalem Peter vacillated in his policy towards the Gentiles. If the encounter at Antioch took place after the Council at Jerusalem of Acts xv. then Peter's weakness is as hard to understand as is the obstinacy of the Jewish party. But if Ramsay's view be accepted it is much easier to reconstruct the history of events. At an informal conference in Jerusalem Peter and other leaders were persuaded to sanction an approach to the Gentiles, but not all the Jerusalem party consented nor indeed had they been consulted. The exact terms on which Gentiles might be admitted were not decided. Later, at Antioch, Peter encountered strong conservative opposition and began to waver, but at the subsequent council at Jerusalem he recovered courage enough to state his own convictions, the Jewish party were compelled to bow to the logic of facts, and the whole question was settled. Such a course of events is not inconsistent with what we know of St. Peter's character.

There are one or two hints in the New Testament as to St. Peter's later history. I. Cor. i. 12 mentions a party of Cephas at Corinth, and some have supposed that this implies a residence of St. Peter at Corinth as a consequence of which a party of his admirers was formed. But this is by no means certain, and the evidence of Dionysius of Corinth (*c.* 170) is too late to give substantial support to the belief.

If the first Epistle of Peter be genuine—and to some extent even if it be not—it furnishes some information about the Apostle's subsequent activities. It may suggest a ministry in Asia

Minor (i. 1), and it implies a residence in "Babylon." Babylon has been very commonly taken to mean Rome (Rev. xvi. 19, xvii. 5, etc.), and, if so, we have very early evidence of St. Peter's residence in the capital of the Empire. The belief that Peter lived in Rome goes back to Irenaeus (3 I. i.), Clement of Alexandria (*Comment. on I. Peter*), and Tertullian (*Scorp.* 15). Some hold that it is implied by Clement of Rome who couples the names of Peter and Paul as "champions nearest to us" (I. Ep. v.), and by Ignatius who says to the Romans, "I do not command you as Peter and Paul" (*ad. Rom.* iv). Irenaeus states that Mark acted as Peter's assistant in Rome, and this tradition receives support from I. Pet. v. 14 and from Papias (Euseb. *H.E.* iii. 39, 15). Thus the evidence that St. Peter was at Rome is strong though not conclusive; that he actually founded the Church of Rome is virtually disproved by the silence of Acts and of St. Paul.

Early tradition (Origen, Clementines, Eusebius, Apostolic Constitutions and Jerome) also connects Peter with Antioch of which church he was said to have been the first bishop. Whether this belief was more than an inference from Gal. ii. 11 we do not know.

Nothing definite is known about the Apostle's death. Tertullian states that he was crucified under Nero, and Origen adds that at his own request he was crucified head downwards. But this testimony is late, and we have seen that Joh. xxi. suggests rather that Peter's sufferings were those of old age and restraint upon his liberty. Clement's reference to Peter's fate is very vague. If the Apostle was the author of I. Peter it is almost certain that he lived to a later date than the reign of Nero (*see* PETER, FIRST EPISTLE OF). Early in the third century the grave of Peter and Paul was shown in the Vatican (Euseb. *H.E.* 2. 25, *Acta Petri* 84), and the relics were moved to the catacombs in A.D. 258. Whether or not they were genuine we have no means of judging.

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(P. G.-S.)

PETER I., called "the Great" (1672–1725), emperor of Russia, son of the tsar Alexius Mikhailovich and Natalia Naruishkina, was born at Moscow on May 30, 1672. His earliest teacher (omitting the legendary Scotsman Menzies) was the *dyak,* or clerk of the council, Nikita Zotov, subsequently the court fool, who taught his pupil to spell out the liturgical and devotional books on which the children of the tsar were generally brought up. After Zotov's departure on a diplomatic mission, in 1680, the lad had no regular tutor. From his third to his tenth year Peter shared the miseries and perils of his family. His very election (1682) was the signal for a rebellion. He saw one of his uncles dragged from the palace and butchered by a savage mob. He saw his mother's beloved mentor, and his own best friend, Artamon Matvyeev, torn, bruised and bleeding, from his retaining grasp and hacked to pieces. The haunting memories of these horrors played havoc with the nerves of a supersensitive child. The convulsions from which he suffered so much in later years must be partly attributed to this violent shock.

During the regency of his half-sister Sophia (1682–1689) he occupied the subordinate position of junior tsar, and after the revolution of 1689 Peter was still left pretty much to himself. So long as he could indulge freely in his favourite pastimes—shipbuilding, ship-sailing, drilling and sham fights—he was quite content that others should rule in his name. He now found a new friend in the Swiss adventurer, François Lefort, a shrewd and jovial rascal, who not only initiated him into all the mysteries of profligacy (at the large house built at Peter's expense in the German settlement), but taught him his true business as a ruler. His mother's attempt to wean her son from his dangerous pastimes, by forcing him to marry the beautiful but stupid Eudoxia Lopukhina (Jan. 27, 1689), was a disastrous failure. Peter practically deserted his consort about a year after their union.

The death of his mother (Jan. 25, 1694) left the young tsar free to follow his inclinations. Tiring of the great lake at Pereyaslavl (he had seen the sea for the first time at Archangel in July 1683) he returned to Archangel on May 1, 1694, to launch a ship built by himself the year before. Shortly afterwards he nearly perished in a storm in an adventurous voyage to the Solovetsky Islands in the White Sea. From the first the lad had taken an extraordinary interest in the technical and mechanical arts, and their application to military and naval science. He was taught the use of the astrolabe (which Prince Yakov Dolgoruki, with intent to please, had brought him from Paris) by a Dutchman, Franz Timmerman, who also instructed him in the rudiments of geometry and fortifications.

Peter had begun to build his own boats at a very early age, and the ultimate result of these pastimes was the creation of the Russian navy. He had already surrounded himself with that characteristically Petrine institution "the jolly company," or "the company," consisting of his personal friends and acquaintances. "The company" was graduated into a sort of mock hierarchy, political and ecclesiastical, and shared the orgies and the labours of the tsar. Merit was the sole qualification for promotion, and Peter himself set the example to the other learners by gradually rising from the ranks. In 1695 he had only advanced to the post of "skipper" in his own navy and of "bombardier" in his own army. The disreputable Lefort, for the sake of his own interests, diverted the young tsar from mere pleasure to serious enterprises, by persuading him first to undertake the Azov expedition, and then to go abroad to complete his education.

Creator of the Russian Navy.—By this time the White Sea had become too narrow for Peter, and he was looking about him for more hospitable waters. The Baltic was a closed door to Muscovy, and the key to it was held by Sweden. The Caspian remained; it had for long been a common saying with foreign merchants that the best way of tapping the riches of the Orient was to secure possession of this vast inland lake. But so long as the Turks and Tatars made the surrounding steppes uninhabitable the Caspian was a possession of but doubtful value. The first step making for security was to build a fleet strong enough to provide against the anarchical condition of those parts; but this implied a direct attack not only upon the Crimean khan, who was mainly responsible for the conduct of the Volgan hordes, but upon the khan's suzerain, the Turkish sultan. Nevertheless Peter did not hesitate. War against Turkey was resolved upon, and Azov, the chief Turkish fortress in those regions, which could be approached by water from Moscow, was attacked from July 8 to Sept. 22. On Nov. 22, Peter re-entered Moscow. His first military expedition had ended in unmitigated disaster.

Immediately after his return he sent to Austria and Prussia for as many sappers, miners, engineers and carpenters as money could procure. He meant to build a fleet strong enough to prevent the Turkish fleet from relieving Azov. The guards and all the workmen procurable were driven, forthwith, in bands, to fell timber in the forests of the Don, and the shipwrights worked day and night, turning out scores of vessels of all kinds. Peter himself lived among his workmen, himself the most strenuous of them all, in a small two-roomed wooden hut at Voronezh. By the middle of April two warships, twenty-three galleys, four fireships and numerous smaller craft were safely launched. On May 3, "the sea caravan" sailed from Voronezh, "Captain Peter Aleksyeevich" commanding the galley-flotilla from the galley "Principium," built by his own hand. The new Russian fleet prevented the Turks from relieving Azov by sea; and on July 18 the fortress surrendered. Peter thereupon established a new naval station, named Taganrog, at the head of the Sea of Azov.

Turkey was too formidable to be fought single-handed, and it was therefore determined to send a grand embassy to the principal western powers to solicit their co-operation against the Porte. On March 10, 1697 this embassy, under the leadership of Lefort, set out on its travels. Peter attached himself to it as a volunteer sailorman, "Peter Mikhailov," so as to have greater facility for learning ship-building and other technical sciences. As a political mission it failed utterly, the great powers being at that period far more interested in western than in eastern affairs. But personally Peter learnt nearly all that he wanted to know—gunnery at Königsberg, shipbuilding at Saardam and Deptford, anatomy at Leyden, engraving at Amsterdam—and was proceeding to Venice

to complete his knowledge of navigation when the revolt of the *stryeltsy*, or musketeers (June 1698), recalled him to Moscow. This revolt has been greatly exaggerated. It was suppressed in an hour's time by the tsar's troops, of whom only one man was mortally wounded; and the horrible vengeance (September-October 1698) which Peter on his return to Russia wreaked upon the captive musketeers was due not to any actual fear of these antiquated warriors, but to his consciousness that behind them stood the reactionary majority of the nation who secretly sympathized with, though they durst not assist, the rebels.

Peter's foreign tour had more than ever convinced him of the inherent superiority of the foreigner. Imitation had necessarily to begin with externals, and Peter at once fell foul of the long beards and Oriental costumes which symbolized the arch-conservatism of old Russia. On the 26th of April 1698 the chief men of the tsardom were assembled round his wooden hut at Preobrazhenskoye, and Peter with his own hand deliberately clipped off the beards and moustaches of his chief boyars. The *ukaz* of the 1st of September 1698 allowed as a compromise that beards should be worn, but a graduated tax was imposed upon their wearers. The wearing of the ancient costumes was forbidden by the *ukaz* of the 4th of January 1700; thenceforth Saxon or Magyar jackets and French or German hose were prescribed. That the people themselves did not regard the reform as a trifle is plain from the numerous rebellions against it. By the *ukaz* of the 20th of December 1699 it was next commanded that henceforth the new year should not be reckoned, as heretofore, from the 1st of September, supposed to be the date of the creation, but from the first day of January, *anno domini*.

The Great Northern War.—The year 1700 is memorable in Russian history as the starting-point of Peter's long and desperate struggle for the hegemony of the north. He had concluded peace with the Porte (June 13, 1700) on very advantageous terms, in order to devote himself wholly to a war with Sweden to secure for Russia her proper place on the Baltic. The possession of an ice-free seaboard was essential to her natural development; the creation of a fleet would follow inevitably upon the acquisition of such a seaboard; and she could not hope to obtain her due share of the trade and commerce of the world till she possessed both. All the conjunctures seemed favourable to Peter. The Swedish government was in the hands of an untried lad of sixteen; and the fine fleets of Denmark, and the veteran soldiers of Saxony, were on the same side as the myriads of Muscovy. It seemed an easy task for such a coalition to wrest the coveted spoil from the young Charles XII.; yet Peter was the only one of the three conspirators who survived the Twenty-one Years' War in which they so confidently embarked during the summer of 1701. He was also the only one of them who got anything by it. Charles's "immersion in the Polish bog" (1702–1707), as Peter phrased it, enabled the tsar, not without considerable expense and trouble, to conquer Ingria and lay the foundations of St. Petersburg (Leningrad).

In these early days Peter would very willingly have made peace with his formidable rival if he had been allowed to retain these comparatively modest conquests. From 1707 to 1709 the war on his part was purely defensive; Charles would not hear of peace till full restitution had been made and a war indemnity paid, while Peter was fully resolved to perish rather than surrender his "paradise," Petersburg. After Pultava (June 26, 1709), Peter, hitherto commendably cautious even to cowardice, but now puffed up with pride, rashly plunged into as foolhardy an enterprise as ever his rival engaged in. The campaign of the Pruth (March to July 1711) must have been fatal to the tsar but for the incalculable behaviour of the omnipotent grand vizier, who let the Russian army go at the very instant when it lay helpless in the hollow of his hand. Even so, Peter, by the peace of the Pruth, had to sacrifice all that he had gained by the Azov expedition fifteen years previously. On receiving the tidings of the conclusion of the peace of Nystad (August 30, 1721), Peter declared, with perfect justice, that it was the most profitable peace Russia had ever concluded. The gain to Russia was, indeed, much more than territorial. In surrendering the pick of her Baltic provinces, Sweden had surrendered with them the hegemony of the north, and her pretensions to be considered a great power.

Reforms.—The Great Northern War was primarily a training school for a backward young nation, and in the second place a means of multiplying the material resources of a nation as poor as she was backward. During the whole course of it the process of internal domestic reformation had been slowly but unceasingly proceeding. Brand-new institutions on Western models were gradually growing up among the cumbrous, antiquated, worn-out machinery of old Muscovy; and new men, like Menshikov, Goloykin, Apraksin, Osterman, Kurakin, Tolstoy, Shafirov, Prokopovich, Yaguszhinsky, Yavorsky, all capable, audacious, and brimful of new ideas, were being trained under the eye of the great regenerator to help him to carry on his herculean task. At first the external form of the administration remained much the same as before. The old dignities disappeared of their own accord with the deaths of their holders, for the new men, those nearest to Peter, did not require them. "The Administrative Senate" was not introduced till 1711, and only then because the interminable war, which required Peter's prolonged absence from Russia, made it impossible for him to attend to the details of the domestic administration. Still later came the "Spiritual Department," or "Holy Synod" (January 1721), which superseded the ancient patriarchate. It was established, we are told, "because simple folks cannot distinguish the spiritual power from the sovereign power, and suppose that a supreme spiritual pastor is a second sovereign, the spiritual authority being regarded as higher and better than the temporal."

The official birthday of the Russian empire was Oct. 22, 1721, when, after a solemn thanksgiving service in the Troitsa Cathedral for the peace of Nystad, the tsar proceeded to the senate and was there acclaimed: "Father of the Fatherland, Peter the Great, and Emperor of All Russia." Some Russians would have preferred to proclaim Peter as emperor of the East; but Peter himself adopted the more patriotic title.

Towards the end of the reign the question of the succession to the throne caused the emperor some anxiety. The rightful heir, in the natural order of primogeniture, was the little grand duke Peter, son of the Tsarevich Alexius, a child of six; but Peter decided to pass him over in favour of his own beloved consort Catherine. The *ustav*, or ordinance of 1722, heralded this unheard-of innovation. Time-honoured custom had hitherto reckoned primogeniture in the male line as the best title to the Russian crown; in the *ustav* of 1722 Peter denounced primogeniture in general as a stupid, dangerous, and even unscriptural practice of dubious origin. The *ustav* was but a preliminary step to a still more sensational novelty. Peter had resolved to crown his consort empress, and on Nov. 15, 1723 he issued a second manifesto explaining at some length why he was taking such an unusual step. The whole nation listened aghast to the manifesto. The coronation of a woman was in the eyes of the Russian people a scandalous innovation, and the proposed coronation was doubly scandalous in view of the base origin of Catherine herself. (*See* CATHERINE I.) The ceremony took place at Moscow on May 7, 1724.

During the last four years of his reign Peter's policy was predominantly Oriental. He had got all he wanted in Europe, but the anarchical state of Persia at the beginning of 1722 opened up fresh vistas of conquest. The war which lasted from May 1722 to September 1723 resulted in the acquisition of the towns of Baku and Derbent and the Caspian provinces of Gilan, Mazandaran and Astarabad. The Persian campaigns wore out Peter's health. A long and fatiguing tour of inspection over the latest of his great public works, the Ladoga Canal, during the autumn of 1724, brought back another attack of his paroxysms, and he died after terrible suffering, on Jan. 28, 1725.

Character.—Peter's claim to greatness rests mainly on his recognition of the requirements of the Russian nation and his own obligations as its ruler. It would have materially lightened his task had he placed intelligent foreigners at the head of every department of state, allowing them gradually to train up a native bureaucracy. But he was determined that, at whatever cost,

hardship and inconvenience, Russia should be ruled by Russians, not by foreigners; and before his death every important place in his empire was in the hands of capable Russians of his own training. Even in his most sweeping reforms he never lost sight of the idiosyncrasies of the people. He never destroyed anything which he was not able to replace by something better. He possessed, too, something of the heroic nature of the old Russian *bogatuirs*, or demigods, as we see them in the *skazki* and the *builinui*. His expansive nature loved width and space.

No doubt this last of the *bogatuirs* possessed the violent passions as well as the wide views of his prototypes. All his qualities, indeed, were on a colossal scale. His rage was cyclonic: his hatred rarely stopped short of extermination His banquets were orgies, his pastimes convulsions. He lived and he loved like one of the giants of old. There are deeds of his which make humanity shudder, and no man equally great has ever descended to such depths of cruelty and treachery. Yet it may generally be allowed that a strain of nobility, of which we occasionally catch illuminating glimpses, extorts from time to time an all-forgiving admiration. Strange, too, as it may sound, Peter the Great was at heart profoundly religious. Few men have ever had a more intimate persuasion that they were but instruments for good in the hands of God.

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(R. N. B)

PETER II. (1715–1730), emperor of Russia, only son of the Tsarevich Alexius, was born on Oct 18, 1715 From his childhood the orphan grand duke was kept in the strictest seclusion. On May 18, 1727 Peter II., according to the terms of the supposed last will of Catherine I, was proclaimed sovereign autocrat. The education of the young prince was entrusted to the vice-chancellor Osterman. Menshikov, who lodged Peter II. in his own palace on the Vasily island, had intended to marry him to his daughter Maria; the scheme was frustrated by his fall (Sept 21, 1727). Peter fell into the hands of the equally unscrupulous Dolgoruki, who carried him away from Petersburg to Moscow, where he was crowned on Feb 25, 1728. He was betrothed to Catherine, second daughter of Alexis Dolgoruki, but on the day fixed for the wedding (Jan 30, 1730) the emperor died of small-pox

PETER III. (1728–1762), emperor of Russia, only son of Charles Frederick, duke of Holstein-Gottorp, and of Anne, eldest surviving daughter of Peter the Great, was born at Kiel on Feb. 21, 1728. In December 1741 he was adopted by his aunt, Elizabeth Petrovna, as soon as she was safely established on the Russian throne, and on Nov 18, 1742 was received into the Orthodox Church, exchanging his original name of Karl Peter Ulrich for that of Peter Fedorovich. On Aug. 21, 1745, by the command of his aunt, he married the princess Sophia Augusta Frederica of Anhalt-Zerbst (Catherine Aleksyeevna) The union between a prince who physically was something less than a man and mentally little more than a child, and a princess of prodigious intellect and an insatiable love of enjoyment, was bound to end in catastrophe. But there is no foundation for the stories of Peter's neglect and brutality. Even when Peter III. succeeded Elizabeth on Jan. 5, 1762, he paid off Catherine's debts, without inquiring their origin. He gave her a magnificent establishment and great domains. His infidelities Catherine took as a matter of course, provided her own love affairs were not interfered with.

Peter's foreign policy reversed that of Elizabeth He had not been on the throne for two months when he made pacific overtures to the king of Prussia, whom he habitually alluded to as "the king my master." Peter's worship of Frederick resulted in a peace (May 5) and then (June 19) in an offensive and defensive alliance between Russia and Prussia, whereby Peter restored to Prussia all the territory won from her by Russia during the last five years, and engaged to defend Frederick against all his enemies. This was followed up by a whole series of menacing rescripts addressed by Peter to the court of Vienna, in which war was threatened unless Austria instantly complied with all the demands of the king of Prussia Finally he quarrelled with Denmark, and the Russian army received orders to invade Denmark by way of Mecklenburg But before the actual collision took place news came of the coup d'état at St. Petersburg, by which Catherine (*see* CATHERINE II.) succeeded to the throne of Russia. From July 9 to July 18 Peter was in custody at the castle of Ropsha His end is uncertain, but the evidence points to his murder (July 18, 1762) by Alexius Orlov, Theodore Baryatinski, and several other persons still unknown.

See R. N. Bain, *Peter III., Emperor of Russia* (London, 1902); V. A. Bilbasov, *History of Catherine II.* (Rus), vol i (Berlin, 1900).
(R N B)

PETER (PEDRO), the name of several Spanish kings.

PETER I, king of Aragon (d. 1104), son of Sancho Ramirez, recovered Huesca from the Mohammedans in 1096.

PETER II, king of Aragon (1174–1213), son of Alphonso II, and Sancia, daughter of Alphonso VIII of Castile, had a very marked and curious personal character. As a Spanish prince he was a crusader, and took a distinguished part in the victory over the Almohades at the Navas de Tolosa in 1212. His lands to the north of the Pyrenees brought him in touch with the Albigenses and in 1213 he fought against Simon de Montfort's crusaders, moved not by sympathy with the Albigenses, but by hostility to the conquering intervention of the north under pretence of religious zeal A favourer of the troubadours, he combined great personal valour with the most lax morality He was killed at the battle of Muret (Sept. 12, 1213).

See J Forster, *Chronicle of James I of Aragon* (Trans London, 1883); F. Darwin Swift, *Life and Times of James the First the Conqueror* (Oxford, 1894).

PETER III, king of Aragon (1236–1286), son of James the Conqueror and Yolande, daughter of Andrew II of Hungary. Through his marriage with Constance, daughter of Manfred of Beneventum, he claimed Naples and Sicily from Charles, duke of Anjou, thus beginning the strife of the Angevin and Aragonese in southern Italy His conquest of Sicily earned him the surname of "the Great" He repelled an invasion of Catalonia by the French king and died Nov 8, 1286

See Ramon de Muntanez, *Chronica . . .* ed R Lanz (Stuttgart, 1844, Fr trans by Buchon, Paris, 1824–28 Coll des chroniques nationales); O. Cartellieri, *Peter von Aragon u die Sizilianische Vesper* (Heidelberg, 1904).

PETER IV, king of Aragon (d 1387), son of Alphonso IV. and Teresa d'Entença, known as "The Ceremonious" by the rigid etiquette he enforced, and as "he of the dagger" because he wounded himself in cutting to pieces the so-called "charter of the Union" which authorized the rebellions of his nobles. His life was spent in warfare. He routed his nobles at Epila (1348), re-annexed the Balearic islands, was engaged in conflict with Peter the Cruel of Castile until the accession of Henry of Trastamara (1369), conquered Sicily in 1377 and ceded it to his son Martin (d. 1410). He was three times married. to Mary, daughter of the king of Navarre; to Eleanor, daughter of Alphonso IV. of Portugal; to Eleanor, daughter of Peter II. of Sicily, by whom he had a daughter, Eleanor, whose marriage with John I. of Castile carried the crown of Aragon to the Castilian line.

See Zurita *Anales de Aragon* (Saragossa, 1610).

PETER, "the Cruel," king of Castile (1333–1369), son of Alphonso XI. and Maria, daughter of Alphonso IV. of Portugal, began to reign at the age of 16. Controlled at first by his mother, he emancipated himself with the encouragement of the minister Albuquerque, against whom he turned under the influence of his

mistress, Maria de Padilla, the one woman of his harem of whom he never became tired. In 1354 he was coerced into marrying Blanche of Bourbon, and deserted her at once. Imprisoned in the period of turmoil that ensued, he escaped from Toro to Segovia, and from 1356–66 he was master, and was engaged in continual wars with Aragon. It was at this time that he perpetrated the series of murders which made him odious, earning the reputation of monstrous cruelty indicated by his title. In 1366, attacked by Henry of Trastamara, he fled and took refuge with the Black Prince, who reinstated him. When the Black Prince left Spain, disgusted by his ally's ferocity, Peter was overthrown by Henry, with the aid of du Guesclin, in whose tent he was murdered March 23, 1369.

See P. Lopez de Avala, *Crónicas de los reyes de Castilla* . . . (Madrid, 1779–80, 2 vols); P. Merimee, *Histoire de Don Pèdre I., roi de Castille* (Paris, 1848; Eng. trans., 1849).

PETER I. (1844–1921), first King of the Serbs, Croats and Slovenes, was the eldest son of Alexander Karagjorgjević, who had been elected as Prince of Serbia on the expulsion of the Obrenović dynasty in 1842, and was therefore grandson of Kara George, the first leader of Serbian independence. His father lost his throne in 1858, and withdrew to Austria, where Peter grew to manhood. Accused of conspiring against Prince Michael Obrenović (1868), Prince Alexander transferred himself to Switzerland, and Peter made Geneva his headquarters for many years.

In 1870 he joined the French Army as a volunteer, and served with distinction in the campaign against Germany. In 1876 he joined the Bosnian insurgents against Turkey and fought under the assumed name of Peter Mrkonjić, leaving behind him a legend which had its influence on the young revolutionaries of a later generation. In 1882 he, the exiled Pretender, and not the newly proclaimed King of Serbia, was invited to attend the coronation of Tsar Alexander III., who resented Milan's dependence upon Vienna; and it was very largely due to the Tsar's personal influence that in 1883 Peter married Zorka, daughter of Prince Nicholas of Montenegro. For a time he lived at Cetinje, but after his wife's death in 1890 he again lived in Geneva.

In 1903 shortly after the murder of King Alexander and Queen Draga by a military gang, Peter was unanimously elected King of Serbia and though he was gravely embarrassed at home by the political interference of the regicides, and abroad by the odious circumstances to which he owed his accession, he set himself steadily to work for constitutional government, his tact, self-effacement and liberal outlook forming a marked contrast to the attitude of Serbia's previous rulers and contributing to the rapid political consolidation which followed the upheaval of 1903. In June 1914 ill-health forced him to entrust Crown Prince Alexander with the regency, and condemned him to a passive rôle during the World War. But the simplicity of his life, his stirring proclamations to his soldiers and the visits which he paid to the trenches in a half crippled condition, did much to encourage Serbian resistance; and he shared the privations of the great retreat across Albania, lying in a litter. After the war and his election as "king of the Serbs, Croats and Slovenes," he lived mainly in retirement at Topola and died on Aug 16, 1921 (R. W. S.-W)

PETER, FIRST EPISTLE OF. The Epistle is addressed to the elect who are sojourners of the dispersion (*diaspora*) in Pontus, Galatia, Cappadocia, Asia and Bithynia. The term "dispersion" suggests scattered Jews, but references in the epistle to their previous benighted state (i 14, ii. 9–10, iv 3) seem rather to imply that the recipients were Gentiles, and if so, the word "dispersion" is used metaphorically for Christians scattered among the heathen. The primary purpose of the writer seems to have been to strengthen the courage of these Asian Christians who were faced with persecution, and to enjoin on them such conduct as would remove all excuse for the common confusion between Christianity and crime.

The questions of date and authorship are closely connected, for many critics have maintained that the contents of the epistle imply a date subsequent to the death of St. Peter. (a) References to persecution occur in i. 6, ii. 12, iv. 12–19, v. 9; the recipients are undergoing a "fiery trial"; they have to bear reproaches, and to endure an evil reputation; they may "suffer" as do thieves and murderers, although it is not clear that death is the inevitable penalty; so severe is the trial that it must mark the beginning of the end; persecution is general, and not confined to the provinces addressed. These are very similar conditions to those implied in Pliny's letter to Trajan, and therefore it is argued that I. Peter belongs to the same period and was written long after the Apostle's death.

It is true that if we accept the tradition of Peter's death under Nero it is very difficult to suppose that these conditions existed during his lifetime. There was certainly no general persecution before Nero, and our only real authority (Tacitus) gives no hint that the Neronian persecution extended beyond the city of Rome where it was due to local causes. Systematic religious persecution was so strange to the easy tolerance of Rome that most scholars think that a considerable time must be allowed for the policy to have developed. Ramsay thinks that the Flavian emperors began systematic persecution after the Jewish war; others believe that there was nothing serious in the provinces before the reign of Domitian (81–96), and Professor Merrill (*Essays in Early Christian History*) is sceptical even about that. But the evidence of the Apocalypse seems decisive that Rome persecuted systematically in the time of Domitian, at least in Asia. I Peter appears to have been written at a time when the conditions reflected in Pliny's letter were just coming into being; the imperial authorities were manifesting hostility due to a lack of understanding, but there had been few if any martyrdoms, and the author betrays none of the ferocious resentment against Rome which characterizes the Apocalypse, indeed he still entertains a respect for the authorities not unlike that of St. Paul (I. Pet. iii 13). There is no allusion to the Emperor-worship which caused trouble in Domitian's time. On these grounds it seems possible to date the epistle roughly. The *terminus ad quem* is fixed by the full development of the Domitian policy. If Ramsay is right in connecting persecution with the Jewish war, 70 is the *terminus a quo*; if not, 85–90 is the most probable date, but the epistle must be considerably earlier than the Domitian portions of the Apocalypse. (b) It is generally agreed that the epistle has close affinities with some other early Christian works, notably the Epistle to the Romans (*q.v.*), the Epistle to the Ephesians (*q.v.*), the Epistle of James (*q.v.*), and the Epistle of Polycarp. Unfortunately the dates of some of these works are uncertain, and it is not agreed on which side is the dependence. The majority of scholars allow that in the case of Romans the dependence is on the side of Peter, and the balance of opinion favours the priority of Ephesians, though not of James. If so, the author of I. Peter wrote at a time when Romans and Ephesians were well known at least in his neighbourhood. If the Pauline authorship of Ephesians is rejected the inference must be that I. Peter was written at a time when a pseudo-Pauline epistle had had time to gain currency, and that could hardly be earlier than the second century But, as we have seen, there are difficulties in dating I. Peter after the Apocalypse. If Ephesians be a genuine work of St. Paul then I. Peter may have been written at any time after St. Paul's imprisonment. If James is dependent on I. Peter then we have an additional argument for the early date of I. Peter. The objection that Peter would not be likely to quote Paul is only forcible on the old Tubingen theory of a life-long feud between them. (c) The theology of I. Peter is simple and bears marked resemblances to that which finds expression in the early speeches in Acts. Its "Paulinism" has been much exaggerated. Jesus is the promised Messiah, and "the Spirit of Christ" is the spirit which was in the prophets. His suffering for sin had rescued the elect, and his endurance was an example for Christians faced with persecution. After death Jesus preached to "the spirits in prison." The source of Christian life is to be found in belief in God and in baptism. Christians are a royal priesthood, a holy nation, destined at the end of the world, which is close at hand, to inherit the promises. Church organization as it appears in this epistle is very simple and primitive; there are elders who shepherd the flock, but there is no trace of a developed organization. There is nothing in these facts to preclude a belief in the Petrine author-

ship of the epistle. If, in spite of tradition to the contrary, St. Peter survived the days of Nero and lived subsequently in Rome, he may well have been acquainted with some of St. Paul's letters, particularly with one written to the Romans and with another written during the Apostle's imprisonment in the city. He may have lived to see the beginnings of that persecuting policy which wrought such havoc in the time of Domitian and which we find fully established in the days of Pliny. Nor is the language difficulty serious. St. Peter had lived for many years among Greek-speaking communities, and he would doubtless employ an amanuensis. I. Peter was the first of the Catholic epistles to secure a place in the canon of Scripture, and it seems to have been widely accepted by the end of the second century. It is, however, omitted from the Muratorian canon which probably represents the opinion of Rome about A.D. 200. The omission may have been accidental, and Zahn would emend the text.

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PETER, SECOND EPISTLE OF. This epistle claims to have been written by "Simon (or Symeon) Peter, a servant and Apostle of Jesus Christ." The author, after a preliminary exhortation, declares his desire to testify again to the power of Jesus. He bases his testimony partly on his own experience "in the holy mount," and partly "on the word of prophecy." The mention of prophecy leads him to deal with the question of false prophets who are accused of false doctrine and immoral practices. In this section (ii. 1–22) is included almost the whole of the epistle of Jude (*q.v.*). The author then deals with the expectation of the *Parousia* which some were beginning to doubt. This is the main object of the letter, to attack the false prophets and to defend the certainty of the *Parousia* of the Lord.

As I. Peter was the first of the Catholic Epistles to be admitted into the canon, so II. Peter was the last. It was accepted at Alexandria in the third century, thence it passed into the canon of the church of Constantinople; but not until the fourth century was it accepted at Rome, and the Syrian church admitted it in the sixth century.

The cumulative weight of the following objections to its authenticity is generally held to disprove its claim to Petrine authorship:— (a) Origen, the first to mention it as Petrine, admits that its authorship was disputed. (b) The style, language and thought not only differ from I. Peter but from the rest of the New Testament. (c) References to immorality associated with false teaching seem to belong to a date much later than that of the Apostle Peter. (d) The incorporation of Jude makes Petrine authorship improbable. (e) The attribution of scriptural authority to the Pauline epistles (iii. 16) points to a date not earlier than the second century.

It is impossible to say when or where the epistle originated. For the date, a *terminus a quo* must be fixed by (1) the prevalence of an immoral gnosticism; (2) the attainment by the Pauline epistles of a quasi-scriptural authority; (3) the use made of the epistle of Jude, and perhaps of the Apocalypse of Peter. The *terminus ad quem* is the use of the epistle by Origen. We may say that the most probable date for its composition is the middle of the second century.

It may have been written in Egypt, where it first appears; or, as Deissmann thinks, it may have originated in Asia Minor.

The theology of II. Peter is suggestive of a late date. Christ is referred to as "our God and Saviour," and the fatherhood of God seems to be understood only in reference to the Son. The work of Christ was the redemption of the elect, and this redemption awaits its consummation in the *Parousia.* The present world will be destroyed by fire, and the wicked, whether angels or men, will be finally condemned; then will begin a new era of happiness for the elect.

BIBLIOGRAPHY.—*See* the bibliographies to PETER, FIRST EPISTLE OF, JUDE, EPISTLE OF. (P. G.-S.)

PETERBOROUGH, a city and port of entry of Ontario, Canada, and capital of Peterborough county, situated 70 m. N.E. of Toronto, on the Otonabee river and the Canadian National and Canadian Pacific railways. Pop. (1921) 20,994. The five falls of the Otonabee at this point, with a total descent of 50 ft., furnish power for a large and increasing number of manufacturing establishments, whilst its canalization as part of the Trent canal gives communication with Lake Ontario and Georgian bay. Peterborough has an electric railway, and contains important manufactories of electrical machinery and supplies, iron and steel bridges, farm implements, saw, flour and woollen mills.

PETERBOROUGH, a city and municipal borough of Northamptonshire, England, 76 m. N. from London by the L.N.E. railway; served also by the L.M.S. railway. Pop. (1921) 35,532. It is situated on the river Nene, on the western border of the Fen country.

Peterborough (*Burgh, Burgus sancti Petri*), in early days named Medehamstede, was a Saxon village before 655 when Saxulf, a monk, founded the monastery on land granted to him for that purpose by Penda, king of Mercia. Its name was altered to Burgh between 992 and 1005 after Abbot Kenulf had made a wall round the minster, but the town was not a borough until the 12th century. The burgesses received their first charter from "Abbot Robert," probably Robert of Sutton (1262–73). Until the 19th century the dean and chapter, who succeeded the abbot as lords of the manor, appointed a high baliff, and the constables and other borough officers were elected at their court leet, but the borough was incorporated in 1874. Among the privileges claimed by the abbot as early as the 13th century was that of having a prison for felons taken in the soke and borough. In 1576 Bishop Scamble sold the lordship of the hundred of Nassaburgh, coextensive with the soke, to Queen Elizabeth, who gave it to Lord Burghley, and from that time until the 19th century he and his descendants, marquesses of Exeter, had a separate gaol in Peterborough. Weaving and woolcombing were carried on in Peterborough in the 14th century. The city sent two members to parliament for the first time in 1547, but the number was reduced to one in 1885, and in 1918 the representation of the town was merged with that of the county.

The cathedral of St. Peter is the third church that has occupied the site; the first, founded under Penda, king of the Mercians, about 656, was destroyed by the Danes in 870, and the second, founded in King Edgar's reign, was accidentally burnt in 1116. The present building, founded in the following year, was consecrated on Oct. 4, 1237. It embraces eight periods of construction, and in no other building can the transition be better studied through the various grades of Norman to Early English, while the later addition is Perpendicular.

The erection proceeded as usual from east to west, and, while an increase in elaboration is observable in the later parts, the character of the earlier buildings was kept so that no sense of incongruity is produced. A series of uniform Decorated windows were added in the 14th century. The early Norman choir, terminating in an apse, was founded in 1117 or 1118 by John de Sais or Sez, and dedicated in 1140 or 1143; the aisles of both transepts and the whole of the south transept were built by Martin of Bec, 1140–55; the remaining portions of the transepts and the central tower, of three stories, were completed by William de Waterville, 1155–75; the nave, late Norman, was completed by Abbot Benedict, 1177–93, who added a painted roof of wood; the western transepts, transitional Norman, were the work of Abbot Andrew, 1193–1200; the western front, actually a portico of three arches, was probably built between 1200 and 1250. The lady chapel, built parallel with the choir, was consecrated in 1290; the bell-tower was erected between 1260 and 1274; the south-west spire, the pinnacles of the flanking tower of the west portal, and the enlargement of the windows of the nave and aisles in the beginning of the 14th century; the "new building" or eastern chapel in the Perpendicular style, begun in 1438, was not completed till 1528. In 1541 the church was converted into a cathedral, the abbot being made the first bishop. In 1643 the building was defaced by the soldiers of Cromwell. To obtain materials for repairs

the lady chapel was taken down. In the latter part of the 18th century the church was repaved and in 1831 further restoration took place. On account of the insecure state of the central tower in 1883 it was taken down, and reconstructed as it stood except for the four corner turrets added early in the 19th century.

In 1895 the restoration of the west front and other parts was begun; during this restoration the site of the cruciform Saxon church, enclosed within a crypt under the south transept, was discovered. Catherine of Aragon was interred in the cathedral in 1536, and Mary Queen of Scots in 1587, but the body of the Scottish queen was removed to Westminster Abbey in 1612. The cathedral is approached by a Norman gateway, above which is the chapel of St. Nicholas, built by Abbot Benedict, and on the left the chapel of St. Thomas à Becket, built by Abbot Ashton in the 15th century as it stands, but originally Norman. The gateway to the bishop's palace, formerly the abbot's house, was built in 1319, and the deanery gate about 1520. One of the canonry houses is formed partly from a hall of the 13th century.

Peterborough is included for civil purposes in the parish of St. John the Baptist, but for ecclesiastical purposes it is divided into four, the additional parishes being St. Mary's Boongate (1857), St. Mark's (1858) and St. Paul's (1869). The old parish church of St. John originally stood to the east of the cathedral, but was rebuilt on its present site in the centre of the city (1401–07) in Perpendicular style. The educational establishments include the Henry VIII. grammar or chapter school, which used the chapel of St. Thomas à Becket until 1885; and Deacon's and Ireland's charity school, established in 1721 for the clothing and educating of 20 poor boys. The principal public building is the market house (1671), used as a town-hall. The modern prosperity and rapid growth of the town are chiefly due to the trade caused by the junction of so many railway lines. Adjoining the town are extensive railway works. The principal manufactures are of agricultural implements, bricks and tiles. There is trade in agricultural produce. The municipal borough was incorporated in 1874. The soke or liberty of Peterborough, with a population (1921) of 53,464, constitutes a separate administrative county (1888). The diocese of Peterborough includes the whole of Rutland, nearly all Leicestershire and Northamptonshire, and small portions of Derbyshire and Huntingdonshire.

PETERBOROUGH AND MONMOUTH, CHARLES MORDAUNT, 3RD EARL OF (*c.* 1658–1735), English soldier and statesman, son of John Mordaunt, created Viscount Mordaunt of Avalon and Baron Mordaunt of Reigate, in 1659, and Elizabeth Carey. He served in the Navy and then became a Whig and keen opponent of James II. In Holland in 1686 he proposed to William of Orange the invasion of England; and, later, when William was king, Mordaunt was made a privy councillor, first lord of the treasury, and earl of Monmouth. Against the king's wishes, he introduced a bill for triennial parliaments in 1693, and in 1697 he was sent to the Tower on the ground of complicity in Sir John Fenwick's conspiracy. Soon after, on the death of his uncle, Henry Mordaunt, he became earl of Peterborough.

In the reign of Anne he drew down on himself in 1702 the censure of the Commons for his action in trying to secure the return of his nominee at Malmesbury, and was sent off in 1705 to command an expedition in Spain. He besieged Barcelona and in 1706 entered Valencia in triumph. It is difficult to understand the action of Peterborough during this campaign, unless on the supposition that he was out of sympathy with the movement for placing the Austrian prince Archduke Charles on the throne of Spain. He was recalled to England to explain his conduct and joined the Tories in 1707. The differences between the three peers, Peterborough, Galway and Tyrawley, who had served in Spain, caused angry debates in the Lords, but the majority declared for Peterborough, and votes of thanks were passed to him in 1708. He next went to Vienna, where he engaged the ministry in pledges of which they disapproved. Nevertheless, he was made a Knight of the Garter. With the accession of George I. Lord Peterborough's influence was gone, and he died at Lisbon on Oct. 25, 1735.

Short in stature and spare in habit, he was of fierce and turbulent disposition. He is said to have seen more kings than any man in Europe, and the point of Swift's lines on "Mordanto" consists in a description of the speed with which he hastened from capital to capital. He was eloquent in debate and intrepid in war, but his influence was ruined by inconsistency and his want of union with his colleagues. His first wife, Carey, daughter of Sir Alexander Fraser of Dores, Kincardineshire, died in 1709. In 1722 he secretly married Anastasia Robinson, a famous singer of great beauty and sweetness; but she lived apart from him (regarded as his mistress), and it was only shortly before his death that she was acknowledged as the countess of Peterborough.

BIBLIOGRAPHY.—*See* the life by William Stebbing (1890), and the *War of the Succession in Spain,* by Colonel the Hon. Arthur Parnell (1905). The earlier lives are founded on the memoir of Captain George Carleton (1728), which was dismissed as a fictitious narrative inspired by Swift, in the *Eng. Hist. Rev.* (1891), vi. 97–151.

PETER DES ROCHES (d. 1238), bishop of Winchester under John and Henry III., was a Poitevin by extraction. He received the office of chamberlain towards the close of Richard's reign, and under Richard's successor became an influential counsellor. In 1205 he became bishop of Winchester, and though his election was disputed, it was confirmed by Pope Innocent III., who honoured Peter by consecrating him in person. None the less, the bishop stood by his royal patron during the period of the interdict and during the struggle with the barons. In 1213 he was made justiciar in succession to Geoffrey Fitz Peter. At the battle of Lincoln (1217) Peter led a division of the royal army and earned some distinction by his valour; but he played a secondary part in the government so long as William Marshal held the regency. After Marshal's death (1219) Peter led the baronial opposition to Hubert de Burgh, with varying success. At first the justiciar was successful. In 1221 Peter meditated going on crusade; 1223–1224 saw his party broken up by Hubert's energetic measures; in 1227 was himself dismissed from his office and left England to join the crusade of the emperor Frederick II. He was absent from England until 1231; but in the meantime enhanced his reputation both as a soldier and diplomatist. After the fall of De Burgh he kept in the background, but offices and honours were heaped on his dependants. This foreign party triumphed over the revolt which was headed by Richard Marshal in 1233. But the primate, Edmund Rich, denounced Peter as a mischief maker, and demanded his dismissal. Peter was permitted to leave the country with a pardon (1235); he conciliated Gregory IX. by rendering efficient aid in a war with the citizens of Rome (1235); and in the next year returned without molestation to his see. Peter died in 1238, and was buried at Winchester.

See C. Petit Dutaillis, *Vie et règne de Louis VIII.* (Paris, 1894); Lecointre Dupont, *Pierre des Roches* (Poitiers, 1868); Stubb's *Constitutional History of England,* vol. ii.; H. W. C. Davis, *England under the Normans and Angevins* (1905); T. F. Tout in the *Political History of England,* vol. iii. (1905).

PETERHEAD, a burgh and seaport of Aberdeenshire, the most easterly town in Scotland. Pop. (1921) 13,126. It is situated about 33 m. by road E.N.E. of Aberdeen and 44¼ m. by rail, on the L.N.E.R. The town is built of locally quarried red granite. A statue to Field Marshal Keith (born at Inverugie Castle, 2 m. N.W. in 1696), was presented to the burgh in 1868 by William I. of Prussia, afterwards German emperor. Peterhead formerly had an extensive foreign trade, and seal and whale fisheries, now practically extinct. It is, however, an important station of the herring fisheries and head of a fishery district, with a large herring fleet and a busy local trade. The north and south harbours lie between the town and Keith Inch—a suburb—and the isthmus dividing them is pierced by a canal. In the north harbour are two graving docks (21 acres). In addition to granite quarrying and polishing, the leading industries are ship-building and fish-curing. A mile south is the convict prison for Scotland. A large harbour, for which the breakwater extends from Boddam point north across the bay, was built by convict labour.

The town and lands belonged of old to the Abbey of Deer, built in the 13th century by William Comyn, earl of Buchan; but when the abbey was erected into a temporal lordship in the family of Keith the superiority of the town passed to the earl marischal, with whom it continued till the forfeiture of the earldom in 1716. The town and lands were purchased in 1720

by a fishing company in England and, on their failure, by the Merchant Maidens' Hospital of Edinburgh for £3,000, who are still the overlords. Peterhead, made a burgh of barony in 1593 by George Keith, fifth earl marischal, was the scene of the landing of the Pretender on Christmas Day 1715.

PETERHOF, a town of Russia in the Leningrad province, in 59° 52′ N., 29° 53′ E., on the south coast of the Gulf of Finland. It was founded in 1711, and grew, as a summer residence of the court, round the palace built by Peter the Great in 1720. Its palaces and gardens illustrate two centuries of imperial architectural taste; the numerous fountains are famous. Pop. (1926) 8,925. The ancient gem-cutting industry still flourishes.

See *Guide to the Soviet Union* (Moscow, 1925, in English).

PETER LOMBARD (*c.* 1100–*c.* 1160), bishop of Paris, better known as *Magister sententiarum,* the son of obscure parents, was born about the beginning of the 12th century, at Novara (then reckoned as belonging to Lombardy). After receiving his education at Bologna, he removed to France, bearing a recommendation to Bernard of Clairvaux, who first placed him under Lotolf at Reims, and afterwards sent him to Paris with letters to Gilduin, the abbot of St. Victor. He obtained a theological chair in the cathedral school. His famous textbook, the *Sententiae,* was written between 1145 and 1150. In 1159 he became bishop of Paris. According to one account he died on June 20, 1160.

His famous theological handbook, *Sententiarum libri quatuor,* is, as the title implies, primarily a collection of opinions of the fathers, "sententiae patrum." These are arranged into four books, of which the first treats of God, the second of the creature, the third of the incarnation, the work of redemption, and the virtues, and the fourth of the seven sacraments and eschatology. The most important thing in the book was its crystallization of the doctrine concerning the sacramental system, by the definite assertion of the doctrine of the seven sacraments, and the acceptance of a definition of sacrament, not merely as "a sign of a sacred thing," but as itself "capable of conveying the grace of which it is the sign." The sentences soon attained immense popularity, ultimately becoming the textbook in almost every theological school, and giving rise to endless commentaries, over 180 of these being written in England. In 1300 the theological professors of Paris agreed in the rejection of 16 propositions taken from Lombard, but their decision did not obtain universal currency.

Besides the *Sententiae,* Lombard wrote numerous commentaries (*e.g.,* on the Psalms, Canticles, Job, the Gospel Harmony, and the Pauline Epistles), sermons and letters, which still exist in ms. The *Glossae seu commentarius in psalmos Davidis,* were first published at Paris in 1533.

Lombard's collected works have been published in J. P. Migne's *Patrologie latine,* Tomes 191 and 192. *See* also Denifle and Chatelain, *Chartularium universitatis parisiensis,* Tome i. (Paris, 1889); Protois, *Pierre Lombard, son époque, sa vie, ses écrits, son influence* (Paris, 1881); Kögel, *Petrus Lombard in seiner Stellung zur Philosophie des Mittelalters* (Leipzig, 1897); A. Harnack, *Dogmengeschichte,* Bd. iii. (1890; Eng. trans. 1894–1899); and the article in Herzog-Hauck's *Realencyklopädie,* Bd. xi. (Leipzig, 1902).

PETERLOO, or the Manchester Massacre, a name given to a meeting held on Aug. 16, 1819, in St. Peter's Fields, Manchester. Its object was to demand the reform of parliament and it was attended by about 60,000 persons, including an unusually large proportion of women and children. None were armed and their behaviour was admittedly wholly peaceable, but the magistrates, who were in a nervous condition, ordered the Manchester yeomanry to seize the speakers immediately after the meeting had begun. The yeomanry, who were untrained Manchester business men, did not confine themselves to arresting the leaders, but made a general attack upon the audience, crying "Have at their flags," and cutting them down with the edge as well as the flat of their sabres. The chairman of the bench of magistrates thereupon ordered the 15th Hussars and the Cheshire yeomanry also to charge the crowd, and in ten minutes the place was cleared except for bodies, "some still groaning, others with staring eyes, gasping for breath; others will never breathe more; all silent save for those low sounds and the occasional snorting and pawing of steeds." The numbers of killed and wounded were disputed; 600 authenticated cases are known. The indignation caused by the behaviour of the yeomanry and its endorsement by the government contributed largely to the ultimate success of the reform movement. A Peterloo medal, now rare, was struck, bearing the legend "The wicked have drawn out the sword, they have cut down the poor and needy and such as be of upright conversation" (Ps. xxvii., 14).

See *Memoirs of H. Hunt, Esq.* (1820–22); S. Bamford, *Passages in the Life of a Radical* (1893); F. A. Bruton, *Story of Peterloo* (1919); and *Three Accounts of Peterloo* (1921). (R. W. P.)

PETER OF BLOIS [Petrus Blesensis] (*c.* 1135–*c.* 1205), French writer, the son of noble Breton parents, was born at Blois. In 1167 he went to Sicily, where he became tutor to the young king William II., and keeper of the royal seal. He made many enemies and soon asked permission to leave the country, returning to France about 1170. Peter entered the employ of Henry II. of England about 1173. He became archdeacon of Bath and soon afterwards chancellor, or secretary, to Richard, archbishop of Canterbury, and to Richard's successor, Baldwin, being sent on two occasions to Italy to plead the cause of these prelates before the pope. After the death of Henry II. in 1189, he was for a time secretary to his widow, Eleanor, in Normandy; he obtained the posts of dean of Wolverhampton and archdeacon of London. He died some time after March 1204.

Peter's writings fall into four classes, letters, treatises, sermons and poems. His *Epistolae,* collected at the request of Henry II., are an important source for the history of the time; they are addressed to Henry II., and to various prelates and scholars, including Thomas Becket and John of Salisbury. His treatises include *De Ierosolymitana peregrinatione acceleranda,* an exhortation to take part in the third crusade, and *Dialogus inter regem Henricum II. et abbatem Bonaevallensem;* his extant sermons number 65 and his poems are unimportant. Peter's works have been printed in several collections, including the *Patrologia* of J. P. Migne and the *Historiae francorum scriptores* of A. Duchesne. Of separate editions the best are those by Pierre de Goussainville (Paris, 1667) and J. A. Giles (Oxford, 1846–1847).

See the *Histoire littéraire de la France,* Tome xv.; W. Stubbs, *Lectures on Mediaeval and Modern History* (Oxford, 1886); Sir T. D. Hardy, *Descriptive Catalogue of Materials relating to the History of Great Britain* (1862–1867), and C. L. Kingsford in vol. xlv. of the *Dict. Nat. Biog.*

PETER OF COURTENAY (d. 1219), emperor of Romania (or Constantinople), was a son of Peter of Courtenay (d. 1183), and a grandson of the French king, Louis VI. Having, by a first marriage, obtained the counties of Nevers and Auxerre, he took for his second wife, Yolande (d. 1219), a sister of Baldwin and Henry of Flanders, who were afterwards the first and second emperors of the Latin Empire of Constantinople. Peter accompanied his cousin, King Philip Augustus, on the crusade of 1190, fought against the Albigenses, and was present at the battle of Bouvines in 1214. When his brother-in-law, the emperor Henry, died without sons in 1216, Peter was chosen as his successor. Consecrated emperor at Rome, in a church outside the walls, by Pope Honorius III. on April 9, 1217, he borrowed some ships from the Venetians, promising in return to conquer Durazzo for them; but he failed in this enterprise, and sought to make his way to Constantinople by land. On the journey he was seized by the despot of Epirus, Theodore Angelus, and, after an imprisonment of two years, died, probably by foul means.

See Gibbon, *Decline and Fall of the Roman Empire* (ed. Bury. London, 1912), Vol. 5., p. 448–449. E. Gerland, *Geschichte des lateinischen Kaiserreiches von Constantinopel,* Vol. i. (1905).

PETER OF SAVOY (*c.* 1203–1268), earl of Richmond, younger son of Thomas I. (Tommaso), count of Savoy, was born at Susa. After spending some years as an ecclesiastic, he resigned his preferments, and in 1234 married his cousin Agnes, daughter and heiress of Aymon II., lord of Faucigny. On the invitation of the English king, Henry III., who had married his niece, Eleanor of Provence, Peter came to England in 1240, and was created earl of Richmond, receiving also large estates and being appointed to several important offices. During several visits to the continent of Europe Peter increased his possessions in the Vaud district, and returning to England in 1252 he became associated with Simon de Montfort, retaining at the same time the king's friendship. He was employed by Henry to negotiate with the pope and

Louis IX. of France, but supported Earl Simon in his efforts to impose restrictions upon the royal power. He went over to Henry's side in 1260, and was consequently removed from the council. In 1263 he left England, and when his nephew, Boniface, count of Savoy, died in the same year he assumed the title of count of Savoy. This was also claimed by another nephew, Thomas; but Peter compelled the inhabitants of Turin to submit to him and secured possession of the county. He died on May 16, or 17, 1268, leaving an only child, Beatrice (d. 1310). Peter gave his name to the Savoy palace in London.

See L. Wurstemberger, *Peter der Zweite, Graf von Savoyen* (Zürich, 1858); F. Mugnier, *Les Savoyards en Angleterre* (Chambéry, 1890); and C. Bémont, *Simon de Montfort* (Paris, 1884).

PETERS or **PETER, HUGH** (1598–1660), English Independent divine, was educated at Trinity college, Cambridge, where he graduated M.A. in 1622. He took Anglican orders, and was appointed lecturer at St. Sepulchre's, but his unorthodox opinions drove him to the Continent, where he remained till 1635. In this year he sailed for America, where he already had connections, and he became minister at Salem, Massachusetts. He played a leading part in the affairs of the colony and in the founding of Connecticut. Returning to England as agent for the new colony in 1641, he became involved in political matters. He was chaplain to the force of adventurers in Ireland, served in Lord Forbe's expedition, and in the campaigns of 1645 and 1646, and by his eloquence is said to have materially assisted the parliamentary cause. Although an influential leader of the Independents, Peters was disliked by the Presbyterians. He supported the army in its quarrel with parliament, and in 1649 he accompanied Cromwell to Ireland and was present at the fall of Wexford; also the battle of Worcester. Appointed chaplain to the Council of State (1650), he preached at Whitehall continually during the protectorate, and gained much influence. In 1652–53 he protested against the Dutch war, and was severely reprimanded. Soon after he retired from public life. At the Restoration, however, he was specially exempted from the Act of Indemnity, and being tried for abetting the execution of Charles I., he was found guilty and executed at Charing Cross on Oct. 16, 1660.

Peters was the author of several tracts, and his accounts of battles and sieges are valuable.

PETERS, KARL (1856–1918), German explorer, one of the founders of German East Africa, was born at Neuhaus on the Elbe on Sept. 27, 1856, the son of a Lutheran clergyman. He studied at Göttingen, Tübingen and Berlin. After visiting London to study English principles of colonization, he returned to Berlin and promoted the German Colonization Society (*Deutsche Kolonialverein*). In the autumn of 1884 he proceeded with two companions to East Africa, and concluded in the name of his society treaties with the chiefs of Useguha, Nguru, Usagara and Ukami. Returning to Europe early in 1885, he formed the German East Africa Company, which obtained an imperial charter. In 1888 Peters undertook an expedition from the east coast of Africa, avowedly for the relief of Emin Pasha. This expedition was not sanctioned by the German government and was regarded by the British authorities as a filibustering exploit. One of its objects was to extend the sphere of German influence, and, reaching Uganda early in 1890, Peters concluded a treaty with the king of that country in favour of Germany. He left Uganda hastily on the approach of a representative of the British East Africa Company, and on reaching Zanzibar learned that his treaty was useless, as an agreement had been come to between Germany and Great Britain whereby Uganda was left in the British sphere. On his return to Germany Peters was received with great honours, and in 1891 published an account of his expedition entitled *Die deutsche Emin Pasha Expedition* (Eng. trans. *New Light on Dark Africa* 1891). In 1891 he went out again to East Africa as imperial high commissioner for the Kilimanjaro district, and in 1892 was one of the commissioners for delimiting the Anglo-German boundary in that region. In June 1892 accusations were brought against him of excesses in his treatment of the natives, and after three investigations had been held he was, in 1897, deprived of his commission for "misuse of official power." (He was regranted his title of imperial commissioner in 1906.) During 1893–1895 Peters was employed in the colonial office at Berlin. In 1896 he removed to London, where he occupied himself in schemes for exploiting parts of Rhodesia and Portuguese East Africa. In the interests of a company he formed, Peters explored the Fura district and Macombe's country on the Zambezi, where in 1899 he discovered ruins of ancient cities and deserted gold mines. He returned in 1901 and gave an account of his explorations in *Im Goldland des Albertums* (1902), Eng. trans. *The Eldorado of the Ancients* (1902). In 1905 he again visited the Zambezi and Sabi rivers. He died on Sept. 9, 1918.

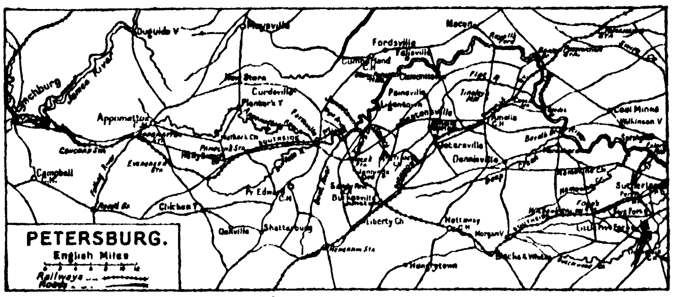
See his disquisition on early gold production entitled *Das goldene Ophir Salomo's* (1895), Eng. trans. *King Solomon's Golden Ophir* (1899); and his autobiography, *Lebenserinnerungen* (1918). *See* also H. T. Schorn, *Dr. Carl Peters* (1920).

PETERSBURG, a city and a port of entry of Virginia, U.S.A., at the head of navigation on the Appomattox river, 10 m. from the James, and 22 m. S. of Richmond; in Dinwiddie county, but administratively independent. It is on Federal highways 1 and 17-1, and is served by the Atlantic Coast Line, the Norfolk and Western and the Seaboard Air Line railways, and river steamers. Pop. 31,012 in 1920 (44% negroes); estimated at 37,800 in 1928. Petersburg is a city of much historic and scenic interest, and also a progressive modern community, with a commission-manager form of government, an active public-health centre, hydro-electric power, banks with resources of over $22,000,000, wholesale houses doing an annual business approximating $20,000,000, a factory output in 1925 valued at $17,342,476 and an assessed valuation for 1927 of $29,495,141. It is a shipping point for tobacco, peanuts and lumber; is one of the principal trunk-manufacturing centres of the country; makes more than 4,000,000,000 cigarettes annually and 6,000,000 lb. of plug and twist tobacco for export; and cures, steams and orders about 4,000,000 lb. of cigar tobacco. On Center Hill is a fine old mansion (1825) which was the headquarters of Gen. Hartsuff in 1865. From its lawn can be seen the several houses which served as headquarters for Cornwallis, Lafayette and Lee. Many monuments and tablets mark historic sites and commemorate historic events. In the suburb of Blandford (once the most fashionable residential section) is the Bristol Parish church, built in 1736, abandoned in 1800 and restored since 1901 as a memorial to the Southern soldiers buried around it. Veterans of four wars rest in the churchyard, and the oldest stone bears the date 1702. Adjoining it is the Confederate cemetery, with 30,000 graves. Two national cemeteries (at Poplar Grove, 4 m. S., and at City Point, 9 m. E.) contain about 12,000 graves. At Ettrick, across the river from Petersburg, is the Virginia Normal and Industrial institute for negroes (1883) and a mile west is the State hospital for the coloured insane. Petersburg is the seat also of the Bishop Payne Divinity school (Protestant Episcopal) for negroes and charitable institutions for white and for coloured.

In 1645 Ft. Henry was built at the falls of the Appomattox, within the present boundaries of Petersburg. A trading post was established in 1733 by Maj. Peter Jones (a companion of Col. William Byrd), after whom it was called Peter's Point, and later Petersburg. It was incorporated as a town in 1748 and as a city in 1850. On April 25, 1781, the British occupied Petersburg, but they were dislodged by Lafayette in the following month. At the opening of the Civil War the city had a population of 18,266. Both armies considered it a strategic point, and important operations took place in the vicinity in 1864–5. (*See* below.) Many of the fortifications still remain. During the World War, Camp Lee, 3 m. E. of the city, was one of the largest training camps, and at Hopewell there were munitions plants employing 30,000 persons.

PETERSBURG CAMPAIGN (1864–65). The name of Petersburg is associated with operations in the American Civil War, which formed the sequel of the Wilderness Campaign (*q.v.*) and the last act in the struggle between the armies of Grant and *Lee* for supremacy. Petersburg and Richmond, Virginia, connected by rail and covered north, east and south by 40m. of entrenchments, formed the salients of a vast fortress, into which reinforcements and supplies could be poured from the rear by means of the James canal, the Virginia Central, the Lynchburg, the Dan-

ville and the Weldon railroads—the latter bringing up to Petersburg from Wilmington (225m. distant) the cargoes of blockade runners. Petersburg became a strategic point as soon as Grant determined to carry the army of the Potomac—defeated at Cold Harbor on the Chickahominy (*see* WILDERNESS CAMPAIGN)—south of Richmond, and, being joined by Butler's Army of the James (momentarily checked in the Bermuda Hundred peninsula



LEE'S RETREAT

by a small army under *Beauregard*), to operate from the east, depending on the James river as his line of supply. The policy of the Confederate president was to employ *Robert E. Lee's* army to protect his capital. Petersburg was nearer than Richmond to the navigable part of the James river—City Point is only 10m. distant—and the capture of Petersburg would involve the fall of Richmond and the capitulation or flight of *Lee's* army.

As early as June 9, 1864, while the main armies were still north of the James and Petersburg was garrisoned by a brigade under Gen. *Wise*, a Federal expedition from the Army of the James approached the city. The column on the City Point road discovered strong earthworks, and that on the Jerusalem Plank road experienced a repulse: the total force of the Federals was 4,500, and *Wise's* brigade (2,400) had been quickly reinforced from *Beauregard's* central position at Bermuda Hundred. A week later a more serious attempt was made to break through the defences, while Gen. *Lee's* main army was detained north of Richmond. Grant detached the II. and XVIII. Corps under Generals Smith and Hancock, who were to unite and operate along the City Point railroad and capture the outer line of works about 2m. from Petersburg while a demonstration was made along the Norfolk railroad by cavalry under Kautz. On June 15 Smith attacked and captured five redans before Hancock came up, and when next day Burnside's corps (IX.) arrived and Gen. Meade assumed control of the three corps, he attacked again at 6 P.M. On June 17 Warren's (V.) corps arrived, and Meade made a third assault with two corps (V., IX.). On June 18 the attack was renewed with three corps (II., V., IX.) late in the afternoon, and the results of the four days' fighting were so far satisfactory that ground was won which could be entrenched and held against any sortie of the Petersburg garrison. Probably on June 18 the town of Petersburg might have been captured by Meade, for at this crisis *Lee* was in temporary eclipse.

It was late on June 17 when *Beauregard*, who had for three days valiantly held his main lines south of Richmond with some 14,000 infantry against three Federal corps, succeeded in convincing *Lee* that the main army was in the wrong place. But when at last the Confederate leader was aroused to a sense of his danger he soon filled every road with divisions marching to save Petersburg: they marched all night; they slept in the trenches on arrival, and on June 19 these reinforcements convinced Meade that his main attack between the Appomattox river and the Jerusalem Plank road was delivered a day too late. At a cost of 10,000 casualties Meade had gained half a mile of ground, but the Confederates in falling back had concentrated, and now that the new plan of operations was exposed and the main bodies were again face to face the power of defensive tactics reasserted itself.

Yet June was not to close without adding some 8,000 men to the Federal casualties, for in addition to daily losses by sharpshooting along the front, over 5,000 men fell or were captured in operations directed against the southern railroads. Grant had resolved to deprive his enemy of these lines of supply: his plan was to prolong his line of investment westward and construct redoubts (such as Fort Davis, Fort Stedman and Fort Sedgwick) as a continual menace to the Confederate garrison and a defence against sorties, while his cavalry and portions of five corps (II., V., VI., IX. and XVIII.) engaged in enterprises which it was hoped would tempt *Lee* to fight outside his works. A decisive victory in the field, a successful assault on the defences between Richmond and Petersburg, or the complete destruction of the railroads, would precipitate disaster to the South, and of these three methods the last would be the surest in its effects. But such a method was necessarily slow. Wilson's cavalry (5,500) destroyed 30m. of the Lynchburg or South Side railroad, and 30m. of the Danville railroad, together with Burkesville junction and Ream's station on the Weldon railroad; but Wilson was caught by the Confederate cavalry 100m. from Petersburg and escaped only by destroying his wagons and limbers and abandoning 12 guns. Even the Virginia Central railroad could not be held by the Federals after Sheridan with the main body of the cavalry had been called back to White House on the Pamunkey to escort a great convoy.

By the end of June the whole of the rival forces were concentrated about the Richmond-Petersburg defences, and Gen. *A. P. Hill* had already sallied out on June 21 to drive the II. Corps from the Weldon railroad. Federal policy and Federal strategy, surmounting the crisis of Cold Harbor, were, however, at last in unison. Grant had a free hand in respect both of his dispositions and his resources in men and money, and had resolved to use unsparingly the resources placed at his disposal.

On July 25 Grant resolved to weaken the enemy on his front by a demonstration north of the James, and accordingly moved a corps (II.) and two cavalry divisions across the river to Malvern hill under cover of Foster's corps (X.). But *Lee* possessed the inner line, and the Federal detachment found two cavalry divisions in its front, and the Richmond defences had been

strengthened by three divisions of infantry. The expedition then returned to take part in a fresh enterprise, which ended disastrously to the Federals. A Confederate redan faced Burnside's IX. corps 100yds. distant, and this strong work was to be destroyed by mining operations. The mine was fired and produced a crater 150ft. long, 60ft. wide and 25ft. deep, into which the Federals poured (*see* FORTIFICATION AND SIEGECRAFT). But the troops could be got no farther before the Confederate counterattack was upon them, and Burnside's corps lost 4,300 men.

In Aug. Sheridan was detached to operate against *Early* in the

Shenandoah valley, and in order to prevent *Lee* reinforcing *Early* another demonstration against Richmond was planned. But *Lee* again strengthened his left and the result of the fighting was a loss to the Federals of nearly 3,000 men. Meanwhile another attack on the Weldon railroad by Warren's corps was met by *A. P. Hill* on Aug. 20, and the possession of the railroad cost the Federals 3,000 men. A further attempt on this railroad by Hancock's II. Corps and Gregg's cavalry division at a point 3m. south of Ream's Station was foiled by *A. P. Hill*, now aided by *Hampton's* two cavalry divisions, and the Federals here lost 2,372 men and nine guns. The Confederates, therefore, still retained possession of the railroad to a point within one day's hauling by wagon to Petersburg. During Sept. another Federal enterprise north of the James with two corps (X. and XVIII.) resulted in the capture of Fort Harrison near Chaffin's Bluff, and when *Lee* reinforced his left and counter-attacked his troops were repulsed with heavy loss. The Federals lost over 2,000 men and failed in the attempt to take Fort Gilmer, Confederate gunboats below Richmond aiding in the defence. While this operation was in progress on the Confederate left under Grant's personal supervision *Lee* was apprised of attacks on his extreme right at Peebles farm by four divisions, which captured a Confederate redoubt covering the junction of two routes to the south-west. *A. P. Hill* prevented a further advance of the enemy by a vigorous counter-attack which caused Warren and Parke (IX.) a loss of 2,000 men, of whom nearly three-fourths allowed themselves to be captured; for the ranks, since the losses of the May battles, had been swamped with drafted and substitute recruits of poor quality and almost insignificant training. The Federals had, however, by these operations pushed their entrenchments beyond the Weldon railroad westward and established new works within a mile of the Confederate right. At the end of Oct. Grant resolved to make a serious effort to bring the South Side railroad within his lines and deprive the enemy of this important line of supply. Parke (IX.), Warren (V.) and Hancock (II.) took each some 11,000 infantry with four days' rations on pack animals. Gregg's cavalry (3,000) were attached for the operation, and both Grant and Meade accompanied the troops. *A. P. Hill* encountered this force with three divisions (14,000) and Hampton's cavalry (5,500), and he contrived to hold two corps with one division and attack Hancock (II.) with his main body. The Federals were stopped when 6m. from the railway.

Lee meanwhile had been called to Chaffin's Bluff, where again Butler was demonstrating with the Army of the James on the approaches to Richmond. But *Longstreet* signalized his return to duty with the Army of Northern Virginia by driving Butler off (Oct. 27). In Dec., however, Warren contrived to evade *A. P. Hill* and destroy the Weldon railroad at a point on the Meherrin river 40m. from Petersburg.

There seemed now little to tie *Lee* to the lines he had so painfully constructed, for his army was without coffee, tea or sugar, and though of foreign meat they had 3½ million rations and of bread 2½ million rations in reserve, the troops lived chiefly on cornbread. *A. P. Hill* on the right held on from Hatcher's Run to Fort Gregg, whence *Gordon* and *Anderson* prolonged to the left as far as the Appomattox river, and *Longstreet* continued the line northwards along the Bermuda front across the James as far as White Oak swamp (37m. in all). The winter was very severe, and the continual trench-work and outpost duty overtaxed the patriotism of *Lee's* 50,000 infantry and stimulated desertion. Supplies were brought in by wagons, as the rolling stock on the railways was worn, and on Feb. 5, 1865, Gen. Gregg moved out to the Boydton Plank road to intercept the Confederate convoys. Gregg failed to locate the wagons, and *Lee*, hearing of the expedition, sent out a force which drove him back. Sheridan, after driving *Early* from the Valley in Oct., destroyed the railways about Staunton, Charlottesville, Gordonsville and Lynchburg, and even rendered the James canal useless as a line of supply.

Grant recalled Sheridan to the main army in March, and at the end of the month prepared for a turning movement westward with the object of drawing *Lee* out of his lines. *Lee* had anticipated such an attempt, and had resolved to abandon his lines and unite with Johnston in North Carolina, but the roads were not yet in a state for the movement of artillery and wagons, and it was to gain time that he now ventured upon a bold offensive stroke—a night attack upon a strong point in the Federal right called Fort Stedman—the success of which might cause Grant to call in the detachments on his left and so facilitate the proposed movement of the Confederates towards Danville. Gen. *Gordon* was selected to conduct the operation and his corps was strongly reinforced for the occasion. The opposing lines east of Petersburg were only 150yds., and the sentries of each side 50yds. apart. *Gordon's* men dashed across the intervening space at 4:30 A.M. on March 25, surprised the garrison and occupied Fort Stedman, but when daylight broke and the Federal guns could be brought to bear the fort was found to be untenable. Parke's corps (IX.) recaptured the work at a cost of 1,000 men, and *Gordon* fell back, leaving nearly 2,000 men in the hands of the Federals.

At this time Sherman visited Grant at City Point and proposed to move at the end of ten days on Burkesville junction and so cut off *Lee* from Danville and Lynchburg; it was while Sherman was preparing for this operation that Grant finished the campaign. Secure behind his formidable entrenchments, Grant had no fear for his base on the James river, and transferred large bodies of troops to his left without *Lee's* knowledge. Sheridan was instructed on March 29 to gain the enemy's right and rear, moving by Dinwiddie Court-House and across Hatcher's Run. But the Confederates were on the alert and quick to extend their right. Sheridan got into a flat country of dense forest, tangled undergrowth, streams and swamps, and the soil of clay and sand was impassable for wagons and guns until he had corduroyed the route. On March 29 *Lee* perceived that the object of Grant was to seize the routes south of the Appomattox river, by which a movement south-west could be made to unite with Johnston's army, and he endeavoured to cover these roads, including the South Side railway, without losing his hold upon his works about Richmond and Petersburg, but in such a contest it was evident that numbers must prevail.

Sheridan's cavalry had reached Five Forks on the White Oak road on March 31, and on his right Humphreys and Warren (II. and V.) held the Confederates to their works along Hatcher's Run astride the Boydton Plank road; yet *Lee* was able to concentrate his three cavalry divisions, and supported them by *Pickett's* five infantry brigades. Sheridan was attacked and driven south as far as Dinwiddie Court-House; but Humphreys and Warren held their ground (action of White Oak ridge) at a cost of 2,000 men. *Pickett* and the cavalry fell back to Five Forks during the night and hastily entrenched, for he had been ordered to defend this position; since the Boydton Plank road could no longer be held, the possession of White Oak road and the South Side railway became necessary for the flank movement which *Lee* had resolved to attempt. Grant meanwhile had ordered Warren to support Sheridan in an attack on *Pickett* at daybreak. Sheridan advanced on April 1 and at 3 P.M. issued his orders for attack, explaining verbally a diagram he had prepared for the use of divisional commanders. *Pickett* held a front of 2m. with a division of cavalry on either flank and *Rosser's* cavalry guarding the baggage behind Hatcher's Run, and when attacked at 4 P.M. he was with *Rosser* 1½m. in rear. Before *Pickett* was made aware of a battle being in progress his left was destroyed. *Lee* seems to have made no arrangements to support him in this direction. *Pickett's* position on the right was finally carried by Sheridan's cavalry dismounting and storming the entrenchments frontally. *Pickett's* routed brigades were rallied at the South Side railroad but the Confederates had lost White Oak road, and unless *Lee* was capable of a vigorous counterstroke on his extreme right it was evident he must also lose the South Side railroad.

But a crisis was approaching. Sheridan's success at Five Forks induced Grant to deliver a general assault on April 2. The Confederate lines were bombarded all night, and on April 2 with Wright's corps (VI.), Grant attacked the weakest part of *Lee's* line and broke through, losing 1,100 men in 15 minutes. *A. P. Hill* was killed and his corps broke and was cut off from Peters-

burg. At the same time Parke's corps (IX.), on the right of the VI., attacked the eastern front near Fort Stedman but was repulsed; then Humphreys' corps (II.) on the left attacked a Confederate division and forced it to retreat to the South Side railroad, where at Sutherland station a final attack dispersed it. Wright, supported by Gen. Ord (commanding the Army of the James), afterwards won the strong redoubts called Fort Whitworth and Fort Gregg, and thus in a day the Confederate right had been destroyed from Five Forks to a point some two or three miles west of the Weldon railroad; 10m. of works had been abandoned, and if Grant had been able to press his advantage at once the campaign must have ended. But Grant was not aware of the enemy's plight, and so resolved to wait until the morrow before completing his victory.

Meanwhile *Lee* perceived that the hour had come at last when Richmond must fall, and at 3 P.M. he had issued orders for the march of the remains of his army to Lynchburg via Amelia Court-House, a march which evidently must partake of the character of a forlorn hope, hastily planned, ill prepared, and undertaken by troops whom the disasters and hardships of the past six months had weakened physically and morally. Yet if *Lee* had negotiated a peace on April 2 military history would have lost one of the finest examples of the strategic pursuit. *Lee's* proposed movement involved the transfer of the army and its baggage 100m. on bad roads across the front of an enemy, and nothing but mischance could prevent the Federals intercepting *Lee's* columns by a shorter route and seizing the South Side railroad, on which supplies were to be forwarded from Lynchburg to meet the retreating army at Appomattox station, Pamplin's station or Farmville station. The Appomattox river must be crossed two or three times at its bends. Various creeks and swamps must be bridged, and the bridges destroyed after crossing. The wagons must move on separate roads so as to be covered by the columns during marches and combats and the infantry were to follow the artillery on the roads. *Longstreet, Gordon* and *Mahone's* division from Richmond all crossed the Appomattox at Goode's bridge. *Ewell* from Richmond crossed the Appomattox by the Danville railroad bridge north of Goode's bridge. *Anderson* commanded the flank guard which moved south of the Appomattox with *Fitzhugh Lee's* cavalry. *Lee* gained a day's start by moving at 8 P.M., for Grant was making preparations to attack the entrenchments next day (April 3), but the start was lost in waiting for President *Davis* and the Government to escape from Richmond. Sheridan's cavalry got in touch with *Lee's* flank-guard early on April 3 near Namozine creek, and at nightfall the Federal advance-guard was at Deep creek. On April 4 Sheridan reached the Danville railroad at Jetersville, and on April 5, when *Lee* had halted at Amelia Court-House on the railroad to get supplies, the Federals had three corps (II., V., VI.) in support of Sheridan 8m. nearer than *Lee* to Sailor's creek, the point where he must again cross the Appomattox.

Interception was now a *fait accompli,* though neither side suspected it. *Lee* was unaware of the enemy's proximity, and Grant believed that *Lee* would remain at Amelia Court-House, but *Lee* moved west, crossing Flat creek at sunset on April 5, to the Lynchburg railroad (*Longstreet,* marching all night, reached Rice's station at sunrise on April 6), while the Federals moved northward on the same day to attack *Lee* at Amelia Court-House, and on discovering *Lee's* evasion the three Federal corps effected a wheel to the left and advanced on Deatonsville after bridging Flat creek. Meanwhile the Federal cavalry had located and destroyed a convoy at Painesville, but had in turn been attacked by *Fitzhugh Lee's* cavalry and driven back on the main body at Flat creek. The rearguard of *Lee's* army was *Gordon's* command, which was at Amelia springs at 8 A.M. on the 6th of April. *Lee's* army stretched out for 15m., and when its advance-guard was at Rice's station its rearguard was still at Amelia Court-House. Rice's station is 62m. from Lynchburg. Here *Longstreet* waited all day for *Anderson, Ewell* and *Gordon* to close up, and then at night he moved 8m. to Farmville station (68m. south-west of Richmond), where 80,000 rations had been railed from Lynchburg; then *Longstreet* crossed the Appomattox, and on April 7 moved forward towards Lynchburg, covered by *Fitzhugh Lee's* cavalry. Meanwhile the remainder of *Lee's* army had been practically destroyed within a few miles of the point where *Longstreet* had halted. Sheridan's cavalry and two corps (II., VI.) had caught it entangled with the trains of the army attempting the passage of Sailor's creek; and Ord would even have attacked *Longstreet* (whom he had located late at night) had his march been delayed.

Complete disorganization and demoralization seem to have taken hold of the Confederates on this fatal day, and *Lee* was once more in eclipse. The Federal cavalry headed the column, the infantry attacked it, and *Ewell* became the victim of tactical envelopment after *Anderson* had been defeated and *Gordon* had failed to save the trains of the army. Surrender or massacre being the alternatives, *Ewell* surrendered, and here in fact the career of the army of Northern Virginia ended, as Grant plainly saw, for at 5:30 P.M. he addressed a demand to *Lee* for his capitulation. But *Lee* clung to his diminished forces for another 48 hours. *Longstreet* in crossing at Farmville had burnt the bridges and thus delayed the pursuit; but *Gordon* and *Mahone,* who had crossed at High bridge (the railroad bridge), failed to check Humphreys' corps (II.), and so were compelled to take up a position of defence on the north bank until darkness enabled them to slip away. *Lee* was with this remnant of the army. Meanwhile Sheridan with the cavalry and two corps (V., XXIV.) had hastened along the South Side railroad, seizing the supplies waiting for *Lee* at Pamplin's Station, and then moving on another 12m. to Appomattox station. At nightfall he found that he was astride the enemy's line of operation, which was also his line of supply, and so *Lee* would be compelled to give battle or capitulate on the morrow.

Lee, quitting Farmville heights on the night of April 7 changed the order of march during the next day, so that *Gordon* (8,000) was in the van and *Longstreet* (15,000) furnished the rear-guard. *Ewell's* corps was now represented by 300 effectives. The cavalry still numbered some 1,600 sabres. *Lee's* column was pursued along the Lynchburg road by two Federal Corps (II., VI.), which marched 26m. in 18½ hours, and at midnight halted within 3m. of *Longstreet,* who had entrenched near Appomattox Court-House, facing east and covering the road on which *Gordon's* corps and the cavalry was to press forward to Lynchburg at daylight. But *Gordon* on the morning of April 9 found Sheridan's cavalry in his front, and in accordance with plans made overnight he commenced an attack, driving the Federals back until he encountered at 10 A.M. two corps of infantry (V., XXIV.) under Ord, who had marched 29m. in order to support Sheridan at the crisis; and when at the same moment *Longstreet* was threatened by Humphreys and Wright (II., VI.) the situation had arisen which *Lee* considered would justify surrender, an event which had been anticipated on both sides as the result of the fighting about Farmville on April 6 and 7.

The closing operations from March 29 to April 9 were all in favour of the Federals, but, nevertheless, the historian counts their losses during this period at nearly 10,000 in the five corps and cavalry which constituted Gen. Grant's field army. On April 9, at the Appomattox Court-House, the two leaders exchanged formal documents by which 2,862 officers and 25,494 enlisted men were paroled, all that remained in the field of some 55,000 Confederates who were drawing rations on Feb. 20 as the army of Northern Virginia. (G. W. R.)

PETERSFIELD, a market town in Hampshire, England, 55 m. S.W. from London by the S.R. Pop. of urban district (1921) 3,934. The church of St. Peter retains some ornate Norman work. Ecclesiastically a chapelry of Buriton, Petersfield (Peterfelde) owes its origin as a borough to the charter granted by William, earl of Gloucester, in the reign of Henry II., and confirmed later by his widow, Hawise. Petersfield is not mentioned in Domesday, but it was probably then included in the manor of Mapledurham. It was a mesne borough possessing by its first charter the liberties and customs of Winchester together with a merchant gild. These grants were confirmed by John in 1198 and in 1415 Henry V. in addition freed the burgesses from all tolls. Gradually privileges and rights other than those of a mesne

borough were usurped by the mayor and burgesses, but were recovered by a suit brought against them by Thomas Hanbury, owner of the borough, in 1611. A mayor continued to be elected until 1885. Petersfield was represented in parliament from 1307 until 1885 when the representation was merged in that of the county.

PETER'S PENCE or ROM-FEOH, a tax of a penny on every hearth, formerly paid annually to the popes; now represented by a voluntary contribution made by the devout in Roman Catholic churches. Its date of origin is doubtful. The first written evidence of it is contained in a letter of Canute (1031) sent from Rome to the English clergy. At this time it appears to have been levied on all families possessed of land worth thirty pence yearly rental, out of which they paid one penny. At the Norman Conquest it appears to have fallen into arrears for a time, for William the Conqueror promised the pope in 1076 that it should be regularly paid. The threat of withholding Peter's pence proved more than once a useful weapon against recalcitrant popes in the hands of English kings. Thus in 1366 and for some years after it was refused on the ground of the pope's obstinacy in withholding his consent to the Statute of Praemunire. The tax was fairly regularly paid by the English until 1534, when it was abolished by Henry VIII.

PETER THE HERMIT, a priest of Amiens, who *may*, as Anna Comnena says, have attempted to go on a pilgrimage to Jerusalem before 1096, and have been prevented by the Turks from reaching his destination. It is uncertain whether he was present at Urban's great sermon at Clermont in 1095; but it is certain that he was one of the preachers of the crusade in France after that sermon, and his own experience may have helped to give fire to his eloquence. He was an emotional revivalist preacher: his very ass became an object of popular adoration; and thousands of peasants took the cross at his bidding. The crusade of the *pauperes,* which forms the first act in the first crusade, was his work; and he himself led one of the five sections of the *pauperes* to Constantinople, starting from Cologne in April, and arriving at Constantinople at the end of July 1096. Here he joined the only other section which had succeeded in reaching Constantinople—that of Walter the Penniless; and he crossed to the Asiatic shore in the beginning of August. In spite of his warnings, the *pauperes* began hostilities against the Turks; and Peter returned to Constantinople. In his absence the army was cut to pieces by the Turks; and he was left in Constantinople without any followers, during the winter of 1096–1097, to wait for the coming of the princes. He joined their ranks in May 1097, and marched with them through Asia Minor to Jerusalem. But he played a very subordinate part in the history of the first crusade. He appears, in the beginning of 1098, as attempting to escape from the privations of the siege of Antioch—showing himself, as Guibert of Nogent says, a "fallen star." In the middle of the year he was sent by the princes to invite Kerbogha to settle all differences by a duel; and in 1099 he appears as treasurer of the alms at the siege of Arca (March), and as leader of the supplicatory processions in Jerusalem which preceded the battle of Ascalon (August). At the end of the year he went to Laodicea, and sailed West. Albert of Aix records that he died in 1151, as prior of a church of the Holy Sepulchre which he had founded in France.

The legend which made Peter the instigator of the first Crusade, relating how Christ appeared to him in the Church of the Sepulchre, appears in the pages of William of Tyre. Raymond of Antioch caused the *Chanson des Chétifs* to be composed in honour of the Hermit and his followers, soon after 1130. It also appears in the pages of Albert of Aix, who wrote somewhere about 1130; and from Albert it was borrowed by William of Tyre.

PÉTION DE VILLENEUVE, JERÔME (1756–1794), French writer and politician, was the son of a *procureur* at Chartres. He became an avocat in 1778. In 1789 he was elected a deputy to the Tiers État for Chartres and showed himself a radical leader. He supported Mirabeau on June 23, and was elected president on Dec. 4, 1790. On June 15, 1791 he was elected president of the criminal tribunal of Paris. After the last meeting of the assembly on Sept. 30, 1791 Robespierre and Pétion were made the popular heroes and were crowned by the populace with civic crowns. Pétion was elected on Nov. 16, 1791, mayor of Paris in succession to Bailly. On Aug. 3, 1792, at the head of the municipality of Paris, Pétion demanded the dethronement of the king. He was elected to the Convention for Eure-et-Loir and became its first president. L. P. Manuel's proposal that the president of the Assembly should have the same authority as the president of the United States, was rejected, but Pétion got the nickname of "Roi Pétion," which contributed to his fall.

His jealousy of Robespierre allied him to the Girondin party. He was elected in March 1793 to the first Committee of Public Safety; and he attacked Robespierre, who accused him of knowing and keeping secret Dumouriez's project of treason. His name was among those of the twenty-two Girondin deputies proscribed on June 2. He escaped to Caen and raised the standard of provincial insurrection against the Convention; and, when the Norman rising failed, he fled to the Gironde. At last, a month before Robespierre's fall in June 1794, he committed suicide.

See *Mémoires inédits de Pétion et mémoires de Buzot et de Barbaroux, précédés d'une introduction par C. A. Dauban* (1866); *Oeuvres de Pétion* (3 vols., 1792); F. A. Aulard, *Les Orateurs de la Constituante* (1882).

PÉTIS DE LA CROIX, FRANÇOIS (1653–1713), French Orientalist, was born in Paris in 1653. He inherited in 1695 his father's office of Arabic interpreter of the French court, transmitting it in turn to his own son, Alexandre Louis Marie. At an early age François was sent by Colbert to the East; during the ten years he spent in Syria, Persia and Turkey he mastered Arabic, Persian and Turkish, and also collected rich materials. He conducted the negotiations with Tunis and Tripoli in 1685, and those with Morocco in 1687. His zeal, tact and linguistic knowledge were at last rewarded in 1692 by his appointment to the Arabic chair in the Collège Royal de France, which he filled until his death in 1713.

He published *Contes turcs* (1707), and *Les Mille et un jours* (5 vols., 1710–1712); an *Armenian Dictionary* and an *Account of Ethiopia.* But the lasting monument of his literary fame is his excellent French version of Sharaf-uddīn 'Alī Yazdi's *Zafārnāma* or *History of Tīmūr* (completed A.H. 828; A.D. 1425), which was published after his death (4 vols., 1722; Eng. trans. by J. Darby, London, 1723).

PETITION, a term meaning generally a prayerful request for redress by a person aggrieved. It may be made in Great Britain to the Crown or its officers, or to either house of parliament, or in certain cases to courts of justice.

The right of petitioning the Crown was recognized indirectly as early as Magna Carta in the famous clause, *Nulli vendemus, nulli negabimus aut differemus, rectum vel justitiam* (25 Edw. I. c. 29), and directly at various periods later, *e.g.*, in the articles of the Commons assented to by Henry IV., by which the king was to assign two days in the week for petitions (*Rot. Parl.* 8 Hen. IV., p. 585). The case of the seven bishops in 1688 confirmed the right, and finally the Bill of Rights in 1689 declared "that it is the right of the subjects to petition the king, and all commitments and prosecutions for such petitioning are illegal." Petitions to the Crown appear to have been at first for the redress of private and local grievances, or for remedies which the courts of law could not grant (May, *Parl. Pr.,* 11th ed., 522). As equity grew into a system, petitions of this kind not seeking legislative remedies tended to become superseded by bills in chancery. Statutes were originally drawn up by the judges at the close of the session of parliament from the petitions of the Commons and the answers of the Crown. Under this system of drafting it was found that the tenor of the petition and answer were not always stated correctly. To obviate this inconvenience demands for legislation came in the reign of Henry VI. to be drawn up in the form of bills which the Crown could accept or reject, but could not alter. (*See* Anson, *Law and Custom of the Constitution.*) In the same reign the words "by authority of parliament" were added to the words of enactment, and from the time of Henry VII. public legislation has been by bill and not by petition.

Petitions to either house of the legislature seem to have been later in origin than petitions to the Crown. They are not referred to in the Bill of Rights, but the right of petition is a convention

of the constitution. Petitions to the Lords or the whole parliament can be traced back to Henry III. No petition to the Commons has been found earlier than Richard II.; but from the time of Henry IV. petitions to the Commons have been freely made. The political importance of petitioning dates from about the reign of Charles I. The development of the practice of petitioning had proceeded so far in the reign of Charles II. as to lead to the passing in 1662 of an Act (13 Car. II. c. 5) against "tumultuous petitioning," which is still on the statute book. It provides that no petition or address shall be presented to the king or either house of parliament by more than ten persons; nor shall any one procure above 20 persons to consent or set their hands to any petition for alteration of matters established by law in church or State, unless with the previous order of three justices of the county, or the major part of the grand jury. And in 1817 (57 Geo. III. c. 19 s. 23) meetings within a mile from Westminster Hall for the purpose of considering a petition to both houses or either house of parliament while either house is sitting were declared to be unlawful assemblies. Up to 1688 petitions to either house usually dealt only with some specific grievance. From that time dates the present practice of petitioning with regard to general measures of public policy. Petitions to the Houses of Lords or Commons must be framed in the form prescribed by the standing orders, must be properly superscribed, and must conclude with a prayer.

Petitions to the Commons must be in writing, must contain none but genuine signatures, and must be free from disrespectful language or imputations upon any tribunal or constituted authority. They must be presented by a member of the house, except petitions to the House of Commons from the corporation of London, which may be presented at the bar by the sheriffs, and formerly from the corporation of Dublin, presented by the lord mayor. There is no means of compelling a member to present a petition. The rules as to petitions to the House of Lords are similar. Applications for leave to bring before either house bills for private or local and personal matters must under the standing orders of both houses be made by petition; and the same rule obtains as to applications for leave to be heard in opposition to such bills. (*See* PETITION OF RIGHT and JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.)

See Clifford, *History of Private Bill Legislation* (1887).

United States.—The right to petition the Government for a redress of grievance is safeguarded in the United States by its inclusion in the 1st amendment to the Federal Constitution. It forms part of similar constitutional bills of rights in the various States. It is only natural that the early statesmen in the United States, enamoured with those individual liberties that they conceived to be the heritage of all free-born Englishmen, should take care to make such rights part and parcel of their fundamental law and place them beyond legislative interference. No penalties can thus attach to a petitioner as a consequence of his complaint, though immunity does not attach to scurrilous or libellous matter contained in a petition. The petition was commonly used in the early history of the United States as a means to enforce legislative action. The rise of the press has reduced its political significance. Petitions are, however, commonly presented to legislatures to influence their action on pending bills. Rules provide for their introduction and presentation by the members of the legislature.

PETITION OF RIGHT. This term is now specifically appropriated in English law to the peculiar procedure by which a subject may sue the Crown. At common law the Crown—a term which is, in constitutional law, merely an abstraction for the king in his official capacity—could not be sued in the king's courts; the king was, historically, the supreme lord of those courts, administering justice therein between his subjects, and as the supreme lord he was not amenable to their jurisdiction. His writs could not run against himself. Hence a practice arose, where a subject's real or personal property had come into the possession of the king or his servants without legal title, for the subject to "petition" the king in council praying for its restoration. The king then might or might not in his discretion, refer the suppliant's petition to one of his courts, usually the old court of exchequer, with a writ directing the judges to do what is just. Although the procedure of Petition of Right has now been regulated by statute, the discretion of the king, or rather of his ministers, is still absolute and no one can sue the Crown directly except by the Crown's grace and favour. This means that none of the Government departments—which are, in theory, merely "emanations of the Crown" and therefore bask in the shelter of its prerogatives—can be sued as a matter of right. The exceptions to this consequence are more apparent than real: a few departments such as the India Office, *i.e.*, "the secretary of State for India in council," have been incorporated by statute and thereby have become, what the other Government departments are not, "legal persons" with the power to sue and the liability to be sued. In such exceptional cases one can proceed against them directly, but even so they enjoy all the prerogatives of the Crown, mentioned below, such as immunity from actions for tort, from "Discovery," and from Execution.

Originally the scope of a Petition of Right was confined to issues of fact. Where the subject relied on some title appearing by record, such as letters patent issued by the Crown, he could proceed by what was known as a *monstrans de droit* or "manifestation of right." This was the procedure adopted in the famous Bankers' Case of 1696–1700 (14 State Trials 1) in which certain bankers applied directly to the court of exchequer for a judgment that the arrears of interest granted to them by letters patent of Charles II., in return for loans, should be paid. The court, in particular C. J. Holt, held that, their plea being "matter of record," the court could, in such a case, proceed without the leave of the king (which was essential in the case of an ordinary Petition of Right); a decision which was reversed by Lord Somers on appeal. There was another method, known as a traverse of inquest of office, by which a subject might in certain cases, such as escheat or forfeiture, challenge the king's title to land or chattels. These antiquities are of little importance to-day in view of the Petition of Right Act, sometimes known as Bovill's Act, of 1861.

The Petition of Right Act (1861) does not create any rights or abolish any old prerogatives. It merely regulates procedure. It provides that anyone seeking to sue the Crown shall file a petition, which is in effect a statement of claim, with the home secretary, who invariably refers it to the attorney-general for advice. If the latter advises that there is a substantial "cause of action," the home secretary endorses it with his *fiat*. If he refuses it, the subject is without remedy. The discretion of the secretary of State is absolute and a Mandamus will not issue to compel him to grant his *fiat* (cf. *Irwin* v. *Grey*, 1862, 3 F. and F. 635). In practice the *fiat* is rarely refused, unless the claim appear to be a purely frivolous one. The fact remains, however, that in such a case the Executive, not the courts, performs a judicial function which, in the case of litigation between subject and subject, is entrusted solely to the judiciary under the Rules of the Supreme Court, namely the function of deciding whether there is a reasonable cause of action. The grant of the *fiat* in no way prejudges the issue to be tried and the Crown is entirely free, after having granted it, to plead before the courts that the action does not lie, *e.g.*, it may "demur" on the ground that the suppliant's claim is one for tort, and it is a rule of law that the king, who "can do no wrong," can never be sued, even by Petition of Right, for the tortious acts of his servants, *i.e.*, Government departments are exempt from liability in this respect.

Once the *fiat* is granted, the proceedings enter on the stage of an ordinary action between subject and subject. The Crown must enter an appearance within 28 days. It can, however, avail itself of many prerogatives in practice and pleading at the expense of the subject. Of these the most important is the prerogative as to "Discovery" which is succinctly expressed in the words "The law is that the Crown is entitled to full discovery, and that the subject as against the Crown is not" (Rigby C. J. in *Attorney-General* v. *Newcastle on Tyne Corporation*, 1897, 2 Q.B. 384). This means that the suppliant cannot, as in an ordinary action between subject and subject, compel the other party, *i.e.*, the Crown, to produce for inspection documents which may be essen-

tial to prove his case. So too with "amendment." The Crown may amend its answer to any extent but the subject cannot amend his petition with the same freedom as a plaintiff may amend his pleadings in an ordinary action. A recent decision (*Badman Brothers* v. *the King*, 1924, 1 K.B. 24) has relaxed the hardship of this rule in favour of the suppliant to some extent but not materially. Furthermore the Crown may claim "privilege" in respect of any attempt by the suppliant to compel a witness, whether in the service of the Crown or not, to disclose "matter of State," though this prerogative is not peculiar to procedure by Petition of Right. In all these respects the Crown has an immense advantage over the suppliant. On the other hand, the suppliant has one great advantage, which the plaintiff in an ordinary action does not possess, in that his claim cannot be barred by the Crown pleading the Statute of Limitation of 21 James I. by which statute action of contract must be brought within six years—this for the curiously technical reason that the Statute only bars "legal proceedings" and a "Petition of Right" is not strictly a "legal proceeding" (this was decided in *Rustomjee* v. *the Queen* 1 Q.B.D. 487). Another peculiarity of proceedings by Petition of Right is that the subject cannot demand, as of right, trial by jury even where, had it been an action between subject and subject, he might have done so. This has been recently decided by the High Court in *Marconi Company* v. *the King* (1918) 1 K.B. 193 on the construction of certain words in the Petition of Right Act. That decision, however, inflicts no great hardship on the subject as it rests solely within the jurisdiction of the court, without interference from the Crown, to decide whether trial shall be by the judge alone or by judge and jury. The suppliant, if successful, is entitled to his costs; if unsuccessful, he is liable to pay the costs of the Crown. This is a statutory exception to the common law rule that, to use the quaint language of Blackstone, it is "beneath the dignity" of the Crown either to pay costs or to receive them.

Judgment is given in the ordinary way. But the "execution" of the judgment is quite another matter. The courts cannot decree execution against the Crown and its servants. The Act of 1861 provides, however, that, where judgment is in favour of the suppliant, it shall be "certified" by the court to the Treasury which shall then satisfy it out of the public funds. In practice the Treasury never fails to satisfy the judgment of the court. Whether, if it failed so to do, it could be compelled by the courts, by a Writ of Mandamus, to satisfy it as a "statutory duty" is an open question.

Scope of the Remedy.—It remains to consider the scope of this remedy against the Crown. For a long time it appears to have been held, although the matter is not free from doubt, that it would only lie to recover possession of real or personal property of the subject in the hands of the Crown. But in the leading case of *Thomas* v. *the Queen* (1874) 44 L.J.Q.B. 9, the courts held, relying on the somewhat doubtful authority of the *Bankers' Case*, that a Petition of Right would lie for unliquidated damages for breach of contract. This decision was really revolutionary. It has since been held that it will also lie for the recovery of duty overpaid to the Revenue authorities (*In re Nathan*, 1884, 12 Q.B.D. 461), for compensation for the requisitioning of premises for national defence (*The De Keyser Case*, 1920, A. C. 508), and for such "implied contracts" as "Quantum Meruit" and "Money had and received." Petition of Right will, however, never lie to enforce a contract or service with the Crown, whether civil or military, for it is the king's prerogative to determine such contracts at his pleasure (*see* PREROGATIVE).

On the other hand, the scope of the remedy is subject to considerable limitations of which the most important is the exclusion of any redress against the Crown for "wrongful," *i.e.*, tortious acts such as, for example, negligence, trespass or the infringement of a patent. This was long ago settled, if indeed it was ever doubted, in the case of *Tobin* v. *the Queen*, 33 L.J.C.P. 199, to go no further back. The only remedy open to the subject in such a case is to sue, in an ordinary action, the particular officer of the Crown who was responsible for the wrongful act or omission. Great play had been made by writers like Prof. Dicey with this liability of the individual officer to answer to the subject, when wronged, for his acts, even though committed in an official capacity, and they institute a comparison between this "rule of law" and the comparative rightlessness of the subject, as they regard it, in the matter of suing an official in respect of his official acts, in countries like France and Germany with their system of "administrative law." It would take too long to discuss this aspect of the matter here; it is sufficient to say that the subject is, as a matter of fact, far better protected in France and Germany; under the law of those countries the State, unlike the Crown in England, *is* responsible, and can be sued in the ordinary way for the torts of its servants. Moreover, in England the rule of *respondeat superior* by which a person wronged can sue the employer, whether an individual, a partnership or a company, for the wrongful acts of his servants does not apply in the case of torts committed by the servant of a Government department. In such a case not only can the Crown, *i.e.*, the State, not be sued but neither can one sue the immediate superior of the servant committing the wrongful act. The postmaster general, for example, is not liable for the negligence of a Post Office engineer (*Bainbridge* v. *the Postmaster General*, 1906 1 K.B. 178). Further, the servant of the Crown, although personally liable, has the advantage, as against the plaintiff, of a "Statute of Limitations" of a very peculiar and invidious kind, known as the Public Authorities Protection Act of 1893, which requires all actions for tort against "public authorities"—a term which has been held (cf. *The Danube*, 1921 P.D. 183) to include servants of the Crown as well as local authorities—to be brought not, as in the case of an action between subject and subject, in six years but in six months. This Act is peculiar in every respect: it compels the plaintiff to bring his action not, as in the case of ordinary Statutes of Limitation, within a fixed period from the date when a "cause of action" arose, *e.g.*, the resulting damage, but within six months from the date of the tortious act which caused the damage. The result of this is, often, to extinguish, in spite of all vigilance on the part of the plaintiff who has suffered injury, any right of action altogether, for by the time the damage has made itself evident he may be too late (see *Freeborn* v. *Leeming* 95 L.J.K.B. 114). And if he is a day too late in bringing his action, he not only loses it but is subjected by the Act to penalties, in the matter of special costs, not known to the common law.

Need for Reform.—It will be obvious that the state of the law as to proceedings against the Crown is in need of reform. The decision of the courts in the famous case of *Dyson* v. *the Attorney-General* (1911) 1 K.B. 410 that a subject might apply *directly* to the courts, without recourse to a Petition of Right, for a "declaration," *i.e.*, a "declaratory judgment," as to whether the Crown was illegally invading his rights (in that case the question was whether the plaintiff was bound, under penalty, to answer certain questions contained in "forms" issued by the Revenue authorities), and that the courts could declare the action of the Crown illegal, was a great victory for the rights of the subject. But that decision was specifically made subject to the qualification that no such declaration could issue where the proper remedy was by Petition of Right. The advocates of reform of the law have therefore directed their agitation to two things (1) that the subject should no longer be dependent on the grace of the Executive where he conceives himself to have what amounts to a cause of action against the Crown, but should be enabled to sue the Crown in the same way as he can sue a fellow-subject; (2) that the Crown, thus made directly suable, should be liable in tort. In some of the dominions and colonies, most notably in the Australian Commonwealth, this reform has long been effected by statute. In Scotland the law is equally enlightened. In consequence of the strong feeling on the subject, to which the courts themselves have often given public expression, a committee was appointed by the lord chancellor in 1921 to investigate the whole subject and, subsequently, to draft a Bill to reform the law. It did not report till six years later, namely in 1927, when its report took the form of a "Crown Proceedings Bill" embodying, among other things, the two main principles of reform indicated above. The draft Bill, however, is open to two serious objections:

it preserves the prerogative in the matter of "Discovery" and it applies and incorporates the vicious provisions of the Public Authorities Protection Act. None the less it marks a real advance. Unfortunately there appears, at the time of writing, no prospect of this measure being adopted by the Government and there is no doubt that the encroaching bureaucracy are bitterly opposed to it.

See J. H. Morgan, *Remedies against the Crown* (1926); W. S. Holdsworth, "History of Remedies against the Crown," in *Law Quarterly Review*, vol. 38, p. 280; G. S. Robertson, *The Law and Practice of Civil Proceedings by and against the Crown and Departments of the Government* (1908); W. Clode, *The Law and Practice of Petition of Right under the Petitions of Right Act, 1860* (1887); Crown Proceedings Committee Report, Cmd. 2,842 of 1927.

(J. H. Mo.)

PROCEEDINGS AGAINST THE STATE IN THE UNITED STATES

The rule that the sovereign was immune from suit at the hands of the private citizen is an accepted principle of American law Both the Federal Government and the States, whose sovereignty had not been surrendered to the national Government, were clothed with this immunity The Constitution authorized the Supreme Court to take original jurisdiction in all cases "in which a State shall be a Party," and in 1793 the Supreme Court in *Chisholm* v *Georgia*, 2 Dall 419, held that it could take cognizance of a suit by a citizen against a State This decision, contrary to the general expectation of the framers of the Constitution, so aroused the nation that in 1798 the 11th amendment to the Constitution was adopted which re-established the original theory that the States were immune from suit by private citizens. No such procedure as the "Petition of Right" was known to American law. Claimants against the United States were originally referred to auditors of various governmental departments and, in the event of unsatisfactory treatment, were obliged to petition Congress Such petitions were ordinarily disposed of before committees who might recommend a pecuniary grant from Congress In a few instances Congress by special legislation authorized suit to be brought against the Government and the claims would be adjudicated in the courts The unsatisfactory character of this method of dealing with claims against the Government led in 1855 to the establishment of the court of claims. At first the court was simply authorized to hear claims and by appropriate bills refer them to Congress for payment In 1863 the court was authorized to give judgments subject to revision by the secretary of Treasury. The secretary was shortly thereafter deprived of this power and the court is now empowered to render final judgments against the United States subject to an appeal to the Supreme Court The jurisdiction of the court of claims illustrates that in the United States suits against the Government are governed by much the same principle that underlies the English procedure by petitions of right No liability arising out of a tort is recognized, but sovereign immunity is waived only in a class of cases where the obligation of the Government is contractual in nature. The court is given jurisdiction of all claims, except for pensions, founded upon the Constitution or any law of Congress and upon contracts, express or implied. Jurisdiction of claims sounding in tort is specifically negatived Claims arising from the taking of property for public use, for which compensation is required by the Constitution, for the return of taxes illegally assessed, for the breach of contracts, constitute the great bulk of its litigation Where the claim does not exceed $10,000 in amount the lower Federal courts are given concurrent jurisdiction with the court of claims. The grant of jurisdiction in claims upon an "implied contract" has given rise to much confusion Whether such contracts include obligations implied in law as well as in fact has been a question upon which the decisions of the Supreme Court have not been wholly uniform

A few of the States have established courts of claims upon the model of the U S. court of claims, but in most States the procedure of enforcing claims against the State Government is by petitioning the legislature.

See Richardson, *History of the Court of Claims* (1882); Crane, "Jurisdiction of the Court of Claims," 34 *Harv. L. Review*, 161 (1920); Borchard, *Government Liability in Tort* (1925); Maguire, "State Liability for Tort," 30 *Harv. L. Review*, 20 (1916). (J. M. La.)

PETITOT, JEAN (1608–1691), French-Swiss enamel painter, was born at Geneva, a member of a Burgundian family which had fled from France on account of religious difficulties. His father, Faulle, was a wood carver; his mother's name was Étienette Royaume Jean was the fourth son, and was apprenticed to a jeweller goldsmith named Pierre Bordier, with whom he struck up a close friendship. The two friends went into France, and eventually came to England with letters of introduction to Turquet de Mayern, physician to Charles I. For the king they made a St. George for the badge of the order and carried out many commissions for portraits, amongst others preparing two large ones of Rachel de Ruvigny, countess of Southampton, now at Chatsworth, and Mary Villiers, duchess of Richmond and Lennox, dated 1643, at one time in the possession of the Crown and now in the Pierpont Morgan collection On the execution of the king, Petitot left England for Paris with the royal household, while Bordier remained in England to carry out certain important commissions for Cromwell and the parliament

In Paris Petitot entered into partnership with a goldsmith, Jacques Bordier, a cousin of Pierre; probably the enamel portraits attributed to Petitot were really the work of the two partners, the actual drawing being the work of Petitot, while for the enamel process Bordier was mainly responsible. The two painters were given apartments in the Louvre, received numerous commissions from Louis XIV., and painted portraits of almost every person of importance in his brilliant court. The friendship between the two lasted for thirty-five years, and was only put an end to by Bordier's death. The enamellers rendered special political services in France for the republic of Geneva, and were practically regarded as the official representatives of the republic

On the revocation of the Edict of Nantes, 1685, pressure was brought to bear upon Petitot to change his religion The king protected him as long as possible, and when he was arrested, with his niece, Annie Bordier, sent Bossuet to convert the old man. Eventually Petitot abjured, but in 1687 he returned to Geneva, and was received back to the Huguenot communion He died on April 3, 1691

His eldest son JEAN LOUIS PETITOT (1652–*c* 1730), followed his father's profession, painting enamels which are difficult to distinguish from those of Jean the elder. He lived chiefly in London, where he executed several enamel portraits of Charles II, and died there in 1730. A portrait of him by Mignard is in the Geneva museum and another, in enamel by himself, belongs to the earl of Dartrey.

Of the works of Petitot the most important collection is in the Jones Bequest at the Victoria and Albert Museum There are many in the Louvre, sixteen at Chantilly, seventeen at Windsor, and others in the collections of Earl Beauchamp, the duke of Rutland, the duke of Richmond, the earl of Dartrey, Mr Alfred de Rothschild and the late Baroness Burdett-Coutts Amongst Lord Dartrey's examples are portraits of Petitot and of his son, and two of the wife of Jean Petitot the younger A second portrait of the artist belongs to the queen of Holland, and another is in the collection of the late Mr Stroehlin of Geneva. In Mr. Pierpont Morgan's collection there are many exceedingly fine examples, but especially three drawings on paper, the only three which appear to have survived, and the large signed miniature of the duchess of Richmond already mentioned, the largest work Petitot ever executed save the one at Chatsworth

See *Petitot et Bordier*, by Ernest Stroehlin (Geneva, 1905); "Some New Information respecting Jean Petitot," by G C. Williamson, *Nineteenth Century and After* (January 1908), pp 98–110, the privately printed *Catalogue of the Collection of Mr J Pierpont Morgan*, vol iii; *The History of Portrait Miniatures*, by G C Williamson, vol ii. (London, 1904).

PETITS-CHEVAUX (Fr for "little horses"), a gambling game played with a mechanical device consisting of a board perforated with a number of concentric circular slits, in which revolve, each independently on its own axis, figures of jockeys on horseback, distinguished by numbers or colours. The bystanders having staked their money according to their choice on a board marked in divisions for this purpose, the horses are started revolving rapidly together by means of mechanism attached to the board, and the horse which stops nearest a marked goal wins, every player who has staked on that horse receiving so many times his stake. Figures of railway trains and other objects sometimes take the place of horses

PETŐFI, ALEXANDER (1823–1849), Hungarian lyric poet, was born at Kis-Körösö, Pest county, on New Year's Day, 1823. The family received its diploma of nobility from the emperor Leopold in 1688, but the ultra-patriotic Alexander early changed the old family name, Petrovics, which pointed to a Croatian origin, into the purely Magyar form of Petőfi. He was disowned by a tyrannical father, and for three years led the wretched life of a strolling player, except for a brief interval when, to escape starvation, he enlisted as a common soldier in an infantry regiment. His first volume of original poems was published in 1844 by the Society Nemzeti Kör, through the influence of the poet Vörösmarty, when every publisher had refused his ms., and the seventy-five florins which he got for it had become a matter of life or death to him. The little volume published by the Nemzeti Kör was followed by the parody, *A Helység Kalapácsa* (1844); the romantic epic *János Vitéz* (1844); *Ciprislombok Etelké Sirjáról,* a collection of passionate elegies over his lost love, Etelké Csapó (1845); *Uti Jegyzetek,* an imitation of Heine's *Reisebilder* (1845); *Szerelem Gyöngyei* (1845); *Felhök* (1846); *Szerelme ès házassága* (1846), and many other volumes.

The first edition of his collected poems appeared in 1847. Petőfi was not yet twenty-five, and, despite the protests of the classicists, who regarded him with cold dislike, the best heads in Hungary, poets like Vörösmarty and critics like Szemere, already paid him the homage due to the prince of Magyar lyrical poets. The great public was enthusiastic on the same side, and posterity, too, has placed him among the immortals. Petőfi is as simple and genuine a poet of nature as Wordsworth or Christian Winther, and his erotics, inspired throughout by a noble idealism, have a Byronic fervour, though it is perhaps in his martial songs that Petőfi's essentially passionate and defiant genius asserts itself most triumphantly. On Sept. 8, 1847 Petőfi married Julia Szendrey. When the revolutionary war broke out, he espoused the tenets of the extreme democratic faction. He took an active part in the Transylvanian campaigns of the heroic Bem; rose by sheer valour to the rank of major, and was slain at the battle of Segesvár (July 31, 1849). The first complete edition of Petőfi's poems appeared in 1874. The best critical edition is that of Haras, 1894. (R. N. B.; X.)

PETRA (ἡ πέτρα = the rock), a ruined site, 30° 19′ N. and 35° 31′ E., in Trans-Jordan, lying in a rock basin on the eastern side of the Wadi el-Arāba, the great valley that continues the rift of Jordan southward to the Gulf of Aqaba. The descriptions of Strabo (xvi. p. 779), Pliny (*N.H.* vi. 32) and other writers leave no doubt as to the identity of this site with the famous capital of the Nabataeans (*q.v.*) and the centre of their caravan trade. Petra commanded routes to Gaza in the west, to Bosra and Damascus in the north, to Elath and Leucè Comè on the Red sea, and across the desert to the Persian gulf.

The country around is assigned by tradition to the Horites, *i.e.,* probably "cave-dwellers," the predecessors of the Edomites (Gen. xiv. 6; xxxvi. 20–30; Deut. ii. 12). But that Petra itself is mentioned in the Old Testament cannot be affirmed with certainty, although some have tried to identify it with the name Sela, which also means a rock. Eusebius and Jerome, apparently on the authority of Josephus (Ant. iv. 7, 1; 4, 7), assert that Rekem was the native name, but this also presents many serious difficulties. Others think that the reference to *petra* by Diodorus Siculus (xix. 94–97), where the expeditions of Antigonus against the Nabataeans (312 B.C.) are described, refers to Petra. But *petra,* referred to as a natural fortress and place of refuge, cannot be a proper name. The tombs at Petra offer some evidence of the early Nabataean settlement. Two types of tombs may be distinguished, the Nabataean and the Graeco-Roman. The former start from the simple pylon-tomb of pre-Hellenic age (round about the 6th century B.C.); they then pass through various stages evolving to the full Nabataean type, which retains all the native features and at the same time shows characteristics which are partly Egyptian and partly Greek. There are close parallels of this type, with inscriptions, at el Hejr in north Arabia. The next stage in the evolution of the tombs gives tomb fronts terminating in a semi-circular arch, a feature derived from North Syria, and there finally appear the elaborate façades from which all trace of native style has vanished, copied from the front of a Roman temple. This particular evolution suggests that Petra had cultural relations with many different groups at this time, as is to be expected from its position as a great trade focus. After the period of the pre-Hellenic tombs we notice a period which combined Greek, Egyptian and Syrian elements, clearly pointing to the age of the Ptolemies. Towards the close of the 2nd century B.C., when the Ptolemaic and Seleucid kingdoms were equally depressed, the Nabataean kingdom came to the front; under Aretas III. Philhellene (*c.* 85–60 B.C.) the royal coins began; at this time probably the theatre was excavated and Petra must have assumed the aspect of a Hellenistic city. It is to the long and prosperous reign of Aretas IV. Philopatris (9 B.C.–A.D. 40) that the fine tombs of the el Hejr type may be dated, and perhaps also the High-place. Then the city became more and more Romanized. In A.D. 106 Arabia Petraea ("Arabia belonging to Petra") was absorbed into the Roman empire, and the native dynasty came to an end. When the city was more prosperous than ever, at the time of Alexander Severus (A.D. 222–235), the issue of coinage came suddenly to an end. This was possibly due to a desert raid on a large scale, associated, perhaps, with the neo-Persian power under the Sassanid dynasty. Meanwhile, Palmyra was growing in importance, and attracted much of the Arabian trade away from Petra, and the latter declined. It seems, however, to have lingered on as a religious centre, for we are told by Epiphanius (*c.* A.D. 315–403) that in his time a feast was held there on Dec. 25 in honour of the virgin, Chaabou, and her offspring, Dusares (*Haer.* 51.). The chief god of Petra was Dhū-sharā (Δουσάρης), *i.e.*, the lord or owner of Sharā; he was worshipped under the form of a black rectangular stone, a sort of Petraean Ka'ba. Associated with Dhū-sharā was Allāt, the chief goddess of the ancient Arabs. Christianity found its way into Petra in early times; Athanasius mentions a bishop of Petra named Asterius, and at least one of the tombs was used as a church, with an inscription recording its consecration "in the time of the most holy Bishop Jason" (A.D. 447). The Christianity of Petra, as of north Arabia, was swept away by the Mohammedan conquest in A.D. 629–632. Under the Latin kingdom, Petra was occupied by Baldwin I.; it was held by the Franks till 1189; fragments of the Crusaders' citadel are still standing.

The present ruins are extensive and are usually approached by a track which leads round Jebel Hārūn (Mt. Hor) and enters the plain of Petra from the south. Another entrance is from the east, through a narrow gorge called the Sīk, also the waterway of the Wadi Mūsā. Near the end of the defile stands the most elaborate of the ruins, el-Hazne, or "the Treasury of Pharaoh," hewn out of the cliff. A little further on, at the foot of en-Nejr, comes the theatre. On en-Nejr is the great High-place, consisting of a rock-hewn altar of burnt offering. Not far off are two obelisks cut out of the solid rock; these were either images of Dhū-sharā and Allāt, or, more probably, marked the limits of the *haram* or the sanctuary. There are other places of sacrifice around. It seems probable that en-Nejr must have been the sacred mountain, the original sanctuary of Petra. The mountain walls around the city are lined with rock-cut tombs, in the form of towers. The city itself covered a space of about 1¼ sq.m., on fairly level ground on either bank of the Wadi Mūsā. Among the ruins on the south bank stand the fragments of a temple called Kasr Fir'aun, of late Roman date.

See Brünnow and Domaszewski, *Die Provincia Arabia* (1904); Dalman, *Petra und seine Felsheiligtümer* (1908); Musil, *Arabia Petraea* (1907–08). *See* also the *Corpus Inscr. Sem.*, ii. 305 *sqq.*; Baedeker-Socin's, *Palestina* (7th ed.) and *Revue biblique* (1897–98 and 1903).

PETRARCH (1304–1374). Francesco di Petracco (Francesco Petrarca), the great Italian poet and humanist, was born at Arezzo on July 20, 1304. His father, Ser Petracco, held a post of notary in the Florentine Rolls court of the Riformagioni; but, having espoused the same cause as Dante during the quarrels of the Blacks and Whites, Petracco was expelled from Florence by the decree of Jan. 27, 1302, which condemned Dante to lifelong exile. With his wife he took refuge in the Ghibelline township of Arezzo. His mother, having obtained permission to return from

banishment, settled at Incisa, a little village above Florence, and here Petrarch acquired that pure Tuscan idiom which he used with such consummate mastery in ode and sonnet. In 1312 Petracco set up a house at Pisa; but he removed in 1313 to Avignon, where at that time the popes had their residence.

At Carpentras, under the direction of Convennole of Prato, Petrarch studied the humanities between 1315 and 1319, when he went to Montpellier to study law. Like Ovid and many other poets, Petrarch felt no inclination for law. There is an authentic story of Petracco's flinging the young student's books of poetry and rhetoric upon the fire, but saving Virgil and Cicero half-burned from the flames at his son's passionate entreaties. Nevertheless, after four years of study at Montpellier, he passed three years at the law school of Bologna with his brother Gherardo. In 1326, when his father died, he returned to Avignon. Banishment and change of place had already diminished Petracco's fortune, which was never large; and a fraudulent administration of his estate after his death left the two heirs almost destitute. The most precious remnant of Petrarch's inheritance was a ms. of Cicero. Petrarch took ecclesiastical orders and Giacomo Colonna, afterwards bishop of Lombez, now befriended him and partly supported him for some years.

Laura.—On April 6, 1327, happened the most famous event of Petrarch's personal history. He saw Laura for the first time in the church of St. Clara at Avignon. Who Laura was remains uncertain still. Petrarch kept the secret jealously, and the identification of her by the abbé de Sade in the 18th century with the wife of Hugues de Sade is more than suspect We may, however, reject the sceptical hypothesis that Laura was a figment of Petrarch's fancy. If we accept her personal reality, the poems of her lover demonstrate that she was a married woman who accepted the poet's homage, but refused intimate relations.

Petrarch's inner life after this date is mainly occupied with the passion which he celebrated in his Italian poems and with the friendships which his Latin epistles dimly reveal. Besides the bishop of Lombez he was now on terms of intimacy with another member of the great Colonna family, the cardinal Giovanni. A German, Ludwig, whom he called Socrates, and a Roman, Lello, who received from him the classic name of Laellius, were among his best-loved associates. He lived mainly at Avignon until 1333, when he undertook the first of many long journeys. He was a great traveller and keenly observant. He was one of the first alpinists and loved the mountains for their own sake. On this tour he visited Paris, Ghent, Liége, Cologne, making the acquaintance of learned men and copying classical manuscripts. On his return to Avignon he pleaded the cause of the Scaligers in their lawsuit with the Rossi for the lordship of Parma, and addressed two poetical epistles to Benedict XII. upon the restoration of the papal see to Rome. His eloquence on behalf of the tyrants of Verona won him the friendship of their ambassador, Azzo di Correggio. Not long after these events Petrarch made his first journey to Rome, a journey memorable from the account which he has left us of the impression he received from its ruins.

In 1337 Petrarch established himself at Vaucluse, and began his life of solitary study, heightened by communion with nature in her loneliest and wildest moods. Here he spent his time among books, meditating on Roman history, and preparing himself for the Latin epic on Scipio Africanus, *Africa*. For recreation he climbed the hills or traced the Sorgues from its fountain under those tall limestone cliffs, while odes and sonnets to Madonna Laura were committed to paper. He wrote many of his most important treatises in prose, as well as a large portion of his Latin correspondence, in this retreat. Some woman, unknown by name, made him the father of a son, Giovanni, in 1337; and she was probably the same who brought him a daughter, Francesca, in 1343. Both children were afterwards legitimized by papal bulls.

Meanwhile his fame as a poet in the Latin and the vulgar tongues increased, until, when the first drafts of the *Africa* began to circulate, about 1339, it became manifest that no one had a better right to the laurel crown than Petrarch. A desire for glory was one of his most deeply-rooted passions, and it is probable that he exerted his influence in several quarters with the view to a public coronation. On Sept. 1, 1340, he received two invitations, from the university of Paris and from King Robert of Naples respectively. He accepted the latter, journeyed in Feb. 1341 to Naples, was honourably entertained by the king, and, after some formal disputations on poetry, was sent with magnificent credentials to Rome. There, in April, he assumed the poet's crown upon the Capitol from the hand of the Roman senator amid the plaudits of the people and the patricians The oration which he delivered on this occasion was composed upon these words of Virgil.—

Sed me Parnassi deserta per ardua dulcis
Raptat amor.

Henceforth Petrarch ranked as a rhetorician and a poet of European celebrity During the spring of 1341 his friend Azzo di Correggio had succeeded in freeing Parma from subjugation to the Scaligers and was laying the foundations of his own tyranny in that city. He invited Petrarch to attend him when he made his triumphal entry in May, and for some time Parma and Vaucluse were his headquarters. The one he called his Transalpine, the other his Cisalpine, Parnassus

The events of the next six years of his life may be briefly recapitulated. He lost his old friend the bishop of Lombez by death and his brother Gherardo by the entrance of the latter into a Carthusian monastery. Various small benefices were conferred upon him; and repeated offers of a papal secretaryship, which would have raised him to the highest dignities, were rejected. In Jan. 1343 his patron Robert, king of Naples, died, and Petrarch was sent on an embassy from the papal court to his successor Joan The notices which he has left of Neapolitan society at this epoch are interesting and, it was now, perhaps, that he met Boccaccio. The beginning of 1345 was marked by the discovery at Verona of Cicero's *Familiar Letters*. But Petrarch found the precious ms. after the style of his own epistles had been already modelled upon that of Seneca and St. Augustine.

In May 1347, when Cola di Rienzi accomplished the revolution which for a short space revived the republic in Rome, Petrarch, who in politics was no less visionary than Rienzi, threw himself into the republican movement and sacrificed his old friends of the Colonna family to what he judged a patriotic duty.

In 1347 Petrarch built himself a house at Parma where he hoped to pursue the tranquil avocations of a poet and of an idealistic politician. But the next two years brought a series of calamities Laura died of the plague on April 6, 1348. Francesco degli Albizzi, Mainardo Accursio, Roberto dé Bardi, Sennuccio del Bene, Luchino Visconti, the cardinal Giovanni Colonna and several other friends died in rapid succession. Friendship with him was a passion; he needed friends for the maintenance of his intellectual activity at the highest point of its effectiveness.

We may say with certainty that Laura's death, followed by that of so many friends, was the turning-point in Petrarch's inner life. He began to think of quitting the world and establishing a kind of humanistic convent, where he might dedicate himself, in the company of kindred spirits, to still severer studies and a closer communion with God Though nothing came of this scheme, a marked change was henceforth perceptible in Petrarch's literary compositions. The death of Laura left him purified from passion, but able to realize his poetic mistress more clearly than he had ever done in her lifetime The poems written *In Morte di Madonna Laura* are of more religious tone.

At the same time his increasing renown led to fresh relations with Italian despots. The noble houses of Gonzaga at Mantua, of Carrara at Padua, of Este at Ferrara, of Malatesta at Rimini, of Visconti at Milan, vied with Azzo di Correggio in entertaining him. In vain his correspondents pointed out the discrepancy between his zeal for Italian liberties, his recent enthusiasm for the Roman republic, and this alliance with tyrants who were destroying the freedom of the Lombard cities. Petrarch remained an incurable rhetorician; and, while he stigmatized the despots in his ode to Italy and in his epistles to the emperor, he accepted their hospitality. They, on their part, seem to have viewed his political theories as of no practical importance. The patronage of art and letters which distinguished Italian princes throughout the Renaissance first manifested itself in the attitude of Visconti and

Carraresi to Petrarch.

In 1350 Petrarch made a pilgrimage to Rome, passing through Florence, where he established a firm friendship with Boccaccio. This alone of his friendships stands out with clearness. Boccaccio carried his admiration for Petrarch to the point of worship. Petrarch repaid him with sympathy, counsel in literary studies, and moral support in his effort to conquer his over-sensuous nature. It was Boccaccio who in 1351 brought to Petrarch, then at Padua, an invitation from the seigniory of Florence to accept the rectorship of their recently founded university. This was accompanied by a diploma of restoration to his rights as citizen and restitution of his patrimony. Petrarch declined the offer, and maintained his independence and his leisure. In 1351 he was again at Vaucluse, engaged on his *Epistle to Posterity*.

Early in 1353 he left Avignon for the last time, and made his way to Milan, where the archbishop Giovanni Visconti was virtually despot. He employed Petrarch on various diplomatic missions, notably as a mediator betwen Genoa and Venice in 1353. On Nov. 8 he delivered a studied oration before the doge Andrea Dandolo and the great Venetian council. His eloquence had no effect; but the orator entered into relations with the aristocracy which were afterwards extended. After Giovanni's death he remained at Milan in the court of Bernabo and Galeazzo Visconti, closing his eyes to their cruelties and exactions, serving them as diplomatist and orator. In their interest he addressed epistles to the emperor Charles IV. upon the distracted state of Italy, and entreated him to resume the old Ghibelline policy of imperial interference. Charles IV. passed through Mantua in 1354 and there Petrarch made his acquaintance but, finding him unfit for any noble enterprise, declined attending him to Rome. When Charles returned to Germany, after assuming the crowns in Rome and Milan, Petrarch addressed to him a letter of vehement invective and reproach. Yet the Visconti sent him on an embassy to Charles at Prague in 1356. In 1361, on his return to Milan from one of his embassies to France, he received news of the deaths of his son Giovanni and his old friend Socrates, carried off by plague.

Soon afterwards, in May 1362, he settled at Padua. In 1363 he visited Venice, making a donation of his library to the republic of St. Mark. Here his friend Boccaccio introduced to him the Greek teacher Leontius Pilatus. Petrarch, who possessed a ms. of Homer and a portion of Plato, never acquired the Greek language, and he could only approach the *Iliad* in Boccaccio's rude Latin version. About this period he saw his daughter Francesca happily married, and undertook the education of a young scholar from Ravenna, whose sudden disappearance from his household caused him the deepest grief. This youth has been identified, on insufficient grounds, with that Giovanni Malpaghini of Ravenna who was destined to form an important link between Petrarch and the humanists of the next age of culture. Much of this last stage of his life was occupied in a controversy with the Averroists, whom he regarded as dangerous antagonists of sound religion and culture. A curious treatise, which grew in part out of this dispute and out of a previous duel with physicians, was the book *De sui ipsius et multorum ignorantia*.

At last, in 1369, he retired to Arquà, a village in the Euganean hills, where he continued his unremitting study. All through these declining years his friendship with Boccaccio was maintained. It rested on a solid basis of mutual affection and of common studies, the different temperaments of the two scholars securing them against rivalry. One of Petrarch's last compositions was a Latin version of Boccaccio's story of Griselda. On July 18, 1374, his people found the old poet and scholar dead among his books in that little house which looks across the hills towards the Adriatic.

The Founder of Humanism.—Petrarch was the inaugurator of the Renaissance in Italy. What he achieved for the modern world was not merely to bequeath to his Italian imitators masterpieces of lyrical art unrivalled for perfection of workmanship, but also to open out for Europe a new sphere of mental activity. Standing within the threshold of the middle ages, he surveyed the kingdom of the modern spirit, and, by his own inexhaustible scholarship and study, he determined what we call the revival of learning. He was the first to collect libraries, to accumulate coins, to advocate the preservation of mss. His friends knew that the most acceptable of all gifts to him was an addition to his collection of manuscripts. For him the authors of the Greek and Latin world were living men, and the rhetorical epistles he addressed to Cicero, Seneca and Varro prove that he dwelt with them on terms of sympathetic intimacy.

Eminently religious and orthodox, he did not seek to substitute a pagan for the Christian ideal. This was left for the scholars of the 15th and 16th centuries in Italy. But he venerated the Latin orators, historians and poets as depositories of a tradition only second to revelation. For him there was no schism between Rome and Galilee, between classical genius and sacred inspiration. The latter concerned man's eternal welfare, the former the perfection of his intellect and the civilization of his manners. Whatever in literature revealed the hearts of men was infinitely precious to him; and for this reason he professed almost a cult for St. Augustine. It was to Augustine, as to a friend, that he poured forth his soul in the *De contemptu mundi*. Much as Petrarch effected by restoring a sound conception of learning, he did more by impressing on the age his own striking personality. Whether we regard him as a priest who published poem after poem in praise of an adored mistress, as a plebeian man of letters who conversed on equal terms with kings and princes, as a solitary dedicated to the love of nature, as an amateur diplomatist treating affairs of state with pompous eloquence in missives sent to popes and emperors, or again as a traveller eager for change of scene, ready to climb mountains for the enjoyment of broad prospects; in all these divers manifestations of his peculiar genius we trace some contrast with the manners of the 14th century, some emphatic anticipation of the 16th.

As an author Petrarch must be considered from two points of view—first as a writer of Latin verse and prose, secondly as an Italian lyrist. In the former capacity he was speedily outstripped by more fortunate scholars. His eclogues and epistles and the epic of *Africa*, on which he set such store, exhibit a comparatively limited command of Latin metre. His treatises, orations and familiar letters, though remarkable for a prose style, are not distinguished by purity of diction. Much as he admired Cicero, he had not freed himself from current mediaeval Latinity. Seneca and Augustine had been too much used by him as models of composition. He possessed a copious vocabulary, a fine ear for cadence and a complete faculty of expression.

In Italian poetry Petrarch occupies a very different position. In the *Rime in Vita e Morte di Madonna Laura* perfect metrical form is married to language of the choicest and the purest. It is true that even in the *Canzoniere*, as Italians prefer to call that collection of lyrics, Petrarch is not devoid of faults and affectations belonging to his age. He appealed in his odes and sonnets to a restricted audience already educated by the chivalrous love-poetry of Provence and by Italian imitations of that style. He was not careful to exclude the commonplaces of the school, nor anxious to finish a work of art wholly free from fashionable graces and from contemporary conceits. There is, therefore, a certain artificiality in his treatment; and this has been perpetuated with wearisome monotony by versifiers who chose him for their model. But, after making due allowance for peculiarities, the abuse of which has brought the name of Petrarchist into contempt, we can agree with Shelley that the lyrics of the *Canzoniere* "are as spells which unseal the inmost enchanted fountains of the delight which is the grief of love." Petrarch links the metaphysical lyrists of Tuscany with more realistic amorists of succeeding generations. He was the first Italian poet of love to free himself from allegory and mysticism, and yet he was far from approaching the analysis of emotion with the directness of a Heine or De Musset. Laura is not so much a woman as woman in the abstract; and perhaps on this account the poems written for her have been taken to the heart by countless lovers. The same criticism might be passed on Petrarch's descriptions of nature. That he felt the beauties of nature keenly is certain; yet he has written nothing so characteristic of Vaucluse as to be inapplicable to any solitude where there are woods and water. The *Canzoniere* is therefore one long melodious monody with the

indefinite form of a beautiful woman seated in a lovely landscape, a perpetual object of delightful contemplation. This disengagement from local circumstance without the sacrifice of emotional sincerity is a merit in Petrarch, but a fault in his imitators.

Petrarch's odes to Giacomo Colonna, to Cola di Rienzi and to the princes of Italy display him in another light. They exhibit oratorical fervour and the pleader's eloquence in its most perfect lustre. Modern literature has nothing nobler, nothing more harmonious in the declamatory style than these three patriotic effusions. Their spirit itself is epoch-making in the history of Europe, for up to this point Italy, as a nation, had scarcely begun to exist. To the high conception of Italian nationality, to the belief in that spiritual unity which underlay her many discords and divisions, Petrarch attained partly through his disengagement from civic and local partisanship, partly through his liberal culture.

The principal materials for a life of Petrarch are afforded by his letters divided into *Familiar Correspondence, Correspondence in Old Age, Divers Letters* and *Letters without a Title*, by the autobiographical *Epistle to Posterity*, and by the epistles and eclogues in Latin verse, the Italian poems and the rhetorical addresses to popes, emperors, Cola di Rienzi and some great men of antiquity. For the comprehension of his character, the *De contemptu mundi* is invaluable. His erudition can be shown by a brief enumeration of his most important writings In moral philosophy, we find *De remediis utriusque fortunae*, a treatise on human happiness and unhappiness; *De vita solitaria*, a panegyric of solitude, and *De otio religiosorum*, on monastic life. On historical subjects there are *Rerum memorandarum libri*, a miscellany from a student's commonplace-book, *De viris illustribus*, an epitome of the biographies of Roman worthies, *Contra cuiusdam anonymi Galli calumnias apologia, Contra medicum quendam invectivarum libri*, and *De sui ipsius et multorum ignorantia*—controversial compositions, which grew out of Petrarch's quarrels with the physicians of Avignon and the Averroists of Padua In this connection may be mentioned the satires on the papal court, included in the *Epistolae sine titulo*. Five public orations have been preserved. Among his Latin poems *Africa* takes the first place. Twelve *Eclogues* and three books of *Epistles* in verse close the list. In Italian we possess the *Canzoniere*, including odes and sonnets for Laura during her lifetime, those written after her death, and a miscellaneous section containing the three patriotic odes and three famous poetical invectives against the papal court. Besides these lyrical compositions are the semi-epical or allegorical *Trionfi*—Triumphs of Love, Chastity, Death, Fame, Time and Divinity, written in terza rima of smooth and limpid quality. Though these Triumphs, as a whole, are deficient in poetic inspiration, the second canto of the *Trionfo della morte*, in which Petrarch describes a vision of his dead love Laura, is justly famous for reserved passion and pathos tempered to a tranquil harmony (J. A. S.; X)

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The Sonnets, Triumphs, and other poems were translated by various hands in Bohn's library (1859). Selections of the Sonnets have been translated by R. Garnett (1896), A. Crompton (1898), G Robertson (1902), J. W. Higginson (1903) and by A. Tobin (1906) Of the *Trionfi*, the best translations are those by the countess of Pembroke (*see* ed. in *Publ. of Mod. Lang. Assoc. of America*, xxvii., 1912) and by H. Parker (*c.* 1565, reprinted by Roxburgh club, 1887). Petrarch's *Letters* were edited by Fracassetti (1859–63. Eng. trans. of the letters to classical authors, Chicago, 1910, and a trans. of a selection of his letters, 1914). The *De Remediis* was translated in 1797 and the *De Contemptu Mundi* in 1911

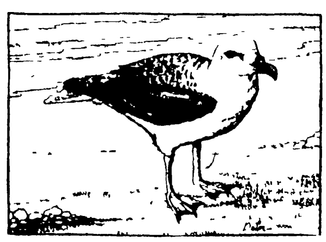
See De Sade, *Mémoires de la vie de Pétrarque* (Amsterdam, 1764–67); G. Körting, *Petrarca's Leben und Werke* (Leipzig, 1878); F. de Sanctis, *Saggio critico sul Petrarca* (1869, new ed. 1907); H. Hollway-Calthorp, *Petrarch, His Life and Times* (1907); P. de Nolhac, *Pétrarque et l'Humanisme* (2 vols., 1907); E. H. R. Tatham, *F. Petrarca*, 2 vols. (1925) and P. Mazzei, *La Vita e le Opere di Petrarca* (1927).

PETRE, SIR EDWARD (1631–1699), Jesuit confessor of King James II. of England, was born in Paris, the son of Sir Francis Petre, Bart., of Cranham, and his wife Elizabeth Gage. Educated at the Jesuit College at St. Omer, he entered the order under the name of Spencer in 1652, but did not receive the full orders till 1671, when he was sent on a mission to England. In 1679 he succeeded his brother in the title and family estates. On the accession of James II. in 1685 he became confessor to the king, whom he encouraged in the policy which ended by producing the revolution of 1688. The king contemplated making him archbishop of York, as the see was then vacant, but the pope, Innocent XI., who was not friendly to the order, would not grant a dispensation to hold it, and even directed Petre's superiors to rebuke him for his excessive ambition. On the outbreak of the revolution, Petre fled, and had no further relations with James II. After a visit to Rome, he became head of the Jesuit College at St. Omer in 1693, whence he was transferred to Walten in Flanders in 1697. He died on May 15, 1699.

PETRE, SIR WILLIAM (*c.* 1505–1572), English politician, was educated at Exeter College, Oxford, afterwards becoming a fellow of All Souls College (1523) He entered public service in early life, and began his official career by serving the English government abroad In 1536 he was made deputy, or proctor, for the vicar-general, Thomas Cromwell, and as such he presided over the convocation which met in June of this year. In 1543 Petre was knighted and was appointed a secretary of state; in 1545 he was sent as ambassador to the emperor Charles V. He retained his position under Edward VI. and Mary and though he resigned his secretaryship in 1557, he took some part in public business under Elizabeth until his death on Jan. 13, 1572 His son John Petre (1549–1613) was created Baron Petre of Writtle in 1603.

PETREL, group of birds whose name is derived from their apparent habit of walking on the water as St Peter is recorded (Matt. xiv. 29) to have done. They form with the shearwaters (*q v.*) and albatrosses (*q.v.*) the order *Tubinares*, the name denoting the tubular structure of their nostrils (*see* ORNITHOLOGY). There are two families, *Procellariidae* and *Oceanitidae*.

Petrels are archaic oceanic forms, with great powers of flight, dispersed throughout the oceans of the world; some species apparently never resort to land except for the purpose of nidification During the breeding-season many of them are nocturnal in their habits, passing the day in holes in which they generally nest, the hen laying a single white egg, sparsely speckled, in a few species, with fine reddish dots Of those species that frequent the North Atlantic the stormy petrel, or Mother Carey's chicken, *Hydrobates pelagicus*, is the commonest. Other Atlantic forms are Leach's or the fork-tailed petrel, *Oceanodroma leucorrhoa*, a larger but less common bird, and Wilson's petrel, *Oceanites oceanicus*, the type of the family *Oceanitidae*, which is common on the American side In the southern ocean petrels are most abundant, both as species and as individuals. The Cape-pigeon or Pintado petrel, *Daption capensis*, is one that has long been well known to mariners, while those who voyage to or from Australia meet with many more species, some, as *Ossifraga gigantea*, as large as albatrosses, and several called by names having reference to their strong smell of musk. The colouring of petrels is sooty-black, grey of various tints, and white.



BY COURTESY OF THE AMERICAN MUSEUM OF NATURAL HISTORY

THE PETREL, AN OCEANIC BIRD THAT COMES TO LAND ONLY DURING THE BREEDING SEASON

PETRIE, SIR WILLIAM MATTHEW FLINDERS (1853–), English Egyptologist, was born at Charlton on June 3, 1853, the son of William Petrie, C.E, and Anne, daughter of Captain Matthew Flinders (*q.v.*). He took an early interest in archaeological research, and between 1875 and 1880 studied ancient British remains at Stonehenge and elsewhere; in 1880 he published his book on Stonehenge. He was much interested in

ancient weights and measures, and in 1875 published a work on *Inductive Metrology*. In 1881 he began a long series of important surveys and excavations in Egypt, beginning with the pyramids at Giza, and following up his work there by excavations at the great temple at Tanis (1884), and discovering and exploring the long-lost Greek city of Naucratis in the Delta (1885), and the towns of Am and Daphnae (1886), where he found important remains of the time when they were inhabited by the Pharaohs. Between 1888 and 1890 he was at work in the Fayum, opening up Hawara, Kahun and Lachish; and in 1891 he discovered the ancient temple at Medum. Much of this work was done in connection with the Palestine Exploration Fund. By this time his reputation was established. He published in 1893 his *Ten Years' Diggings in Egypt*, and was appointed Edwards Professor of Egyptology at University College, London. In 1894 he founded the Egyptian Research Account, which in 1905 was reconstituted as the British School of Archaeology in Egypt (not to be confused with the Egypt Exploration Fund, founded 1892). Perhaps the most important work which the School has accomplished has been the investigation of the site of Memphis (*q.v.*). Flinders Petrie was knighted in 1923.

The extent as well as the chronological order of Professor Petrie's excavations may best be shown by a list of his works.

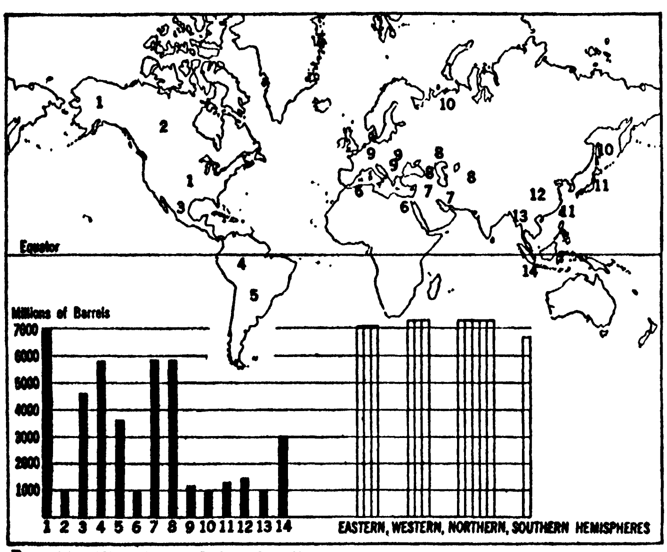
WORKS.—His chief general works on Egyptian subjects are, *Ten Years' Diggings in Egypt* (1893); *History of Egypt* (1894–1905); *Religion and Conscience in Ancient Egypt* (1898); *Syria and Egypt* (1898); *Hyksos and Israelite Cities* (1906); *Religion of Ancient Egypt* (1906); *Arts and Crafts in Egypt* (1909); *Historical Studies* (1910); *Revolution of Civilisation* (1911); *Eastern Exploration* (1919); *Prehistoric Egypt* (1920); *Social Life in Ancient Egypt* (1923); *Religious Life in Ancient Egypt* (1924); *Descriptive Sociology of Ancient Egypt* (1926). He has also written a long series of monographs on special subjects.

PETROGRAD: *see* LENINGRAD.

PETROL: *see* GASOLENE.

PETROL ENGINE: *see* INTERNAL COMBUSTION ENGINE.

PETROLEUM consists essentially of only two elements, hydrogen and carbon. The inorganic theory of its origin holds that hydrogen and carbon as elements in the rocks of the earth have been brought together under great heat and pressure and so were forced into various combinations. The organic theory, which



PETROLEUM PRODUCTION OF THE WORLD: NUMBERS AT BOTTOM OF DIAGRAM CORRESPOND TO THOSE ON MAP INDICATING LOCALITY

has in recent years been more widely accepted, holds that the hydrogen and carbon both come from remains of pre-existing plant and animal life. This organic material represents, in the main, microscopic marine and swamp life rather than true land life. Sea bottom muds and sands of ancient geological eras, squeezed by the weight of the thousands of feet of overlying muds and sands, crumpled and broken and finally thrown up above sea level by the movement of the earth's crust, finally become the shales and limestones and sandstones of to-day. The organic theory maintains that it is this organic mud containing microscopic plant and animal life which comes into the sea with the river silts, together with the much greater volume of similar tiny marine plants and animals that is the principal source material of petroleum.

Petroleum so formed and disseminated uniformly through great bodies of organic mud, is not yet available to man. It has still to be accumulated in a definitely limited reservoir such as is formed by the pore spaces between the grains in a bed of sand or, more rarely, in the cracks and cavities of a limestone, whence it can issue under pressure into the well which the oil operator drills into the reservoir. Concentration of petroleum is accomplished (1) by pressure which transforms the mud into a dense shale while forcing the oil into the more open, non-compressible sands, and (2) by water moving down through the bed from where it outcrops on the earth's surface, or rising upward along the bed under pressure from greater depths, but in either case flushing the oil ahead of it until the latter finally accumulates in the top of a fold or against the broken edge of a sand bed. These, briefly stated, are the conditions, according to the organic theory, which form petroleum fields. It is believed that the organic material which contributes most to the origin of oil is the abundant microscopic life in shallow sea water, commonly referred to as plankton.

PRODUCTION

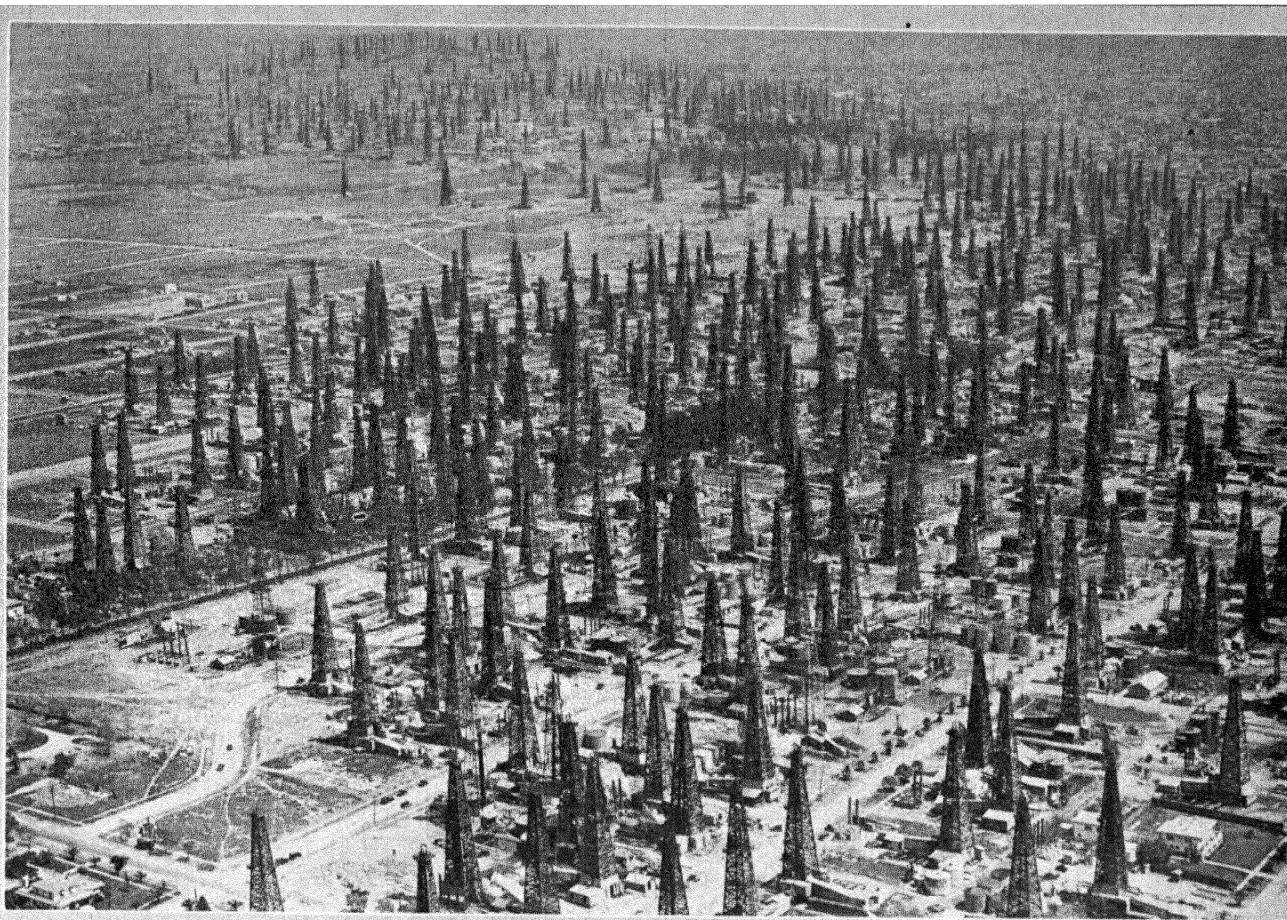
In 1927, according to an estimate of the Department of Commerce, the production of the United States amounted to approximately 896,000,000 bbl. moved from producing properties with about 9,800,000 bbl. consumed on leases or added to the storage held by producers; making a grand total production of 905,800,000 barrels. Since the total world output is estimated as 1,254,145,000 bbl. in 1927, American production therefore represents 72·23%. The Department of Commerce's estimate by countries follows:—

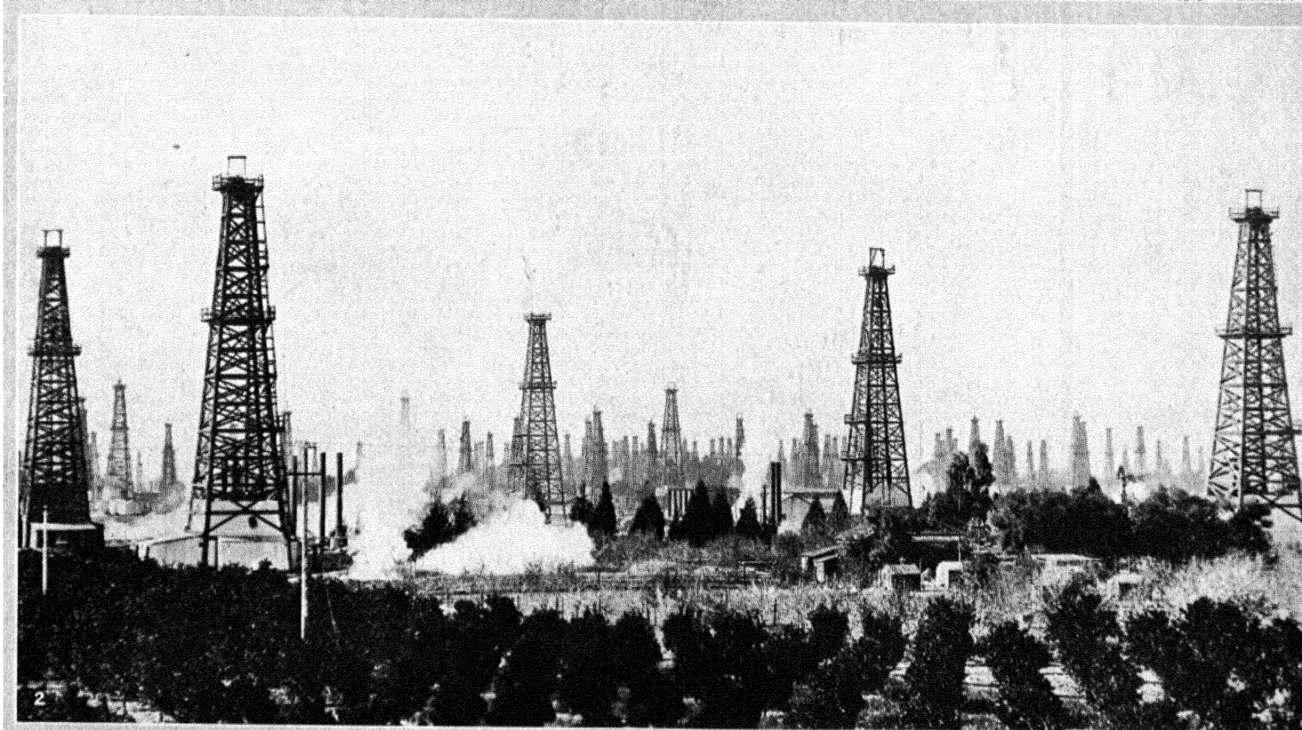
	Thousands of barrels	Per cent
United States	905,800	72·23
Russia	72,400	5·77
Venezuela	64,400	5·14
Mexico	64,200	5·12
Persia	36,800	2·93
Rumania	26,100	2·08
Dutch East Indies	21,400	1·71
Colombia	14,600	1·16
Peru	9,800	·78
Argentina	8,700	·69
British India	8,200	·65
Poland	5,800	46
Trinidad	5,200	·42
Sarawak	5,000	·40
Japan and Formosa	1,700	·14
Egypt	1,270	·10
Germany	700	
France	525	
Canada	500	
Ecuador	450	
Sakalin	200	
Czechoslovakia	140	
Italy	60	
Others	200	
Total	1,254,145	100

Since the first recorded production in 1857 the United States has supplied over 65% of the world's output. The total petroleum production (1857–1927) of the world was 15,811,962,000 bbl.; of the United States 10,346,346,000 barrels. Except for a relatively small production in Rumania, Poland and the Dutch East Indies, the production operations of American oil companies in foreign fields are chiefly confined to Mexico and South America, or fields relatively close to American refineries.

UNITED STATES

Because over 70% of the world's production of petroleum is in the United States, the petroleum refining industry in that country far exceeds that of all other countries combined. The United States not only consumes more oil than any other country but is also more dependent upon oil, with its oil-fuelled navy, a 62% oil-burning merchant marine and 25,000,000 motor cars. On Dec. 31,





OIL FIELDS IN CALIFORNIA

1. Aeroplane view of the great Signal Hill oil fields of the Los Cerritos district near Long Beach, California. Oil derricks are set so closely together that from a distance they resemble a great forest
2. Typical scene in Los Angeles county, California. An orange grove is seen in the foreground and a forest of oil well derricks are shown in the background. Drilling is in progress at the derricks where the live steam is seen escaping in white clouds

)27, there was in the United States one car for every 5·12 per-ons; in the United Kingdom one for every 37 persons; in France 1e for every 40 persons, and in Germany one for every 148 ersons. The total exports from the United States in 1926 (U.S. ureau of Commerce) amounted to $4,808,465,000, of which pe-oleum and its products amounted to $539,477,000 or 11%.

The total crude oil production of the United States by years, 1d percentage of United States production are shown in the companying tables.

Total Crude Oil Production of the United States

Year	Thousands of barrels	Year	Thousands of barrels	Year	Thousands of barrels
1859	2	1883	23,450	1907	166,095
1860	500	1884	24,218	1908	178,527
1861	2,114	1885	21,859	1909	183,171
1862	3,057	1886	28,065	1910	209,557
1863	2,611	1887	28,283	1911	220,449
1864	2,116	1888	27,612	1912	222,935
1865	2,498	1889	35,164	1913	248,446
1866	3,598	1890	45,824	1914	265,763
1867	3,347	1891	54,293	1915	281,104
1868	3,646	1892	50,515	1916	300,767
1869	4,215	1893	48,431	1917	335,316
1870	5,261	1894	49,344	1918	355,928
1871	5,205	1895	52,892	1919	378,367
1872	6,293	1896	60,960	1920	442,929
1873	9,894	1897	60,476	1921	472,183
1874	10,927	1898	55,364	1922	557,531
1875	8,788	1899	57,071	1923	732,407
1876	9,133	1900	63,621	1924	713,940
1877	13,350	1901	69,389	1925	763,743
1878	15,397	1902	88,767	1926	770,874
1879	19,914	1903	100,461	*1927	905,800
1880	26,286	1904	117,081		
1881	27,661	1905	134,717	Total	10,346,346
1882	30,350	1906	126,494		

*Estimated
Authority: U.S. Bureau of Mines

UNITED STATES AND WORLD CRUDE OIL PRODUCTION
(Thousands of barrels)

Year	World production	United States production	Percentage U S. production of world
1857	2		
1860	500	500	98·2
1870	5,799	5,261	90·7
1880	30,018	26,286	87·6
1890	76,633	45,824	59·8
1900	149,137	63,621	42·7
1910	327,763	209,557	63·9
1911	344,361	220,449	64·0
1912	352,443	222,935	63·3
1913	385,345	248,446	64·5
1914	407,544	265,763	65·2
1915	432,033	281,104	65·1
1916	457,500	300,767	65·8
1917	502,824	335,316	66·7
1918	503,430	355,928	70·7
1919	555,795	378,367	68·1
1920	688,804	142,929	63·6
1921	765,903	472,183	61·6
1922	858,909	557,531	64·9
1923	1,015,727	732,497	71·9
1924	1,014,160	713,940	70·4
1925	1,068,741	763,743	71·5
1926	1,095,934	770,874	70·3
*1927	1,254,145	905,800	72·2
Total 1857-1927 inclusive	15,811,962	10,346,346	65·4

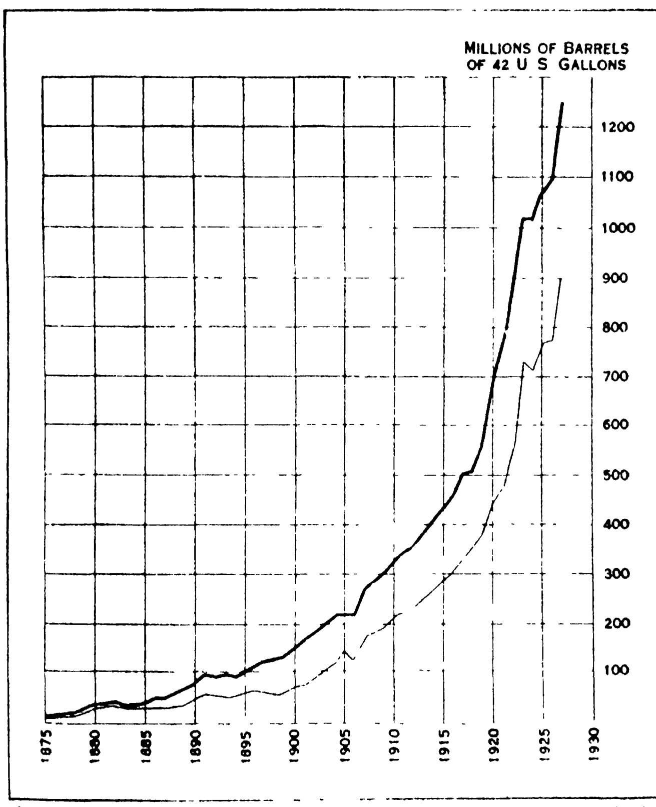
*Estimated.
Authority: U.S. Bureau of Mines.

The principal producing areas in the United States are, in order of their importance, as follows: Mid-Continent, California, Gulf Coast, Rocky Mountain, Appalachian, Illinois and south-west Indiana and Lima-Indiana.

The Appalachian area includes Kentucky, West Virginia, Pennsylvania, New York and eastern Ohio. The first commercial production in America was developed in this region with the drilling in Aug. 1859 of the Drake well, on Oil Creek, at Titusville, Pa. From this, well development spread first over the eastern United States, embracing parts of northern Ohio, Illinois and Indiana, and then became general, subsequently extending to Canada and California. More recently Tennessee was added and, more recently still, Michigan began to produce oil in commercial quantities. In recent years, the Appalachian fields, while continuing to produce a large quantity of oil, have yielded primacy in quantity to the great producing areas of the Mid-Continent and Far West.

Mid-Continent.—The Mid-Continent district embraces Oklahoma, Kansas, northern, central, eastern and south-western Texas, northern Louisiana and southern Arkansas and is the principal producing area. Pools are scattered throughout this area and new pools are being constantly discovered. While oil had been discovered previously in Oklahoma, it was not until the Bartlesville pool and the Glenn pool were discovered in 1905 that the great petroleum development in that State occurred. The Healdton pool followed In 1912, the Cushing pool was discovered, reaching a maximum production (1915) of 331,000 bbl a day. In 1914, the Augusta pool, in Butler county, Kan., was opened up and, in 1915, the El Dorado pool, which, in 1917, reached a maximum production of 109,000 bbl. a day.

Late in 1917, the discovery of oil near Ranger in central Texas



GRAPH SHOWING PRODUCTION OF CRUDE PETROLEUM FROM 1875–1927
Heavy line represents the total for the world; lighter line represents the total for the United States. The aggregate for the years 1857–1874 is 70,998,000 barrels, of which 65,284,000 barrels were produced in the United States. Figures for 1927 are preliminary

brought about a sensational development which took in Eastland, Stevens and other central Texas counties, and resulted in Ranger, Burkburnett and Breckenridge area production. In 1921, production was developed in southern Arkansas In the same year, the Mexia pool, Texas, was developed.

Since that date a large number of major pools have been developed in Oklahoma, including Burbank, Bristow, Hewitt, Tonkawa and, more recently in 1926–27, the Seminole area field, which is rated as one of the largest ever developed. In 1923–24 a succession of flush pools reached their peak concurrently, among

these being the Burbank and Tonkawa fields in Oklahoma, the original Smackover development in Arkansas and the Powell field in eastern Texas, all in the Mid-Continent area. In Dec. 1924, the sensational and short-lived Wortham pool in eastern Texas came in. In 1926, the Panhandle (Texas) oil field was first developed, and large producing areas have since been added by finds in various parts of west Texas, including Pecos, Crane, Upton and Winkler counties.

Gulf Coast.—In 1901 the Gulf Coast district came into prominence when the Spindletop pool in Jefferson county, Texas, was developed. The district includes southern Texas and southern Louisiana. Among the more important pools are Goose Creek, Hull, Humble, West Columbia and Sour Lake. In 1926, deeper drilling in the Spindletop field resulted in bringing in a major pool which was responsible for a peak production of over 100,000 bbl. a day.

Rocky Mountain.—The principal producing area in the Rocky Mountain district is the Salt Creek field in Wyoming. A great amount of exploration work has been done throughout the Rocky Mountain country in recent years resulting in discoveries and commercial production in Colorado, Montana and New Mexico.

California.—California has alternated with Oklahoma as the most important oil-producing State. Before 1923, the principal producing districts were in Kern and Fresno counties, with small production in Santa Barbara, Ventura and Los Angeles counties. Subsequently the great fields in the Los Angeles basin have been developed, among them Huntington Beach, Santa Fe Springs, Long Beach, Torrance, Dominguez, Inglewood and Seal Beach. Recently production in Ventura county has reached major proportions. Commercial development of California's oil began in the early '80s.

MEXICO

Development of oil in Mexico and in some countries of South America, notably Venezuela, Colombia and Peru, has direct bearing on the oil operations in the United States because the oil developed in these countries is shipped in large quantity to the United States for refining.

The rapid rise and fall of the production of petroleum in Mexico should be noted. As early as 1901 there was a small quantity produced in Mexico, but it was not until 1910 that the Mexican production became appreciable. Within a few years the output became second only to that of the United States. In the latter part of 1910, the Huasteca Petroleum Company's Juan Casiano No. 7 well was drilled and also the Aguila Oil Company's Potrero del Llano No. 4, and both became among the world's largest producers. The two principal oil fields in Mexico are distinguished as the Northern and the Southern. These wells were in the Southern field which lies in the northern part of the State of Vera Cruz and the southern part of the State of Tamaulipas and which is known as the "Golden Lane." Starting with the Aguila's Dos Bocas No. 3—which, when brought in (1908) flowed wild, caught fire and was never controlled—a considerable number of wells estimated as coming in at over 100,000 bbl. a day were recorded. Among these are the Juan Casiano No. 7 and the Potrero del Llano No. 4, above mentioned, estimated as having produced 75,000,000 bbl. and nearly 100,000,000 bbl. of oil, respectively, before exhaustion. The Huasteca's Cerro Azul No. 4, brought in (1916) with an estimated initial production of over 200,000 bbl. a day, is credited with being the world's largest producing well.

Shortly before 1910 oil production had been developed at Ebano, 40 m. west of Tampico, in the northern part of the Tampico-Tuxpam area, and in the Tehuantepec area, the last named region extending along the Gulf coast in southern Vera Cruz and the State of Tabasco. The "Golden Lane" supplied the bulk of Mexican oil in the years 1919 to 1922, inclusive, after which production in the Southern area fell off materially and is now confined principally (except for occasional new wells) to "stripping" operations. However, the Northern field has done much to offset these losses.

The trend of Mexican production is shown in the following table:

Year	Thousands of barrels	Year	Thousands of barrels	Year	Thousands of barrels
1901	10	1911	12,553	1921	193,398
1902	40	1912	16,558	1922	182,278
1903	75	1913	25,696	1923	149,585
1904	126	1914	26,235	1924	139,678
1905	251	1915	32,911	1925	115,515
1906	502	1916	40,546	1926	90,421
1907	1,005	1917	55,293		
1908	3,933	1918	63,828	Total	1,400,927
1909	2,714	1919	87,073		
1910	3,634	1920	157,069		

Authority: U.S. Bureau of Mines.

While the bulk of Mexico's crude oil is exported to the United States, a considerable quantity is refined in Mexico and the products are, in turn, exported largely to the United States. With the decline in production exports also fell off. In 1923, exports of crude oil and refined products totalled 135,576,000 bbl., of which approximately 78,000,000 bbl. were of crude oil. In 1926 the total exports were 80,719,000 bbl., of which about 38,000,000 bbl. were crude oil. A feature of Mexico's oil production has been the decline in so-called light oil output and the increase in so-called heavy oil production. In 1923 the light oil output amounted to 61,000,000 bbl. as against 32,000,000 bbl. in 1926.

CANADA

Until recent years, virtually all of Canada's petroleum was produced in Ontario but, in the autumn of 1922, oil was struck at Wainwright, south-east of Edmonton, in Alberta. This discovery has stimulated drilling in the Wainwright-Erma district. In 1924, a well producing oil of 73° American Petroleum Institute standard, was brought in at the Turner Valley field south-west of Calgary. A small production is obtained in New Brunswick. In 1920, oil was discovered on the MacKenzie river, 150 m. south of the Arctic Circle. The well was located north-west of Ft. Norman and was operated in 1922–23 for a small production. Other wells having been drilled in 1923–24 with negligible results, the Ft. Norman operations were suspended. Active search for oil in Canada has gone on ever since 1859, but commercial production in Canada dates only from 1870.

SOUTH AMERICA AND THE WEST INDIES

The oldest producing country in South America is Peru. The country of greatest immediate importance is Venezuela. Production is also obtained from Colombia, Argentina, Bolivia and Ecuador, and other countries of South America have oil possibilities. South America is recognized as one of the world's greatest potential oil continents, and the Caribbean countries, being easily accessible both to the United States and to the world markets, are being rapidly developed for oil. Oil is also being produced in Trinidad, in the West Indies. In 1926 South America and the West Indies produced 68,059,000 bbl., or 6% of the world's total production of 1,095,934,000 barrels.

Argentina.—Argentina's commercial production dates from 1910. Oil was first discovered in 1907 when a well being drilled for water by the Government near Comodoro Rivadavia, Chubut Province, on the coast of Patagonia, produced oil. The Government having reserved part of the oil-bearing land, Argentina's petroleum development has been in large part in its hands; but, in recent years, private companies have been active both on Government and privately owned lands. From Comodoro Rivadavia the oil belt extends northward, through the territory of Neuquen and the provinces of Mendoza, Salta and Jujuy to the Bolivian border. Most of the production since the beginning of operations has come from the Comodoro Rivadavia field. The oil is heavy and of asphalt base and ranges in gravity from about 18° to 22° American Petroleum Institute standard.

Colombia.—The principal oil development in Colombia is that of the Infantas field on the De Mares concession, located on the Rio Colorado in Santander del Sur. The field is approximately 350 m. from the mouth of Magdalena river. It is entirely con-

trolled by the International Petroleum Co., Ltd., of Canada. In 1926, a pipe line, having a daily capacity of about 30,000 bbl., was completed and, in 1927, the capacity of this line was practically doubled. In 1926, Colombian oil was being shipped to the United States and other countries. There is one small refinery in Colombia. Oil from the Infantas field ranges from about 26° to 31° American Petroleum Institute standard.

Peru.—Production in Peru dates from 1900, although as early as 1896 there was a small production developed. The principal fields are Negritos, Lagunitos, Lobitos and Zorritos. The oil ranges from 32° to 48° American Petroleum Institute standard.

Venezuela.—Venezuela is considered one of the most important potential oil-producing countries. The developed oil fields are very favourably located in the Lake Maracaibo basin, since the shallow channel by which Lake Maracaibo opens into the Caribbean sea permits economical oil carriage by specially built shallow-draft tankers. Oil has been found and is being produced on all sides of the lake, and in the bed of the lake itself, but the greatest development and the largest part of the production is from the east side of the lake and adjacent areas

Large producing areas of Venezuela are controlled by single interests, and development of some of the known fields has been very limited. This is particularly true of El Mene, La Paz, La Concepción, Río de Oro and La Tarra, in which fields drilling has been largely confined to informational testing to estimate reserves There has also been extensive drilling at La Rosa, Ambrosia and Lagunillas, but this has been for the most part line drilling, the extent of which has not yet been wholly defined.

Oil produced in Venezuela varies in gravity. Lagunillas oil is about 28° American Petroleum Institute standard, Mene Grande, 16° to 17·9° American Petroleum Institute standard, and La Paz, 22° to 28° American Petroleum Institute standard El Mene oil is about 35·2° American Petroleum Institute standard. Most of the production is a so-called heavy oil, which is "topped" at refineries and from which the principal product is fuel oil. However, all Venezuelan oil carries a fair percentage of gasolene from first distillations and responds well to "cracking" processes (*q.v.*).

Except for limited refining and consumption in Venezuela, the bulk of Venezuelan crude oil is exported. There are two small refineries, one at San Lorenzo, the other at La Rosa A large refinery at Curaçao is also operated on Venezuelan oil. A substantial part of the production is being shipped (1928) to refineries in the United States The growth of Venezuelan oil production has been phenomenal In 1923 the production was 4,201,000 bbl. and in 1926 it had grown to 37,381,000 barrels

Production of Oil in Venezuela

Year	Thousands of barrels	Year	Thousands of barrels	Year	Thousands of barrels
1917	120	1921	1,433	1925	19,687
1918	333	1922	2,201	1926	37,381
1919	425	1923	4,201		
1920	457	1924	9,042	Total	75,280

Authority: U.S Bureau of Mines

Trinidad.—Trinidad first appeared as an oil producer in 1910, although, as early as 1902, wells had been drilled north of the Pitch Lake at Guayaguayare in the extreme south-east of the island. This district became prominent in 1908 when a large well was brought in; but this "sanded up" later The oil fields of Trinidad are mainly in the southern part of the island. The oil ranges in gravity from 14° to 25° American Petroleum Institute standard and is largely a fuel oil

GROWTH OF THE AMERICAN OIL INDUSTRY

The oil industry in America within 70 years has grown from a single well of 69½ ft. in depth producing a few barrels of oil per day and representing an investment of less than $2,000, to an industry which is second only to agriculture and the railroads. Seven hundred and sixteen thousand wells had been drilled between 1858 and 1927 To-day there are 318,600 wells producing oil at the rate of about 2,400,000 bbl a day. Equipment and facilities in the industry are valued at $11,000,000,000 and more than 1,250,000 people are actively engaged in its operations in addition to 1,500,000 who are directly interested through ownership of royalty or stocks and bonds. The investment in the industry is roughly divided as follows:

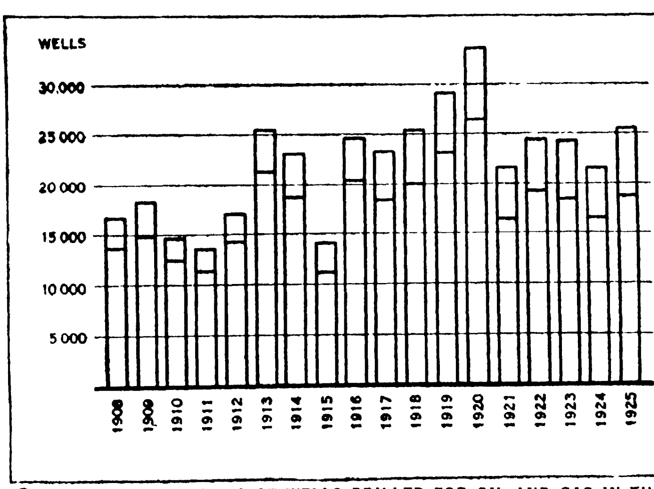
Production	$5,000,000,000
Refineries	3,000,000,000
Marketing	1,200,000,000
Pipe lines	1,000,000,000
Tank cars	300,000,000
Tank steamers	500,000,000

Drilling methods have been steadily improved and productive wells have been completed at depths below 6,000 ft. in less time than was required to complete the first shallow well in 1859 More than 90,000 m of pipe lines have been built for the economical transportation of petroleum in bulk from fields to refineries, to tidewater and to market Tankage for the storage of over 800,000,000 bbl. of crude oil and refined products has been erected in the fields, at refineries and at points of market distribution. More than 330 refineries with a daily capacity of 3,000,000 bbl. of crude oil have been built to manufacture finished products.

These products range from the lighter grade of aviation gasolene to residual coke, and include the gasolenes and distillates which have made possible the development of the automobile industry; gas oils, the base material from which homes are heated and lighted, fuel oil, which has revolutionized marine transportation, made possible the cheap operation of railway service in territory barren of other fuel and through the Diesel engine, reduced the cost of power developed in stationary plants, lubricating oils and greases of hundreds of grades and uses; medicinal oils, paraffine wax for candles; asphalt for road surfacing and roofing

HOW OIL IS PRODUCED

Petroleum is found by prospecting and the drilling of oil wells. (*See* DRILLING, PETROLEUM.) Physics, geology and palaeontology —and recently geophysics—are sciences entering into oil finding It is now known that petroleum deposits may occur in sedimentary rocks of any age from the oldest to the youngest and in any



GRAPH SHOWING NUMBER OF WELLS DRILLED FOR OIL AND GAS IN THE UNITED STATES, 1908–1925 THE UPPER PORTION OF EACH COLUMN INDICATES THE NUMBER OF DRY HOLES

The total number of wells from 1859 to the end of 1925 was 687,302, of which 287,922 were drilled in the 49 years, 1859–1907, and 399,380 in the 18 years represented in this diagram

structural position The greater part of the earth's surface is composed of sedimentary rocks, but only some of them contain oil. The aggregate acreage of all the actually producing areas in the United States is insignificant compared with the total area of the sedimentary rocks in that country There are numerous instances of test holes having been drilled in a certain region without success, the region then abandoned and, after a time, redrilled and found to contain important deposits.

The production of oil in the United States comes from hundreds of pools scattered in many States When a field is first brought in,

its production is usually derived from flowing wells or "flush" production, as distinguished from "settled" production; *i.e.*, that from pumping wells of older fields.

Areas of fields vary greatly. After a pool is discovered it is sometimes extended and not infrequently adjacent pools are developed and included in its area. There have been only about 27 oil fields of the United States which have produced approximately 100,000 bbl. (or more) a day at their peak.

Production of oil in new or "flush" fields usually increases rapidly after the discovery well is drilled in, and quickly reaches an early peak from which the decline is at first rapid and then more gradual. Factors influencing the production of "flush" fields are the size of individual leases and the number of wells drilled. Under the system of competitive leasing and drilling, the owner of the first well usually endeavours to get all the oil possible before it is drained away by other owners whose wells will draw on the same pool. In cases where a large block of land is held by one or comparatively few interests, this extremely rapid exploitation of a pool seldom occurs. The time taken in developing a field is also affected by the size of the pool, whether extensions or new pools are found and whether producing sands are found at different depths in the same field.

Only comparatively few of the 318,600 producing oil wells in the United States are yielding oil at a high rate, these being flowing wells which were recently drilled. Others are still flowing but their production has greatly declined since completion and is steadily declining to a point where the wells must be pumped to be commercially productive. Still another class of wells, and this is by far the largest in point of number, are the pumping wells with a "settled" production.

Production.—The average daily production per well in the United States during Dec. 1926 was 7·4 barrels. In the older fields where virtually all the wells are pumping wells the average production per well is in most cases less than one barrel a day. "Flush" wells supply a great amount of the current production as is indicated by the fact that 2·6% of the total number of producing oil wells are responsible for 50% of the production.

Nearly 30,000 wells are drilled annually. Over one-fourth of all wells drilled for oil and gas are failures. In addition, many wells which are listed when they come in as producing wells fall off rapidly and fail to maintain commercial production. Most of the wells that strike oil are small wells. Of the total completed in a year in the area of the United States east of the Rockies 31·7% have an average daily production of 25 barrels or less.

Cost.—Leasing land and drilling wells for oil in unproven territory are called "wild-catting." Investigations show that probably half of the purely wild-catting wells are failures. It costs on an average around $30,000 or $35,000 to drill an oil well. The cost is increasing every year as deeper drilling is required. In the Mid-Continent field the major portion of the crude oil is coming from the deeper wells which cost on the average about $65,000 to $75,000.

The producer has been constantly required to go deeper to obtain oil. Moreover, the wells increase in cost in much greater ratio than the increase in their depth. In 1915 a 2,500 ft. well could be drilled for from $20,000 to $25,000, but now a 4,500 ft. well costs from $65,000 to $75,000. A well recently completed in Logan county, Okla., to a depth of nearly 6,000 ft. cost about $190,000. Producers have spent several hundred thousand dollars on single wells drilled in remote territories.

Methods have been devised, chiefly the air or gas lift, so that deep wells, after they cease to flow naturally, are effectively pumped at much greater depths than formerly.

SCIENCE IN OIL PRODUCTION

The geologist was slow to be accepted in the oil industry. When he first appeared about 20 years ago he was placed in the same class with "oil witches" and "oil smellers." The nicknames "rock hound," "wrinkle chaser" and "pebble pup" date back to that time, not so long ago, when oil producers were either skeptical of the value of geology in oil production or quite convinced of its uselessness. To-day every producing company of any importance considers a geologist indispensable in their work. At first he concerned himself with surface geology, but more recently with sub-surface geology, which is carried on principally through study of the records or "logs" of wells, which show every formation through which the drill stem penetrates. Samples of rock from the well are reduced in size or pulverized and are carefully washed. A thorough microscopic examination of them is made. Beds are distinguished by the presence of fossils, by the presence or absence of certain minerals and, in a few regions, by the general appearance of the small particles. These fossils and minerals used as indicators are not always easily found. Often they are discovered only after long and tedious search under a high-power lens. Nevertheless, when once found and correctly identified, they become of great value in locating oil-producing horizons. The oil industry, which once smiled at the geologist, now not only accepts the geologist but welcomes the palaeontologist as well.

Instruments.—Geophysical methods have recently been successfully applied to the finding of oil. The seismograph and the torsion balance (*q.v.; see* also PROSPECTING) are the principal instruments. The seismometer (*q.v.*) is best known as the instrument which records earthquakes. In geological explorations for oil the seismograph performs a similar function, with the difference that the geologist must create his own miniature earthquake by the explosion of powder. (*See* PROSPECTING.) The waves from this explosion travel down into the earth, and if they impinge upon a rock structure, such as a dome or other fault in which the normal position of the rocks is disturbed, they are reflected back to the surface. By measuring the distance the waves have travelled the geologist can locate certain structures, thus getting a clue as to where he may find oil.

In recent years Baron Eötvös, a Hungarian professor of physics, conducted a large number of experiments in an effort to develop the laboratory torsion balance into a practical machine which could be utilized in field service to locate anticlines and other structures. The present highly developed torsion balance (*q.v.*) is the result. The Eötvös torsion balance was invented over 30 years ago and the possibilities of its application in geological work were proved some 20 years ago. Yet it seems almost entirely to have escaped the attention of American geologists and geophysicists, though an unsuccessful attempt was made in 1914 by an American geologist to secure an instrument. It was not until 1922 that the Eötvös and other similar instruments began to be used in the Gulf Coast district in this country. The results were highly satisfactory and geophysical methods in oil search are now firmly established.

Water Flooding has been successfully used in some of the Pennsylvania fields, *e.g.*, in the Bradford field, for a long time. The cost of flooding is large and the system cannot be operated economically on low-priced oil or for sands giving only a meagre yield. There is some difference of opinion as to whether the greater number of oil sands in the United States will respond to flooding, but it has been demonstrated that after a sand ceases to yield oil because of the exhaustion of gas pressures and when it fails to respond to pumping, a large quantity still remains in the sand.

The Gas Lift is a means of aiding and extending the flowing life of a well and giving some wells a flowing period when otherwise they would be started as pumpers, by furnishing externally the same kind of pressure, *i.e.*, compressed gas, that flowing wells possess naturally. The gas lift in oil wells developed from the use of the air lift (*q.v.*), which evolved from the use of the relatively old air lift for water wells. Dry gas under pressure is pumped into the head of a well and forced to the bottom. There it mixes with and is absorbed by the oil. The gas, expanding as it rises, lifts the oil to the surface in the form of a spray or froth. The gas, now saturated with the lighter fractions of the oil, is separated from the oil and as wet gas is sent through a process similar to that by which gasolene is made, and the gasolene recovered.

CONSERVATION AND STABILIZATION

While there has never been a shortage of petroleum and the

United States has been recording the greatest oil production in history, nevertheless, oil conservation is an important problem in the solution of which both the Federal Government and the oil industry are co-operating. In Dec. 1924, President Coolidge appointed the Federal Oil Conservation Board comprising the secretaries of the Interior, War, Navy and Commerce. This board has conducted and is continuing an exhaustive investigation.

The most important conservation development relates to the saving and utilization of gas encountered in oil pools. The oil in an underground pool is in the form of a gaseous mixture. In most pools there is free gas. What is called gas when it is seen at the top of the ground is, in fact, a liquid mixed with crude oil which is under high pressure. In general, the pressure is so great that the oil pool is ready to flow when any one drills a hole to it. When wells are first drilled into the producing sand the gas serves to lift the oil and the well is termed a "flowing" or "flush" well. Frequently, much gas escapes. When free gas pressure fails the oil must be brought up by pumping. New methods of production and discoveries made as to the function of gas in the oil sand present revolutionary possibilities with respect to conservation and to the stabilization of the petroleum industry.

Evidence before the Federal Oil Conservation Board indicated the general belief of oil experts that not more than 25% of the oil in an oil sand is recoverable by ordinary flowing and pumping. (*See* PHYSICAL RESOURCES OF THE WORLD: *Petroleum.*) It is believed that there will be considerably further recovery from the known sands. But the practical application of these discoveries is complicated because of the prevailing methods of oil development. Unrestricted gas pressure at the time of the opening of a new field has furnished the large "flush" wells which account for a large percentage of the production. To stop or reduce the escape of natural gas at the well would be to reduce the size of the wells in the first stages, thus eliminating the enormous production in the new fields characteristic of present practices.

Property Rights.—Under the usual system of land titles the petroleum in the earth is the property of the owner of the land above it. This system was settled before sub-surface resources, such as petroleum, were ever thought of. Laws were framed with particular reference to precious metals and solid minerals, the general rule being that he who owns the land surface holds title extending to the centre of the earth and this takes in petroleum deposits. But in furnishing oil deposits, nature disregards the law of man. Oil pools are often, so far as the surface above them is concerned, a checkerboard of ownership, and the oil well on one owner's land can draw the oil from beneath not only his own land but his neighbour's. A single well or a very few wells may drain an entire oil pool covering an area of 40 or 50 square miles.

As it is impossible to expect one owner above an oil pool to restrict his flow when his neighbour permits his well to run "wide open," the matter of property rights is involved, making necessary new methods which call for a sort of joint operation. These new methods mean the drilling of fewer wells and the recovery of a greater total of oil. But many scientific facts as to the function of gas and its effect on the rate of flow of oil and the recovery of oil must yet be determined. In the meantime, studies are being made to determine what legislative steps, if any, should be taken. The American Petroleum Institute continues to make investigations of this problem through its various committees, and the oil companies, through field experiments and laboratory research, are giving much attention to these matters.

Standardization.—Specifications have been completed on 90% of the equipment used in the drilling and producing of oil, under the auspices of the American Petroleum Institute, and its standards are becoming the international standards of the oil business and promise economies running into millions of dollars annually.

Refining.—The general principles involved in making the products that come from crude oil are simple and similar, broadly, to the distillation of water (*q.v.*). A still is filled with an average grade of crude oil having a gravity of 36° B., and weighing about 7 lb. per gallon. Most crudes are lighter than water, water weighing about 8¼ lb. per gallon. But crude oil has not a uniform boiling point, as has water. But as the temperature is raised the gasolene, which is the lightest fraction, is distilled off first, then the kerosene, followed by distillate and gas oil. Finally there is left in the bottom of the still that fraction of the crude oil, commonly known as fuel oil, which cannot be further distilled.

If the temperature in the still were maintained at about 200° F, only a small amount of very light gasolene would be distilled off. The practice is gradually to increase the temperature of the still and this results in all the gasolene being driven out of the crude oil, the last distilling at around 400° F. All of this would probably be discharged into one tank, and would be a blend of all the gasolene obtained from the crude oil. It has been found that this blended gasolene gives satisfactory operation in internal combustion engines of most types. The first gasolene that is distilled off is too light or boils at too low a temperature, and the last fraction would be too heavy, but mixture of the two gives a proper fuel.

The next product that distils over is kerosene. This is driven out of the crude oil as the temperature of the still is gradually increased from 400° to 475° F. Next is a small amount of distillate, very similar to and sometimes used in place of kerosene, but mostly utilized as fuel for domestic and other heating, which distils off between 475° to 500° F. Finally, as the temperature is increased from 500° to 575° F, gas oil is distilled off. This product is mostly used in the manufacture of carburetted or water gas for illuminating and heating. When the fire is turned out and the still allowed to cool, there remains in the bottom of the still about 36% of the original oil, which is pumped out and sold as fuel oil to railroads, steamships and many industries.

From 42 gal. or 1 bbl. of crude oil are obtained the following products: 14·7 gal. of gasolene or 35%; 3·3 gal. of kerosene or 8%; 1·7 gal. of distillate or 4%; 6·3 gal. of gas oil or 15%. We have left in the bottom of the still 15·1 gal. of fuel oil or 36%. From 1 to 2% would be lost in the operation, due largely to the evaporation losses in the gasolene friction.

If it is considered desirable, the temperature of the crude oil in the still can be increased above the 575° and more gas oil will be distilled out of the crude oil. In fact, the temperature can be increased to 700° or more until nothing is left in the bottom of the still but coke. This coke is similar to coal and is used as fuel in the same manner. A greater percentage of gas oil would be distilled, but the gas oil, however, would not be as desirable for most uses as when a smaller percentage is obtained.

Impurities.—Practically all crude oils contain impurities, the most important of which is sulphur. After distillation it is necessary to treat gasolene and kerosene to remove the sulphur and other impurities. One common method is to mix thoroughly a small amount of sulphuric acid with the gasolene and kerosene, which are then washed out with water.

Lubricating Oils.—The manufacture of lubricating oils is more difficult. There are many different grades of these oils. The general principle of manufacture may be set forth by explaining the making of what is termed "light oil." The 15·1 gal. of fuel oil left in the bottom of the still after the other products have been distilled off are heated to a high temperature, until a product which is called wax distillate comes off. This distillate contains some lubricating oil and wax. The wax has to be separated from the lubricating oil because it has no value as a lubricant and will cause the oil to congeal in cold weather. If this wax distillate is poured on a cake of ice it will be noted that the wax becomes a semi-solid and sticks to the ice. This fact is the basis for the method of extracting the wax from the distillate. The distillate is cooled to a low temperature and then pumped into wax presses which retain the wax.

After that operation, the wax-free distillate is redistilled. Then it is treated with sulphuric acid to remove impurities. Finally, it is percolated through fuller's earth (*q.v.*) to remove certain remaining impurities and also to give it the colour which makes it a marketable product. The fuel oil which is left in the still after the wax distillate is removed also contains heavy lubricating oils. The problem here is to separate this desirable lubricating oil from the asphalt, wax, sulphur and other impurities. This is done in part by treating the fuel oil with sulphuric acid and other chemi-

cals, and running the oil through centrifugal separators which operate on the same principle as a cream separator in which the lighter portion or cream is removed from the milk. In this manner the heavier lubricating oil is separated from the lighter amorphous wax.

The wax used in candles and as a sealing material for canning is made from the wax pressed out of the wax distillate; before it is suitable for use, however, it is further refined and all impurities removed.

This general description of the refining operation approximates what is known as the old "batch" method, long since obsolete at the majority of refineries but it serves to illustrate the principles of oil refining. In recent years new types of furnaces, pipe stills, fractionating equipment, many kinds of heat exchanges and other mechanical apparatus have taken the place of or supplement the old "batch" equipment.

Cracking.—"Cracked" gasolene is made by heating the gas oil or fuel oil in a still designed to withstand high pressure. The operation is controlled so that the distillation takes place at pressures which are as high as 750 lb. per square inch and at temperatures which vary from 750° to 1,200°. At these high temperatures and pressures a dissociation or "cracking" of the gas oil or fuel oil takes place. The character of the oil in the still is changed so that it is dissimilar to the original crude oil, but "cracked" gasolene looks and acts much like other gasolene.

Casing-Head Gasolene.—Whether the crude oil is flowing naturally or is obtained by pumping, gas is obtained along with the oil from a majority of the wells and, up until about 15 years ago, was wasted, being allowed to escape into the atmosphere. It was discovered that this gas contained a small quantity of gasolene, the amount varying from a fraction of a gallon per 1,000 cu.ft. to as much as 8 or 10 gallons.

The gasolene manufacturer has devised means to extract the gasolene from this gas commonly called "wet" gas to distinguish it from the "dry" gas obtained from natural gas wells which in most cases does not contain any gasolene. One method of extracting the gasolene is to compress or literally "squeeze" the gasolene out of the gas. The gas is compressed by large compressors to about 300 pounds. At this high pressure the gas is cooled and the gasolene condensed and recovered.

Another method is to bring the gas in contact with a refined oil, or perhaps with the distillate obtained from distillation operations described above, which absorbs the gasolene. Then by distilling the mixture the gasolene is recovered. A combination of these two methods is most commonly used. About 1,700,000,000 gal. or more than 10% of the total gasolene made in 1927 was natural gasolene.

This natural or "casing-head" gasolene is usually even of lighter gravity than the lightest gasolene obtained by distilling crude oil. It is not suitable for automobiles although it is now quite widely used by aeroplanes. The practice is to blend it with the so-called straight-run and cracked gasolenes previously mentioned and it is then adaptable for use in any type of internal combustion engine.

PETROLEUM GEOLOGY

There is an old statement that the requisites for occurrence of petroleum are substantially (a) porous rock to contain the oil, (b) an impervious cover to prevent it from escaping, (c) geological structure to permit the accumulation of oil from relatively large areas into a restricted area, and (d) a source from which oil has been derived. Wherever petroleum occurs in nature, natural gas is generally found in the same locality or region. Gas, however, is less restricted in its distribution than is oil, and numerous gas pools exist where no petroleum occurs in close proximity. The occurrence of oil and gas is wide-spread, no stratified rock being so young, and scarcely so old, as to preclude their existence. However, it should be understood that many parts of the world are unsuitable for oil occurrence for a variety of reasons. Geologists say, for instance, that no petroleum will be found in the immense regions occupied at the surface by rocks of Archaean or Algonkian age or in those of later periods which are entirely of an igneous or intensely metamorphosed character. These perhaps represent half of the earth's surface.

Various surface indications of the occurrence of petroleum are found throughout the world, in the form of oil and gas exudations, mud volcanoes, bituminous dikes and even lakes of asphalt; but surface indications are not essential, and in the last analysis oil occurrence is found to be independent of the existence or nonexistence of surface indications, even though these may lead to its discovery in some regions.

Occurrence.—The conditions essential to occurrence of oil may be more accurately described as follows: Presence of rocks of sedimentary origin, or in a few instances of those in proximity to rocks of sedimentary origin; absence of intense metamorphism; presence of sandstones, limestones, sands or other strata sufficiently porous to hold oil; some source from which the oil may have been formed; such water conditions as do not prohibit the accumulation of oil in pools; suitable cover to prevent the oil from seeping away or being pushed to the surface of the earth by underground waters; suitable structure or attitude of the strata to cause oil to be collected locally into pools, with the assistance of such other factors as water, gravitation, rock pressure, etc.

The relation between geologic structure and oil occurrence has been realized for several decades beginning with the advancement of the "anticlinal" theory. A marked increase in the value of geology to oil development was due to the evolution of the "structural theory" as an offshoot from the anticlinal theory. Briefly described, the structural theory holds that through some means petroleum and gas have come into or have been generated in the porous formations in which they are found. The theory of the origin of oil and gas is not an essential part of the structural theory; it is simply recognized that the oil, gas and water in the formations were at first widely diffused in the porous formations or in contiguous strata. Where beds have been folded, as in most of the oil fields of the world, the oil, gas and water have been allowed to separate and arrange themselves according to their relative specific gravities. The separation and concentration may have been assisted by rock-pressure, diastrophism, hydraulic pressure, seepage, capillarity or molecular attraction, internal heat, metamorphism or other causes; but whatever causes may account for the movement of the oil, gas and water, the law of gravitation, being ever operative, was of the greatest importance in determining their arrangement. Hence the accumulation was in the order of the densities of the substances.

The structural hypothesis agrees with the anticlinal theory, in acknowledging that, on a given anticlinal, monoclinal or quaquaversal structure, gas lies nearest the crest, oil lies lower down, while the salt water, when present, lies still lower on the flanks of the uplift. Whether the pools occur at the exact crest of the anticlines, lower on their slopes, or in the synclines, is determined by factors of secondary importance. The various structures in which oil occurs may be divided into main classes as follows, each of these classes also including special types of structures: Aclinal or sub-aclinal structures; anticlinal and synclinal structures; monoclinal structures; quaquaversal structures or "domes"; contact of sedimentary and igneous rocks; strata dipping unconformably away from old shore lines; crevices of igneous rocks; crevices of sedimentary rocks; faults; oil sands sealed in by bituminous deposits.

Composition.—Oil is at once most simple and most complex in constitution. It is simple in that it consists essentially of only two elements, namely, hydrogen and carbon; but it is complex in that hydrogen and carbon by uniting with each other in different proportions, form a veritable multitude of compounds—solid, liquid and gaseous—each with totally distinctive properties. A bewildering number of these hydrogen-carbon compounds, or hydrocarbons as they are commonly designated, are present in ordinary petroleum and are, in fact, its essential constituents.

Formation.—That oil is produced by geological forces acting generally through long intervals of time on the debris of aquatic organisms buried in the sediments is believed by most geologists. The evidence is almost overwhelming, though it is largely circumstantial, that petroleum is a geochemical result of rock pressure and earth temperatures working through long time, and possibly

under catalysing influences, on fossil organic matter, which is generally regarded as the "mother substance." The rocks in which this fossil organic matter occurs are frequently spoken of as "source rocks."

The combustible vestiges of plants, and possibly of animals, entering into the mother substance are generally those more resistant to decay in water, on account of their waxy, resinous, waxy-fatty or oil composition which characteristically imparts to the aggregate deposit relatively high hydrogen and low oxygen content. Specifically, the principal among these surviving vestiges of structure, plant secretion, etc., are (1) spore exines, (2) so-called fatty algae, (3) fragments of cuticles, (4) particles or flakes of wax and resin, the latter usually rare in the typical mother substance, and (5) the "humic" (or "ulmic") colloidal decomposition binder. All of these kinds of fossil components may be present and the "humic" binder is always present. In some cases nearly all the debris of plants or animals seems to have succumbed to bacterial action in the process of biochemical decomposition.

Some of the organic compounds in the plant or its secretions, such, for example, as waxes, spore exines and resins, doubtless pass the biochemical process and enter the unaltered sedimentary deposit with little or no chemical change. However, the organic aggregate, comprising both the fossil plant and animal debris, on the one hand, and the humic decomposition matter, on the other, is known to undergo progressive devolatilization (carbonization) as the deposit is, under dynamic (geophysical) influences, altered, stage by stage, from the organic mud (saprophile) to black slates and graphitic schists.

Most geologists believe that the primary petroleums are in the course of time generated in the buried mother substance under the influence (geophysical) of (1) intermittent pressure and heat; (2) added pressure by the generated gases; (3) heat of gravitative friction; and (4) heat of chemical change. On the other hand, there are many, especially among British geologists, who believe that either the oils were originally brought to the deposit by the organisms taking part in the sediments, or that they were generated during deposition as products of biochemical (microbian) action. In either case the oils existed, presumably disseminated, in the sediments at time of deposition of the strata. According to this view oil is at the outset deposited in most carbonaceous aquatic, especially marine, sediments. Still another, though small group, adheres to an entirely inorganic origin of oil, through generation from carbides or similar compounds of plutonic origin, coming from far beneath the sedimentary strata in which they are now found.

Another, a very large group of geologists, including perhaps, most European geologists, together with most chemists, believe that the petroleum deposits of the world are mainly, at least, the product of alteration, either in the biochemical process or subsequent to burial, of animal fats, rather than of organic matter of plant derivation. The theory of the generation of hydrocarbons from metallic carbides can be successfully demonstrated in the laboratory, but it is so incompatible with the geological occurrence of oil observed in the field that it commands little consideration.

Of great importance, however, is the question as to the primary contribution (as by diatoms) or the generation of the oil through the biochemical decomposition processes at time of deposition of the organic debris in the sediments, on the one hand, as opposed, on the other, to the generation of the oil at different times long afterwards by what might be termed natural geological distillation in the crust of the earth. The latter view implies the restriction of oil fields to areas subjected to compressive stresses.

The organic theory holds that the hydrogen and carbon that make up petroleum both come from the remains of pre-existing plant and animal life. This organic material represents, in the main, former marine life and swamp life rather than true land life; similarly it represents microscopic life, principally, rather than larger forms of life. Thus, the argument for the organic theory is written in the records of the ancient seas which ebbed and flowed across the margins of the continents. These seas periodically advanced and retreated across the land, so that, in their greatest expanse, they mingled the waters of the oceans on the opposite sides of the continents. The present Gulf of Mexico is the modern remnant of one of these continental seas. Throughout the ages, rivers flowed down to these seas and then as now carried with them great volumes of mud and sand to be spread out by currents and tides over the sea bottom. Each day and each year through millennium after millennium new deposits were distributed, layer upon layer, over the sea floor.

With the increasing load due to the weight of these new beds the earth's crust sank so that the depth of water remained about constant. Thus were built up the thick series of compacted muds and sands which characterize the formations penetrated in our oil wells. These sea bottom muds and sands of a geological yesterday, squeezed by the weight of thousands of feet of overlying muds and sands, crumpled and broken and finally thrust up above sea-level by the movement of the earth's crust around and beneath them, finally became the shales and limestones and sandstones of to-day.

It is this organic mud, the mass of microscopic plant and animal life which comes into the sea with the river silts, together with the much greater volume of similar tiny marine plants and animals, that the organic theory maintains is the principal source material of petroleum. These minute organisms, dead and settled to the bottom, buried by subsequently deposited muds, sealed from the air, and further protected from ordinary decay by the brine of the ocean itself, were subjected to a slow decomposition which finally yielded, among other products, the petroleum of commerce. Petroleum so formed, and disseminated uniformly through great bodies of organic mud, is not yet available to man. It has still to be concentrated, to accumulate in a definite limited reservoir such as the pore spaces between the grains of a bed of sand, or, more rarely, the cracks and cavities of a limestone, whence it can issue under pressure into the well which the operator drills into the reservoir.

This concentration of disseminated petroleum, again, is accomplished in part by pressure which transforms the mud into a dense shale, at the same time driving the oil into the more open, noncompressible sands, and in part by water moving down through the bed from its outcrop on the earth's surface, or rising upward along the bed under pressure from greater depths, but in either case flushing the oil ahead of it until the latter finally accumulates in the top of a fold or against the broken edge of a sand bed whence the water cannot dislodge it. These are the conditions, according to the organic theory, which make oil.

Under the auspices of the American Petroleum Institute, a scientific research in the geology, physics and chemistry of petroleum was initiated on Nov. 15, 1925, under a fund contributed by John D. Rockefeller and subsequently added to by the Universal Oil Products Company, of Chicago, Ill., and among the projects are several dealing with the study of the origin of petroleum.

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PETROLOGY, the science of rocks, the branch of geology concerned with the investigation of the composition, structure and history of the rock masses building up the accessible portions of the earth's crust (Gr. πέτρος, rock). Rocks are usually defined as aggregates of minerals without reference to their state of cohesion. Loose sands, clays, gravels or soils are included among rocks as being mineral masses playing an important rôle in field geology. On the other hand, the less soluble parts of the skeletons of animals and plants may form a considerable portion of rocks as, for example, coral-limestone, lignite and chalk. Lastly rocks may be built up almost wholly of non-crystalline material as obsidian, pitchstone or tachylyte, representing liquids so rapidly chilled that consolidation has occurred in the glassy state. Rocks are the units with which the geologist deals in investigating the structure of the crust, and some varieties cover enormous areas. Granite, sandstone and schist often form whole provinces and build up lofty mountains, while other rock types are of such rare occurrence that they are known only in one or two localities in distant parts of the earth's surface.

Treatment of the Subject.—Broadly speaking, rocks are divided into three great classes, *igneous, sedimentary,* and *metamorphic rocks.* In this paragraph the subject matter of that part of the science of petrology concerned with igneous rocks is briefly surveyed; the object is to point out the headings under which particular subjects are treated (there is a separate article on each italicized item). Here we confine ourselves to a discussion of the nature, composition, classification and origin of igneous rocks, and the methods by which they are examined (for the other groups *see* SEDIMENTARY ROCKS and METAMORPHISM).

Igneous rocks occur as intrusions or extrusions. The plutonic or deep seated intrusive rocks which cooled far below the surface occur as *batholiths, bosses, laccoliths* and *veins,* and include *granite, syenite diorite, gabbro* and *peridotite:* related to the granites are *aplite greisen, pegmatite* and *schorl-rock;* to the syenites, *borolanite, monzonite, nepheline-syenite* and *ijolite;* to the diorites, *aphanite, napoleonite* and *tonalite;* to the gabbros *pyroxenite* and *theralite,* and to the peridotites, *picrite* and *serpentine.* The hypabyssal intrusive rocks occur as *sills, veins, dikes, necks,* etc., and are represented by *porphyry* and *porphyrite, dolerite* and *lamprophyre;* to the porphyries belong *felsite* and *quartz-porphyry.* The extrusive rocks are volcanic and found typically as lava flows; they include *obsidian, perlite, pitchstone* and *rhyolite, phonolite* and *trachyte, andesite, dacite* and *basalt* (with the related *spilite, tachylyte* and *variolite*), *nephelinite* and *tephrite.*

Intermediate between the sedimentary and igneous rocks comes the group of rocks known as pyroclastic or fragmental volcanic rocks. These include *agglomerate,* some types of *breccia* and *tuff* (*see* also VOLCANOES). The agencies which affect igneous (among other) rocks and modify them are discussed under METAMORPHISM, METASOMATISM and PNEUMATOLYSIS.

Composition of Igneous Rocks.—Though the number of recognized minerals approximates to 1,000, only a comparatively small number are important as rock-formers, more especially if the subdivisions into which the common species are broken up are disregarded. The vast majority of the igneous rocks are built up of less than a dozen groups of minerals. These are (1) quartz, (2) felspars, (3) pyroxenes, (4) amphiboles, (5) micas, (6) olivines, (7) nepheline, (8) leucite, (9) iron ores and (10) apatite. To this list, for sedimentary rocks, we may add chlorite, kaolin calcite, dolomite, and a few other minerals. Metamorphic rocks are built up largely of the same minerals as igneous rocks but include special species which are foreign to igneous rocks, partly on account of their composition and partly because they appear to require special physical conditions (stress) for their production. The mineralogical nature of a rock is primarily dependent on its chemical composition, but other factors are of first importance in determining the paragenesis of rock-forming minerals, principally the mode of origin of the rock or the physical conditions obtaining during its formation. Two rock masses may have very much the same bulk composition and yet differ fundamentally in their mineralogical assemblages. Thus, certain lamprophyres rich in biotite have much the same composition as certain leucite-basalts, a hornblendite as a camptonite and so on. Igneous rocks of identical chemical composition but dissimilar mineralogical constitution are said to be heteromorphous. The governing factors are the physical conditions attending consolidation of the rock.

All crystalline rocks have consolidated from solution or from fusion. A granite arises by the consolidation of a liquid at high temperatures and great pressures; a metamorphic rock like mica-schist, on the other hand represents the recrystallization-product of a clay rock under the influence of heat and stress. Throughout this conversion the rock has been essentially solid, recrystallization taking place in the presence of minor amounts of interstitial liquid. Other crystalline rocks, like rock-salt, gypsum, anhydrite, etc., have been deposited from solution in water, mostly owing to evaporation on exposure to the air. The majority of sedimentary rocks, however, consist of a mechanical aggregate of crystalline particles; such are sandstone, clay, etc. The structure of these sedimentary and all pyroclastic rocks is referred to as fragmental.

Origin of Igneous Rocks.—All igneous rocks have solidified from a state of liquidity, the liquid that finally consolidates as rock being technically referred to as magma (Gr. μάγμα from μάσσειν, to knead). Rock-magma is a complex silicate solution carrying gases, the most important of which is water, which may constitute 5–6% of the mass. The greater part of the clouds given off by active volcanoes consists of steam, with which is associated minor amounts of other gases, the chief being CO_2, CO, HCl, S vapour, oxides of sulphur, H_2S, HF, NH_3, CH_4, Cl, F, H and N. When the magma consolidates the major part of these volatile constituents usually escapes. With very rapid cooling, however, the magma may solidify without crystallization as a volcanic glass, at the same time retaining much of its water. Analyses of pitchstone show not infrequently a content of 5–6% of water, and even higher values are recorded; on the other hand unaltered crystalline igneous rocks seldom show a water content greater than 2%. Here we have almost direct confirmation of the conclusion that the water-content of the magma before crystallization is greater than the water-content of the rock formed from it.

From what source is igneous magma derived? In the older conception of the earth a volcano was pictured as a safety valve of a molten interior, but a close study of igneous action, past and present, clearly negatives any such interpretation. The active vents of Mauna Loa and Kilauea (Hawaii) though only some 20 m. apart, have the summits of their lava columns at a difference of level of 10,000 ft. Yet liquid lava is erupted more frequently and in greater quantity from the higher column. Clearly these two outlets are not directly connected with a common liquid reservoir. Again, neighbouring vents, as those of the Lipari Isles, erupt widely different products, and each may maintain its independent behaviour regardless of what is happening to its neighbour. The conclusion is enforced that each distinct eruptive centre possesses its own reservoir, and we must conceive a number of independent magma chambers underlying an eruptive region. At greater depth these are no doubt connected with some magmatic reservoir of much larger dimensions. In some such common source the close community of petrographic character revealed in the succession of liquids erupted or intruded throughout any given igneous cycle is to be traced.

METHODS OF INVESTIGATION

Macroscopic Characters.—The macroscopic (Gr. μακρος, large) characters of rocks, those visible in hand-specimens without the aid of the microscope, are very varied and difficult to describe accurately and fully. The geologist in the field depends principally on them and on a few rough chemical and physical tests; and to the practical engineer, architect and quarry-master they are all-important. Although frequently insufficient in themselves to determine the true nature of a rock, they usually serve for a preliminary classification and often give all the information

really needed. With a small bottle of acid to test for carbonate of lime, a knife to ascertain the hardness of rocks and minerals, and a pocket lens to magnify their structure, the field geologist is rarely at a loss in deciding to whât group a rock belongs. The fine grained species may be indeterminable in this way, and the minute mineral components of all rocks can usually be ascertained only by microscopic examination; but it is easy to see that a sandstone or grit consists of more or less rounded, water-worn sand-grains and if it contains dull, weathered particles of felspar, shining scales of mica or small crystals of calcite these also rarely escape observation. Shales and clay rocks generally are soft, fine grained, often laminated and they not infrequently contain minute organisms or fragments of plants. Limestones are easily marked with a knife-blade, effervesce readily with weak cold acid and often contain entire or broken shells or other fossils The crystalline nature of a granite or basalt is obvious at a glance, and while the former contains white or pink felspar, clear vitreous quartz and glancing flakes of mica, the other will show yellow-green olivine, black augite and grey striated plagioclase.

Microscopic Characters.—But when dealing with unfamiliar types or with rocks so fine grained that their component minerals cannot be determined with the aid of a lens, the geologist is obliged to have recourse to more delicate and searching methods of investigation With the aid of the blowpipe (to test the fusibility of detached crystals), the goniometer, the magnet, the magnifying glass and the specific gravity balance the earlier travellers attained surprisingly accurate results. Examples of these may be found in the works of von Buch, Scrope, Darwin and many others About the end of the 18th century, Dolomieu examined crushed rock powders under the microscope and Cordier in 1815 crushed, levigated and investigated the finer ground-mass of igneous rocks. His researches are models of scrupulous accuracy, and he was able to announce that they consisted essentially of such minerals as felspar, augite, iron ores and volcanic glass, and did not differ in nature from the coarser grained rocks. Nicol, whose name is associated with the discovery of the Nicol prism, seems to have been the first to prepare thin slices of mineral substances, and his methods were applied by Witham (1831) to the study of plant petrifactions

This method, subsequently of such far-reaching importance in petrology, was not at once made use of for the systematic investigation of rocks, and it was not till 1858 that Sorby pointed out its value. The great work of this investigator was the production of very thin sections of rocks and their systematic examination under the high powers of the microscope. To-day the densest, blackest rock can be made to yield a section of $\frac{1}{1000}$ in in thickness, so thin and transparent that fine print can be easily read through it, and transmitting light so clearly that the most high powered objectives of the microscope can be used to discern and study the minutest structures it presents with the same facility that they can be employed upon sections of organic material prepared by the microtome. The introduction of this powerful weapon of research, inaugurated a new era in petrology—that of petrography or the descriptive branch of petrology The optical study of sections of crystals had been advanced by Sir David Brewster, Nicol and other physicists and mineralogists, and it only remained to apply their methods to the minerals visible in rock sections. The pioneer workers who brought quantitative methods into the optical side of the problem were Des Cloiseaux, Rosenbusch, Zirkel, Schuster, Fouqué and Levy. At the present day optical methods for determining minerals with the petrographic microscope are highly developed.

Although rocks are now studied principally in micro-sections the investigation of fine crushed rock powders, which was the first branch of microscopic petrology to receive attention is still in use. A mineral whose optical properties are known can be accurately determined by immersing its powder in liquid media whose indices of refraction are known, and determining the optical constants. In the hands of a skilled petrographer the principal optical constants of a single grain of a mineral can be determined in half an hour The chief fundamental constants measured are the principal indices of refraction, the crystallographic orientation of the directions of light-vibration corresponding to those indices, and the amount of absorption of light vibrating in these directions, all for one or more standard wave-lengths of light. The double refraction, optical character, optical axial angle, dispersion of the optic axes and bisectrices, extinction angle and pleochroism are all fixed by the fundamental constants and can be estimated under the microscope.

The immersion media cover a range of optical refraction from that of water (1·333) to that of a selenium—arsenic selenide melt (3·17). The liquids are chiefly organic substances,—acetone alcohol, cinnamon oil, monobrom-naphthalene and methylene iodide. Most minerals have refraction constants ranging in the interval 1·450–1·870, and their refractive indices may therefore be matched by a set of liquids whose refractions cover this range. The modern rotation apparatus whereby thin sections may be tilted from the horizontal so that the axis of the microscope passes through them at different angles has been of inestimable value in measuring accurately the optical constants of a single grain in a rock slice, and is now widely used for the determination of felspar and other mineral species of variable composition A few measurements on a selected section of a mineral permit the determination of its exact chemical composition and the crystallographic orientation of the section itself. The technical methods employed for the determinations referred to above are largely founded on the use of polarized light.

Mechanical Separation of Rock Constituents.—The separation of the constituents of a crushed powder in order to obtain pure samples suitable for analysis is also extensively practised The two principal methods adopted involve either the electromagnet or heavy liquids.

By the use of an electromagnet the component minerals of a rock may be separated by varying the strength of the current. A weak magnetic field attracts magnetite, then hematite and ilmenite Silicates containing iron will follow in definite order, augite, hornblende, tourmaline, olivine and biotite being successively attracted. The degree of attraction is not however proportional to the iron content. The colourless non-magnetic minerals—quartz, felspar, muscovite, nepheline, etc.—remain

Separation by means of water is not much used in petrographic work. However, a preliminary "panning" as practised by miners is often useful as a means of concentrating rare minerals occurring in very small quantity in the rock before the application of the methods next to be described Methods of separation of minerals by which they are sorted according to their specific gravities by means of heavy fluids have an extensive application. The fluids used are those which do not attack the majority of the rock forming minerals Of the many liquids used methylene iodide (sp gr. 3·32) and bromoform (sp gr 2·86) are perhaps the most convenient. For more dense minerals Clerici's solution—an aqueous solution of thallium formate—is best adopted. By concentration the specific gravity can be raised to 4·32 at 60° C so that even the heavier rock minerals can be separated without difficulty By dilution with water, or, in the case of methylene iodide, dilution with bromoform or benzol, successive crops of minerals may be separated in appropriate separating funnels. In this way a granite may be successively fractionated into its component minerals, biotite (sp gr. 3·1), muscovite (2·85), quartz (2·65), oligoclase (2 64) and orthoclase (2 56). All these minerals float in methylene iodide: on dilution with benzol they are precipitated in the order given. Rocks like eclogite containing heavier minerals, such as ilmenite (sp gr 4·84), garnet (4·20) titanite (3·50) and diopside (3·29), may be similarly separated by means of a thallium formate-water solution.

Micro-chemical Methods.—Chemical methods are frequently of great use. Weak hydrochloric acid will dissolve calcite from a crushed limestone leaving dolomite and silicate minerals, and hydrofluoric acid may be used to extract the glassy base of volcanic and hypabyssal rocks from the pyroxenic minerals. Of much wider use however are microchemical methods for distinguishing minerals under the microscope They are of special value in discriminating alkali minerals like nepheline, haüyne, nosean,

analcime and sodalite in the ground mass of igneous rocks. The methods depend on selective attack by acids, the formation of distinctive precipitates and the staining of gelatinous residues. Quartz and felspar in fine grained rocks may be differentiated by etching with hydrofluoric acid; quartz remains clear while the surface of the felspar grain becomes cloudy, being altered to aluminium fluosilicate, and may be stained by an aniline dye. This method is particularly useful in discriminating quartz and felspar in fine grained metamorphic rocks in which the felspar is without crystal form, is untwinned and shows lack of cleavage.

Chemical Analysis.—The ultimate chemical composition of a rock is of fundamental importance in determining its nature, and the chemical analysis of rocks is now widely carried out. In rock analysis of the better class as many as 25 constituents are determined and recorded. The most abundant, or major, constituents are stated as oxides, and any rock analysis of good quality records the content of at least nine or ten of these. They are silica, alumina, ferric and ferrous oxides, magnesia, lime, soda, potash and water. These nine oxides make up about 98% of the igneous rocks. Two other oxides are usually determined, TiO_2 and P_2O_5, as they are represented in the common minor constituents—ilmenite and apatite—titanium being also present in some pyroxenes, amphiboles and micas. Such a chemical analysis is usually sufficient to determine to which of the two great classes, igneous or sedimentary, a rock belongs, and if it is igneous, the position the rock is to be assigned in any of the conventional classifications. In the case of metamorphic rocks it often establishes whether the original mass was a sediment or of igneous origin.

Specific Gravity.—By the balance and the pycnometer the specific gravity of rocks is determined in the usual way. It is greatest in those rocks rich in iron, magnesia and the heavy metals, and least in rocks rich in alkalis, silica and water. Eclogites (sp.gr. 3·5) are among the heaviest of the silicate igneous rocks, while the vitreous lavas of high silicity like obsidian (sp.gr. 2·35) are among the lightest.

ROCK SYNTHESIS

The methods of investigation described above may be grouped together as analytical, in contradistinction to the synthetic investigation of rocks—which proceeds by experimental work to reproduce different rock types and thus to elucidate their origin and explain their structures. Though the experiments of de Saussure (1740–99) on the fusion of granites and porphyries may be said to mark the earliest beginnings of experimental petrology, the era of rock synthesis must be considered to date from the time of Sir James Hall's researches on the fusion of dolerites found in the neighbourhood of Edinburgh. This investigator showed convincingly that the crystalline dolerites (or whinstones) could be fused and consolidated, according to the rate of cooling, either as black glasses resembling natural pitchstones or as crystalline aggregates of minerals much like the dolerites from which they came. Hall's most famous experiments however, were conducted with limestones. Powdered chalk by being heated in gas-tight gun barrels, was converted into a crystalline mass of calcite, thus supporting the contention of Hutton that heat and pressure had consolidated limestones and converted them into marbles. A lapse of almost 90 years occurred before the experiments of Hall were substantiated, when in 1878 the French petrologists Fouqué and Michel Lévy began their extensive researches on the synthesis of minerals and rocks by pyrogenetic methods. They succeeded in producing, by the use of a gas furnace and a nitrogen thermometer such rocks as porphyrite, basalt and dolerite, at the same time obtaining the characteristic textures—porphyritic, ophitic, etc.—by modifying the conditions under which the melts were cooled. With the more siliceous or acid rocks their experiments were much less successful. They advanced for the first time in a convincing manner the explanation that for the crystallization of these rocks the gases, never absent in natural rock magmas, were indispensable mineralizing agents (mineralizers). It is now known that the formation of many minerals is facilitated, or can only be accomplished, in the presence of volatile constituents, as water, borates, chlorides, fluorides, etc. Not only do they assist in promoting the fluidity of the liquid and facilitate crystallization, but they form essential constituents of some of the important minerals occurring in acid igneous rocks (micas, tourmaline, topaz, etc.).

Among the pioneers in synthetic petrology may also be mentioned Ste. Clair Deville, Senarmont, Berthier, Bourgois, Hautefeuille, von Chrustschoff, Doelter, Morosewicz and Vogt. To Vogt we owe the first comprehensive essay towards bringing the crystallization of igneous rock magmas definitely under the known laws of solution. Beginning a study of a large series of silicate slags, more or less comparable in composition with igneous rocks, he has brought together a large body of information throwing light on the order of crystallization, the composition of the eutectics and the lowering of freezing points of the minerals in slag mixtures, and has directly applied these results to the elucidation of the crystallization processes in natural magmas.

Up to this period the synthetic work, involving as it did the measurement of the melting point of minerals and the succession of crystallization in more or less complex mixtures, though very suggestive, lacked the strictly quantitative element. Experiments were carried out on materials always containing impurities or foreign substances, and the methods adopted for the determination of fixed thermal points as melting points, inversion points or heat changes were of doubtful precision. Since 1904, with the establishment of the Geophysical Laboratory at Washington, synthetic or physico-chemical petrology has entered upon a new quantitative era. The work of this laboratory was undertaken to enter upon a quantitative study of rock formation which should include both the minerals and rocks which are geologically important and those which are economically useful, those formed directly from the magma and those formed by subsequent alteration. The individual problems are in reality problems for physics and physical chemistry; but the delay in their attack has lain in the fact that the measured relations established by the exact sciences have scarcely been of adequate scope to meet the needs of large petrological questions. The great body of physical and physico-chemical measurements have been confined to a temperature region below 100° C, while processes operating in rocks may have extended over a temperature region extending to 1,400°, an enormous range over which to stretch the application of ordinary methods and one in which the common forms of apparatus will not only fail but are themselves threatened with destruction. The initial work of the Geophysical Laboratory has been primarily to extend the methods of accurate temperature measurement to include the entire field of rock formation from 0° to 1,600°; the electric pyrometer has reached now such precision that an error of one or two degrees is all that need be expected in measuring temperatures up to 1,600°; moreover these temperatures can be maintained quite steady for days or weeks at a time. Calorimetric measurements have been improved; specific heats can be determined with great accuracy even at the highest temperatures. At the same time petrographic methods have been advanced so that the crystallographic and optical constants of the very minute crystals obtained in silicate melts can be accurately measured. The investigation of mineral substances under high pressures and high temperatures combined, and in the presence of volatile constituents has also been a subject of study.

With these methods of precision available for the study of rock materials, examination of simple mineralogical systems has been prosecuted. An understanding of the chemistry of the common oxides of rocks and their combinations is essential to the progress of petrology. Already experimental work has been conducted on the combinations of the oxides CaO, MgO, Al_2O_3, SiO_2; the six possible binary systems have been fully worked out and the four possible ternary systems thoroughly studied, while portions of the quaternary system have been successfully explored. Much light has thereby been thrown on the processes taking place during the consolidation of igneous magmas which, though much more complex in their constitution, yet clearly show by petrographic examination closely similar phenomena, as are revealed in the crystallization behaviour of these simpler systems. The applica-

tion of these laboratory investigations to elucidate the origin and evolution of igneous rock types will be considered hereafter under the heading of physical chemistry of igneous magmas.

Classification of Igneous Rocks.—Igneous rocks according to their composition, chemical and mineralogical, their structures and textures, or their mode of occurrence, are subdivided into many groups. Between allied rocks there are, however, no hard and fast boundaries, for by increase or decrease in the proportions of their constituent minerals, they pass by every gradation one into the other. Similarly the distinctive textures of one kind of rock may often be traced gradually merging into those of another. Hence the definitions adopted in establishing rock nomenclature merely correspond to more or less arbitrarily selected points in a continuously graduated series. This is frequently urged as a reason for reducing rock classification to its simplest possible terms and using only a few generalized rock designations.

The earliest attempts at the classification of rocks on modern lines are to be found in the works of Von Leonhard (1823) and Brongniart (1827). These and other efforts, principally by Naumann (1850), Von Cotta (1855) and Roth (1861), while being built on the criteria of composition and structure of rocks, were largely developed from purely macroscopic investigation or ultimate chemical analysis. The pioneer work of Sorby (1858) in preparing transparent microsections of rocks opened the way for the unravelling of the mineral constituents and textures of the finer grained igneous rocks, and rapid advances in the knowledge of the constitution of igneous rocks followed The classifications of Zirkel (1873) and Rosenbusch (1877) were the first products of the application of the new method of petrographic research, and in these mineral constitution was accorded first place as a basis of subdivision. The effect of microscopic study was to stress the importance of mineralogical and textural characters of rocks to the neglect of other characteristics. Rosenbusch in particular, influenced by the contention principally of Lossen (who urged the significance of the geological relations of igneous rocks, their occurrence and manner of formation), further developed his classification to express the relationship of geological occurrence and texture, and introduced in the second edition of his work a fundamental change.

The new classification is based first on geological position, texture and finally mineral and chemical composition Igneous rocks are divided thus into three great groups.—(1) Deep seated rocks, (2) Dike rocks and (3) Effusive rocks Like others before it, it is still essentially a qualitative classification, and at the present day is the one most commonly adopted by petrographers. The latest exposition of Rosenbusch's classification is set forth in his *Elemente der Gesteinslehre* revised by A. Osann (1923).

HABIT OF IGNEOUS ROCKS

Igneous rocks occur essentially in two different ways, either as lavas or intrusions.

Lavas or Effusive Types.—The lavas have been poured out at the surface and have consolidated after ejection, under conditions which are fairly well understood, seeing that they may be examined at active volcanoes in many parts of the world; the intrusive rocks, on the other hand, have been injected from below into cracks and fissures in the strata and have cooled there beneath masses which conceal them from view till exposed by denudation at a subsequent period The members of these two groups differ in many respects from one another, so that it is often possible to assign a rock to one or other of them on mere superficial inspection. The lavas (or effusive rocks), having cooled rapidly in contact with the air, are mostly finely crystalline or have at least a fine-grained ground-mass representing that part of the viscous semi-crystalline lava flow which was still liquid at the moment of eruption. At this time they were exposed only to atmospheric pressure, and the steam and other gases, which they contained in great quantity, were free to escape; many important modifications arise from this, the most striking being the frequent presence of numerous steam cavities (vesicular structure) often drawn out to elongated shapes subsequently filled up with minerals by infiltration (amygdaloidal structure). As crystallization was going on while the mass was still creeping forward over the surface of the earth, the latest formed minerals (in the gound-mass) are commonly arranged in subparallel winding lines following the direction of movement, and the larger early minerals which had previously crystallized may show the same arrangement. Most lavas have fallen considerably below their original temperatures before they are emitted. In their behaviour they present a close analogy to hot solutions of salts in water, which, when they approach the saturation temperature, first deposit a crop of large, well-formed crystals (labile stage) and subsequently precipitate clouds of smaller less perfect crystalline particles (metastable stage). In igneous rocks the first generation of crystals generally forms before the lava has emerged to the surface, that is to say, during the ascent from the subterranean depths to the crater of the volcano It has frequently been verified by observation that freshly emitted lavas contain large crystals borne along in a molten, liquid mass. The large, well-formed, early crystals are generally admitted to be porphyritic; the smaller crystals of the surrounding matrix or ground-mass belong to the post-effusion stage. More rarely lavas are completely fused at the moment of ejection; they may then cool to form a non-porphyritic, finely crystalline rock, or if more rapidly chilled may in large part be non-crystalline rock, or glassy (vitreous rocks such as obsidian, tachylyte, pitchstone) A common and easily recognized feature of glassy rocks is the presence of rounded bodies (spherulites. Gr σφαῖρα, a ball), consisting of fine divergent fibres radiating from a centre, these divergent fibres consist of imperfect crystals of felspar, mixed with quartz or tridymite; similar bodies are often produced artificially in glasses which are allowed to cool slowly. Rarely these spherulites are hollow or consist of concentric shells with spaces between (lithophysae: Gr. λίθος, a stone; φῦσα, bellows). Perlitic structure, which is also found to be common in glasses, consists in the presence of concentric rounded cracks owing to contraction on cooling (*see* PERLITE)

The phenocrysts (Gr. φαίνειν, to show; κρύσταλλον, a crystal) or porphyritic minerals are not only larger than those of the ground-mass; as the matrix was still liquid when they formed they were free to take perfect crystalline shapes, not being interfered with by the pressure of adjacent crystals They seem to have grown rapidly, as they are often filled with enclosures of glassy or finely crystalline material like the material of the ground-mass Microscopic examination of the phenocrysts often reveals that they have had a complex history. Very frequently they show successive layers of different composition, indicated by variations in colour or other optical properties; thus augite may be green at the centre and various shades of brown outside this; or may be pale green centrally and darker green with strong pleochroism (aegirine) at the periphery. In the felspars the centre is usually more basic and richer in lime than the surrounding faces, and successive zones may often be noted, each less basic than those which lie within it. Phenocrysts of quartz (and of other minerals), instead of sharp, perfect crystalline faces, may show rounded corroded surfaces, with the points of the crystals blunted and irregular tongue-like projections of the matrix into the substance of the crystal; it is clear that after the mineral had crystallized it was partly again dissolved or corroded at some period before the matrix solidified Corroded phenocrysts of biotite and hornblende are very common in some lavas; they are surrounded by black rims of magnetite mixed with pale green augite The hornblende or biotite substance has proved unstable at a certain stage of consolidation and has been replaced by a pseudomorph of augite and magnetite which may be partially or completely substituted for the original crystal but still retains its characteristic outlines.

Plutonic or Abyssal Types.—Let us now consider the characteristics of a typical deep-seated rock similar to granite or diorite. That these are clearly igneous is proved by the manner in which they have burst through the superincumbent strata, filling the cracks with ramifying veins, that they were at a very high temperature is equally clear from the changes which they have induced in the rocks in contact with them. But as their

heat could dissipate only very slowly, because of the masses which covered them, complete crystallization has taken place and no vitreous rapidly chilled matter is present. As they have had time to come to rest before crystallizing they are not fluidal. Their contained gases have not been able to escape through the thick layer of strata beneath which they were injected, and may often be observed occupying cavities in the minerals, or have occasioned many important modifications in the crystallization of the rock. Because their crystals are of approximately equal size these rocks are said to be granular; there is typically no distinction between a first generation of large well-shaped crystals and a fine-grained ground-mass. Their minerals have formed, however, in a definite order, and each has had a period of crystallization which may be very distinct or may have coincided with or overlapped the period of formation of some of the other ingredients. The earlier have originated at a time when most of the rock was still liquid and are more or less perfect; the later are less regular in shape because they were compelled to occupy the interspaces left between the already formed crystals which pressed on them. The former are said to be idiomorphic (*i.e.*, having their own characteristic form, Gr. ἴδιος, belonging to one's self), the latter are allotriomorphic (Gr. ἀλλότριος, belonging to another). There are also many other characteristics which serve to distinguish the members of these two groups. Orthoclase, for example, is the typical felspar of granite, while its modification sanidine occurs in lavas of similar composition; leucite is common in lavas, very rare in plutonic rocks; muscovite is confined to the intrusives. These differences show the influence of the physical conditions under which consolidation takes place.

Intrusive or Hypabyssal Types.—There is a certain class of intrusive rocks which have risen upwards towards the surface, but have failed to reach it, and have solidified in fissures as dikes and intrusive sills at no great depth. To this type the name *hypabyssal* is often given in distinction to the *plutonic* (or *abyssal*) which formed at greater depths. As might be expected, they show structures intermediate between those of the effusive and the plutonic rocks. They are very commonly porphyritic, not rarely vitreous, and sometimes even vesicular. In fact many of them are indistinguishable petrologically from lavas of similar composition.

The attempt to form a special group of hypabyssal (intrusive and dike) rocks has met with much criticism and opposition. Such a group certainly cannot rank as equally important and equally well characterized with the plutonic and the effusive. But there are many kinds of rock which are not found to occur normally in any other manner. As examples we may cite the lamprophyres, the aplites and the porphyries. These never occur as lava flows or as great plutonic bosses; if magmas of the same composition as these rocks occur in either of these ways they consolidate with different assemblages of minerals and different structures.

Subdivisions of Igneous Rock Class.—In subdividing the plutonic, the hypabyssal and the effusive rocks, the principle is followed of grouping those together which resemble one another in mineral constitution and in chemical composition. In a broad sense these two properties are interdependent.

Chemical Characters.—Twelve elements (oxygen, silicon, aluminium, iron, calcium, sodium, potassium, magnesium, titanium, phosphorus, hydrogen and manganese) constitute about 99·6% of the earth's crust. Of these oxygen is the most abundant and constitutes 46·59% of the igneous rocks of the crust, the elements given above being placed in their order of abundance. These "petrogenic" or rock elements occur typically as oxides, simple silicates, aluminates, fluorides, chlorides and sulphides. In rock analyses they are stated as oxides. From a computation based on 5,159 analyses Washington and Clarke have arrived at the following as the average percentage composition of all igneous rocks:—SiO_2, 59·12; Al_2O_3, 15·34; Fe_2O_3, 3·08; MgO, 3·49; CaO, 5·08; Na_2O, 3·84; K_2O, 3·13; H_2O, 1·15; TiO_2, 1·05; P_2O_5, 0·3; MnO, 0·12; Inclusive 0·5.

The known igneous rocks show a wide but limited range of composition. As the most abundant and essential rock minerals are either silica or silicates, silica shows the highest maximum and the widest range of these oxides. In some magmatic ores its content falls to zero but rises to 93–96% in rare igneous rocks (northfieldite); alumina reaches a maximum of about 60% in some corundum-bearing syenites; iron oxides have a general range from 15 to under 1%, and magnesia from 25 to under 1%. In some olivine rocks (dunite) it reaches a value of 48%. Lime is highest in some pyroxenites and anorthosites (20–22%), but its general range is from 15% to zero. Soda reaches a maximum of 20% in almost pure nepheline rocks (congressite) but has a general range from 15% to nearly zero. Potash has a maximum 18% in an almost pure leucite lava (italite), but usually varies from 10% to zero. Water in fresh crystalline igneous rocks seldom reaches more than 2% but glassy lavas may contain 10%.

The commonest minerals of igneous rocks are the felspars, pyroxenes and amphiboles, quartz, and the micas. From a statistical examination of 700 igneous rocks an average composition has been calculated as follows, felspars 59·5, pyroxenes and amphiboles 16·8, quartz 12·0, micas 3·8, other minerals 7·9 (apatite 0·6, titanium minerals 1·5). This estimate however is clearly only an approximation. Rock minerals have been classified empirically into two groups, according as they are capable or incapable of existing in the presence of free silica, namely saturated and unsaturated minerals. The former group includes such minerals as the felspars, pyroxenes, amphiboles and micas; and the latter olivine, nepheline, leucite and other felspathoid minerals.

Certain minerals are as a matter of common observation not found together in igneous rocks. Thus olivine (except fayalite) and quartz do not occur in association, but are represented by rhombic pyroxene. The associations nepheline and quartz, leucite and quartz, pyroxenes or amphiboles and muscovite, are almost unknown among magmatic crystallizations; on the other hand we find certain mineral associations or parageneses to occur frequently; thus aegirine and arfvedsonite, nepheline and nosean, common hornblende and titanite, are well known as faithful com-

Igneous Rocks

	Acid	Intermediate		Basic	Ultrabasic
Commonest minerals	Quartz Orthoclase (and oligoclase) Mica Hornblende Augite	Little or no Quartz Orthoclase Hornblende Augite Biotite	Plagioclase Hornblende Augite Biotite	No Quartz Plagioclase Augite Hypersthene Olivine	Augite Hornblende Olivine (Basic plagioclase)
Plutonic	Granite	Syenite	Diorite	Gabbro Norite	Peridotite Pyroxenite Hornblendite (Anorthosite)
Hypabyssal	Quartz-Porphyry	Orthoclase Porphyry Orthophyre	Porphyrite	Dolerite	Picrite
Volcanic	Rhyolite Obsidian	Trachyte	Andesite Dacite	Basalt Tachylyte	Limburgite Augitite

panions in igneous rocks. Again some minerals are restricted to particular magmas; melanite, melilite and certain rare zirconium-titanium minerals are almost confined to the alkaline igneous rocks. By inspection of a rock analysis it is frequently possible to state approximately what minerals the rock will contain, but there are numerous exceptions to any rule which can be laid down. The minerals which crystallize from an igneous magma may depend largely on the physical conditions under which the liquid consolidates; accordingly we find rocks of almost identical chemical composition with widely different mineralogical constitution. Such rocks as already noted are referred to as heteromorphic. Some familiar examples of assemblages of this character are mica syenite and leucite basalt, minette and leucite basalt, pyroxenite and allivalite, monzonite and leucite tephrite, hornblendite and websterite.

Certain minerals are practically confined to deep seated rocks, *e.g.*, microcline, muscovite, diallage and almandine garnet; on the other hand leucite is very rare in plutonic rocks, as is also anorthoclase and the variety of potash felspar known as sanidine Some of these peculiarities are readily explicable, being dependent on the pressure, temperature, or concentration of volatile constituents in the crystallizing magma. Others still remain as a problem for solution. The subject will be referred to again in a later part of this article.

In the classification generally adopted by petrographers, the silica content of the magma forms a basis of further subdivision of igneous rocks. The division of volcanic rocks into acid, intermediate and basic we owe in the first place to Abich (1841). As applied to igneous rocks in general, those which contain most silica and which if crystallized yield free silica as quartz, are erected into a group designated the "acid" rocks in allusion to the rôle of silica in the mineral kingdom. Those with low silica percentages and rich in magnesia, lime and iron—so that quartz is absent while olivine, pyroxene or calcic felspar is usually abundant—form the basic group. The "intermediate" rocks include those characterized by the general absence of both quartz and olivine An important subdivision of the intermediate as well as the basic group contains a very high percentage of alkalis (soda or potash or both), and consequently has minerals such as nepheline, nosean, analcime or leucite, minerals not common in other rocks. This group is often referred to as the alkaline rocks. Lastly a small subgroup rich in olivine (peridotite, dunite), pyroxene (pyroxenite), or calcic felspar (anorthosite) have been called the "ultrabasic" rocks. They have low percentages of silica but much iron, magnesia or lime. With the exception of the last group, including also ultrabasic lavas as augitite and limburgite and a few related rocks as monchiquite, melilite basalt and alnoite, practically all igneous rocks contain felspar or felspathoid minerals. In the acid rocks the common felspars are orthoclase, with perthite, microcline and oligoclase, all having much silica and alkalis. In the basic rocks labradorite, bytownite and anorthite prevail, being rich in lime and poor in silica, potash and soda. Augite and olivine are the common ferromagnesian minerals of the basic rocks, but hornblende and biotite are on the whole more frequent in the acid rocks.

The classification in the two tables that follow is based essentially on the mineralogical constitution of the three great groups of igneous rocks. The alkali rocks containing nepheline and leucite are treated separately, for though they show transitions into the corresponding intermediate and basic rocks (syenites, diorites, gabbros, etc.), they contain many minerals which are unknown in other rocks. In a purely formal classification such as is outlined here they are more conveniently considered as a distinct series. Their genetic relations among themselves and with the other rock types are considered later.

Diaschistic Rocks.—Two groups of rocks not specifically included in the tables form important members of the hypabyssal division of igneous rocks. These are the aplites and the lamprophyres. The aplites are acid leucocratic differentiation products of the granites, syenites, diorites and gabbros, while the lamprophyres are basic differentiates. The two groups are together known as *complementary* or *diaschistic* rocks and usually occur as dikes or sills in association with the parent rock from which they are derived. Thus the minettes, vogesites and kersantites (*see* LAMPROPHYRE) are complementary to granitic aplites and occur in association with granitic masses. Camptonites and bostonites (syenite aplites) have a parent magma in the essexites or theralites which they accompany.

Nepheline- and Leucite-bearing Rocks

Commonest minerals	Alkali felspar Nepheline or leucite Augite Hornblende Biotite	Plagioclase (lime-soda) Nepheline or leucite Augite Hornblende (Olivine)	Nepheline or leucite Augite Hornblende (Olivine)
Plutonic	Nepheline syenite Leucite syenite	Essexite Theralite	Ijolite Urtite Missourite
Hypabyssal	Nepheline syenite—porphyry Tinguaite	Essexite and Theralite } Dolerite	Nepheline dolerite
Volcanic	Phonolite Leucitophyre	Tephrite Basanite	Nepheline basalt Nephelinite Leucite basalt

The classificatory scheme here adopted is admittedly artificial for rocks are subdivided without particular reference to their genetic relationships Even regarded as a classification for a utilitarian end there are many imperfections; the subdivisions are of unequal value and transitional types are not included. The latter however can be accommodated by further subdivision Many of them have received special names The quartz syenites may be interposed between granite and diorite, the tonalites between granite and diorite and so on

The question may be asked—When is a rock entitled to be recognized as belonging to a distinct species or variety and deserving a name for itself? It must, first of all, be proved to occur in considerable quantity at some locality, or better still at a series of localities or to have been produced from different magmas at more than one period of the earth's history. In other words, it must not be a mere anomaly. Moreover, it should have a distinctive mineral constitution, differing from other rocks, or something individual in the characters of its minerals or of its structures. It is often surprising how peculiar types of rock, believed at first to be unique, turn up with identical features in widely scattered regions; *alnöite*, for example, occurs in Norway, Scotland, Montreal, British Columbia, New York and Brazil, *tinguaite* in Scotland, Norway, Brazil, Montana, Portugal, etc. This indicates that underlying all the variations in mineralogical, structural and chemical properties there are definite relationships which tend to repeat themselves, producing the same types whenever the same conditions are present.

Various attempts have been made to introduce a quantitative element into igneous rock classification. These have followed either chemical or mineralogical lines. The principal of these is the *Quantitative chemical classification* introduced by a group of American petrographers. The chemical composition of an igneous rock is here regarded as its fundamental characteristic and a series of subdivisions is erected on this basis Other criteria are relegated to the background. The completed rock analysis is first interpreted in terms of an ideal set of minerals which constitute the "norm," but which in reality seldom corresponds to the actual composition ("mode"). The rocks are then divided into groups strictly according to the relative proportions of these ideal minerals to one another. The details of the classification need not be described here as they are fully set forth in a treatise specially devoted to this classification (*Quantitative Classification of Igneous Rocks*, Chicago, 1902; *see* Bibliography).

In other systems a quantitative element is introduced by subdividing rocks into groups by arbitrary lines based on mineral percentages: a complicated system framed on these lines is that

devised by A. Johannsen (*Journal of Geology*, 1917, 1919). In another the prime divisions are erected on a so-called "principle of silica-saturation" (Shand, *Eruptive Rocks*, 1927). In all the effect of the introduction of the quantitative element has been to increase the artificiality of the system and by this means to obscure the genetic relations existing between rock types. For this reason these systems are unlikely to supplant the qualitative classification in general use. It is indeed, largely to the influence of "quantitative classifications" that the bewildering and unnecessary multiplicity of igneous rock names must be ascribed.

A natural classification based on the genetic relationships of the igneous rocks is yet to be framed The writings of Becker and Vogt contain some essay towards this goal. As a basis, the eutectic relation has been emphasized, the eutectic mixture possessing definite properties and a fixed composition. Experimental work of recent years has clearly shown however that the eutectic relation is only one of a number of possible relations existing between the components of a magma; that its importance has been over-emphasized is abundantly shown by the experimental investigation of silicate melts, and is indeed revealed in the sequence of crystallization decipherable in igneous rocks

Petrographical Provinces.—As long ago as 1872 Vogelsang had noted that the igneous rocks of certain districts possessed textural or mineral characters in common, serving to distinguish them from the rocks of other districts. The researches of Judd (1886) and Iddings (1892) further substantiated this observation and showed that this community of petrographic character applied to the igneous rocks erupted or intruded during a particular period of igneous activity within the region. To such regions Judd gave the name *petrographical provinces* and Iddings employed the term *consanguinity* to express the genetic relationship implied in these resemblances among associated rocks. Excellent examples of such petrographical provinces or *comagmatic regions*, as they have been termed by Washington, are the Oslo region of southern Norway characterized by Devonian alkaline intrusions and extrusions, the Roman region characterized by rocks rich in potash; the alkaline province of central Montana; and the Tertiary calc-alkaline province of Hungary. On a larger scale the volcanoes which girdle the Pacific (Andes, Cordillera, Japan, Philippines, etc) and those which occur on the volcanic islands of the Atlantic, illustrate the same phenomena. The consanguinity in the igneous series of a petrographical province implies that the whole assemblage is derived from some common deep-seated magma, during a period which, while necessarily prolonged, was not of vast duration in a geological sense. The assemblages of a province may and often do show a wide diversity of rock type embracing intrusions and extrusions. Prolonged eruptions have in a few cases a somewhat monotonous character owing to the predominance of one kind of rock. Thus the lavas of the Hawaiian islands are mostly basaltic, as are those of Oregon, Washington and the Deccan, all of which form geological masses of enormous magnitude. In the Oslo district on the other hand the assemblages comprise (among the intrusive rocks) a wide range of type—hornblendite, essexite, larvikite, lardalite, nordmarkite, soda—and potash-granites.

Differentiation.—The process by which a magma is split into a variety of partial products is known as *Differentiation;* its importance from the standpoint of theoretical petrology is very great; it is in point of fact, the fundamental problem of petrogenesis. The variation expressed may appear in two ways; either as a variation in a single rock body, or in an associated series of separate intrusions or extrusions In the first case a single intrusion shows variation in different parts of its mass, the extreme varieties being usually connected by gradual transition. The contrasted parts are frequently arranged symmetrically with reference to the borders of the mass forming concentric zones in bosses or laccoliths suggestive of a differentiation *in situ* connected with the cooling of the mass. Most commonly the marginal zones are of more basic composition Excellent examples of variation of this kind are provided by the gabbro mass of Carrock Fell (Cumberland) with its basic border rich in iron ore, and the shonkinite laccolith of Shonkin Sag, Montana, in which a transition from syenite to shonkinite becoming denser outwards, occurs, the shonkinite finally passing at the margin into a fine leucite-basalt-porphyry. Variation in an associated series, is exemplified by the succession of lavas emitted from a volcanic focus. These may differ considerably from one another. Thus in the Berkeley Hills near San Francisco the volcanic succession is a repeated series of andesites, basalts and rhyolites. In other cases the lavas emitted are much more varied, and while no significant relations in the succession can be discerned, it is to be remembered that a significant order may be obscured by the overlapping of the flows from neighbouring volcanoes. In the simpler cases the order of eruption is one of increasing divergence from an initial type.

Plutonic Complexes.—A series of plutonic rocks intimately associated and localized at a centre constitutes a *plutonic complex*. Such complexes often contain a great diversity of petrographical types ranging from peridotite and gabbro through diorite to acid granite. The succession of these intrusions follows an order of decreasing basicity, the later and more acid rocks usually occupying the greater part of the complex, the earlier, and more basic being subordinate in amount and restricted to the borders of the mass Excellent examples of such plutonic complexes are provided by the early Devonian intrusions of "newer granites" of the Scottish Highlands (*e g.*, Garabal hill, Loch Lomond) What then are the factors operating which led to differentiation?

The possible processes leading to heterogeneity in a magma may be considered under (*a*) those occurring in the liquid prior to crystallization and (*b*) those occurring during or subsequent to crystallization Of the first, we may consider (i) differences of composition set up in a liquid due to a temperature gradient; (ii) differences of composition due to a pressure gradient; and (iii.) differences of composition due to the separation of distinct liquid phases. Each of these processes has in the past been appealed to to explain the variation seen in an igneous rock mass intruded singly, or in a rock series arising as a result of successive eruptions or intrusions. The type of composition-variation due to a temperature gradient is commonly known as the Soret effect and has been especially applied to explain the variation seen in a single rock body, such as the concentration of the minerals of early crystallization towards a cooling boundary. In a liquid with a temperature gradient, for dilute solutions the concentration varies inversely as the absolute temperature; and it has been thought that by the operation of this process, substances near their saturation point might accumulate at the cooler surfaces. Both theoretical considerations and experimental results clearly indicate however that the actual Soret effect is in fact negligible and such effects as are actually observed are due in reality to departures from the laws of ideal solutions, for if both solvent and solute obeyed osmotic pressure laws there would be no relative concentration of one with respect to the other The effects of a pressure gradient appear to be of the same order of magnitude and both these processes are now in effect abandoned as factors in differentiation.

The effects possible as a result of the separation of immiscible liquid phases stand on a different basis. Many liquids, homogeneous at high temperatures, separate with falling temperature into two or more non-consolute fractions, and the hypothesis that igneous magmas form such immiscible fractions has been favoured by some petrologists, notably Rosenbusch, Bäckstrom and Daly. From his own studies Vogt concluded that the rock-forming silicates are freely miscible. The only known case among magmas for which immiscibility can be claimed is that of sulphide-containing silicate melts. Such a magma unmixes at a temperature above the region of crystallization of the usual sulphides, and liquid sulphides, especially those of iron, are separated as liquid drops. These, owing to their greater density, sink to the floor of the magma collecting as a distinct sulphide layer, or, in some cases, the liquid layer may be injected into the surrounding rocks. These sulphide aggregates form important ore deposits. It is among lavas which as a group show the various stages of quenching of liquid magmas that the evidence for immiscibility might be expected; the absence of lavas containing glassy glob-

ules of composition distinct from that of the main mass of lava, goes far to reassure us that immiscibility is not an operating factor in petrogenesis. Recent experimental evidence of immiscibility in silicate liquids has indeed been obtained, but the composition range of liquids which show it is unlike that exemplified by rock magmas. This limited miscibility is found in mixtures of silica with any of the oxides CaO, MgO, FeO, Fe_2O_3, but in a region of very high silica-content. The minimum temperature for the existence of two liquids is in each case only a little below the melting point of silica, or in the vicinity of 1,700° C. The oxides Na_2O, K_2O, Al_2O_3 show no such immiscible region in their silica mixtures, and moreover it requires only a small proportion of any of these miscible oxides to render miscible with silica the oxides which are themselves immiscible with silica. No natural magmas are known which approximate in composition to the region of immiscibility in these melts. It is true that natural magmas contain in addition water, and that its effect is experimentally unknown. Nevertheless if its addition changes the limits of immiscibility so that unmixing becomes a possible factor in differentiation, its behaviour must differ from that of the oxides studied.

Of all the processes suggested as important factors in the differentiation of rocks, crystallization alone seems competent to produce important results. Indeed fractional crystallization is now believed to be the fundamental process in rock differentiation. Either the localization of crystallization or the localized aggregation of crystals is sufficient to produce heterogeneity in a rock magma. The first case, the localization of crystallization, is competent to explain those cases of differentiation *in situ* exemplified by the basic marginal phases of intrusive masses. The mechanism of the process has been much discussed. Examination of igneous rocks early showed that minerals crystallize in a more or less definite order. In general the first minerals to separate belong to a group known as the minor accessories: this includes zircon, apatite, titanite and iron-oxides; then follow in order olivine, augite, hornblende, biotite, plagioclase, orthoclase, microcline and quartz. To this rule there are many exceptions, but the succession given above holds in the great majority of cases. Expressed in this way the more basic minerals precede the less basic: it is known as Rosenbusch's law of decreasing basicity. Accordingly it is supposed that at a cooling boundary there is a precipitation of minerals of early crystallization (basic minerals), the continued growth of many crystals being maintained by diffusion. The completion of this process results in a crystalline mass with a border phase enriched in the minerals of early crystallization.

The rate of diffusion in silicate melts has been the subject of laboratory study and the results obtained show that the possible effects are exceedingly small and incompetent to account for the formation of border phases about large intrusions. The marginal phase indeed appears to represent rather a chilled phase having a composition close to that of the original magma, the more acid phase which it encloses representing a differentiate formed by much slower cooling of the remainder of the magma. The relative movement of crystals with respect to the liquid from which they separated may be of two kinds, (*a*) movement under the influence of gravity—sinking or floating of crystals and (*b*) movement by straining off or squeezing out of residual liquid by earth movement. Both of these processes can be applied to explain the more important case of differentiation exemplified by an associated series of intrusions or extrusions. In a crystallizing magma, provided viscosity does not inhibit the free movement of crystalline material, as the first formed crystals are denser than the molten material in which they form, they should sink under the influence of gravity in the liquid. The lower regions of the rock mass into which the crystals sink become enriched, the upper regions impoverished, in the constituents of which they are formed. The sinking of crystals in silicate melts has been both experimentally verified in the laboratory and observed in nature. Darwin long ago (1844) suggested that this process was a potent factor in producing diverse rock types. Turning to the evidence of consolidated rock masses themselves, we find intrusions in which such gravitational segregation is indubitably exemplified. Thus the concentration of early formed olivine crystals near the base of sheet- or sill-like intrusions has been observed in the case of the quartz-dolerite sill of the Palisades (Hudson river) and the picrite sill of Lugar (Ayrshire). Examples of this nature appear however to be exceptional, and indicate an extreme fluidity of the liquid magma. Most sheets or laccoliths show no heterogeneity throughout the vertical extent of their mass. In other cases where a variation is observed, it is to be ascribed to successive injection of magmas of varying composition.

In the magma basins of the deeper parts of the crust, the case may be conjectured to be otherwise. The retarding influence of viscosity, which appears to prevent any notable gravitative segregation in intrusive sheets cooled comparatively rapidly in those parts of the crust laid bare by denudation, is at deeper levels counteracted by the time factor. The extremely slow rate of cooling in these deeper regions may permit significant settling of crystals, giving rise to a differentiated reservoir more or less stratified according to gravity, more basic at the bottom, more acid upwards. The mechanism by which it is conceived a varied group of liquids becomes drafted off from an intercrustal reservoir and injected to form the igneous rock bodies now made visible by denudation is, of necessity, one into which the element of speculation largely enters. Remelting of successive stratified layers by a gradual use of temperature from the base upwards, together with earth movement, the straining off of residual liquid from a crystalline meshwork under the influence of crustal stress, all are processes to which appeal is made to explain not only the variety among associated igneous rocks injected as plutonic complexes but also the chronological succession of the intrusions themselves.

Assimilation.—Fragments of foreign rock frequently become incorporated in rock magmas, and the mutual reaction between solid and liquid may lead to heterogeneity or the development of new varieties of rock. This process is known as assimilation and has been claimed by some petrologists as an important factor in petrogenesis.

It seems probable that the heat effect connected with the solution of solid rock by a liquid magma is always negative, solution being accompanied by absorption of heat usually of the order of the latent heat of melting. Simple solution demands large amounts of heat which are only available if the liquid possesses great super-heat. Intruding magmas, however, can scarcely be at a temperature much above their crystallization range. Such effects of magma upon its enclosures, as are observed, must therefore be attributed to reaction and precipitation, which in some cases leads simply to an adjustment in the composition and relative proportions of the existing phases, but is also productive of new minerals foreign to the magma, especially if reaction be incomplete. Where igneous rocks have absorbed sedimentary material in any quantity they present distinctive features. Granites which have assimilated shales or slates usually contain minerals such as andalusite, sillimanite or cordierite, which are foreign to normal igneous rocks. Gabbros under similar conditions pass first into norite by the formation of rhombic pyroxene and anorthite at the expense of monoclinic pyroxene and eventually into cordierite norites. Rocks of this character are well developed in Aberdeenshire. In general it may be said that there is little reason to believe that foreign rock is essential to the production of any particular type of differentiate, or that the process of assimilation is an important factor in petrogenesis.

Geographical Distribution of Igneous Rocks.—A study of the geographical distribution of igneous rocks has shown that the earth's surface may be mapped out into more or less definite petrographical provinces, each with its own community of petrographical characters. Strongly contrasted provinces may exist almost side by side, as is seen in the Tertiary Bohemian and Hungarian provinces standing on either side of the Carpathian range, the one characterized by a suite of igneous rocks rich in alkali, the other comprising an assemblage relatively rich in lime, magnesia and iron oxide. The chain of volcanoes that fringes the shores of the Pacific from Tierra del Fuego to Alaska and thence by Japan and the Philippines to Java and Sumatra

represents a province of a larger order, characterized by rocks which have so much similarity in many important features that they are certainly of allied origin. These rocks are all of Tertiary and recent age; their eruptions began in Eocene or Miocene times and have continued with more or less frequent intermissions up to the present day. The igneous rocks of the Atlantic islands from the Azores to Tristan d'Acunha comprise an assemblage of types strikingly different from the Pacific igneous rocks. Each of these magmas has been taken as a type, and referred to as the "Pacific" and "Atlantic" magmas. Chemically the Atlantic (or alkali) rocks are characterized by high percentages of alkalis (potash and soda) in relation to silica and alumina, and mineralogically by the presence of alkali minerals, especially felspathoids (nepheline, sodalite, analcime, etc.). The Pacific (subalkali or calcic) rocks on the other hand show relatively more abundant lime, magnesia and iron oxides. Certain suites of rocks characterized by high potash, and mineralogically by the presence of leucite or abundant potash felspar and micas have in recent years been separated from the Atlantic suite, though they are perhaps not of co-ordinate importance. Rocks of this character are illustrated by the Quaternary province of the Roman region; Vesuvius belongs to a line of volcanoes (extending from lake Bolsena to the Phlegrean Fields) that have poured out lavas of this character. From their occurrence on the borders of the Mediterranean they are sometimes known as the Mediterranean suite.

When we turn to the igneous rocks of older geological periods the same contrasted suites can be recognized. The midland valley of Scotland has been the theatre of igneous action both in Lower Devonian and Carboniferous times. The igneous assemblages of the two periods show, however, a striking contrast. The earlier lavas are distinctly of the Pacific type including andesites, basalts and rhyolites, while the Carboniferous extrusions and dike rocks include trachytes, teschenites, picrites and monchiquites—an Atlantic assemblage. Petrographical provinces are therefore clearly not permanent—a point to which we shall later return.

Each of the great suites—Pacific, Atlantic and Mediterranean is characterized by a set of rock types which reflects the chemical and mineralogical peculiarities. Arranged in tabular form the typical assemblages of the three suites are as follows:—

PACIFIC:—

PLUTONIC: granites, quartz-diorites, diorites, gabbros, pyroxenites, peridotites, anorthosites.

HYPABYSSAL: granite-porphyries, porphyrites, dolerites and some lamprophyres (spessartites, odinites).

VOLCANIC: rhyolites, dacites, andesites, basalts.

ATLANTIC:—

PLUTONIC: soda-granites, pulaskites, foyaites, essexites, theralites.

HYPABYSSAL: soda-granite-porphyries, pulaskite-porphyries, tinguaites, essexite- and theralite-porphyries and some lamprophyres (camptonites, monchiquites).

VOLCANIC: pantellerites, soda-trachytes, phonolites, alkali-basalts.

MEDITERRANEAN:—

PLUTONIC: quartz-syenites, syenites, monzonites, shonkinites and missourites.

HYPABYSSAL: syenite-monzonite-etc. porphyries and some lamprophyres (minettes, alnöites).

VOLCANIC: quartz-trachytes, trachytes, latites, ciminites, leucitites and leucite-basalts.

The recognition of these three suites and their distinctive products constitutes without doubt the first step towards a natural or genetic classification of igneous rocks.

Study of the geological relations of igneous rocks clearly reveals that there is a general correspondence both in time and space between igneous action and movements of the earth's crust, whether these be simply vertical movements of elevation and depression or tangential movements of folding and overthrusting which build up great mountain chains. As in crustal movements, so in igneous action, periods of activity have alternated with periods of quiescence. The movements of compression which led to the folded mountain chains fringing the Pacific were accompanied and followed by widespread vulcanicity and the movements of depression, which in Tertiary times led to the formation of the Great Rift Valley of East Africa, were attended and followed by a great suite of volcanic eruptions. The interdependence of igneous action and crust movement is even of a still more intimate kind, for not only the distribution of igneous rocks, but the distribution of different kinds of igneous rock is seen to stand in unmistakable relation to the great tectonic structures of the earth. The examples referred to above are illustrative of this conclusion. The volcanoes of the Pacific cordillera erupted calcic andesites and basalts, and are associated with granodiorite and quartz-diorite intrusions; the eruptions associated with the African Rift valley are in contrast, being of alkaline type and including soda-trachytes, phonolites and related alkaline lavas. Whether attention is confined to Tertiary igneous rocks or extended to those of earlier date, the conclusion is enforced that rocks of the Pacific suite are closely associated with folded mountain chains and appear in regions subject to movements of compression and lateral thrust, and that the Atlantic or alkaline suites are associated with regions of subsidence, subject to tension and faulting. That a particular region at successive epochs may be the theatre of action of contrasted igneous suites plainly forbids the assumption that the distribution of rock types is due to initial heterogeneity of the crust. Rather it would appear that calcic and alkaline suites are ultimately derived from the same primitive magmas. The manner of their evolution is a problem of great complexity.

The mode of origin of the massive fringes of pegmatite mantling the "older granites" of the south eastern highlands of Scotland may perhaps provide the initial clue to the actual mechanism involved. By Barrow these pegmatite fringes are conceived to represent the acid residual liquid squeezed out from partially crystallized granite magma under the influence of crustal stress. To an analogous process operating at deeper levels, and on a grander scale, Harker has made appeal to account for the separation in a horizontal sense of alkaline and calcic magmas from some common deep-seated stock.

Physical Chemistry of Igneous Rocks.—Natural rock magmas are polycomponent systems with seldom fewer than six or seven oxides, and no adequate discussion of their physical chemistry is at present possible. It is the function of the petrologist to elucidate the nature and behaviour of these complex systems under different physical conditions. In the last 25 years much progress has been made on the experimental side and the foundation for an extended exploration of the crystallization history of silicate magmas has now been laid. The main contributions have come from the Geophysical Laboratory at Washington. Investigations initially concerned with the perfection of experimental methods of attack have been followed by a physico-chemical study of simple oxides and their combinations. As yet these investigations have been almost wholly confined to dry systems but an attack on wet systems with volatile components is already in progress. Systems have now been investigated which approach in their complexity some of the simpler types of igneous rocks and the results obtained justify the conclusion that the fusion and solidification phenomena of igneous rocks are capable of systematic treatment. Starting with pure chemical substances the melting points, dissociation temperatures and inversion points of numerous rock-forming minerals have been determined, and the equilibrium phenomena of two and three component systems involving the commoner oxides of igneous rocks have been quantitatively elucidated. This study has embraced the six binary and four ternary systems of the oxides, CaO, MgO, SiO_2, Al_2O_3, and portions of the quaternary system itself have been explored. The investigation of mineral inversions has provided data throwing light on the temperature of consolidation of igneous magma. Such of these inversions as are enantiotropic or reversible and take place without appreciable lag can be appropriately used as geological thermometers. The inversion α quartz $\underset{\longleftarrow}{\xrightarrow{575^\circ C}}$ β quartz is a striking example, as it is accompanied by a significant volume change whereby it is possible to recognize whether quartz at ordinary temperatures has crystallized as α or β quartz. The criteria

include complicated twinning and fracturing. It can thus be shown that the quartz of granites has consolidated as β quartz and therefore at a temperature above 575°. The quartz of many pegmatites and igneous quartz veins on the other hand has consolidated as α quartz and therefore below 575°. (Note: some writers use α and β in the inverse senses.) The inversion pseudo-wollastonite $\underset{\longleftarrow}{\xrightarrow{1,190°C}}$ wollastonite provides another case, from which it is concluded that wollastonite occurring in rocks has crystallized below 1,190°.

Some minerals melt with dissociation or incongruently. The most important examples are clinoenstatite dissociating at 1,557° into forsterite and silica, and orthoclase with a dissociation temperature of 1,170° yielding leucite and silica. The incongruent melting of these two minerals has important petrogenetic implications which will be noticed hereafter.

Binary Systems.—The manner of crystallization of binary systems is dependent on the mutual relations of the constituents. In the simple case of two independent components each lowering the melting point of the other and not forming solid solutions the completion of crystallization takes place at a definite temperature (the eutectic point) at which both solids separate simultaneously from a solution of fixed composition (the eutectic mixture). Many examples of eutectic crystallization are known among silicates. It frequently gives rise to a graphic texture in which there is an intimate intergrowth of the two phases. The intergrowths of quartz and orthoclase in graphic pegmatites and micro-pegmatite are believed to be eutectic aggregates This is revealed not only in their simultaneous crystallization but also in their constant relative proportions (quartz 26%, orthoclase 74%). Not all graphic textures can, however, be regarded as evidence of eutectic crystallization, nor do all eutectic mixtures form graphic intergrowths

The conception of eutectics has played an important part in petrogenetic theory, and—as already noted—Vogt has attempted to recognize in eutectics the basis of a genetic classification of rocks. The eutectic relation is, however, only one of a number of possible relations existing between two or more components of a system. Where two components exhibit perfect isomorphous relations, eutectic crystallization is eliminated and the two substances crystallize as a single phase—an homogeneous solid solution. Of rock-forming minerals exhibiting this relation the plagioclase felspars are the most important. The equilibrium relations in such a system may be illustrated diagrammatically as in fig. 1. The horizontal line represents the composition, the vertical the temperature. The pure components are albite and anorthite. Anorthite (An.) melts at 1,550° C The melting point of albite (Ab) is fixed close to 1,100°; its melts are highly viscous and crystallize only with great reluctance. The upper curve of the diagram is the freezing point curve of intermediate mixtures of the two components. It is known as the *liquidus*. The lower curve is the melting point curve, or *solidus*. Above the liquidus all mixtures are liquid, below the solidus all are crystallized. Mixtures of albite and anorthite do not melt at definite temperatures but have a melting or crystallization interval, the lower limit fixed by the solidus, the upper by the liquidus.

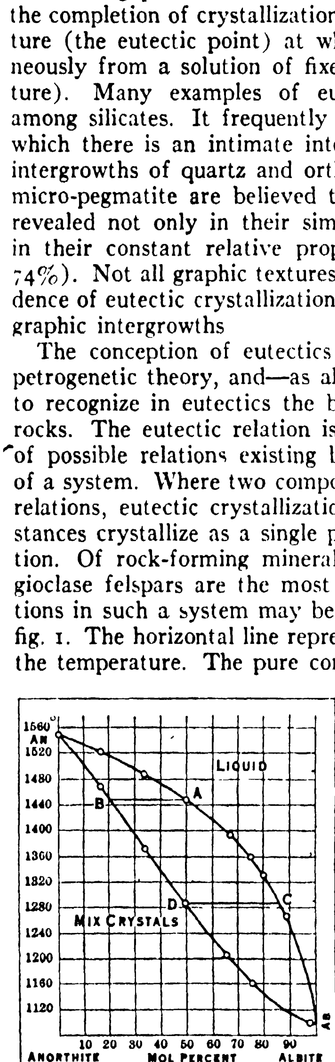

FIG. 1

Let us consider the phenomena attending crystallization of a mixture of given composition. A liquid of composition Ab_1An_1 as the temperature falls begins to crystallize at A. The crystals in equilibrium with this liquid have the composition B (Ab_1An_4), the liquid being always richer in albite than the crystals with which it is in equilibrium. As the temperature slowly falls the crystals continue to form, at the same time changing in composition along the solidus curve by continuous reaction with the liquid. Throughout the course of crystallization, this process of reaction proceeds until finally the crystals have the composition D, that of the original liquid, the last drop of liquid having the composition C. If, however, equilibrium between the solid and liquid phases is not continuously maintained, the course of crystallization is extended. At a moderately rapid rate of cooling the first formed crystals of composition B are not adjusted to the liquid, and there results a deposition of new layers upon the first formed crystals, each of composition corresponding to the temperature at which they are formed. When crystallization ceases, as the bulk composition of the crystals is that of the original liquid and the cores of the crystals are richer in anorthite, the outer layers must be enriched in albite The composition of the outer layer is represented by a point beyond D and that of the final liquid by a point beyond C The process first described is exemplified in the zonary banding or zoning of the common plagioclase felspars in igneous rocks. Either very slow cooling or very rapid cooling gives crystals free from zoning; at intermediate rates of cooling, crystallization is accompanied by zoning, and at some definite rate of cooling it might be expected that a maximum zoning would result in which case the final drop of liquid would have the composition of pure albite.

The theoretical investigations of Roozeboom have shown that five types of crystallization of isomorphous substances may occur; in three the mutual solubility of the two components is unlimited, in two it is limited, so that only mixed crystals of certain types may occur Some of these have been identified in rock-forming minerals, others are suspected though not yet proven

Ternary Systems.—Crystallization is more complicated in ternary systems than in binary Roozeboom and Schreinemakers worked out the theory of these systems To represent their behaviour resort must now be made to a solid figure All possible mixtures of three components can be represented by points within an equilateral triangle, the apices of which represent the three components. Binary mixtures appear as points on the sides of the triangle. If lines be drawn through any point within the triangle and parallel to its sides, they will cut the sides at distances which represent the relative proportions of the components represented by the point. To represent temperature, vertical ordinates are erected upon the equilateral triangle The solid figure thus obtained is a triangular prism bounded above by freezing point surfaces meeting in boundary lines. These can be conveniently represented in plane projection. In the simplest ternary systems each pair of the components form a binary eutectic and the three together a ternary eutectic, which represents the composition in the system possessing the lowest fusibility.

The crystallization course of such a simple system may be illustrated in the diagram (fig 2). A, B and C represent the three pure components, AB, BC and AC represent binary mixtures, and E_{ab}, E_{bc} and E_{ac} the respective binary eutectics. The ternary eutectic is represented by the point E_{abc} within the figure. A liquid of composition *a* when cooled to the freezing point surface separates crystals of the composition A, the composition of the liquid moving away from A towards *b* At *b*, the liquid becomes saturated for the component C which will begin to crystallize, both A and C crystallizing while the composition of the liquid changes along the boundary curve bE_{abc}. Finally B also begins to crystallize and the ternary eutectic point is reached at which the three components crystallize simultaneously in definite proportions (at E_{abc}) until the whole is completely solidified. This simple ternary system though realized among metallic alloys—for example in the system lead-tin-bismuth, where the ternary eutectic melts at 96°—has not been yet discovered among rock-forming silicates. There the relations are much more complex.

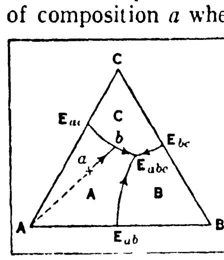

FIG. 2

Occurrence of inversion points in one or more of the components; the formation of binary or ternary compounds with congruent and incongruent melting points; the formation of isomor-

phous mixtures, limited or unlimited, among the phases, are some of the many complications in silicate systems already investigated. As an example of a very complicated system, the ternary system $CaO-Al_2O_3-SiO_2$ may be briefly noted.

In addition to the three components, there are nine binary compounds, some with enantiotropic inversions; and three ternary compounds, only two of which are stable. The fields meet three together in a large number of quintuple points eight of which are ternary eutectics. Investigation of this system has involved the undertaking of over 7,000 heat treatments and microscopical preparations.

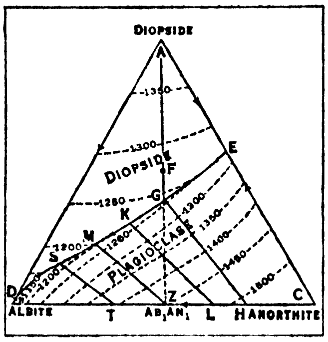

FIG. 3

Among the ternary silicate systems that have been studied three in particular are of great importance in the interpretation of the crystallization-history of rock magmas. They include those mixtures from which the phases, plagioclase, pyroxene, olivine, spinel and silica have separated. An important system is that of diopside—albite—anorthite. The equilibrium diagram is shown in fig. 3. The crystallizing phases are diopside and plagioclase. These mixtures are therefore comparable with simple basaltic or gabbroic magmas on the one hand and simple dioritic (augite-diorite) magmas on the other according to the nature of the plagioclase.

As before, consider the crystallization of a liquid whose composition is represented by the point F. (50% diopside, 50% plagioclase—Ab_1An_1). Crystallization begins with a separation of diopside (supposed to be a simple mineral and not an isomorphous mixture, as it would usually be in rocks) at about 1,275°. At 1,235° the excess of diopside (G) has separated out, and felspar begins to crystallize. It has about 80% anorthite (H). Thereafter diopside and felspar both crystallize, but as the temperature travels along the line EGD from G to M the composition of the felspar changes from H to Z (if we suppose that all the early felspar which is unduly rich in anorthite is stage by stage resorbed). The resulting rock has the mineral composition above stated; but if resorption of felspar is incomplete the last-formed felspar is richer in albite and has a composition T. The felspar crystals in that case are zonal with basic centres. If at any time crystallization is suddenly brought to an end a glassy ground-mass will be formed, which is richer in soda and silica than the original magma and contains zoned felspar crystals. This is exceedingly like what takes place in many basaltic lavas. Again, if the original mixture had been richer in felspar, so that the composition point lay below the line DE, felspar would have crystallized out first. This seems to be in keeping with the structure of many dolerites, which contain felspar partly enclosed in augite crystals of later formation (ophitic structure), while others show that the augite appears in porphyritic crystals and began crystallizing before felspar.

The separation of liquid from crystals can be accomplished not only by zoning but also by the sinking of crystals from the upper layers of the liquid. The resulting liquid is enriched in albite and, under favourable circumstances, the final liquid may approach the albite-diopside eutectic of composition 97% Ab, 3% diopside. The analogy with the differentiation course of gabbroic magma is clear. A mixture rich in diopside and anorthite-rich plagioclase, corresponding to an anorthite-rich gabbro or eucrite may pass to an assemblage rich in more acid plagioclase with subordinate diopside, corresponding to an augite-diorite. We shall see by a study of another system how this differentiation from a basic magma may be extended to the granitic (diopside-granite) stage.

The continuous reaction relation between crystals and liquid in the systems just studied is of fundamental importance in the crystallization-history of magmas. This reaction is common to all solid solution series, and such solid solutions are called *continuous reaction series.* Very similar effects, however, are produced by another type of crystallization phenomenon revealed in synthetic melts. In this case an early precipitated phase reacts at a certain temperature with the surrounding liquid and a new phase is precipitated, a reaction process of a discontinuous kind. This reaction is illustrated in the system forsterite (olivine)-silica. Here there are three solid phases, forsterite, clinoenstatite ($MgSiO_3$) and cristobalite (SiO_2). The monoclinic pyroxene, clinoenstatite, has an incongruent melting point and dissociates at 1,557° into forsterite and liquid. From all melts of composition between Mg_2SiO_4 and $MgSiO_3$, the first phase to crystallize is forsterite, which continues to separate until the temperature of 1,557° is reached, when the olivine reacts with the liquid to form clinoenstatite. When equilibrium is established the resulting crystalline mass consists wholly of olivine and pyroxene. If, however, the opportunity for reaction is inhibited, either by the sinking of olivine crystals or by their enclosure in the reaction product, the course of crystallization is extended and the third phase, silica, is precipitated giving a mass composed of residual olivine, pyroxene and silica.

A reaction relation of this type may effect a series of compounds in a crystallizing melt. These, arranged in their order of succession, constitute a *discontinuous reaction series.* The combined effects of discontinuous and continuous reaction are revealed in the related ternary system diopside-forsterite-silica. Here clinoenstatite forms a complete series of solid solutions (monoclinic pyroxenes) with diopside; they form a continuous reaction series, the crystals in equilibrium with the liquid being relatively enriched in the magnesian end member ($MgSiO_3$). The effect of hindering the reaction relations is now twofold, the residual liquid (or upper layers of the liquid if sinking of crystals obtains) is enriched in silica and the diopsidic pyroxene, owing to the offset in composition. The lowest point of formation of liquid in the system (there is no ternary eutectic) is the binary eutectic diopside-silica.

Evidence of these reaction processes in natural magmas is by no means wanting. It is seen in zonary banding of plagioclase felspars and pyroxenic solid solutions. One of the most characteristic features of olivine-bearing basic rocks is the occurrence of olivine crystals with rounded outlines—indicative of resorption—or with mantles of pyroxene formed at their expense. In the synthetic melts the unidirectional reaction-relation existing among the mineral phases results in a differentiated liquid or chain of liquids enriched in silica, from early separation of olivine, in albite from early formation of magnesian-rich pyroxene. Similar reactions proceeding in basic (gabbroic or basaltic) magma serve to explain in large measure the differentiation chain of the calc-alkaline rocks, gabbro-diorite-granodiorite, though here the presence of other oxides—K_2O, H_2O—and other volatile constituents is responsible for more complex reactions and new mineral phases not yet included in synthetic investigation.

Volatile Constituents.—The volatile constituents of magmas have a profound influence on the properties of the silicate solution. Their concentration is greatly affected by changes of pressure and temperature, and equilibria in the melt are therefore of a very mobile kind. They reduce the viscosity of the melt, lower the temperature of crystallization, and are responsible for the precipitation of new mineral phases foreign to dry melts. By fractional crystallization these constituents are concentrated in the residual liquid and become responsible for many of the after-effects seen in pneumatolysis, metasomatism and ore deposition. The formation of amphiboles, micas and many other minerals is to be attributed to their presence.

It has been shown that the phenomena associated with the reaction-relation in dry melts appear among the mineral phases of magmatic melts and can be interpreted in like manner. In the light of laboratory experiment available petrographical data permit the conclusion that the pyroxenes, hornblendes and biotites form a discontinuous reaction series, pyroxene reacting with liquid to form hornblende, hornblende to form biotite. Each of these groups in itself as solid solutions is a continuous reaction series. It is in reactions of this kind that the ordered differentiation sequence gabbro-diorite-quartz diorite-biotitegranite, character-

istic of the calc-alkaline rocks now finds explanation; the continual offset in composition of residual liquid in which water accumulates being accomplished by appropriate removal of crystals, either by gravitative settling or squeezing out or filtering of interstitial liquid by earth movement during crystallization.

Volatile constituents are believed to play a prominent part in the evolution of rocks of the alkaline (Atlantic) suite. They are responsible for the desilication of the alkali aluminium polysilicates. Both carbon dioxide and water appear to be the principal agents in this process: Thus, reactions of the type—

$$KAlSi_3O_8 \rightleftarrows KAlSiO_4 + 2SiO_2$$
$$NaAlSi_3O_8 \rightleftarrows NaAlSiO_4 + 2SiO_2$$
$$2(MgFe)SiO_3 \rightleftarrows (MgFe_2)SiO_4 + SiO_2$$

may represent equilibrium relations in a residual liquid rich in water (such as the granite stage of differentiation) If the precipitation of alkali-felspars, biotite and quartz is followed by their withdrawal, the concentration of nepheline molecules will lead finally to the separation of this constituent Assemblages of nepheline syenites, urtites and ijolites may be differentiated in this way.

The capacity of CO_2 for desilicating polysilicates is attested by laboratory experiment; and it is not improbable that carbonates, by a process of absorption of limestone in a liquid already alkaline, have been effective in the generation of some alkaline rocks, especially those containing such minerals as calcite, cancrinite, melanite and melilite.

More obscurity surrounds the origin of the potassic or leucitic rocks. Their spatial arrangement in relation to the Pacific and Atlantic suites, no less than their chemical characters reflects their intermediate position. They are characteristic of the region lying between the orogenic zones and the foreland or regions of subsidence The position of the potassic Roman province in relation to the Alpine orogenic zone on the one hand and the alkaline (Atlantic) basin of the west Mediterranean illustrates this relation very clearly The formation of leucite by dissociation of orthoclase (incongruent melting) is an important reaction in the genesis of some potassic rocks Normally in the presence of abundant water under cover, the desilication of the polysilicate would appear to proceed a stage further in the formation of the orthosilicate ($KAlSiO_4$) which is precipitated in biotite—usually at the granitic stage—and the generation of leucite would in some cases appear to be connected with a loss of water from a biotite-rich liquid (*e g.*, of the composition of minette) by its intrusion or extrusion near or at the surface Leucite-bearing rocks are rare as plutonic rocks (the leucite being usually replaced by orthoclase and nepheline). The generation of the potassic series may indeed be dependent on a prior differentiation of a magma to a stage in which biotite is accumulated, as revealed, *e g*, in mica-rich lamprophyres.

Desilication of potash-felspar appears then as a characteristic reaction in rocks of the Mediterranean suite. Their relation to the Pacific suite is provided in the equilibria existing between potash-felspar, biotite, leucite and olivine, to the Atlantic suite in the equilibria between alkali-felspars, felspathoids and quartz; in the potassic series desilication of the albite molecule playing a subordinate rôle.

The genetic relations between the three suites are amply attested and enforce the conclusion that no sharp line of division between them is to be recognized. Their source is a common stock magma. Nevertheless we appear to see in the relative distribution of the three series upon the face of the globe, the influence of tectonic processes as an external factor exerting a profound influence on the trend of differentiation

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Much information on rocks is contained in the memoirs of the various geological surveys and in *Quart Journ. Geol. Soc. of London*, *Mineralogical Magazine*, *Geological Magazine*, *American Journal of Science*, *Journal of Geology*, *American Mineralogist*, *Neues Jahrbuch fur Mineralogie* (Stuttgart), Tschermak's *Mineralogische Mitthcilungen* (Vienna), *Fortschritte der Mineralogie* (Berlin), etc. (C. E. T.)

PETRONIUS (PETRONIUS ARBITER), Roman satirist, under whose name we have some considerable fragments of a remarkable satire or satirical romance (*Petroni Arbitri Satirae*). We find various references to the author in later writers, *e g*, Macrob, *Somn. Scip*, i 2 8 "plots full of the fictitious adventures of lovers with which Arbiter occupied himself a great deal," Lydus, *De Magistratibus*, 41 "Turnus and Juvenal and Petronius who by merely pursuing abuse injured the law of satire," Sidonius Apoll, *Carm*, xxiii 155, etc, but none of these throw any clear light upon the date or personality of the writer. Modern scholarship inclines to identify him with Gaius (so apparently Tac, *Ann.* xvi, 17 and 18, though in both passages the reading is disputed: Titus is given as his praenomen in Plin. N H xxxvii. 20 and Plutarch, *Mor.* 60 E) Petronius, the one time favourite of Nero, of whose character a remarkable picture is presented by Tacitus *Ann.* xvi 18: "Regarding Gaius Petronius a few words must be said by way of retrospect His days were passed in sleep, his nights in social engagements and the pleasures of life The fame which other men attain by diligence he won by indolence, and he was not considered a debauchee and a profligate, like others who exhaust their substance, but a man of refined luxury His sayings and his acts, in proportion as they were free and ostentatious of recklessness, were so much the more gladly taken as a type of simplicity. Yet as pro-consul of Bithynia, and presently as consul, he showed himself a vigorous and capable man of affairs Then declining again upon vice, or aping vice, he was admitted by Nero among the select few of his friends—the arbiter

of elegance, those things only appealing to the jaded emperor's eyes and other senses which the approval of Petronius commended to him. Hence the jealousy of Tigellinus, as toward a rival and superior in the science of pleasure. And so he played upon the emperor's cruelty—the lust which now occupied him beyond all other lusts—charging Petronius with being a friend of Scaevinus. . . . The emperor, as it happened, had at that time started for Campania and Petronius, on reaching Cumae, was arrested. He refused to endure the suspense of fear or hope. Yet he did not put away his life precipitately, but he had his severed veins bound up and again re-opened at his pleasure, while he spoke to his friends, not in serious language or such as might win him fame for his firmness, and listened to them repeating—not anything about the immortality of the soul and the doctrines of the philosophers—but light poetry and frivolous verse. To some of his slaves he gave largesse, to others stripes. He dined too and indulged in sleep, that so his compulsory death might resemble a natural one. Nor did he, like most men in their last moments, flatter in his will either Nero or Tigellinus, or any other powerful person, but he wrote out a full account—with the names of his associates, male and female—of the emperor's excesses and of every novel debauchery. This he sealed and sent to Nero, and then broke his signet-ring in order that it might not be used presently to imperil others." This last act is paralleled by Plin. xxxvii. 20, who tells how the dying Petronius broke a precious bowl to prevent it falling into the hands of Nero.

While the identity of this Petronius with the author of the *Satirae* is perhaps incapable of definite proof (1) the cognomen Arbiter—which is not a cognomen in the proper sense, but only a nickname—strongly recalls the expression—*arbiter elegantiae*—applied to C. Petronius by Tacitus; (2) it is clear that the Petronius of Tacitus had the social experience, the temperament, and the ability to compose just such a satire; (3) the internal evidence, vague as it is, seems to suit the age of Nero better than any other. On the other hand, to imagine that the work represents the actual document which Tacitus describes Petronius as sending under seal to Nero is, of course, absurd.

The surviving portions of the work are fragments from the 15th and 16th books. The speaker is one Encolpius, who narrates the adventures of himself and his companions among the towns of southern Italy. The longest and, in many respects, the most important episode is that which is generally known as the *cena Trimalchionis* or *Dinner of Trimalchio*. The scene of the dinner is most probably Cumae (*cf.* § 53 *in praedio Cumano quod est Trimalchionis*). The giver of the feast, Trimalchio, is a fabulously wealthy freedman (§ 37 "Trimalchio's estates range as far as a kite can fly . . . and as for his slaves, I don't believe a tenth of them know their own master"), and his wife, Fortunata, is a strong-minded lady of the humblest origin. The sketch is a humorous presentation of the vulgarity and ostentation of the wealthy provincial. Next in importance is the episode of the *Matron of Ephesus*, in which, for the first time, so far as we know, that legend is introduced into the literature of the West.

In form and, to some extent at least, in manner, Petronius continues the tradition of the *Saturae Menippeae* of Varro. Thus, passages in verse are freely interspersed in the midst of the prose, the longest (295 hexameters), on the Civil Wars, being probably intended as a parody of Lucan's *Pharsalia;* another (65 iambic trimeters) describing the taking of Troy, then, and until the day of Tryphiodorus, a favourite theme of the minor poet. From the standpoint of literary history the work may be regarded as the forerunner of the novel of adventure—such as flourished in England in the 18th century—the type, that is, which Aristotle would have called "epeisodic," in which the episodes succeed one another without probable or necessary sequence (Arist., *Poet.* c. ix), and the interest depends, not on the evolution of a skilfully constructed plot, but on the convincing presentation of individual episodes.

The main purpose of the *cena* is the delineation of the rich and vulgar upstart, the *nouveau riche, repente dives, νεόπλουτος*. The type was, of course, well known both in real life and on the stage: Cic., *Phil.* ii. 65, *exultabat gaudio persona de mimo "modo egens repente dives."* Aristotle describes the state of the *nouveau riche* as "a sort of indiscipline in wealth" (*Rhet.* ii., 16 *ἀπαιδευσία πλούτου*: contrast the *erudito luxu* of Petronius, Tac., *Ann.* xvi. 18). Ostentatious display of wealth in entertaining was a characteristic feature: Plut., *Lucull.* 40, "The daily dinners of Lucullus were the dinners of a *nouveau riche:* not only were there purple-dyed coverlets, cups set with precious stones, choirs and individual artists introduced as interludes, but also he roused the envy of the vulgar with the elaboration of all sorts of meats and curiously prepared sweetmeats." The extreme type of the *nouveau riche* was the newly-wealthy freedman, the "newly-wealthy Phrygian" or Aristoph., *Vesp.*, 1309, the *νεόπλουτος ἀπελεύθερος*, who does not know either how to dress properly or how to behave at table (Lucian, *Hist. Conscr.*, 20), who, dining with philosophers, apes their subtleties by propounding the question: "Why do white and black beans alike make pale soup?": only to be silenced by a reminder of his antecedents: "Why do white and black straps alike make purple weals?" (Plut. , *Quaest. Conv.*, ii. 12), whose vulgarity reveals itself in an over-anxiety to please his guests: Plut., *Quaest. Conv.*, vii. 3. "To ask what meats and sweetmeats the guest likes best, or to question him about different wines and perfumes," is very vulgar and a mark of the *nouveau riche, cf.* Petron. 48. "If you don't like the wine I'll change it." Trimalchio is a most felicitous presentation of the wealthy parvenu in his parade of his wealth—so frankly vulgar as to become almost an engaging simplicity (§ 48 "I don't have to buy . . . everything is grown on my suburban estate, which I haven't seen yet. I'm told it joins my lands in Terracina and Tarentum. What I wish now is to annex Sicily to my little crofts so that, if I want to go to Africa, I may be able to make the whole journey on my own estates"), his cheap sentimentality (§ 35 *Eheu nos miseros, quam totus homuncio nil est, cf.* § 72), his pretence to learning (§ 48, "I've two libraries, one Greek, the other Latin"), which is only pretence (§ 71 "Gaius Pompeius Trimalchio Maecenatius lies here . . . Pious, brave, faithful, starting from a humble beginning he left a quarter of a million and never listened to a philosopher").

For the student of social manners, as for the student of colloquial language and colloquial idiom, the extant remains are of inestimable value, and, if only on that ground, the loss of the rest of the *Satirae* is one which, in spite of the indecency which mars the work, every scholar must most deeply regret.

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PETROPAVLOVSK, (1) a town in the Akmolinsk district of the Kazakstan A.S.S.R., in 55° N. and 69° E., on the left bank of the Ishim river, where the Trans-Siberian railway crosses it. Pop. (1926) 44,272. The town is a centre for caravan trade from the Kirghiz steppe in corn, cattle, furs, tea, wool and cotton and has an Asiatic appearance.

(2) A port on the eastern shores of Avacha bay in Kamchatka, in the Far Eastern area of the Russian S.F.S.R. in 53° 16′ N., 159° E. Pop. (1926) 1,670. The inhabitants are mainly Russians, Japanese, Chinese, Koreans and natives, and the town, which has been growing rapidly recently, is a centre for the fur trade. There are summer sailings to Vladivostok and Japan, but the harbour is frozen from November to May. There is a wireless station, linking with Vladivostok and with the fish canneries in the north of Kamchatka. The Russian Pacific fleet was stationed here for a time and defeated a combined attack by the French and English during the Crimean War. It was transferred in 1854 to Nikolayevsk-on-Amur and ultimately to Vladivostok.

PETROPOLIS, a city of the State of Rio de Janeiro, Brazil, in an elevated valley of the Serra de Estrella, 2,634 ft. above sea-level and 27 m. N. of the city of Rio de Janeiro, with which it is connected by a combined railway and steamship line, and also

by a longer railway line. Pop. (1920, including the municipal district) 67,574. Petropolis is served by the Principe do Grão Pará railway, now a part of the Leopoldina system, which connects with Rio de Janeiro and Nictheroy on the coast, and with the station of Entre Rios on the Central of Brazil railway. Its favourable altitude gives the city a cool invigorating climate. The rainfall is abundant, and especially so in summer (Dec. to March) when the humidity is extreme. Vegetation is luxuriant. Its water-power and cool climate are making it an important manufacturing town.

Petropolis was founded in 1845 by Julius Frederick Koeler under the auspices of the emperor of Brazil, Dom Pedro II., on lands purchased in 1822. The Mauá railway was opened to the foot of the *serra* in 1854, and the macadamized road (now a good motor road) up the *serra* to the town in 1856. The mountain section of the railway, on the Riggenbach system, was completed in 1883. Petropolis has since become the summer residence of the diplomatic corps and Government officials.

PETROVARADIN, a town and fortress of Croatia-Slavonia, Yugoslavia, situated on a promontory formed by a loop of the Danube. Pop. (1921), 5,101. It is connected with Novi Sad on the opposite bank by a railway bridge and a steam ferry. The fortifications consist of the upper fortress, on a lofty serpentine rock rising abruptly from the plain on three sides, and of the lower fortress, rising from the river on the northern base of the rock, the two together accommodating a garrison of 10,000 men. The fortress is believed to represent the Roman Acumincum, and received its present name from Peter the Hermit, who in 1096 marshalled the levies of the first crusade here. It was captured by the Turks in 1526 and was retained by them for a period of 160 years.

PETROVSK, the name of several Russian towns, the most important being Petrovsk in the province of Saratov, on the Medvyeditsa, a tributary of the Don, in 52° 22′ N., 45° 19′ E., and on a branch railway linking with the Volga river. Pop. (1926) 19,208. It has oil pressing and flour mills, and manufactures agricultural machinery.

PETROZAVODSK, the chief town in the Karelian A.S.S.R, of the Russian S.F.S.R. in 61° 41′ N., 34° 20′ E., on the west shore of Lake Onega, and on the Leningrad-Murmansk railway. Pop. (1926) 26,344.

PETRUS AUREOLUS (Oriol), scholastic philosopher and monk of the Franciscan order, lived in the latter half of the 13th century, and died in Paris in 1321 just after his appointment as archbishop of Aix. He was one of the first to attack the realist doctrines of Duns Scotus, and is interesting mainly as the precursor of William of Occam in his revival of Nominalism. He was known as *Doctor Facundus* and *Doctor Abundans*.

PETTENKOFER, MAX JOSEPH VON (1818–1901), Bavarian chemist and hygienist, was born at Lichtenheim, near Neuburg. He studied pharmacy and medicine at Munich, and after working under Liebig at Giessen was appointed chemist to the Munich mint in 1845. Two years later he was chosen extraordinary professor of chemistry in the medical faculty, in 1853 he received the ordinary professorship, and in 1865 he became also professor of hygiene. In 1894, he retired from active work, and on Feb. 10, 1901, he committed suicide. The reaction known by his name for the detection of bile acids was published in 1844. In his widely used method for the quantitative determination of carbon dioxide the gaseous mixture is shaken up with baryta or lime water of known strength and the change in alkalinity ascertained by means of oxalic acid. His name is most familiar in connection with his work in practical hygiene and nutrition.

Pettenkofer gave vigorous expression to his views on hygiene and disease in numerous books and papers; he was an editor of the *Zeitschrift für Biologie* from 1865–82, and of the *Archiv für Hygiene* from 1883–94.

PETTIE, JOHN (1839–1893), Scottish painter, was born in Edinburgh on the 17th of March 1839. At sixteen he entered the Trustees' Academy in Edinburgh, working under Robert Scott Lauder. His first exhibits at the Royal Scottish Academy were "A Scene from the Fortunes of Nigel"—one of the many subjects for which he sought inspiration in the novels of Sir Walter Scott—and two portraits in 1858. To the Royal Academy in 1860 he sent "The Armourers"; and in 1862 he settled in London, where he joined Orchardson. In 1866 he was elected A.R.A., and in 1874 R.A. Pettie died at Hastings on Feb. 21, 1893.

John Pettie, R.A. (1908), by his nephew Martin Hardie, gives the story of his life, a catalogue of his pictures, and fifty reproductions.

PETTY, SIR WILLIAM (1623–87), English statistician and political economist, born on May 26, 1623, the son of a clothier at Romsey in Hampshire, received his early education at the grammar school there. He studied for some time at Caen, and on his return to England, seems to have entered the Royal Navy. He went abroad again in 1643, and remained for three years in France and the Netherlands, pursuing his studies. In 1647 Petty obtained a patent for the invention of double writing, *i.e.*, a copying machine. In politics he espoused the side of the parliament. In 1648 he was made deputy professor of anatomy at Oxford, and on obtaining the degree of doctor of physic, 1649, was made a fellow of Brasenose college. In 1654, observing that the admeasurement and division of the lands forfeited in 1641 had been "most inefficiently and absurdly managed," he contracted to execute a fresh survey, which he completed in 13 months. On purchasing a large estate in county Kerry, he set up ironworks in that neighbourhood, opened lead-mines and marble-quarries, established a pilchard fishery, and commenced a trade in timber. Besides the office of commissioner of distribution of the lands he had surveyed, he held that of secretary to the lord-lieutenant, Henry Cromwell, and was also during two years clerk of the council. In January 1658 he was elected to Richard Cromwell's parliament as member for West Looe in Cornwall. After the Restoration he returned to England and was favourably received and knighted by Charles II., who was "much pleased with his ingenious discourses." He obtained from the king a new patent constituting him surveyor-general of Ireland. In 1663 he invented a double-bottomed ship, which twice made the passage between Dublin and Holyhead, but was afterwards lost. He was one of the first members of the Royal Society, and sat on its council. He died in London on Dec. 16, 1687.

Petty's Irish survey was based on a collection of social data which entitles him to be considered a pioneer in the science of comparative statistics. He was also one of the first to break away from mercantilist ideas, and he exhibits a statesmanlike sense of the elements in which the strength of a nation really consists. Roscher names him as having, along with Locke and Dudley North, raised the English school to the highest point it attained before the time of Hume. His *Treatise of Taxes and Contributions* contains a clear statement of the doctrine that price depends on the labour necessary for production. Petty is much concerned to discover a fixed unit of value, and he thinks he has found it in the necessary sustenance of a man for a day. He understands the cheapening effect of the division of labour. He states correctly the notion of "natural and true" rent as the remainder of the produce of land after payment of the cost of production; but he seems to have no idea of the "law of diminishing returns." He has much that is just on the subject of money: he sees that there may be an excess of it as well as a deficiency, and regards the prohibition of its exportation as contrary to sound policy. But he errs in attributing the fall of the rate of interest which takes place in the progress of industry to the increase in the quantity of money. He protested against the fetters imposed on the trade of Ireland, and advocated a union of that country with Great Britain.

A complete list of his works is given in the *Athenae oxonienses*. The most important are: the *Treatise of Taxes and Contributions* (1662, 1667 and 1685); *Political Arithmetic*, presented in ms. to Charles II., but, because it contained matter likely to be offensive to France, kept unpublished till 1691, when it was edited by Petty's son Charles; *Quantulumcunque, or a Tract concerning Money* (1682); *Observations upon the Dublin Bills of Mortality in 1681 and the State of that City* (1683); *Essay concerning the Multiplication of Mankind* (1686); *Political Anatomy of Ireland* (1691). Several papers appeared in the *Philosophical Transactions*. See *Economic Writings of Sir William Petty*, ed. C. H. Hull (2 vols., 1899); W. Roscher, Study on Petty in *Transactions of the Royal Scientific Society of Saxony* (Leipzig).

PETTY SESSIONS: *see* SESSIONS.

PETUNIA, in botany a genus of plants belonging to the nightshade family (Solanaceae) and containing about 25 species, chiefly South American (southern Brazil and Argentina). The garden forms are derived from the white-flowered *P. nyctaginiflora* and the violet- or purple-flowered *P. violacea.* The varieties of petunia make admirable specimens for pot culture.

PETWORTH, a market town in Sussex, England, 55 m. S.S.W. from London by the S.R. Pop. (1921) 2,435. Petworth (Peartingawyrth, Peteorde, Puetewird, Pedewurde, Putteworth, Pytteworth, Petteworth) is named in a grant by Eardwulf, king of Northumbria, to St. Peter's Church, about 791. Under Edward the Confessor Petworth was an allodial manor held by his queen Edith, and in 1086 Robert Fitz-Tetbald held it of Roger Montgomery, earl of Shrewsbury. Petworth house, situated in a park, dates from the 18th century. At Bignor in the neighbourhood are remains of a Roman villa. Near Petworth are stone quarries yielding building material.

PEUTINGER, KONRAD (1465–1547), German humanist and antiquarian, was born at Augsburg. In 1497 he was town clerk of Augsburg, and was on intimate terms with the emperor Maximilian. He was one of the first to publish Roman inscriptions, and his name remains associated with the famous *Tabula peutingeriana,* a map of the military roads of the western Roman Empire, discovered by Konrad Celtes. Peutinger also edited the *Historia Gothorum* of Jordanes, and the *Historia gentis Langobardorum* of Paulus Diaconus.

The *Tabula peutingeriana* was first published as a whole by F. de Scheyb (1753); later editions by E. Desjardins (1869–74) and C. Miller (1888); *see* also E. Paulus, *Erklärung der Peutinger Tafel* (1867); and Teuffel-Schwabe, *Hist. of Roman Literature* (Eng. trans., 1900).

PEVENSEY, a village in Sussex, England, 65 m. S.S.E. from London by the S.R. Pop. (1921) 764. It was the landing place of William the Norman on his way to conquer, and was the *caput* of the rape of Pevensey, granted by William to the earl of Mortain and subsequently became the Honour of the Eagle. Some time before the reign of Edward I. the town of Pevensey was made a member of Hastings and shared the liberties of the Cinque Ports. By an act of 1883 it ceased to exist as a borough. The decline of Pevensey was caused by the recession of the sea. The outer wall, with towers, of the castle is Roman, and is generally considered to have enclosed the strong town of *Anderida.* Within are the ruins, principally of the 13th century, but in part Norman, of the castle proper, with a keep and four round towers. The church of St. Nicholas, close to the castle, is Early English. It is doubtful whether Pevensey was the scene of Caesar's landing in 55 B.C.

PEW, a term, in its most usual meaning, for a fixed seat in a church, usually enclosed, slightly raised from the floors, and composed of wood framing, mostly with ornamented ends. Some bench ends are certainly of Decorated character, and some have been considered to be of the Early English period. They are sometimes of plain oak board, 2½ to 3 in. thick, chamfered, and with a necking and finial generally called a *poppy head;* others are plainly panelled with bold cappings; in others the panels are ornamented with tracery or with the *linen pattern,* and sometimes with running foliages. The large pews with high enclosures, known familiarly as "horse-boxes," and common in English churches during the 18th and early part of the 19th centuries, have nearly all been cleared away. The church of Whitby, in Yorkshire, is perhaps the best surviving example of an unaltered interior.

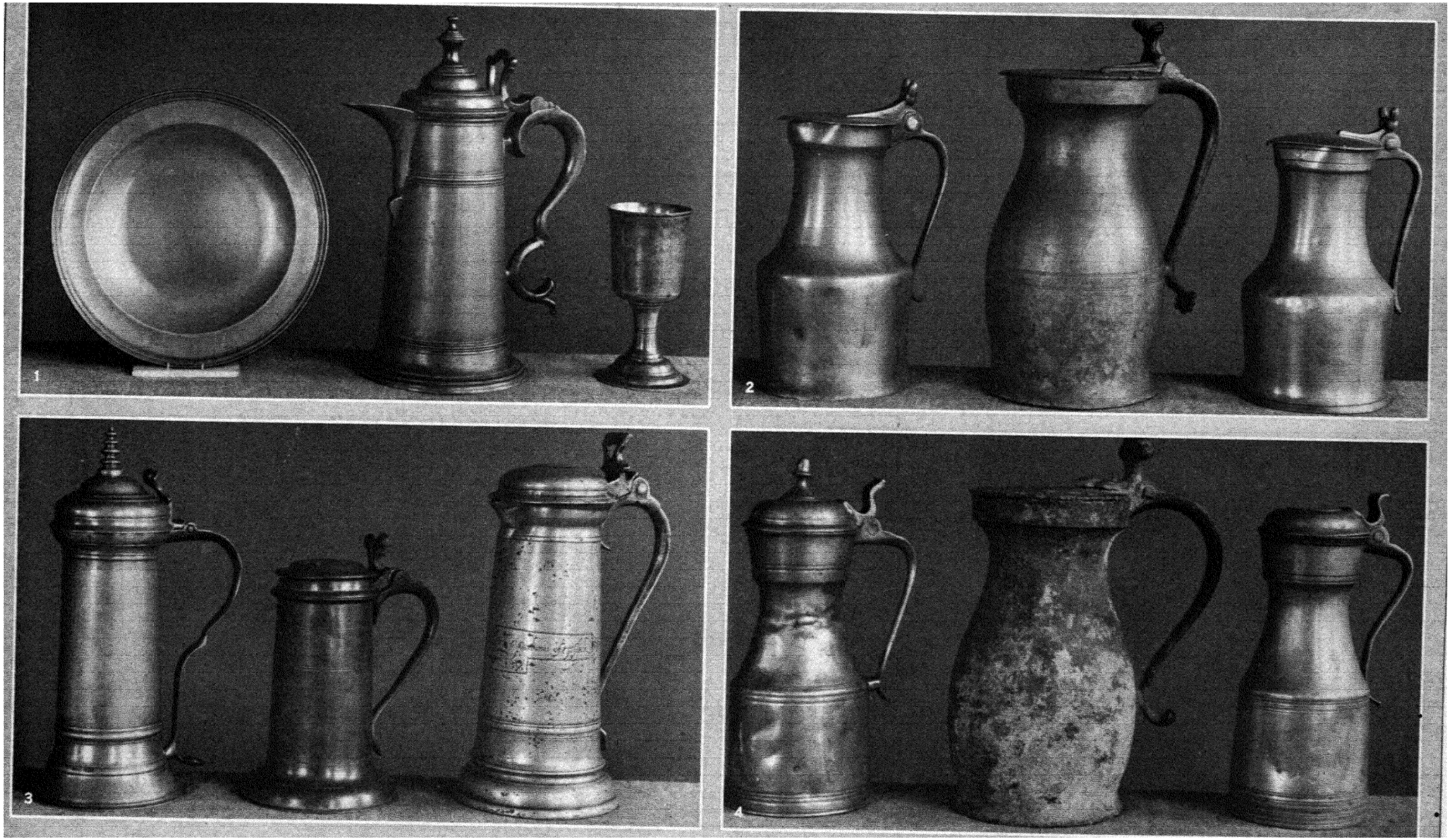
At common law all seats in a parish church are for the common use of all the parishioners, and every parishioner has a right to a seat without paying for it. As against the assignment and disposition of seats by the ordinary, acting through the churchwardens, two kinds of appropriation can be set up (*a*) by the grant of a faculty by the ordinary, and (*b*) by prescription, based on the presumption of a lost faculty. Such faculties are rarely granted now, they were formerly common; the grant was to a man and his family "so long as they remain inhabitants of a certain house in the parish." The letting of pews in parish churches became common in the 16th century, but there are some earlier instances of the use, for example at St. Ewens, Bristol, in 1455.

See A. Heales, *History and Law of Church Seats and Pews* (1872); Phillimore, *Eccles. Law* (1896), ii. 1424 *sq.*

PEWTER, an alloy, the basis of which is tin. It is mixed with another metal, generally lead, the proportions varying from six to four parts of the former to one of the latter. Occasionally brass or copper takes the place of the lead. The Rev. William Harrison, writing in the time of Queen Elizabeth, a period when pewter was much in favour, says, "I have been also informed that it consisteth of a composition which hath thirty pounds of kettle brass to a thousand pounds of tin, whereunto they add three or four pounds of tin glass; but, as too much of this doth make the stuff brickle, so the more the brass be, the better is the pewter, and more profitable unto him that doth buy and purchase the same."

Of its antiquity it is difficult to speak with certainty owing to the doubtful meaning of the terms employed. It is said to have been known to the ancient Chinese, and it is claimed to have been made by the Chaldaeans, Egyptians and Greeks. As to its production by the Romans, mention is made by early writers, and all doubt has been removed by the analysis of some of the pewter of the Roman period found at Appleshaw, Hampshire, and now in the British Museum. From early days the rich mines of Cornwall were the repository which supplied the Continent with tin of fine quality: it is therefore only natural to find the use of pewter very common in England and the adjacent countries. The ordinary methods of working the metal were by casting, turning and hammering. The most satisfactory pewter is marked by simplicity, a good outline and an absence of decoration.

The use of pewter followed three main lines: it was employed for church vessels, for domestic purposes, and in a less degree for what might be termed civic functions. In England pewter was already used in the service of the church in early mediaeval times. Chalices of pewter had replaced wooden vessels before the end of the 11th century; but, in 1175 the Council of Westminster proscribed this metal and bishops were forbidden "to bless a chalice of pewter." From that time until the 15th century it was customary to bury a pewter chalice with the priest. Various references are found from which it may be inferred that in addition to their silver vessels many churches possessed a chalice of pewter or tin destined to be buried with the priest. Such chalices have frequently been found on the opening of coffins. Cruets for the wine and water of the Mass were also of pewter. After the Reformation and throughout the 17th and 18th centuries a large number of pewter vessels are found, especially flagons. The canon of 1603 ordered that the wine should be "brought to the Communion table in a clean and sweet standing pot or stoup of pewter if not of purer metal." Many such flagons still survive, dating from any time up till the end of the 18th century; they follow the shape of the contemporary silver vessels, the commonest being of cylindrical form with bold scroll handle and flat or domed lid. Alms dishes, patens and collecting plates are also found; a set of four beautiful dishes with enamelled centres dating from the 17th century, belong to the church of St. Katherine Cree in the City of London. Complete sets of communion vessels in pewter are rare. The Elizabethan communion cup with its band of engraved ornament is occasionally to be met with in pewter, a rather puzzling fact when it is remembered how common silver was at that period. It seems clear that generally speaking chalices in pewter were merely a makeshift. The churches of Scotland are much richer in communion plate than those of England. At the time of the Reformation St. Giles's Church, Edinburgh, possessed a pair of pewter candlesticks for the high altar which were evidently considered of value. Till the end of the 18th century pewter was much in use, and more and finer vessels are found there than in England: they comprise communion vessels including the beaker form of cup in common use in the north-eastern parts of the country, basins for collecting alms, and a large number of communion "tokens." On the Continent pewter had a much wider application in church vessels and furniture; while chalices and patens were ordered to be of silver at least in part, the cruets were frequently of pewter. This metal was also used for holy-

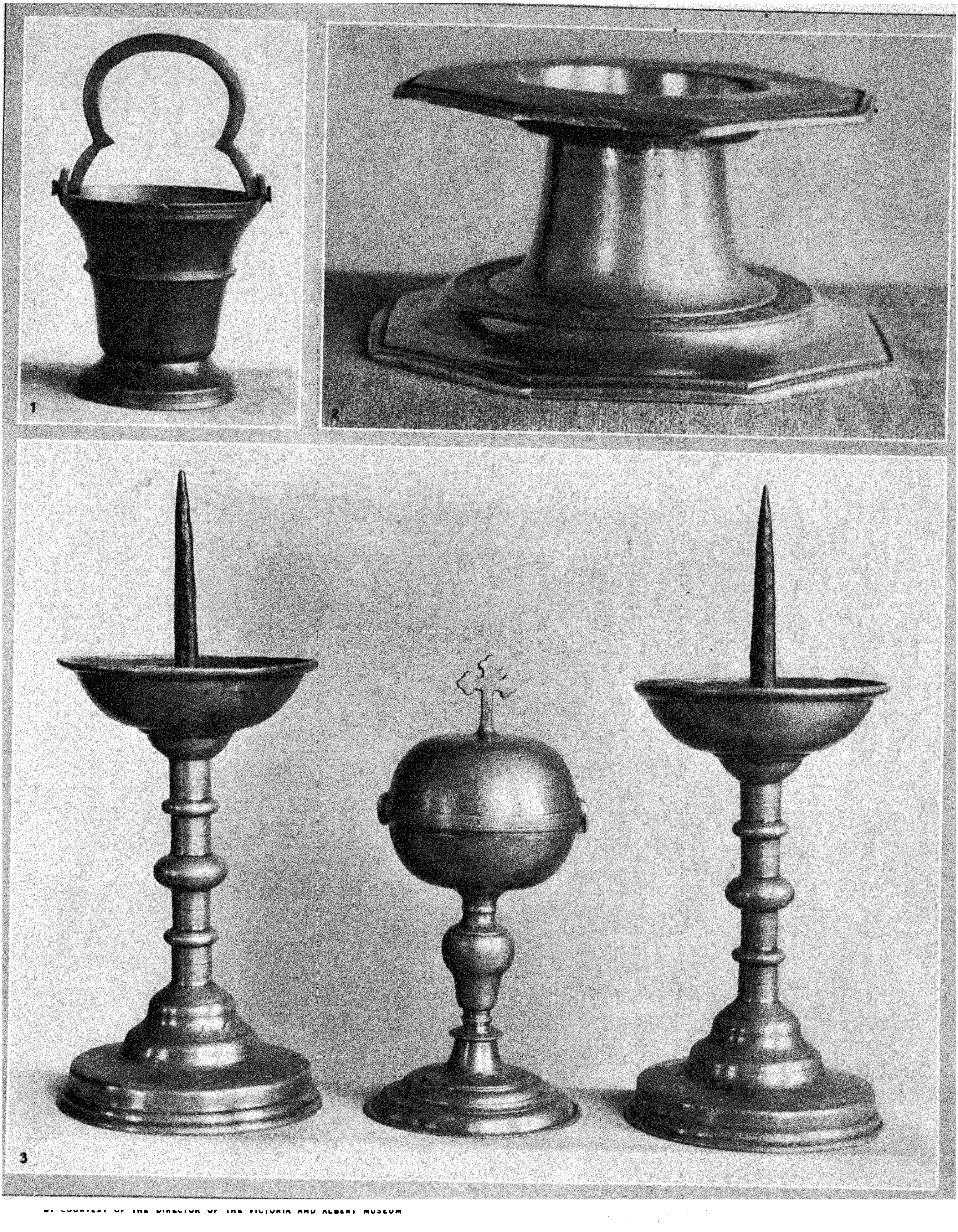


ENGLISH AND SCOTCH ECCLESIASTICAL AND DOMESTIC VESSELS

1. Set of English communion plate from Midhurst Church, Sussex: (a) Communion plate; pewter marks, crowned rose bearing the words "Made in London" and x crowned, 18th century. Diam. 10". (b) Communion flagon, dated 1677. Ht. 13". (c) Communion cup, c. 1670. Ht. 6.4"
2. English measures: (a) Late 17th century. Ht. 10.8". (b) Late 17th century. Ht. 10.5". (c) Early 18th century. Ht. 13.3". Marker's mark of John Home, Snow Hill, London
3. (a) Communion flagon. Pewter. English, 17th century. Ht. 12.8". (b) Communion flagon. Pewter, inscribed "Decemb. 25 1698 Horton." English. Ht. 9.4". (c) Communion flagon. Pewter, inscribed "Willyam Hunt Arter Dauson, churchwardanes of Fosdick. Mark I.E. with a unicorn. The original form has been altered by hammering a spout in the lip. English. Ht. 13.3"
4. English and Scotch measures and flagons: (a) "Tappit-topped hen" flagon, holding a Scotch pint. Scotch, late 17th or early 18th century. Ht. 12", diam. (base) 5". (b) English pewter encrusted with sea-water deposit. Late 17th century. Thumb piece in form of Prince of Wales's feathers; finishing in a *fleur-de-lys*. Ht. 13", diam. (body) 6.5". (c) "Tappit-topped hen" flagon, holding a Scotch pint. Scotch, late 17th or early 18th century. Ht. 11⅜", diam. (body) 4⅞"

FRENCH AND SWISS PEWTER, 16TH CENTURY

1. "Temperantia" ewer, by François Briot of Lorraine, *c.* 1580–90. Signed F.B. It is decorated with figures of the cardinal virtues. (*See* Plate V., fig. 1, for salver.)
2. Large flagon; a guild tankard of silvered pewter cast in relief, with emblematic figures of virtues, vices, muses, and planets, and on the handle figures of Lucretia and Judith, from designs by Peter Flötner of Nürnberg. The marks are Z.P.W.Z. Probably Swiss, Zürich, second half of 16th century
3. Tankard with cover, embossed, the sides containing oval medallions with allegorical figures. French, 16th century. Perhaps François Briot's work. Ht. 7¼", diam. 4⅞"



BY COURTESY OF THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM

ECCLESIASTICAL AND DOMESTIC PEWTER UTENSILS, 16TH–18TH CENTURY

1. Holy-water bucket, English, *c.* 1500; said to have been dug up in Whitechapel
2. Salt cellar, English, *c.* 1660. Ht. 2.9″
3. Pyx and pair of candlesticks. The pyx is South German, Regensburg work, 18th century. The marks are P, with crossed keys. The candlesticks are pewter, with iron prickers, Flemish, 16th century; from a church in Belgium

PEWTER

BY COURTESY OF (1, 2, 3, 5) THE DIRECTOR OF THE VICTORIA AND ALBERT MUSEUM, (4, 6) CHARLES G. J. PORT

17TH CENTURY PEWTER

1. Candlestick. Pewter. English, late 17th century. Height 4.8 in.
2. Cup, Pewter, cast in relief. English, early 17th century. Height 7.3 in.
3. Candlestick, Pewter, bearing arms of the Pewterers' Company and maker's name, William Granger, English, dated 1616
4. German guild flagon, 17th century
5. Canister with cover. Lead, square, impressed on each of the sides with George and the dragon. German, 16th century. Height 9½", 5¼" square
6. German guild cup, 17th century

FRENCH AND GERMAN PEWTER PLATES AND SALVERS

1. Large salver, "Temperantia" dish, cast in relief, by François Briot of Lorraine, *c.* 1580–90, signed F.B. The plate is decorated with figures of Minerva and the seven arts, the four elements and Temperance in the centre. (*See* Plate II., fig. 1, for ewer.)
2. Large salver cast in relief and set with a flagon of Limoges enamel. The band of ornament on the outer rim shows scenes from the parable of The Prodigal Son. French, 1550–70. Diam. 17 11/16″
3. Two plates cast in relief: (a) Mark, the arms of Nürnberg, with the initials I.H. South German, dated 1628. (b) Mark, the arms of Nürnberg with the initials B.O. South German, dated 1619

ENGLISH PEWTER DISH

Charles II. dish, second half of 17th century, engraved in the centre with the royal arms encircled by the garter, with supporters; surmounted by a helmet, crowned, and having above it a lion and the initials C.R. Beneath is the royal motto, "Dieu et mon droit." Along the inner rim is the inscription, "Vivat Rex Carolus Secundus, Beati Pacifici 1662." This plate was presented by a member of the royal family, possibly by George III., to Lord Onslow, in 1765. Diam. 22"

water vessels (*bénitiers*), crosses and crucifixes, chrismatories and altar candlesticks. In England efforts are now being made to revive the use of pewter for altar furniture; the difficulty formerly presented by the softness of the metal and its liability to denting seems likely to be overcome by a method of hardening.

In domestic life pewter played an important part for many centuries in the past. In England its use is recorded in the 13th century. Edward I. is said to have owned over 300 vessels of pewter. The Pewterers' Company of the City of London had already been in existence for more than a century and a half when Edward IV. in 1473 presented its first charter granting the right of assay. London was not the only place of manufacture; pewter was produced in several other towns, among them being York, Newcastle, Exeter and Bristol. Although in great favour with the nobility and even with royalty in those days, its use soon became secondary to that of silver and with the middle classes it took the same place as silver among the wealthy.

In Elizabethan days Harrison relates that it had attained a high degree of popularity. The old men of his village, he says, had told him of "the exchange of vessels, as of treen platters" into pewter, and wooden spoons into silver or tin. "For so common were all sorts of treen stuff in old time that a man should hardly find four pieces of pewter in a good farmer's house . . . whereas in my time . . . will the farmer think his gains very small . . . if he have not . . . a fair garnish of pewter on his cupboard, with so much more in odd vessel going about the house." The craft of the pewter had obviously reached its zenith at that time, and its popularity continued for at least the two following centuries. Tankards, measures, plates and salvers were produced, the forms following those of silver but with the minimum of decoration, as was fitting for such a metal. Engraving is used at times; the Victoria and Albert museum, London, possesses two large dishes of the time of Charles II. decorated with arms and large flowers and fruit executed in a kind of zig-zag engraving, and a set of plates and dishes of the following century engraved with figure subjects in Hogarthian style. The use of pewter declined during the 19th century, although employed for candlesticks, teapots, spoons and other domestic utensils; its manufacture survives still for tankards and measures such as are needed in inns and refreshment houses. The *Art Nouveau* (*q.v.*), movement in the opening years of the present century witnessed an endeavour to revive the manufacture of pewter.

In France pewter is found in the 14th century in the form of drinking vessels, plates and salt-cellars, as well as cooking pots for the kitchen. Companies of pewterers existed in various towns, and the trade was flourishing and vigorous. In the 16th century highly ornamented pieces are found, such as those associated with the name of François Briot, the greatest of French pewterers. His well-known Temperantia salver and ewer are covered with ornament in relief. On the ewer are figures of the cardinal virtues, while on the dish are figures of Minerva and the seven arts, with the four elements. A figure of Temperance occupies the central boss, while the whole of the remaining surface is filled with relief ornament. A medallion portrait of Briot appears on the reverse of the dish. Another salver of similar character shows scenes from the story of the Prodigal Son on the outer rim in relief; two inner borders of strapwork, masks, and other ornament surround a central enamelled boss. Fine examples are preserved in the Cluny museum, Paris. Much good pewter was produced during the 17th and 18th centuries. At the end of the 19th century several craftsmen produced good decorative pewter worthy of the older traditions of the art, and following the style of the 16th century workers.

Germany had an established industry of pewter at Augsburg and Nuremberg in the 14th century, Belgium and Holland perhaps earlier; Switzerland must have been working about the same time, as well as Russia and the Scandinavian countries. There is a greater variety of vessels and a wider application of usefulness than in England or Scotland. The treatment of pewter in relief is much more common, and it may easily be imagined how pewter found a natural home with the wood-panelled German or Swiss room for its setting. A pewter cistern and basin often of fanciful shape was a necessary adornment of the Swiss sideboard, while German hostels afforded much in the way of tankards and other drinking vessels. Some German pieces appear to have been purely ornamental, as for example the plates with portraits of emperors in relief or with medallions of Bible scenes. Caspar Enderlein of Nuremberg imitated the designs of the French pewterer, François Briot, and produced a copy of his Temperantia dish. An unusual treatment of tankards shows a wooden vessel inlaid with pewter scrollwork, while in others the pewter is inlaid with brass.

In Germany and Switzerland are found the enormous cups and flagons which formed the treasures of local trade guilds and similar institutions. Standing cups are as much as three feet in height, and one at least is known approaching four feet. They were frequently surmounted by a figure representing the trade to which they belonged, and a number of labels or medallions hanging from the upper part recorded the names of masters of the guild. Flagons were of capacious dimensions. Perhaps the place of honour may be accorded to an unusually noble example in the Victoria and Albert museum, London, of rather more than 20 in. in height. Round the upper and lower part of the body is a band of plaques of graceful emblematical figures taken from the designs of the well-known German ornamentist, Peter Flötner of Nuremberg. This flagon is Swiss work and dates from the 16th century. In recent years pewter has been produced in Germany at Nuremberg, Crefeld and Munich.

In America pewter was much used in the early colonial households. Some is found dating from the 17th century; but the period which marked its greatest production was the 100 years between 1750 and 1850. Boston appears to have been a main centre of manufacture. Every kind of utensil was made which was in any way requisite for domestic purposes. Some few pieces were produced for church use. Its appearance at a considerably later period than in Europe, and its persistence when other materials were available, prove its great popularity and the hold that it retained upon American taste long after it had ceased to interest the European.

In China, Korea and Japan the manufacture of pewter was known over 1,000 years ago and has continued until the present day. Much was produced in the 17th and 18th centuries, the shapes following those of bronze and porcelain; engraving was frequently added as an enrichment. Pewter was used and still is for rim-mounts of boxes and for decorative inlay. (*See* also DRINKING VESSELS; METAL; BRONZE AND BRASS; LEAD IN ART; SILVERSMITHS' AND GOLDSMITHS' WORK; TIN; COPPER.)

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PFAFF, JOHANN FRIEDRICH (1765–1825), German mathematician, was born on Dec. 22, 1765 at Stuttgart. He studied at Göttingen and Berlin.

From 1788 to 1810 Pfaff was professor of mathematics in Helmstedt; from 1810 till his death, April 21, 1825, he held the chair of mathematics at Halle. His researches bore chiefly on the theory of series, to which he applied the methods of the so-called combinatorial school of German mathematicians, and on the solution of differential equations. His two principal works are *Disquisitiones analyticae maxime ad calculum integralem et doctrinam serierum pertinentes* (4to., vol. i., Helmstedt, 1797) and a memoir on partial differential equations in *Abh. d. Berl. Acad.* (1814–1815). His method of integrating partial differential equations of the first order with any number of variables led Jacobi to introduce the term "Pfaffian problem."

PFALZBURG: *see* PHALSBOURG.

PFEIFFER, IDA LAURA (1797–1858), Austrian traveller, daughter of a merchant named Reyer, was born at Vienna

on Oct. 14, 1797. In 1820 she married Dr. Pfeiffer, a lawyer of Lemberg, who subsequently incurred official persecution and was reduced to poverty. In her later life Mme. Pfeiffer devoted her limited means to extensive travel. Her last journey was in 1846 to Madagascar, where she became involved in a plot to overthrow the government, and was expelled from the country. She died at Vienna on Oct. 27, 1858.

Her travels are described in *Reise einer Wienerin in das Heilige Land* (Vienna, 1843); *Reise nach dem Skandinavischen Norden und der Insel Island* (Pest, 1846); *Eine Frauenfahrt um die Welt* (Vienna, 1850); *Meine Zweite Weltreise* (Vienna, 1856); *Reise nach Madagascar* (Vienna, 1861, with a biography by her son).

PFLANZER-BALTIN, KARL, Freiherr von, Austro-Hungarian general, was born at Pecs in Hungary in 1855. On the outbreak of the World War he was charged with the defence of Transylvania, but when the Russians at this period crossed the Carpathians, Pflanzer-Baltin, with an improvised division threw himself on this enemy. After fighting with varying success in the southern part of Eastern Galicia and in the Bukovina, the VII. Army under his command was driven back by Brussilov's offensive in June 1916, whereupon he was relieved of his command. In the summer of 1918, entrusted with the command on the Albanian front which was yielding before the attack of the Entente army, Pflanzer-Baltin won back, after a brief and powerful attack, the old positions southwards of Fjeri and Berat.

PFLEIDERER, OTTO (1839–1908), German Protestant theologian, was born at Stetten near Cannstadt in Württemberg on Sept. 1, 1839. From 1857 to 1861 he studied at Tübingen under F. C. Baur; and afterwards in England and Scotland. He then entered the ministry, became *repetent* at Tübingen, and for a short time held a pastorate at Heilbronn (1868). In 1870 he became chief pastor and superintendent at Jena and soon afterwards professor ordinarius of theology, but in 1875 he was called to the chair of systematic theology at Berlin, having made his name by his *Der Paulinismus*, published in 1873 (2nd ed., 1890; Eng. trans., *Paulinism*, 2 vols., 1873, etc.). Other important works are: *Das Urchristentum, seine Schriften und Lehren, in geschichtlichem Zusammenhang beschrieben* (1878; enl. ed. 1902; Eng. trans. 1906); *The Development of Theology since Kant, and its Progress in Great Britain since 1825* (1890), written for publication in England; *Religionsphilosophie auf geschichtlichen Grundlage* (1878; Eng. trans., *The Philosophy of Religion on the Basis of its History*, 1886–1888). *Die Entstehung des Christentums* (1905; Eng. trans., 1906); *Religion und Religionen* (1906; Eng. trans., 1907); and *Die Entwicklung des Christentums* (1907). Pfleiderer was Hibbert lecturer in London in 1885, and Gifford lecturer at Edinburgh in 1894. He died on July 18, 1908. In New Testament criticism Pfleiderer belonged to the school of F. C. Baur, but showed a greater disposition to compromise than the early Baur school.

PFLÜGER, EDUARD (1829–1910), German physiologist, was born in Hanau and studied under Müller and du Bois Reymond at Bonn. In 1868 he founded the *Archiv für die gesamte Physiologie*, and ten years later opened the new Institute of Physiology at Bonn. His *Untersuchungen über die Physiologie des Electrotonus* (1859) marked the beginning of his life-long researches on metabolism, embryology and respiration. He experimented with cross-fertilization of the eggs of different species of frogs and became interested in the cleavage in the development of the eggs. He was able to show that the seat of respiration is not in the blood or lungs, but in the tissue.

PFORTA or **SCHULPFORTA,** formerly a Cistercian monastery dating from 1140, and now a German public school. It is in the Prussian province of Saxony, on the Saale, 2 m. S.W. of Naumburg. The remains of the monastery include the 13th century Gothic church, recently restored, the Romanesque chapel (12th century) and other buildings now used as dormitories, lecture rooms, etc. There is also the Fürstenhaus, built in 1573. Schulpforta was one of the three *Fürstenschulen* founded in 1543 by Maurice duke, and later elector, of Saxony, the two others being at Grimma and at Meissen. Pforta passed to Prussia in 1815.

PFORZHEIM, a town of Germany, in the republic of Baden, at the confluence of the Nagold and the Enz, on the margin of the Black Forest, 19 m. S.E. of Karlsruhe by rail. Pop. (1925) 78,859. Pforzheim is of Roman origin. From about 1300 to 1565 it was the seat of the margraves of Baden. It was taken by the troops of the Catholic League in 1624, and was destroyed by the French in 1689. It has the old palace of the margraves of Baden, and the Schlosskirche, the latter an edifice of the 12th–15th centuries. Pforzheim is the chief centre in Germany for the manufacture of gold and silver ornaments and jewellery.

PHAEDO, Greek philosopher, founder of the Elian school, was a native of Elis, born in the last years of the 5th century B.C. In the war of 401–400 between Sparta and Elis he was enslaved in Athens. He became a pupil of Socrates, who conceived a warm affection for him. It appears that he was intimate with Cebes and Plato, and he gave his name to one of Plato's dialogues. Athenaeus relates, however, that he resolutely declined responsibility for any of the views with which Plato credits him, and that the relations between him and Plato were the reverse of friendly. Aeschines also wrote a dialogue called *Phaedo*. Shortly after the death of Socrates Phaedo returned to Elis, where his disciples included Anchipylus, Moschus and Pleistanus, who succeeded him. Subsequently Menedemus and Asclepiades transferred the school to Eretria, where it was known as the Eretrian school and is frequently identified (*e.g.*, by Cicero) with the Megarians. The doctrines of Phaedo are not known, nor is it possible to infer them from the Platonic dialogue. His writings, none of which are preserved, were in the form of dialogues.

See Wilamowitz, *Hermes*, xiv. 189 *seq.*

PHAEDRA, in Greek legend, daughter of Minos and Pasiphaë. With her sister Ariadne she was carried off by Theseus to Athens, and became his wife. On the way to Eleusis she met Hippolytus, (*q.v.* for the rest of the legend).

PHAEDRUS, Roman fabulist, was by birth a Macedonian and lived in the reigns of Augustus, Tiberius, Gaius and Claudius. According to his own statement (prologue to book iii.), not perhaps to be taken too literally, he was born on the Pierian mountain, but he seems to have been brought at an early age to Italy, for he mentions that he read a verse of Ennius as a boy at school. According to the heading of the chief ms. he was a slave and was freed by Augustus. He incurred the wrath of Seianus, the powerful minister of Tiberius, by some supposed allusions in his fables, and was brought to trial and punished. We learn this from the prologue to the third book. The dates of publication of the fables are unknown, but Seneca, writing between A.D. 41 and 43 (*Consol. ad. Polyb.* 27), knows nothing of Phaedrus, and it is probable that he had published nothing then. His work shows little or no originality; he simply versified in iambic trimeters the fables current in his day under the name of "Aesop," interspersing them with anecdotes drawn from daily life, history and mythology. He tells his fable and draws the moral with businesslike directness and simplicity; his language is terse and clear, but thoroughly prosaic. His Latin is correct, and, except for an excessive and peculiar use of abstract words, shows hardly anything that might not have been written in the Augustan age. From a literary point of view Phaedrus is inferior to Babrius, and to his own imitator, La Fontaine; he lacks the quiet picturesqueness and pathos of the former, and the exuberant vivacity and humour of the latter.

In the middle ages Phaedrus exercised a considerable influence through the prose versions of his fables which were current, though his own works and even his name were forgotten. Of these prose versions the oldest existing seems to be that known as the "Anonymus Nilanti," so called because first edited by Nilant at Leiden in 1709 from a ms. of the 13th century. It approaches the text of Phaedrus so closely that it was probably made directly from it. But the largest and most influential of the prose versions of Phaedrus is that which bears the name of *Romulus*. It contains 83 fables, is as old as the 10th century, and seems to have been based on a still earlier prose version, which, under the name of "Aesop," and addressed to one Rufus, may have been made in the Carolingian period or even earlier. The collection of fables in the Weissenburg (now Wolfenbüttel)

ms. is based on the same version as *Romulus.* These three prose versions contain in all 100 distinct fables, of which 56 are derived from the existing and the remaining 44 presumably from lost fables of Phaedrus. Several scholars have tried to restore these lost fables by versifying the prose versions.

The collection bearing the name of *Romulus* became the source from which, during the second half of the middle ages, almost all the collections of Latin fables in prose and verse were wholly or partially drawn.

The first edition of the five books of Phaedrus was published by Pithou at Troyes in 1596. In the beginning of the 18th century there was discovered at Parma a ms. of Perotti (1430–80), archbishop of Siponto, containing 64 fables of Phaedrus, of which some 30 were new. These new fables were first published at Naples, by Cassitto in 1808, and afterwards (much more correctly) by Jannelli in 1809 Both editions were superseded by the discovery of a much better preserved ms of Perotti in the Vatican, published by Angelo Mai in 1831 For some time the authenticity of these new fables was disputed, but they are now generally accepted, and with justice, as genuine fables of Phaedrus They do not form a sixth book, for we know from Avianus that Phaedrus wrote five books only, but it is impossible to assign them to their original places in the five books. They are usually printed as an appendix

Since Pithou's edition in 1596 Phaedrus has been often edited and translated, among the editions may be mentioned those of Burmann (1718 and 1727), Bentley (1726), Schwabe (1806), Berger de Xivrey (1830), Orelli (1832), Eyssenhardt (1867), L. Muller (1877), Rica (1885), and above all those of L Havet (Paris, 1895) and J. P. Postgate (*Phaedri Fabulae Aesopiae,* Script. Class Bibl Oxon 1920) For the mediaeval versions of Phaedrus and their derivatives *see* L Roth, in *Philologus,* i 523 *seq ;* E. Grosse, in *Jahrb f class Philol*, cv (1872); and especially the learned work of Hervieux, *Les Fabulistes latins depuis le siècle d'Auguste jusqu'à la fin du moyen âge* (Paris, 1884), who gives the Latin texts of all the mediaeval imitators (direct and indirect) of Phaedrus, some of them being published for the first time. (J P P.; X)

PHAER (or PHAYER), **THOMAS** (1510?–1560), English translator of Virgil, was educated at Oxford and at Lincoln's Inn He published in 1535 *Natura brevium,* and in 1543 *Newe Boke of Presidentes* He says on the title-page of his version of the *Aeneid* that he was "solicitor to the king and queen's majesties, attending their honourable council in the marches of Wales" He settled at Kilgarran in Pembrokeshire, and combined the study of medicine with his legal practice He wrote several medical works, and was admitted M D of Oxford in 1559 He contributed to Sackville's *Mirrour for Magistrates,* "Howe Owen Glendower, being seduced by false prophecies, toke upon him to be Prince of Wales" In 1558 appeared *The Seven First Bookes of the Eneidos of Virgil converted into English Meter.* He left his task incomplete. The translation was finished by Thomas Twyne in 1584 Phaer was the first to attempt a complete English version of Virgil, the earlier renderings of Surrey and Gawain Douglas being fragmentary

PHAËTHON, in Greek mythology, was the son of Helios, the sun-god, and the nymph Clymene (Gr *phaethōn,* shining, radiant). He persuaded his father to let him drive the chariot of the sun across the sky, but he lost control of the horses, and driving too near the earth scorched it. To save the world from utter destruction Zeus killed Phaëthon with a thunderbolt He fell to earth at the mouth of the Eridanus, a river of northern Europe (identified in later times with the Po), on the banks of which his weeping sisters, the Heliades, were transformed into poplars and their tears into amber. The story is most fully told in the *Metamorphoses* of Ovid (i 750, ii 366, and Nonnus, *Dionysiaca,* xxxviii). The fall of Phaethon is a favourite subject, especially on sarcophagi, as indicating the transitoriness of human life.

See G. Knaack, "Quaestiones phaethonteae," in *Philologische Untersuchungen* (1885); Wilamowitz-Mollendorff and C Robert in *Hermes,* xviii. (1883); Frazer's *Pausanias,* ii. 59, which gives interesting parallels; S. Reinach, *Revue de l'hist. des religions,* lviii (1908).

PHAETON, a low form of horse-drawn carriage also known as pony phaeton, likewise a high carriage with back to back seats. In the United States (1929) the term is being quite generally applied to an open type automobile body with two fixed seats, four doors, folding top and removable curtains. (*See* TOURING CAR)

PHAGOCYTOSIS is the property possessed by many animal cells of engulfing particles by virtue of their power of amoeboid movement. Primarily this power was directed towards nutrition but in higher organisms it has been developed for different purposes and in pathology at the present day bears a wider meaning. The particle having been englobed, one of three things may happen. (1) If the particle be digestible the cell secretes a digestive fluid, a food vacuole is formed, the particle is gradually dissolved by the secretion and the products absorbed into the cell substance (2) If the particle be indigestible, it is retained within the cell for a time and ultimately discharged The particle englobed may comprise almost any material, but if it is to serve as a food it must be of animal or vegetable origin At the time of ingestion it may be dead or living If living the organism is first killed and then digested or (3) the organism may prove resistant, multiply and finally destroy the cell, when a number of organisms are set free. This is one of the means by which, in the higher organisms, a local infection may become distributed through the organism Digestion within a cell is fermentative; a proteolytic ferment has been prepared from the bodies of amoebae which is active in acid, neutral or especially alkaline media

The study of phagocytosis was largely extended in the elaboration of Metchnikoff's view of the nature of immunity Thus, to take an instance from the sponges, minute organisms, which have penetrated the pores of the sponge are seized by the ciliated or amoeboid cells lining those spaces, and are then killed and digested It is readily understandable that we should find such cells on the external surface of an organism or lining the alimentary tract But in addition there are many fixed or wandering cells within the body in which phagocytic power is retained and markedly developed They remove foreign material or debris which may occur within a tissue For instance, as the result of an injury, inflammatory process, etc , cells and other structures of a tissue are destroyed One of the processes preliminary to repair consists in the removal of the resulting debris, which is effected by phagocytes A similar process is seen with red blood corpuscles which have escaped into a tissue through rupture of capillaries Foreign particles accidentally gaining admission to a tissue are in many cases removed in a similar manner, *e g*, soot particles which have passed through the respiratory surface are largely removed by phagocytes and carried to the bronchial lymphatic glands Very commonly living organisms effect an entrance through wound surfaces, the alimentary surface, etc , and one of the processes employed for their destruction and removal is that of phagocytosis Hence the phagocytes are regarded as scavengers of the tissues

In the above-named instances the phagocytes are chiefly wandering cells brought to the seat of their activity by the blood In any tissue where the process is going on phagocytes have accumulated in large numbers They have been attracted to the damaged area by the chemical process of chemiotaxis At the seat of the change chemical substances are produced (*see* PATHOLOGY) which act upon the phagocytes, causing them to migrate towards the source—positive chemiotaxis The same chemical stimulus in a higher concentration may repel the cells—negative chemiotaxis Instances of this are especially frequent in relation to micro-organisms and phagocytes

Metchnikoff held the view, and supported it by many experiments that immunity and susceptibility to infective disease are essentially matters of phagocytosis but this eclectic view is now obsolete though it is not denied that phagocytosis plays an important part in removing bacterial and other debris rendered harmless by other means (*see* IMMUNITY).

As regards the different varieties of phagocytes, leaving apart the cells lining the alimentary tract, a number of free cells possess amoeboid properties as well as also a number of fixed cells. In the latter category are the nerve cells, the large cells of the spleen

pulp and of lymph glands, certain endothelial cells, the neuroglia cells, and perhaps certain cells of connective tissues. Those of greater phagocytic activity are the large splenic and lymph cells, the neuroglia cells and certain endothelial cells. With regard to the wandering cells some are certainly non-phagocytic, for instance the lymphocytes. The polymorphonuclear, the large hyaline and the eosinophil leucocyte are phagocytic. Metchnikoff therefore divided the phagocytes into two classes—the microphages, comprising the polymorphonuclear and the eosinophil cell, and the macrophages, containing the large hyaline cell, the cell of the splenic pulp, the endothelial cell and the neuroglia cell.

The two principal groups of leucocytes are generally spread throughout the vertebrates. Instances of each kind are found even in the lamprey. Cells which show but small differences from the analogous cells of mammals are found in the alligator.

(T. G. B.)

PHAGOTUS, a curious reed instrument, developed by Afranio Albanesi of Pavia (16th century) from the ancient Serbian bagpipe or piva. It was shaped like the letter H, the upper part of each side pillar containing the sound-producing tubes, pierced with finger-holes, and the wind supply being provided by an attached air-reservoir in the form of a bag, and bellows.

PHALANGER, a name applied to the members of the diprotodont marsupial family *Phalangeridae* (*see* MARSUPIALIA).

Phalangers are small or medium-sized woolly coated animals, with long, often prehensile tails, large claws and opposable, nail-less, first hind-toes. They are nocturnal in habit and feed on fruit, leaves and blossoms, though a few are insect-eaters. Several possess gliding membranes between the fore and hind limbs.

The ring-tailed phalangers (*Pseudochirus*) of Australia and New Guinea are the most generalized forms. Allied to them is the Australian "flying-squirrel" (*Petauroides volans*), ranging from Queensland to Victoria. Another flying genus is *Petaurus*, with several species on the Australian continent, Aru Islands and New Guinea. A third parachuting form is the minute *Acrobates pygmaeus* of East Australia.

BY COURTESY OF THE N Y. ZOOLOGICAL SOCIETY

THE PHALANGER, A MEMBER OF A GROUP OF MARSUPIALS

The cuscuses (*Phalanger*) are arboreal animals, the size of cats. They inhabit the Solomon Islands, ranging thence to the Moluccas and Celebes, being the only Old World marsupials found west of New Guinea. The fur is woolly and the tail prehensile. Nearly allied to these are the Australian forms, of which the brush-tailed phalanger (*Trichosurus vulpecula*), about the size of a small fox, is the best known. Other species are *T. fuliginosus* of Tasmania and *T. canina* of South Queensland and New South Wales.

PHALANX, the name, in Greek history of the arrangement of heavy-armed infantry in a single close mass of spearmen (Gr. φάλαγξ, of unknown origin) (*see* ARMY: *History*).

PHALARIS, tyrant of Acragas (Agrigentum) in Sicily, *c.* 570–554 B.C. He was entrusted with the building of the temple of Zeus Atabyrius in the citadel, and took advantage of his position to make himself despot (Aristotle, *Politics*, v. 10). Under his rule Agrigentum seems to have attained considerable prosperity. He supplied the city with water, adorned it with fine buildings, and strengthened it with walls. On the northern coast of the island the people of Himera elected him general with absolute power, in spite of the warnings of the poet Stesichorus (Aristotle, *Rhetoric*, ii. 20). According to Suidas he succeeded in making himself master of the whole of the island. He was at last overthrown in a general rising headed by Telemachus, the ancestor of Theron (tyrant *c.* 488–472), and burned in his brazen bull.

After ages have held up Phalaris to infamy for his excessive cruelty. In his brazen bull, invented, it is said, by Perillus of Athens, the tyrant's victims were shut up and, a fire being kindled beneath, were roasted alive, while their shrieks represented the bellowing of the bull. Perillus himself is said to have been the first victim. There is hardly room to doubt that we have here a tradition of human sacrifice in connection with the worship of the Phoenician Baal (Zeus Atabyrius) such as prevailed at Rhodes. The Carthaginians carried away a brazen bull from Agrigentum to Carthage but it was restored by Scipio.

Later tradition represented Phalaris as a naturally humane man and a patron of philosophy and literature. Plutarch, though he takes the unfavourable view, mentions that the Sicilians gave to the severity of Phalaris the name of justice and a hatred of crime. (Suidas, *s.v.;* Diod. Sic. ix. 20, 30, xiii. 90, xxxii. 25; Polybius vii. 7, xii. 25; Cicero, *De Officiis*, ii. 7, iii. 6.)

The letters bearing the name of Phalaris (148 in number) are now chiefly remembered for the crushing exposure they received at the hands of Richard Bentley in his controversy with the Hon. Charles Boyle, who had published an edition of them in 1695. The first edition of Bentley's *Dissertation on Phalaris* appeared in 1697, and the second edition, replying to the answer which Boyle published in 1698, came out in 1699. Bentley proved conclusively that the letters were written by a sophist or rhetorician (possibly Adrianus of Tyre, died *c.* A.D. 192) hundreds of years after the death of Phalaris. Suidas admired the letters, which he thought genuine and in modern times, before their exposure by Bentley, they were thought highly of by some (*e.g.*, Sir William Temple in his *Essay on Ancient and Modern Learning*), though others, as Politianus and Erasmus, perceived that they were not by Phalaris. The latest edition of the *Epistles* is by R. Hercher, in *Epistolographi graeci* (1873), and of Bentley's Dissertation by W. Wagner (with introduction and notes, 1883); *see* especially R. C. Jebb, *Life of Bentley* (1882).

PHALAROPE, the name given to birds of the genus *Phalaropus*, of which there are three species. The phalaropes are allied to the sandpipers (*q.v.*), from which they differ in their swimming habits and the lobed membranes that fringe their feet and by the close nature of the lower plumage. They are aquatic birds, spending the winter on the open sea. The male is less brightly coloured than the female and performs the duties of incubation. The red-necked phalarope (*P. hyperboreus*) breeds in the Hebrides and Ireland but the group as a whole is an Arctic one. One species, *P. wilsoni*, is exclusively American, the others extend also to Europe.

PHALLICISM or **PHALLISM,** an anthropological term applied to that form of worship in which adoration is paid to the generative function symbolized by the phallus, the male organ (from Gr. φαλλός). The same principle is at the root of the nature worship of Asia Minor, whose chief deity, the Great Mother of the Gods (*q.v.*), is the personification of the earth's fertility: similarly in India worship is paid to divine mothers; the phallus is called *linga* or *lingam*, with the female counterpart called *yoni;* the *linga* symbolizes the generative power of Siva, and is a charm against sterility. The rites classed together as *Sakti puja* represent the adoration of the female principle. Phallic emblems are found in many parts of the world. The tendency, however, to identify all obelisk-like stones and tree trunks, together with rites like circumcision, as remains of phallic worship, has met with much criticism, and the best modern view is that phallicism never developed into an organized cult, *e.g.*, Robertson Smith, *Religion of the Semites*, 3rd ed., pp. 456 and 688.

PHALSBOURG, a town of France, in the department of Moselle, stands on a plateau (1,080 ft.) above the main road from Saverne to Nancy and Metz, 25 m. N.W. of Strasbourg by rail. Pop. (1926) 1,269. The principality of Phalsbourg, of which this town was the capital, originally a part of Luxembourg, afterwards belonged in turn to the bishop of Metz, the bishop of Strasbourg and the duke of Lorraine, and passed to France in 1661 The town commands the passes of the Vosges, and was strongly fortified by Vauban in 1680. Of these fortifications only the Porte de France and the Porte d'Alsace remain.

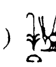
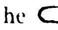
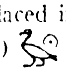
PHALTAN, a native state of India, in the central division of Bombay, ranking as one of the Satara jagirs. Area, 397 sq.m.; pop. (1921), 43,286. The town of Phaltan is 37 m. north-east of Satara; pop. (1921), 8,929.

PHANARIOTES, a name derived from Phanar, the chief Greek quarter at Stamboul, where the oecumenical patriarchate is situated, and applied to those members of families resident in the Phanar quarter who between the years 1711 and 1821 were appointed hospodars of the Danubian principalities; that period of Moldo-Wallachian history is also usually termed the Pha-

nariote epoch. The active part taken by the Greek princes in the revolt of 1820–21 induced the Porte to revert to the appointment of native princes.

PHANIAS, of Eresus in Lesbos, Greek philosopher and historian, important as an immediate follower of and commentator on Aristotle, came to Athens *c.* 332 B.C., and joined his compatriot, Theophrastus, in the Peripatetic school. His *Analytica, Categoriae* and *De interpretatione,* which were either paraphrases or critical commentaries, seem to have added little to Aristotle's own writings. Alexander of Aphrodisias refers to a work πρὸς Διόδωρον, and Athenaeus quotes from another treatise, *Against the Sophists* He and Theophrastus also carried on the physical investigations of Aristotle; Athenaeus frequently quotes from a work on botany which manifests great care in definitions and accuracy of observation. The chief of his historical works were the *Prytaneis Eresii,* which was either a history of his native place or a general history of Greece arranged according to the period of the Eresian magistracy and works on the *Tyrants of Sicily* and on tyranny in general, which are frequently quoted on questions of chronology (*e g.,* by Plutarch, Suidas, Athenaeus) To the history of Greek literature he contributed works on the poets and on the Socratics, both of which are quoted.

PHANTASMAGORIA, a name invented by a certain Philipstal in 1802 (from Gr φάντασμα, phantasm, apparition, and ἀγορά, assembly) for a show or exhibition of optical illusions produced by means of the projecting lantern (*see* LANTERN). The word has since been applied to any rapidly or strikingly changing scene, or disordered phantasy.

PHARAOH (Par'oh), the Hebraized title of the king of Egypt (*q v*), in Egyptian Per-'o, Pheron in Herodotus represents the same. Its combination with the name of the king, as in Pharaoh-Necho, Pharaoh-Hophra, is in accordance with contemporary native usage the name of the earlier Pharaoh Shishak (Sheshonk) is rightly given without the title. In hieroglyphic a king bears several names preceded by distinctive titles In the IVth Dynasty there might be four of the latter. (1)  identifying him with the royal god Horus, the name is commonly written in a frame  representing the façade of a building, perhaps a palace or tomb, on which the falcon stands (2)  connecting him with the vulture and uraeus goddesses, Nekhabi and Buto of the south and north (3)  a hawk on the symbol of gold, signifying the victorious Horus (4)  the old titles of the rulers of the separate kingdoms of Upper and Lower Egypt, to be read *stni,* "butcher(?)" and *byti,* "beekeeper(?)" The personal name of the king followed (4), and was enclosed in a cartouche  apparently symbolizing the circuit of the sun which alone bounded the king's rule. Before the IVth Dynasty the cartouche is seldom found the usual title is (1), and (3) does not occur In the Vth Dynasty the custom began of giving the king at his accession a special name connecting him with the sun· this was placed in the cartouche after (4), and a fifth title was added. (5)  Si-rē, "son of the Sun-god," to precede a cartouche containing the personal name The king was briefly spoken of by his title *stni* (*see* 4), or *ḥnm-f,* "his service," or *Ity,* "liege-lord" These titles were preserved in the sacred writing down to the latest age An old term for the royal palace establishment and estate was Per-'o, "the Great House," and this gradually became the personal designation of Pharaoh. (F LL. G)

PHARISEES, a sect of the Jews first mentioned by Josephus, (Ant. xiii., 5, 9). Their activity extended over a period of three centuries (from *c.* 135 B C.—A.D. 135). They first emerged as an organized party in the reign of John Hyrcanus and were active down to the time of Hadrian. We may assume that the Pharisees occupied a position of considerable influence and power during the reign of John Hyrcanus (135–105 B C). Later, in the reign of Alexander Jannaeus (104–78 B C.) they appear to have quarrelled with the Maccabaean ruler (who, it must be remembered, functioned as high priest as well as king) and the quarrel lasted some time. The breach was healed in the reign of his widow Salome Alexandra (78–69 B.C.) During the New Testament period the Pharisees, as is evident from the pages of the New Testament, played a dominating part in Jewish communal life.

Their general aim was to develop and deepen the work of the earlier *Ḥasidīm* in making the *Torah* the accepted rule of life for the mass of the Jewish people Their work was astonishingly successful They made the synagogue a permanent and widespread institution of Jewish life Here in the weekly assemblages the lections were read and expounded to the people; the synagogue prayers were developed and made familiar. They also organized a system of elementary religious instruction

Origin of the Name.—Of the various explanations of the name, the view of Lauterbach is most plausible, that the term (which means "separated" or "expelled") is due to an actual event, viz. the expulsion of the lay teachers from the priestly Sanhedrin It must be remembered that during the Persian period of the Post-Exilic epoch the schools which perpetuated the teaching of the law were priestly in character and the actual teachers were themselves priests These earlier *Sopherim* were also responsible for the actual transmission of the text. The system lasted on till the earlier part of the Greek period Then the earlier simplicity and self-contained character of the Jewish community began to break down under the influence of Greek conditions This applied also to the teaching of the law to the people "Laymen arose who had as much influence among the people and with the government as the High-Priest, and they became leaders." These laymen were practically the Pharisaic party who were able to force some of their party into the priestly Sanhedrin Later a crisis arose in the Sanhedrin and the lay leaders were apparently expelled—hence the name Pharisees As is well known, the Pharisees stood for the oral law as well as for the written, and one of their chief preoccupations was to deduce arguments for linking up popular custom with the written text of the Pentateuch They were thus led to develop an ingenious system of exegesis which in course of time resulted in the development of a vast hermeneutical literature

In order to estimate Pharisaism aright during its active period it is necessary to remember that it was sharply divided into warring sects and schools. These are probably not exhausted by the rival schools of Hillel and Shammai; and the polemic of Jesus in the Gospels was primarily directed not against the party as a whole, but against one section of it, an extreme wing of the followers of Shammai who were open to the charge of formalism and hypocrisy. It is probable that the Shammaites were in the ascendent at this time; later, after A D 70, the milder peace-loving school of Hillel predominated. Pharisaism was the dominant factor in the development of orthodox Judaism, which assumed a more or less permanent form in the Rabbinical system Its main interest was to bring the sanctions of religion into this life This tendency also appears in its Messianic doctrine, which it has impressed on all parts of the synagogue liturgy Its Messiah is not the transcendental and heavenly figure of some of the apocalyptists, but a purely human son of David *See* G F. Moore, *Judaism;* Art "Pharisees" in *Enc Rel and Ethics* (G H B)

PHARMACOLOGY. In English-speaking countries, and by the majority of German writers, the term pharmacology is applied to the study of the action of chemical substances (as apart from foods) on all kinds of animals, from bacteria up to man; it is, in fact, a comparative study of the action of chemical bodies on invertebrate and vertebrate animals

Pharmacology is a branch of biology; it is also closely connected with pathology and bacteriology, for certain drugs produce structural as well as functional changes in the tissues, and in germ diseases the peculiar symptoms are caused by foreign substances (toxins) formed by the infective organisms present in the body The effects of many of these toxins bear a close resemblance to the action of certain well-known drugs, as in the case of tetanus toxin and strychnine, and are studied by the same methods

The rapid growth of the science of pharmacology has been one of the most striking features of the development of the science

of medicine during the twentieth century.

Organic Chemistry.—The only substances available for medical use a century ago were certain inorganic salts and crude vegetable extracts. The development of organic chemistry provided therapeutics with purified active principles of the crude vegetable extracts, and thus the use of crude preparations of unknown strength was replaced to a large extent by the use of chemical substances of known composition. Organic chemistry rendered a still more important service to pharmacology with the synthesis of organic compounds by which the number of substances available for use in therapeutics was increased indefinitely.

The anaesthetics, ether (1846) and chloroform (1847), were the first synthetic organic compounds to be used extensively in medicine. Twenty years later the first synthetic hypnotic, chloral hydrate, was introduced, and about 1885 the coal tar antipyretics, acetanilide and antipyrin, were discovered. Since then hundreds of new and valuable synthetic drugs have been discovered.

Salvarsan.—The discovery by Ehrlich in 1910 of salvarsan (*q.v.*), a potent remedy for syphilis, established a new method of research which has since yielded other results of great importance and promises to produce even greater successes.

In his search for a substance which would kill the infectious organism of syphilis (*q.v.*), the *Treponema pallidum,* without injuring the patient, Ehrlich started with the knowledge that allied organisms, the trypanosomes, were killed by certain dyes and organic arsenic compounds. Not content with a random examination of the known compounds, he determined quantitatively which types of compounds were the most satisfactory for his purpose and then got new compounds prepared according to a definite plan. He made a systematic examination of a long series of organic arsenic compounds, determining in each case the minimal dose of the drug which would cure an animal infected with trypanosomes (minimal curative dose) and the maximal dose which the animal could tolerate (maximal tolerated dose). He termed the ratio:—

$$\frac{\text{(maximal tolerated dose)}}{\text{(minimal curative dose)}}$$

the therapeutic index, and sought for a drug with the highest possible therapeutic index. The compound salvarsan or arsenobenzole was the 606th arsenic preparation investigated, and in 1910 it was introduced as a remedy for syphilis. Two years later, Ehrlich introduced neosalvarsan or novarsenobenzole, which has to a large extent replaced salvarsan in the treatment of syphilis (*see* VENEREAL DISEASES). Ehrlich's brilliant success stimulated an intensive investigation of the action of organic metallic compounds upon diseases due to infections by animal parasites.

New Methods.—A number of important new methods of treatment have been discovered. Intramuscular injections of bismuth salts have been found to be of value in the treatment of cases of syphilis which are refractory to the organic arsenicals. Salts of antimony also have been found to have important new therapeutic actions. A century ago the production of subacute antimony poisoning by large doses of tartar emetic was a routine treatment for a very large number of diseases, but the revolt against the "heroic" methods of treatment of disease, in the middle of last century led to tartar emetic being almost abandoned as a therapeutic agent. The drug was discovered to possess the new and important therapeutic action of acting like arsenic as a specific disinfectant for animal parasites (*see* HOOKWORM). Intravenous injections of antimony salts have been found of great value in treating various diseases due to trypanosomal infection, and also have been found to cure the disease bilharziasis (*q.v.*).

Perhaps the most important internal disinfectant to be discovered is the compound "Bayer 205," a derivative of the dye trypan blue. This substance has a powerful action both in preventing and relieving the trypanosomal disease sleeping sickness (*q.v.*), the worst scourge of tropical Africa.

Mollgaard showed recently that an organic compound of gold, sodium aurithiosulphate, named "sanocrysin" can produce very remarkable curative effects, in a certain proportion of cases of tuberculosis (*q.v.*), but is equally capable of producing deleterious effects, and therefore great care is needed in its administration.

Antiseptics.—The special conditions of World War surgery made the discovery of powerful wound disinfectants an urgent problem, and a number of new disinfectant compounds of great activity were discovered, for example the dye "acriflavine," and the quinine derivatives "vuzin" and "optochin" (*see* ANTISEPTICS). Although the synthesis of the alkaloid quinine has not yet been effected, nevertheless its chemical structure is known, and it is possible to modify the structure of the alkaloid and thus produce new compounds. Vuzin and optochin are two quinine derivatives which differ from quinine in having a far more potent disinfectant action on bacteria. Another important new wound disinfectant is chloramine-T, an organic chlorine compound which acts by slowly liberating chlorine. The disinfection of the kidney and the bladder is another important problem in which advances recently have been made. A new organic compound termed hexyl resorcinol appears to be a very powerful urinary disinfectant.

Use of Active Principles.—Most of the advances mentioned hitherto have depended upon the discovery of new synthetic organic compounds of greater potency than any known hitherto, but cures for other diseases have been discovered by substituting purified active principles for crude vegetable extracts.

Ipecacuanha has been known for more than a century to benefit amoebic dysentery, but the administration of the drug by mouth was limited by its action as an emetic. Sir Leonard Rogers showed in 1912 that subcutaneous injections of the alkaloid emetine, the chief active principle present in ipecacuanha, usually produced a rapid cure in cases of amoebic dysentery (*see* DYSENTERY).

Similarly, it has been known for many years that leprosy (*q.v.*) is often benefited by administration of Chaulmoogra oil, but it was found impossible to administer large doses of this oil by mouth on account of its irritant properties. Organic chemists isolated from Chaulmoogra oil certain complex fatty acids named hydnocarpic and chaulmoogric acids, which were believed to be the chief active principles present in the oil. Sir Leonard Rogers in India and Heiser in the Philippines introduced the method of injecting preparations of these purified fatty acids intravenously or intramuscularly and obtained remarkable curative effects even in the cases of leprosy of many years' duration (*see* LEPROSY). The most striking recent successes of pharmacology have been achieved in the cure of infectious diseases, because in most other serious diseases some vital organ has received irreparable damage, which drugs may alleviate but cannot cure.

Anaesthetics and Hypnotics.—Important progress has, however, been made in the discovery of drugs needed to produce certain temporary alterations in the functions of the body. General anaesthetics are perhaps the most important group of drugs of this class. In 1924 and 1925 acetylene and ethylene were tried as substitutes for nitrous oxide, but at present it is doubtful whether the new gases will prove superior to nitrous oxide.

Many drugs produce some very useful action but have in addition some highly undesirable side action. Cocaine (*q.v.*), for example, is an excellent local anaesthetic, with the grave disadvantage of sometimes producing dangerous effects on the brain. Of the large number of local anaesthetics, which have been synthesised in the hope of producing some complete substitute for cocaine, Novocaine is one of the best known and can replace cocaine completely for many but not for all purposes. Since 1910 a number of new compounds of great potency as local anaesthetics have been discovered, and cocaine may soon be superseded.

Similarly, a host of new and very potent hypnotics have been synthesised in the hope of finding a reliable hypnotic which will not produce a habit, and is perfectly safe. Unfortunately, not much advance has been made in this field. In a few cases important new uses have been discovered for drugs which have been known for many years, such as the discovery in 1918 that quinidine, one of the alkaloids present in Cinchona bark or Jesuit's bark, can cure the important disorder of the heart known as auricular fibrillation. (*See* CINCHONA, ALKALOIDS OF.)

Physiological Features.—The accurate analysis of the mode of action of drugs of well-established reputation has in certain cases greatly increased their value, making it possible to increase their dosage with safety and thus ensuring that sufficient of the

drug is given to produce the physiological effect desired. The administration of digitalis in heart disease is a case where considerable improvements in technique of this character have been effected in recent years.

The study of the actions of extracts of the glands of internal secretion (*see* ENDOCRINOLOGY) is a field common to physiology and pharmacology. In 1886 it was shown that the two diseases myxoedema and cretinism, due to deficiency of the thyroid secretion, and previously considered completely incurable, could be cured by the simple remedy of administering dried thyroid gland by the mouth. In 1922 Banting obtained an extract from the pancreas, which he termed insulin (*q.v.*), and which he proved would relieve the disease of diabetes mellitus (*q.v.*).

There are peculiar difficulties attending the study of the secretions of the endocrine glands. Active principles have been obtained from the parathyroid glands and the ovaries which also promise to be of value as agents for substitution therapy, where the normal secretions of these organs are deficient. Substances have been obtained from other endocrine organs which have no certain value as agents for substitution therapy but are drugs with powerful and interesting pharmacological actions. One such substance, adrenalin, was discovered in 1896, and has been found of great value in producing constriction of small arteries and thus acting as a haemostatic.

Extracts of the posterior lobe of the pituitary gland produce a rise of blood pressure and constriction of plain muscle and since 1916 this extract has been brought into therapeutic use, and is now very extensively used to cause contraction of the uterus, and thus to accelerate childbirth and to prevent the disastrous complication known as post-partum haemorrhage.

Vitamins.—The vitamins (*q.v.*) are biological products which have important pharmacological actions. They are unstable bodies of unknown chemical composition which are present in minute amounts in a large variety of fresh foods, but usually are absent in preserved foods. Several vitamins exist, and a regular supply of all of them is essential to normal development and health. Scurvy and rickets are two examples of diseases caused by vitamin lack. Lemon juice has been known for more than a century to be a specific cure for scurvy, and biochemists have now succeeded in concentrating the vitamins of lemon juice so that a child suffering from infantile scurvy can be given the vitamin equivalent of 20 lemons in a single day. Similarly, cod liver oil has long been recognized as a cure for rickets, and the vitamin of cod liver oil has also been prepared in concentrated form.

Parasitology.—The disease-producing parasites are of two classes, firstly the animal parasites such as the trypanosomes, and secondly the vegetable parasites, the bacteria. Very remarkable successes have attended the preparation of internal disinfectants for the animal parasites, and cures have been found for a number of the worst diseases that afflict mankind; in particular, cures have been discovered for a number of very serious tropical diseases (*q.v.*). Less striking success has attended the endeavour to find disinfectants that will kill bacteria infecting the body, but a certain amount of progress has been made, and any advance in this field is of the greatest importance to the inhabitants of temperate climates, because most of the worst infectious diseases of the temperate zone are bacterial in origin.

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PHARMACOPOEIA, a book containing directions for the identification of simples and the preparation of compound medicines, and published by the authority of a government or of a medical or pharmaceutical society. The first work of the kind published under government authority appears to have been that of Nuremberg in 1542.

In England until 1617 such drugs and medicines as were in common use were sold by the apothecaries and grocers. In that year the apothecaries obtained a separate charter, and it was enacted that no grocer should keep an apothecary's shop. The preparation of physicians' prescriptions was thus confined to the apothecaries, upon whom pressure was brought to bear to make them dispense accurately, by the issue of a pharmacopoeia in 1618 by the College of Physicians of London, and by the power which the wardens of the apothecaries received in common with the censors of the College of Physicians of examining the shops of apothecaries within 7 m. of London and destroying all the compounds which they found unfaithfully prepared. Between 1618 and 1851, 13 editions of the *London Pharmacopoeia* were issued, each tending towards simplification and elimination of many ridiculous and highly compound medicines that had been in vogue for 2,000 years.

The first *Edinburgh Pharmacopoeia* was published in 1699 and the last in 1841; the first *Dublin Pharmacopoeia* in 1807 and the last in 1850.

The preparations contained in these three pharmacopoeias were not all uniform in strength. In consequence of this inconvenience and danger the Medical Act of 1858 ordained that the General Medical Council should cause to be published the *British Pharmacopoeia*, which should be a substitute throughout Great Britain and Ireland for the separate pharmacopoeias. The first *British Pharmacopoeia* was published in 1864. Since then revised editions have been brought out periodically, physicians and pharmacists being consulted in their compilation. But each new edition requires several years to carry out numerous experiments for devising suitable formulae, so that the current Pharmacopoeia can never be quite up to date. This difficulty has hitherto been met by the publication of such non-official formularies as Squire's *Companion to the Pharmacopoeia* and Martindale's *Extra Pharmacopoeia*, recording all new remedies and their preparations, uses and doses.

National pharmacopoeias now exist in the following countries: Austria, Belgium, Chile, Denmark, France, Germany, Great Britain, Greece, Holland, Hungary, India, Japan, Mexico, Norway, Portugal, Russia, Spain, Sweden, Italy, Switzerland, the United States, Venezuela, Rumania, Finland, Argentina and Servia.

The French *Codex* has probably a more extended use than any other pharmacopoeia outside its own country, being, in connection with Dorvault's *L'Officine*, the standard for druggists in a large portion of Central and South America; it is also official in Turkey. It contains about 1,250 drugs and preparations, or double the average of other modern pharmacopoeias.

Some difficulty has arisen since the passing of the Adulteration of Food and Drugs Act concerning the use of the Pharmacopoeia as a legal standard for the drugs and preparations contained in it. It has been held in the Divisional Courts (*Dickins* v. *Randerson*) that the Pharmacopoeia is a standard for official preparations asked for under their pharmacopoeial name. But for many drugs and chemicals not in the Pharmacopoeia there is no standard of purity that can be used under the Adulteration of Food and Drugs Act. An important step towards supplying this need has been taken by the publication under the authority of the Council of the Pharmaceutical Society of Great Britain of the *British Pharmaceutical Codex*, in which the characters of and tests for the purity of many non-official drugs and preparations are given as well as the character of many glandular preparations and antitoxins that have come into use in medicine, but have not yet been introduced into the Pharmacopoeia.

An International Pharmacopoeia.—Attempts have been made by international pharmaceutical and medical conferences to settle a basis on which an international pharmacopoeia could be prepared, but so far without result. (*See* PHARMACY.) On the other hand, a project for an imperial pharmacopoeia which should be adapted to the general and local requirements of all parts of the British Empire has met with better success. With the aid of the medical and pharmaceutical authorities in each of the seventy administrative divisions of the British Empire an Indian and Colonial addendum to the *British Pharmacopoeia* of 1898 was compiled and published in 1900 in which each article receives official sanction in the countries indicated in the monographs.

Several unofficial universal pharmacopoeias have been pub-

lished in England and in France, which serve to show the comparative strength of parallel preparations in different countries. The greatest stumbling-blocks in the way of uniformity are the tinctures and extracts in which the same name does not always indicate the same thing; thus, extract of aconite signifies an extract of the root in the pharmacopoeias of the United States, Japan and Russia, extract of the leaves in the Danish and Portuguese, inspissated juice of the fresh leaves in the Greek, and alcoholic extract of the root in that of Spain and Italy, and alcoholic extract of the dried leaves in the Chilean pharmacopoeia. It appears probable, however, that the growth of pharmaceutical chemistry will indicate, in time, which of those in use form the most active and trustworthy preparations, while the general adoption of the metric system will lead to clearer approximation of strength than hitherto. Homeopathic and eclectic practitioners as well as dentists have also their special pharmacopoeias.

See Martindale and Westcott, *Extra Pharmacopoeia*, 18th ed. 1924–25, 19th ed. vol i. 1928; *British Pharmaceutical Codex*, London, 1923; *British Pharmacopoeia*, London, 1914; Squire's *Companion to the British Pharmacopoeia*, 19th ed. London, 1916; *Codex medicamentarius Sallieus: Pharmacopée française*, Paris, 1920; *Pharmacopoeia of the United States of America* 10th decennial revision Philadelphia, 1925; *Deutsches Arzneibuch* 6th ed. Berlin 1926. (E. M. Ho.)

PHARMACOSIDERITE, a mineral species consisting of hydrated basic ferric arsenate, $2FeAsO_4 \cdot Fe(OH)_3 \cdot 5H_2O$. Crystals have the form of small, sharply defined cubes of an olive- or grass-green colour, and occur together in considerable numbers on the matrix of the specimens. On account of its cubic form it was early known as "cube ore;" the name pharmacosiderite alludes to the arsenic and iron present (φάρμακον, poison, and σίδηρος, iron). The faces of the cube are striated parallel to one diagonal, and alternate corners may be replaced by faces of a tetrahedron. Natural crystals are sometimes honey-yellow to brown in colour, but this appears to be due to alteration. Pharmacosiderite is a mineral of secondary origin, the crystals occurring attached to gozzany quartz in the upper part of veins of copper ore.

PHARMACY, the art of preparing, preserving and compounding medicines, according to the prescriptions of physicians. The term was first used in this sense in 1597. The International Congresses of Pharmacy, held at intervals from 1865 to 1913, afforded opportunity for the discussion of questions of international importance. Much time and effort were expended in the endeavour to produce an international Pharmacopoeia and to ensure that all medicinal preparations should be the same, no matter in what country they were prescribed. The attempt failed, but it paved the way for the adoption of useful international regulations. (*See* PHARMACOPOEIA.)

International Uniformity.—The congress held in Paris in 1900 recommended that a comparative table should be prepared showing the difference in the strength of medicaments bearing the same name in different pharmacopoeias. This table was considered at a conference of accredited delegates from various nations in Sept. 1902 and a list of preparations was issued upon which agreement as to strength had been reached. An international agreement embodying this list was signed in 1906 by the representatives of 18 nations and, substantially, all the decisions contained in it have been observed in the new issues of the pharmacopoeias of the signatory nations. A similar conference was held in Paris in 1925 to revise some of the decisions of the first conference and to take further steps towards the unification of the pharmacopoeial formulas for potent drugs and their preparations

The 10th international congress held at Brussels in 1910 decided to establish a Fédération Internationale Pharmaceutique for the protection of pharmacy as a profession and as an applied science. The federation was established in 1912 at The Hague with Prof. Van Itallie and Dr. Hofman, the first president and secretary respectively. Twenty-four national societies of pharmacy are now included in it, although Austria, Denmark, Germany, Hungary and Russia have retired since the World War. The Fédération Internationale Pharmaceutique has held meetings annually since 1922.

Modern Pharmacy and Science.—The demands made upon the scientific knowledge and technical skill of the pharmacist have continually increased as shown by successive editions of the British, United States and other pharmacopoeias. The definition of the drugs has become more precise; tests of identity, limits of impurity, methods of assay have been introduced, and the use of the microscope required for the examination of many vegetable drugs. The introduction into medical practice of countless synthetic chemicals, of such organotherapeutical substances as the thyroid gland, pituitrin, etc., and of various vaccines and sera has imposed upon pharmacists the necessity of special study in order to understand them. The same may be said of the X-rays, and of the vitamins, the latter, in an impure form, being used in the form of compressed tablets or of capsules. Hypodermic injections are now commonly supplied sterilised and in ampoules, and the pharmacist must therefore be acquainted with the principles of sterilisation and with the action upon sensitive alkaloids of the heat used and the alkalinity of the glass of which the ampoules have been made.

The Qualifications of the Pharmacist.—In addition, therefore, to a knowledge of chemistry and botany as applied to pharmacy the pharmacist must be an expert microscopist. He must keep himself informed as to the new developments of therapeutics and must be competent to supply such medicines as the physician may prescribe. Disinfection and hygiene also come within his purview. To ensure his competency the Fédération Internationale Pharmaceutique agreed that the following subjects should find a place in the studies of the pharmaceutical student: chemistry (analytical, biological, physiological and pathological), pharmacy (chemical and galenical), pharmacognosy, micrography, toxicology, hygiene, legislation, pharmacology, botany, microbiology, mathematics, crystallography, disinfection, sterilisation and optics.

Modern Developments.—Developments in the treatment of diseases and in the nature and quality of the remedial agents required, which are the outcome of scientific research, have a direct bearing upon pharmacy. Barger, Dale, Carr, Stoll and others have shown that ergot contains two extremely powerful alkaloids, ergotoxine and ergotamine, upon which its activity chiefly depends, accompanied by various amines such as tyroamine and histamine, which possess a subsidiary efficacy. The two alkaloids are soluble in alcohol but insoluble in water and are easily converted into inactive substances from which they can be regenerated. These discoveries opened the way to a preparation of ergot which has proved very satisfactory.

For a long time the group of oxymethylanthraquinone drugs, which includes purgatives such as rhubarb, cascara sagrada, etc., had baffled investigators as the crystalline oxymethylanthraquinones or their glucosides failed to explain, quantitatively at least, the action of the drugs. Maeder has isolated from elder buckthorn bark the glucoside glucorhamnin in which two sugar groups are present. The laxative action of glucofrangulin is such that the amount present in the drug corresponds to the activity of the latter. Probably similar glucosides will be found in other members of the group. Kiefer, working upon Cape aloes, showed that the resins previously considered inactive were, on the contrary, strongly purgative and isolated the substance to which the griping action was due and so made an important step towards a rational preparation of aloes. Bourquelot showed that many enzymes possess a synthetical as well as analytical action and prepared a number of synthetical glucosides and demonstrated the possibility of producing in the laboratory an entirely new class of compounds.

Stabilisation of Drugs.—Pharmacists have long desired to make from drugs preparations which should contain the active constituents in the condition in which they exist in the plant. Goris and Arnould made an important step towards solving this problem by proving that the caffeine in fresh kola nuts exists in combination with kolatin, a combination which is broken up by an oxidase present in the fresh nuts. This oxidase can be rendered inactive by steam or alcohol vapour and the combination then remains unaltered when the nuts are dried and preparations made from them. Such treatment, or "stabilisation," of a drug will probably be extensively adopted.

Medicinal Plants.—During the World War large quantities

of medicinal plants were collected in Great Britain, partly wild, partly cultivated. Attempts to place the cultivation upon a satisfactory footing failed, owing to the difficulty of obtaining assistance for the young industry. In France the Government afforded every aid, and under the direction of Perrot the industry is rapidly growing and much information is being collected as to the effects of soil, manures, etc., necessary to produce the best results. In the United States considerable attention has been devoted to selection experiments with drug plants, and marked progress has been made towards the production of the most suitable strains. The extremely high price of santonin led to a search for other sources of that vermifuge.

Educational System in Great Britain.—The Poisons and Pharmacy Act of 1908 allowed a body corporate, and in Scotland a firm or partnership, to carry on the business of a pharmaceutical chemist or chemist and druggist provided that the business, so far as it related to the keeping, retailing and dispensing of poisons, was under the control of a registered pharmaceutical chemist or chemist and druggist. In the second place powers were given to the Pharmaceutical Society to divide the qualifying examination into two parts and to require candidates for the examination to produce satisfactory evidence that they had received a sufficient preliminary practical training in the subjects of the examination In 1920 the by-laws and regulations necessary for carrying the provisions of the Act of 1908 into effect were drawn up. They came into full force at dates varying from Feb. 1, 1927, to Aug. 1, 1929, and may be briefly summarised as follows:—

Before presenting himself for examination the candidate must have been registered as a student of the Pharmaceutical Society for which purpose he must have passed one of a number of entrance examinations ranging from the junior local examination of Cambridge or Oxford to the matriculation examination of the University of London. After registration he may proceed to the preliminary scientific examination, for which attendance at an approved systematic course of instruction of at least 440 hours in chemistry, botany and physics is necessary. Having passed this, or one of several alternative examinations, he will have to decide whether he will be content with passing the chemist and druggist qualifying examination or aim at the higher qualification by training for the pharmaceutical chemist qualifying examination. In the former case, when giving notice, he must produce a declaration that he has been trained under the direct supervision of a pharmacist in the dispensing and compounding of medicines for 4,000 hours spread over not less than two years in a pharmacy or in the dispensary of a hospital or similar institution approved by the council. He must also have attended an approved systematic course of at least 720 hours in pharmacy, pharmaceutical chemistry, pharmacognosy and forensic pharmacy.

If the candidate elects to proceed from the preliminary scientific examination to the pharmaceutical chemist qualifying examination, then he must be trained for at least 2,000 hours in a pharmacy or hospital and have attended an approved systematic course of at least 1,600 hours in botany, chemistry, pharmacognosy, pharmacy and forensic pharmacy. The statutory examinations in these subjects are conducted by the Pharmaceutical Society.

Thus, whereas in 1920 there was no compulsory curriculum of any kind, the entrant into pharmacy now has to undergo what is practically a two years' approved systematic course of training for the lower qualification and a three years' for the higher; in addition, if he has matriculated, university degrees are open to him. This achievement places the pharmaceutical student in Great Britain on a level with those of most other countries.

Sale of Poisons.—Since the passing of the British Poisons and Pharmacy Act in 1908 the number of substances brought within the range of Part I. of the schedule (those which may not be sold to any person unknown to the seller unless introduced by a person known to both parties and of which the sale must be duly registered) has been much increased. It now includes:

Aconite, aconitine and their preparations; all poisonous alkaloids not specifically named, and their salts and all poisonous derivatives of alkaloids; arsenic and its preparations; atropine and its salts and their preparations; belladonna and all preparations or admixtures (except belladonna plasters) containing 0·1% or more of belladonna alkaloids; cannabis (the dried flowering or fruiting tops of the pistillate plant of *Cannabis sativa*) and the resins prepared therefrom. Cantharides and its poisonous derivatives; coca, any preparation or admixture of, containing 0·1% or more of coca alkaloids; corrosive sublimate; cyanide of potassium and all poisonous cyanides and their preparations; diamorphine (also known as heroin) and all preparations or admixtures containing 0·1% of diamorphine; diethyl-barbituric acid and other alkyl, aryl or metallic derivatives of barbituric acid, whether described as veronal, proponal, medinal or by any other trade name, mark or designation; and all poisonous urethanes and ureides; digitalin and all other poisonous constituents of digitalis; ecgonine and all preparations or admixtures containing 0·1% of ecgonine; emetic tartar and all preparations or admixtures containing 1% or more of emetic tartar; ergot of rye and preparations of ergots; lead in combination with oleic acid or other higher fatty acids, whether sold as diachylon or any other designation (except machine-spread plasters), nux vomica and all preparations or admixtures containing 0·2% or more of strychnine; opium and all preparations or admixtures containing 0·2% or more of morphine; picrotoxin; prussic acid and all preparations or admixtures containing 0·1% or more of prussic acid; savin and its oil and all preparations or admixtures containing savin or its oil; strophanthin and all other poisonous constituents of strophanthus; tobacco, any preparations or admixtures of (other than tobacco prepared for smoking and snuff), containing the poisonous alkaloids of tobacco.

By the Dangerous Drugs Act 1920–23 further restrictions have been placed upon the sale of morphine, cocaine, ecgonine, diamorphine, heroin and their respective salts and medicinal opium. Generally stated, these drugs may, with certain exceptions, be supplied only to physicians' prescriptions and a record must be kept of the quantities bought and sold

The Labelling of Poisons Order, which came into force in Great Britain on Jan. 1, 1926, imposed further conditions upon the sale of poisons (whether contained in Part I. or Part II. of the schedule) This Order and the Act under which it is made require that, in general, every preparation containing as an ingredient any poison to which the Pharmacy Act 1868, as amended, applies shall bear on the label a statement of the proportion which such poison bears to the total ingredients of the preparation. The Fédération Internationale Pharmaceutique is endeavouring to formulate a scheme for the uniform treatment of such preparations by all the states included in it (H. G. G.)

THE UNITED STATES

Education.—The total number of pharmacy schools in the United States is between 70 and 80, the majority of which are enrolled in an organization known as the American Association of Colleges of Pharmacy. This organization, since its establishment in 1900 has had a great influence in raising the standards of pharmaceutical education by voluntary co-operation, as there are no national or State laws covering the subject in a general way

Preliminary requirement for entrance to the study of pharmacy is four years of accredited high school work or its equivalent. The minimum course is of three years duration, each year consisting of 32 weeks of college work with certain requirements as to credit hours and curricula. The minimum degree is Graduate in Pharmacy (Ph.G.), which is acceptable as qualifying for registration under most State laws The degree of pharmaceutical chemist (Ph C.) is also given for a somewhat more advanced course, and the degree of Bachelor of Science in Pharmacy (B Sc in Phar) is annually conferred upon many students who voluntarily take a longer and more difficult course, as this degree is usually the minimum educational qualification for official governmental and State positions and for many positions in manufacturing establishments. Post graduate courses leading to the degree of Master of Science in Pharmacy (M Sc in Phar.), and Doctor of Pharmacy (Phar.D) are available for those who wish to continue their studies, particularly with a view of entering research work or the profession of teaching

Beginning with the classes entering the pharmacy colleges in 1932 no student will be accepted for a course less than four years duration, so that by 1936 the minimum course in pharmacy recognized in the United States will be that leading to the degree of Bachelor of Science in Pharmacy.

Registration Requirements.—There is no national examining or registering body in the United States and each State has its own laws applying to the subject. These laws and the procedures growing out of their enforcement have been materially harmonized and rendered more nearly uniform by the National Association of Boards of Pharmacy The majority of the States now require graduation from a recognized college of pharmacy as a necessary

qualification for admission to the examination for registration. In addition to this, all of the States require from two to four years of what is called "drug store experience," a custom dating from the time when a college education in pharmacy was not required.

Laws Affecting Pharmacists.—The laws pertaining to the adulteration of drugs and medicines and the enforcements of legal standards are both State and national in scope. Prior to 1906 there was no Federal law and the States alone controlled the situation. The passage of what is known as the Federal Food and Drugs Act in 1906 greatly strengthened the control of adulteration and misbranding of drugs The Federal law affects only those products which enter interstate commerce and specifically recognizes the standards of the U.S. Pharmacopoeia and the National Formulary as officially governing drugs and medicines. Since 1906 many State laws have been brought into harmony with the provisions of the Federal Act, and as the State laws control intrastate transactions, the entire situation is governed.

Another important act affecting pharmacists in the United States is the Harrison Antinarcotic Act, which is an act giving police power to the United States government in the control of the distribution of habit-forming drugs such as morphine, cocaine, etc. The provisions of this Act require the registration of every physician prescribing certain habit-forming drugs and of every pharmacist dispensing such drugs, as well as control of the manufacturers and jobbers or wholesalers.

Still another act of prime importance affecting pharmacists is the Volstead Act, which provides the legislative regulation for the Eighteenth Amendment to the Constitution of the United States of America, commonly known as the "Prohibition Amendment." This legislation makes the physician and the pharmacist jointly and solely responsible for the dispensing of intoxicating liquors used in the alleviation and cure of disease. A system of registration and of permits, together with numerous regulations and inspections is in constant enforcement by Federal officials, who, as in the Antinarcotic Act, are given police powers in dealing with the situation. Frequent reports are required in connection with the enforcement of both the Antinarcotic and Prohibition laws.

Pharmaceutical Manufacturing and Retailing.—Pharmaceutical manufacturing on a large scale has reached a very high state of efficiency in the United States. This does not take into account the nostrum or so-called "Patent medicine" business, over which no supervising control whatever is exercised, except in the matter of labeling, where the Food and Drugs Act holds the manufacturers of such preparations to strict accountability in connection with claims for composition and curative value. The manufacture of official preparations which a century ago was almost entirely in the hands of retail pharmacists themselves, has almost all been given over to the large scale manufactures. In addition there is a great volume of business in non-secret medicines which physicians are induced to prescribe by name instead of writing a detailed prescription for each patient.

American pharmacy is confronted with a very embarrassing situation in that the professional courses for registration are longer and more exacting and the demand for professional pharmaceutical services seems to be diminishing. This has led to the development of commercialism in pharmacy to a degree not yet experienced in other countries, and the independent pharmacist who desires to maintain his professional status is having a difficult time to hold his own. (C. H. LAW.)

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PHARNABAZUS, Persian soldier and statesman, the son of Pharnaces, belonged to a family which from 478 B.C. governed the satrapy of Phrygia on the Hellespont, from its headquarters at Dascylium. Pharnabazus first appears as satrap of this province in 413, when he entered into negotiations with Sparta and began war with Athens After the war he came into conflict with Lysander (*q.v.* *see* also PELOPONNESIAN WAR), who tried to keep the Greek cities under his own dominion, and became one of the causes of his overthrow, by a letter which he sent to the ephors at Sparta.

When in 399 the war with Sparta broke out he again tried to conduct it strenuously. With the help of Conon and Evagoras of Salamis he organized the Persian fleet, and while he was hard pressed on land by Agesilaus he prepared the decisive sea-battle, which was fought in August 394 at Cnidus under his and Conon's command, and completely destroyed the Spartan fleet. He sent support to the allies in Greece, by which the walls of the Peiraeus were rebuilt. But in the war on land he struggled in vain against the lethargy and disorganization of the Persian Empire; and when at last, in 387, in consequence of the embassy of Antalcidas to Susa, the king decided to conclude peace with Sparta and to enter again into close alliance with her, Pharnabazus, the principal opponent of Sparta, was recalled from his command in high honours, to marry Apame, a daughter of the king (Plut. *Artax.* 27).

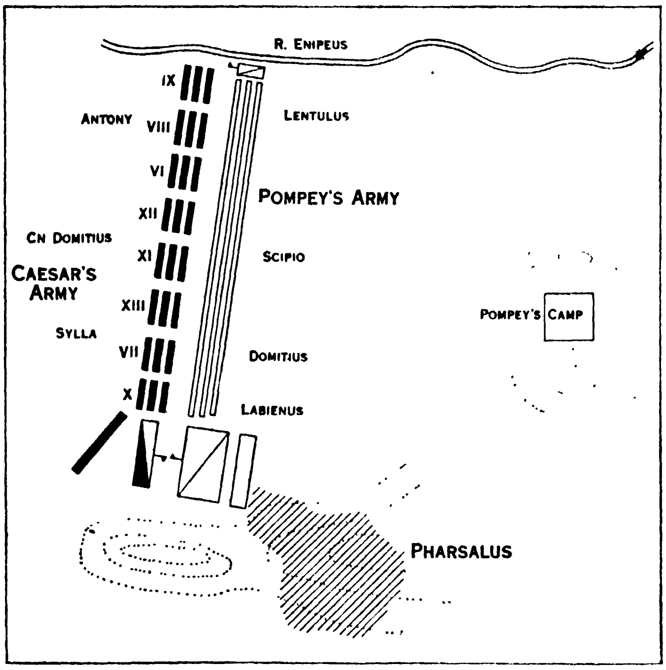
In 385 Pharnabazus was one of the generals sent against Egypt, and in 377 he was ordered to prepare a new expedition against the valley of the Nile. The gathering of the army took years, and when in 373 all was ready, his attempt to force the passage of the Nile failed. A conflict with Iphicrates, the leader of the Greek mercenaries, increased the difficulties; at last Pharnabazus led the army back to Asia. When he died is not known. (ED. M.)

PHARSALUS, BATTLE OF (48 B.C.). The defeat sustained by Julius Caesar at Dyrrachium in May 48 B.C. in no way disheartened him, but it compelled him to change his plan, and that at once. The task before him was a difficult one, namely to retire before a victorious enemy and cross two bridgeless rivers, the Genusus and Apsus. Leaving 15 cohorts and 300 vessels to guard Dyrrachium, on June 3 Pompey set out towards Heraclea whilst Caesar made his way to Aeginium in Thessaly where he was joined by Cn. Domitius and two legions; this brought his force up to nine, some 24,000 men. He moved eastwards and camped north-west of Pharsalus in the plain on the left bank of the Enipeus. There he awaited his enemy whose army numbered 50,000 infantry, 7,000 cavalry and a large number of light troops. Pompey felt certain of victory, but he overlooked the personal factor and forgot that Caesar *was* his army, and that as one writer says: "The whole body was instinct with his purpose." Caesar felt equally certain of success. The battle was fought on June 29.

Pompey planned to hold Caesar's front with his infantry and mass his cavalry, largely outnumbering Caesar's, on his left wing in order to envelop Caesar's right wing and attack it in rear. Pompey's right wing rested on the river Enipeus and was protected not only by the steep banks but by a force of some 600 horsemen, as Caesar saw. It was under the command of Lentulus, and was composed of Cilician and Spanish troops—

good soldiers. His left wing numbered the I. and III. legions and was accompanied by Pompey in person. Scipio held the centre with two Syrian legions and the bulk of the cavalry, slingers and archers, under Labienus were massed on the outer flank of the left wing.

Caesar drew up his legions in three lines of cohorts, four in the first, three in the second and three in the third; his men stood eight deep. On the right he placed the X. legion and on the left the



THE POSITION OF THE ARMIES AT THE BATTLE OF PHARSALUS, MAY 48 B.C. WHEN JULIUS CAESAR DEFEATED THE ARMY OF POMPEY

IX. Antony commanded the left, Sylla the right and Cn. Domitius the centre; he himself took up his position opposite Pompey. Thus far his order of battle was normal, but he had noticed the large force of cavalry massed on his enemy's left. Recognising that this mass was intended to outflank him, he drew up a fourth line of chosen cohorts, taken from the third line, and placed six of these cohorts and his small force of horse on his right, telling them that on their courage would depend the results of the battle. The third line he proposed to hold in reserve, and the first and second he ordered not to charge until he required it to. The trumpets were then sounded, and the battle cry of "Venus Victrix" raised, to which the Pompeians answered: "Hercules Invictus."

Pompey had ordered his men to await the enemy's assault, for he considered that when the two forces clinched his troops would be the fresher; but Caesar realising that this was a sign of weakness ordered his legions forward, trusting as he did to the impetus of the charge inspiring them with courage. Mid-way his men paused to regain breath, then advanced again, and when within range the front rank men hurled their javelins and drawing their swords rushed forward, and the two lines clinched. Immediately Pompey launched his cavalry and archers against his enemy's right flank, driving Caesar's cavalry from the field. Then the fourth line came into play, and in place of casting their javelins they closed on the horsemen with the sword "striking at the horses' breasts, and the men's legs and faces." In spite of their numbers the horsemen turned and fled, and the fourth line falling upon the archers and slingers drove them back, then, wheeling to the left, they struck Pompey's front, now locked in battle, on its flank and rear. At once Caesar galloped to his third line and ordered it to advance. This it did, breaking through Pompey's front. When Pompey saw his cavalry routed, despairing of success, he fled to his camp, possibly to rally the fugitives. The camp was eventually assaulted and taken, whereupon Pompey and 30 horse fled to Larissa and embarked for Egypt, where later on he was assassinated by Ptolemy Auletes, or rather by his tutor the eunuch Photinus, for Ptolemy was but a boy of ten. In this battle Caesar lost 30 centurions and 200 men killed, and Pompey 15,000 killed and 24,000 prisoners. Caesar for political reasons showed great clemency by proclaiming a general pardon. He then organised his prisoners into two new legions and sent them to Asia.

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PHARYNGITIS. The pharynx is frequently the seat of a chronic inflammatory condition, usually associated with derangements of the digestive organs, or with syphilis or gout; sometimes it is due to much speaking or to excessive tobacco-smoking —especially of cigarettes. On inspection, the inflamed mucous membrane is seen unduly red and glazed, and dotted over with enlarged follicles. The condition produces irritation and "dryness," with cough and discomfort, which may eventually become chronic. Treatment consists in removing sources of irritation, and in the application of the electric cautery, of astringent lotions or of mild caustic solutions.

PHARYNX, in anatomy, the cavity into which both the nose and mouth lead, which is prolonged into the oesophagus or gullet below, and from which the larynx or air tube comes off below and in front; it therefore serves as a passage both for food and air. The back and sides of the cavity are formed by the three constrictor muscles of the pharynx, each of which overlaps the outer surface of the one above it, and these are lined internally by thick mucous membrane. Above, the pharynx is attached firmly to the base of the skull and the internal pterygoid plates, so that this part cannot collapse, but below the anterior and posterior walls are in contact, and a transverse section of the pharynx is a mere slit.

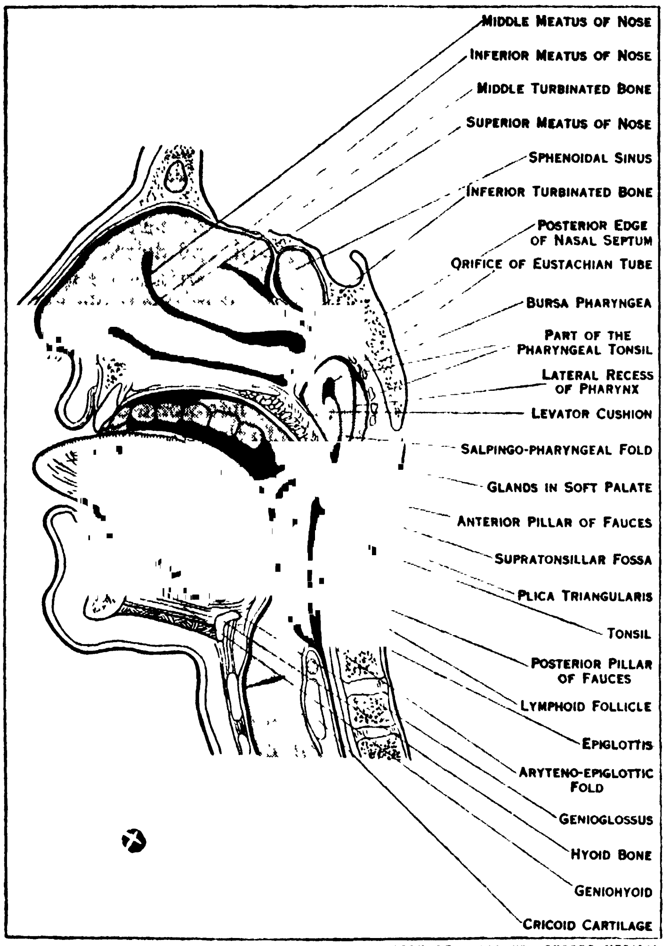
From the front wall, on a level with the floor of the nose and roof of the mouth, a slanting shelf of muscular and glandular tissue covered with mucous membrane, projects downward and backward into the cavity, and divides it into an upper part or naso-pharynx and a lower or oral pharynx (*see* fig.). This shelf is the *soft palate,* and from the middle of its free border hangs a worm-like projection, the *uvula.* The whole of the front wall of the naso-pharynx is wanting, and here the cavity opens into the nose through the posterior nasal apertures (*see* Olfactory System). On each side of the naso-pharynx, and therefore above the soft palate, is the large triangular opening of the Eustachian tube through which air passes to the tympanum (*see* Ear). Behind this opening, and reaching up to the roof of the naso-pharynx, is a mass of lymphoid tissue, most marked in children, known as the pharyngeal tonsil. This tissue hypertrophies in the disease known as "adenoids."

The oral pharynx communicates with the naso-pharynx behind the free edge of the soft palate. Above and in front it is continuous with the cavity of the mouth, and the demarcation between the two is a ridge of mucous membrane on each side running from the soft palate to the side of the tongue, and caused by the projection of the palato-glossus muscle (anterior pillar of the fauces). About half an inch behind this ridge is another, made by the palato-pharyngeus muscle, which gradually fades away in the side of the pharynx below (posterior pillar of the fauces). Between the two pillars is the fossa (tonsilar sinus) in which the tonsil lies.

The *Tonsil* is an oval mass of lymphoid tissue covered by mucous membrane which dips in to form mucous crypts; externally its position nearly corresponds to that of the angle of the jaw. It is very vascular, deriving its blood from five neighbouring arteries. Below the level of the tonsil the anterior wall of the pharynx is formed by the posterior or pharyngeal surface of the tongue (*q.v.*), while below that is the epiglottis and upper opening of the larynx which is bounded laterally by the aryteno-epiglottic folds (*see* Respiratory System). On the lateral side of each of these folds is a pear-shaped fossa known as the *sinus pyriformis.* Below this the pharynx narrows rapidly until the level of the

lower border of the cricoid cartilage in front and of the sixth cervical vertebra behind is reached; here it passes into the oesophagus, having reached a total length of about five inches.

The mucous membrane of the naso-pharynx, like that of the rest of the respiratory tract, is lined by ciliated columnar epithelium, but in the oral pharynx the epithelium is of the stratified



FROM AMBROSE BIRMINGHAM IN "CUNNINGHAM'S TEXT BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

SAGITTAL SECTION THROUGH MOUTH, TONGUE, LARYNX, PHARYNX, AND NASAL CAVITY, VIEWING THE SECTION SLIGHTLY FROM BELOW

squamous variety. Numerous racemose glands are present (*see* GLANDS; TISSUES), as well as patches of lymphoid tissue especially in childhood. Outside the mucous membrane and separating it from the constrictor muscles is the pharyngeal aponeurosis, which blends above with the periosteum of the base of the skull.

Embryology.—The pharynx is partly formed from the ectodermal stomatodaeal invagination (*see* EMBRYOLOGY and MOUTH) and partly from the fore gut, which is the cephalic part of the entodermal mesodaeum. Up to the fifteenth day (*see* MOUTH), the bucco-pharyngeal membrane separates these structures, and, though no vestiges of it remain, it is clear that the upper and front part of the naso-pharynx is stomatodaeal while the rest is mesodaeal. The five visceral arches with their intervening clefts or pouches surround the pharynx, and the Eustachian tube is a remnant of the first of these. The second pouch is represented in the adult by the tonsilar sinus, and until lately the lateral recess of the pharynx was looked upon as part of the same, but it has now been shown to be an independent diverticulum. The *sinus pyriformis* probably represents that part of the fourth groove from which the lateral lobes of the thyroid body are derived.

The tonsil is formed in the second branchial cleft or rather pouch, for the clefts are largely incomplete in man, about the fourth month; its lymphoid tissue, as well as that elsewhere in the pharynx, is formed from lymphocytes in the subjacent mesenchyme (*see* EMBRYOLOGY), though whether these wander in from the blood or are derived from original mesenchyme cells is still doubtful. The development of the ventral part of the pharynx is dealt with in the articles TONGUE and RESPIRATORY SYSTEM.

Comparative Anatomy.—In the lower, water-breathing vertebrates the pharynx is the part in which respiration occurs. The water passes in through the mouth and out through the gill slits where it comes in contact with the gills or branchiae.

The lowest subphylum of the phylum Chordata, to which the term Adelochorda is sometimes applied, contains a worm-like creature Balanoglossus, in which numerous rows of gill slits open from the pharynx, though Cephalodiscus, another member of the same subphylum, has only one pair of these.

In the subphylum Urochorda, to which the Ascidians or sea-squirts belong, there are many rows of gill slits, as there are also in the Acrania, of which Amphioxus, the lancelet, is the type. In all these lower forms there are no true gills, as the blood-vessels lining the large number of slits provide a sufficient area for the exchange of gases.

In the Cyclostomata a reduction of the number of gill slits takes place, and an increased area for respiration is provided by the gill pouches lined by pleated folds of entodermal mucous membrane; these form the simplest type of true internal gills. In the larval lamprey (Ammocoetes) there are eight gill slits opening from the pharynx, but in the adult (Petromyzon) they are reduced to seven, and a septum grows forward separating the ventral or branchial part of the pharynx from the dorsal or digestive part. Both these tubes, however, communicate near the mouth.

In fishes there are usually five pairs of gill slits, though a rudimentary one in front of these is often present and is called the spiracle. Occasionally, as in Hexanchus and Heptanchus, there may be six or seven slits, and the evidence of comparative anatomy is that fishes formerly had a larger number of gill slits than at present.

In the Teleostomi, which include the bony fishes, there is an external gill cover or operculum.

In the Dipnoi or mud fish the work of the gills is shared by that of the lungs, and in the African form, Protopterus, external gills, developed from the ectodermal parts of the gill slits, first appear. In the tailed Amphibians (Urodela) the first and fifth gill clefts are never perforated and are therefore in the same condition as all the gill clefts of the human embryo, while in the gilled salamanders (Necturus and Proteus) only two gill clefts remain patent. The gills in all the Amphibia are external and of ectodermal origin, but in the Anura (frogs and toads) these are succeeded before the metamorphosis from the tadpole stage by internal gills, which, unlike those of fish, are said to be derived from the ectoderm.

In the embryos of the Sauropsida (reptiles and birds) five gill clefts are evident, though the posterior two are seldom at any time perforated, while in the Mammalia the rudiments of the fifth cleft are no longer found in the embryo, and in man, at all events, none of them are normally perforated except that part of the first which forms the Eustachian tube. It will thus be seen that in the process of phylogeny there is a gradual suppression of the gill clefts beginning at the more posterior ones.

The soft palate is first found in crocodiles as a membranous structure, and it becomes muscular in mammals. The bursa pharyngea and pharyngeal tonsil are found in several of the lower mammals. In the sheep the latter is particularly large.

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(F. G. P.)

PHASES. The different luminous appearances presented by the moon (*q.v.*) and several of the planets, the variety of the amount of surface visible from the earth being termed phases.

PHEASANT, the bird, according to legend, introduced by the Argonauts into Europe from the banks of the Phasis (now Rion) in Colchis. Its introduction into England has been attributed, as in the case of so many other species (*e.g.*, the fallow deer, the edible snail, and the Roman nettle), to the Romans, but with

little foundation. This bird, *Phasianis colchicus,* is the type of the family *Phasianidae,* and is reared in England for shooting (*see* SHOOTING). It is distributed in a wild state from the Caspian Sea all over south-east Europe. The male is a handsome bird with brilliant plumage and red wattles; the female protectively coloured in mottled brown. The wings are short; the tail is long. The birds are polygamous; they feed on grain, seeds, shoots, and insects and both fly and run well. The nest is on the ground and 11 or 12 olive-brown eggs are laid. Pheasants will cross with numerous other gallinaceous birds, including the common fowl; the offspring in this case is called a *pero.* The British pheasants have in their blood a mixture of two Chinese species, with white neckrings. This mixture, as well as the pure-bred bird, has been introduced into various parts of U.S.A. and Canada. Reeve's pheasant (*P. reevesi*) from northern China has a very long tail. The golden pheasant (*Chrysolophus pictus*), Amherst's pheasant (*C. amherstiae*) and the silver pheasants (*Gennaeus spp.*) are even more beautiful. They are all Chinese birds and are well known in aviaries. The lovely Argus pheasants (*Argusianus*) of Malacca and Siam may measure 6ft. from the beak to the tail in the male; the secondaries of the wings (which are longer than the primaries) have metallic spots resembling eyes. The monals (*Lophophorus*) inhabit the Himalayas. The peacock pheasants (*Chalcurus* and *Polyplectron*) inhabit Burma, Siam. Indo-China, and the Malay region; the plumage is ornamented with metallic eyespots. The adornments of male pheasants are strikingly displayed in courtship. (*See* COURTSHIP OF ANIMALS.) The so-called Bohemian pheasants are a very rare variety.

BY COURTESY OF THE PUBLISHER'S PHOTO SERVICE

THE GOLDEN PHEASANT (PHASIANUS COLCHICUS LINN)

See Tegetmeier, *Pheasants; their Natural History and Practical Management;* Beebe, *Monograph of the Phasianidae* (1918–22).

PHEASANT'S EYE, a European plant. (*See* ADONIS.)

PHEIDIAS, son of Charmides, universally regarded as the greatest of Greek sculptors, was born at Athens about 500 B.C. Hegias of Athens was his first master. To his early career belong a chryselephantine Athene for Pellene and a Marathon memorial at Delphi. To this period also belongs the great bronze Athene whose helmet and spear could be seen above the Acropolis buildings far out to sea. An Apollo, found in the Tiber, bears so many of Pheidias's known characteristics that it may be Pheidias's own work (Schrader, in *Jahreshefte,* 1911). If so, it is the only original work by him that we have. Our information as to his later career is fuller, but confusing. We know that he made the colossal Zeus at Olympia; that he controlled the artistic activity at Athens under Pericles, and fell into trouble from Pericles's opponents on charges of peculation, and of sacrilege in representing himself and Pericles on Athene's shield. But the order of these events is obscure. All we know is that the Athene Parthenos was dedicated in 438.

It is important to observe that in resting the fame of Pheidias upon the sculptures of the Parthenon we proceed with little evidence. No ancient writer ascribes them to him, and he seldom, if ever, executed works in marble. What he was celebrated for in antiquity were his statues in bronze or gold and ivory. If Plutarch tells us that he superintended the great works of Pericles on the Acropolis, this phrase is very vague. On the other hand, inscriptions prove that the marble blocks intended for the pedimental statues of the Parthenon were not brought to Athens until 434 B.C., which was probably after the death of Pheidias. And there is a marked contrast in style between these statues and the certain works of Pheidias. It is therefore probable that most, if not all, of the sculptural decoration of the Parthenon was the work of pupils of Pheidias, such as Alcamenes and Agoracritus, working on his designs, rather than their own.

Among the Greeks themselves the two works of Pheidias which far outshone all others, and were the basis of his fame, were the colossal figures in gold and ivory of Zeus at Olympia and of Athena Parthenos at Athens, both of which belong to about the middle of the 5th century. Of the Zeus we have unfortunately lost all trace save small copies on coins of Elis, which give us but a general notion of the pose, and the character of the head. The god was seated on a throne, every part of which was used as a ground for sculptural decoration. His body was of ivory, his robe of gold. His head was of somewhat archaic type; the Otricoli mask which used to be regarded as a copy of the head of the Olympian statue is certainly more than a century later in style. Of the Athena Parthenos two small copies in marble have been found at Athens (*see* GREEK ART, fig. 38), which have no excellence of workmanship, but have a certain evidential value as to the treatment of their original. Other works of Pheidias were the Lemnian Athena, an Apollo Parnopius and an Aphrodite Urania at Elis.

The fine torso of Athena in the École des Beaux Arts at Paris, which has unfortunately lost its head, may perhaps best serve to help our imagination in reconstructing a Pheidian original.

As regards the decorative sculptures of the Parthenon, which the Greeks rated far below their colossus in ivory and gold, *see* the article PARTHENON.

Ancient critics take a very high view of the merits of Pheidias. What they especially praise are his elevated ideas of godhead, and these, the expression of the best religious thought of his time, reacted on the religious conceptions of Greece. A copy of the shield that contained his portrait (the "Strangford" shield) is in the British Museum. Pheidias appears as a vigorous, bald-headed old man.

See Petersen, *Kunst des Phidias* (Berlin, 1873); C. Waldstein, *Essays on the Art of Pheidias* (Cambridge, 1885); Collignon, *Pheidias* (Paris, 1886).

PHEIDON (8th or 7th century B.C.), king of Argos. According to tradition he flourished during the first half of the 8th century B.C. He was a vigorous and energetic ruler and greatly increased the power of Argos. He gradually regained sway over the various cities of the Argive confederacy, the members of which had become practically independent, and (in the words of Ephorus) "reunited the broken fragments of the inheritance of Temenus." His object was to secure predominance for Argos in the north of Peloponnesus. Pheidon assisted the Pisatans to expel the Elean superintendents of the Olympian games and presided at the festival himself. The Eleans, however, refused to recognize the Olympiad or to include it in the register, and shortly afterwards, with the aid of the Spartans, who are said to have looked upon Pheidon as having ousted them from the headship of Greece, defeated Pheidon and were reinstated in the possession of Pisatis and their former privileges. Pheidon is said to have lost his life in a faction fight at Corinth, where the monarchy had recently been overthrown. He made changes in the existing system of weights and measures in the Peloponnese, and his system was in use at Athens before Solon (Arist. *Ath. Pol.* x. 2), but Ephorus' statement that he first coined silver money seems unlikely.

His date is disputed. Pausanias assigns the Olympiad at which he presided to 748, but the balance of modern authority is in favour of the first half of the 7th century.

See Herodotus vi. 127; Ephorus in Strabo viii. 358, 376; Plutarch, *Amatoriae narrationes,* 2; Marmor parium, *ep.* 30; Pollux ix. 83; Nicolaus Damascenus, frag. 41 (in C. W. Müller's *Frag. hist. graecorum,* iii.); G. Grote, *History of Greece,* pt. ii. ch. 4; B. V. Head, *Historia Numorum* (1887); F. Hultsch, *Griechische und römische Metrologie* (1882); G. Rawlinson's *Herodotus,* appendix, bk. i., note 8. On the question of Pheidon's date, *see* J. B. Bury, *History of Greece,* ii. 468 (1902); J. P. Mahaffy, *Problems in Greek History,* ch. 3 (1892); J. G. Frazer's note on Pausanias vi. 22. 2; and especially G. Busolt, *Griechische Geschichte* (2nd ed., 1893), ch. iii. 12. C. Trieber, *Pheidon von Argos* (Hanover, 1880), and J. Beloch, in *Rheinisches Museum,* xlv. 595 (1890), favour a later date, about 580.

PHELPS, EDWARD JOHN (1822–1900), American lawyer and diplomat, was born on July 11, 1822, at Middlebury, Vt. He graduated from Middlebury college in 1840, was a schoolmaster for a year in Virginia and was admitted to the bar in 1843. From 1851 to 1853 he was second controller of the U.S. Treasury, and then practised law in New York city until 1857, when he returned to Burlington. He was one of the founders of the American Bar Association, and was its president in 1880–81.

From 1881 until his death he was Kent professor of law in Yale university. He was minister to Great Britain from 1885 to 1889, and in 1893 served as senior counsel for the United States before the international tribunal at Paris to adjust the Bering sea controversy. He died at New Haven, Conn., on March 9, 1900.

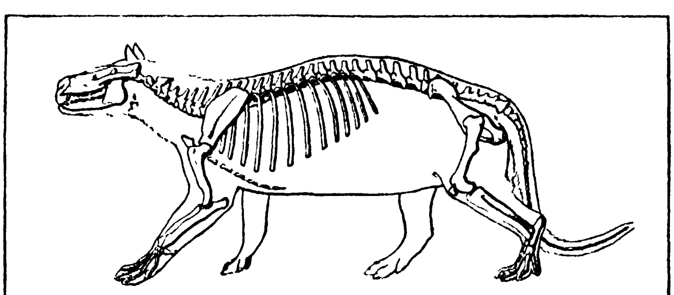
See his *Orations and Essays,* edited by J. G. McCullough, with a "Memoir" by J. W. Stewart (1901); and the memorial address by M. H. Buckham, in *Proceedings of the Vermont Historical Society* (Burlington, Vt., 1901).

PHELPS, SAMUEL (1804–1878), English actor and manager, was born at Devonport on Feb. 13, 1804. He made his first London appearance on Aug. 28, 1837 as Shylock at the Haymarket. After a short season there he was with Macready for about six years at Covent Garden, the Haymarket and Drury Lane successively. In 1844 he became co-lessee of Sadler's Wells Theatre with Thomas L. Greenwood and Mary Amelia Warner (1804–54). Phelps spent 20 years at Sadler's Wells theatre, and raised the house to a leading position in London. Thirty-four of Shakespeare's plays were presented there under his direction. He died on Nov. 6, 1878.

PHENACETIN, a drug crystallizing from water in colourless plates, melting at 135° C. It is soluble in about 70 parts of hot and in about 1,400 parts of cold water. It is prepared by acetylating para-phenetidine, or by heating para-acetylaminophenol and potassium ethyl sulphate with alcoholic soda to 150° C. It is acetyl-*p*-phenetidine, $C_2H_5O{\cdot}C_6H_4{\cdot}NHCOCH_3$. Para-phenetidine is prepared by treating the sodium salt of para-nitrophenol with ethyl iodide, and reducing the nitrophenetole to para-phenetidine or aminophenetole. The yield may be doubled by diazotizing para-phenetidine, coupling with phenol, ethylating and reducing.

Several compounds related to phenacetin have been introduced into medicine. Triphenin is propylphenetidine; lactophenin is lactylphenetidine; pyrantin is para-ethoxyphenyl succinimide, $EtO{\cdot}C_6H_4{\cdot}N[CO{\cdot}CH_2]_2$; salophen or saliphenin is salicylphenetidine; amygdophenin is mandelylphenetidine. In addition, several other derivatives have been suggested which have a greater solubility than phenacetin, *e.g.,* phesin, which is the sodium salt of phenacetinsulphonic acid, apolysin and citrophen (citrophenin), which are citric acid derivatives of para-phenetidin, etc.

Phenacetin is contained in both the British and United States pharmacopoeia, in the latter under the name of acetphenetidin. The dose is 5 to 10 gr. given in cachets or in suspension. When the drug is carelessly made it may contain impurities, producing considerable irritation of the kidneys. The physiological action of phenacetin consists in a sedative action on the sensory tracts of the spinal cord, and a depressant action on the heart, where it tends to paralyse the action of the cardiac muscle. Its chief therapeutic use is as an antineuralgic, and it is of service in migraine, rheumatism of the sub-acute type, intercostal neuralgia and locomotor ataxia.



FROM SCOTT, "LAND MAMMALS OF THE WESTERN HEMISPHERE"

SKELETON OF THE WASATCH CONDYLARTH, IN THE AMERICAN MUSEUM OF NATURAL HISTORY

PHENACODUS, a primitive and generalized hoofed mammal of the Lower Eocene, now extinct. The two best known species are represented by complete skeletons found in the Bighorn basin of Wyoming in 1881. They are of the size respectively of a pig and of a fox, and typically of the family Phenacodontidae of the order Condylarthra.

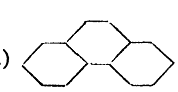
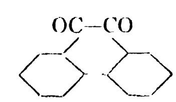
The teeth of *Phenacodus* are very short-crowned, with low rounded cusps, the dentition unreduced, the premolars smaller than the molars and of simpler pattern. The feet are five-toed but the first and fifth digits are considerably reduced; the small flattened hoofs resemble those of the tapir. The arrangement of the wrist-bones is serial, the upper row directly overlying the lower ones, as in *Hyrax* and the elephant, instead of alternating as with other hoofed animals. The astragalus in the hind foot is like that of Carnivora with distinct neck and convex rounded head. This character distinguishes the Condylarthra from the higher ungulates as the primitive construction of their teeth distinguishes them from the variously specialized ungulate tooth patterns. The brain was small and of inferior structure. (W. D. M.)

PHENAKITE, a mineral consisting of beryllium orthosilicate, Be_2SiO_4, occasionally used as a gem-stone. In general appearance it is not unlike quartz, for which indeed it had been mistaken, and was on this account named from Gr. φέναξ (a deceiver). It occurs as isolated crystals, which are rhombohedral with parallel-faced hemihedrism, and are either lenticular or prismatic in habit. There is no cleavage, the fracture is conchoidal, and the crystals are sometimes perfectly colourless and transparent, but more often greyish or yellowish and only translucent. The hardness is high, being 7·5–8; the specific gravity is 2·98.

Phenakite has long been known from the emerald and chrysoberyl mine on the Takovaya stream, near Ekaterinburg in the Urals, where large crystals occur in mica-schist. It is also found with topaz and microline in the granite of the Ilmen mountains in the southern Urals and of the Pike's Peak region, Colorado. Large crystals of prismatic habit have more recently been found in a felspar quarry at Kragerö, Norway, and clear lenticular crystals are abundant at San Miguel de Piricicaba, Brazil.

For gem purposes the stone is cut in the brilliant form, of which there are two fine examples, weighing 43 and 34 carats, in the mineral collection of the British Museum. The indices of refraction ($\omega = 1{\cdot}6540$, $\epsilon = 1{\cdot}6527$) are higher than those of quartz, beryl or topaz; a faceted phenakite is consequently rather brilliant and may sometimes be mistaken for diamond.

PHENANTHRENE, an aromatic hydrocarbon having the same composition, $C_{14}H_{10}$, as anthracene (*q.v.*) and found with the latter in distillates from coal tar boiling between 270° and 400° C. The crude solid hydrocarbons from this fraction are separated by crystallisation from various organic solvents (alcohol, acetone, carbon disulphide, etc.), phenanthrene being more soluble than anthracene. The former is also less oxidisable than the latter so that chromic acid treatment removes residual anthracene. Phenanthrene (formula I.) is obtained in colourless needles

(I.)   (II.)

or triclinic plates melting at 100–101° C and boiling at 340° C; it exhibits a faint blue fluorescence in solution or when vaporised. Its picrate forms yellow crystals melting at 145° C. Phenanthrene is oxidised by chromic acid to phenanthraquinone (formula II.), obtained in orange needles melting at 198–202° C; it is a typical *ortho*-quinone (*see* QUINONES) and condenses with *ortho*-diamines to form phenazines (*q.v.*). Distilled with soda lime, phenanthraquinone yields diphenyl and by further oxidation the quinone gives diphenic acid. These reactions serve to establish the constitution of the phenanthrene nucleus (I.). This nucleus is present in certain of the opium alkaloids, and when distilled with zinc dust morphine yields phenanthrene. Many attempts have been made, but with little success, to utilise phenanthrene in colour making.

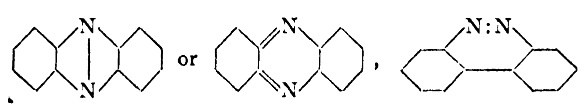
See A. E. Everest, *The Higher Coal Tar Hydrocarbons* (1927).

PHENAZINE, in organic chemistry, the parent substance of many dyestuffs, *e.g.,* the eurhodines, toluylene red, indulines and safranines. (*See* DYES, SYNTHETIC.) It may be obtained by passing aniline vapour over lead oxide, or by the oxidation of dihydrophenazine, which is prepared by heating catechol with orthophenylenediamine. It is also formed when ortho-aminodi

phenylamine is distilled over lead peroxide. It crystallizes in yellow needles which melt at 171° C, and are only sparingly soluble in alcohol. Its formula is $C_{12}H_8N_2$. Sulphuric acid dissolves it, forming a deep red solution. The more complex phenazines, *i.e.*, the naphthophenazines, naphthazines and naphthotolazines, may be prepared by condensing ortho-diamines with ortho-quinones (O. Hinsberg, 1887); by the oxidation of an ortho-diamine in the presence of α-naphthol (O. Witt), and by the decomposition of ortho-anilido (-toluidido-, etc.)-azo compounds with dilute acids. If alkyl or aryl-ortho-diamines be used azonium bases are obtained. The azines are mostly yellow in colour, distil unchanged and are stable to oxidants. They add on alkyl iodides readily, forming alkyl azonium salts.

The symmetrical diaminophenazine is the parent substance of the important dyestuff toluylene red or dimethyldiaminotoluphenazine. It is obtained by the oxidation of orthophenylenediamine with ferric chloride; by oxidizing a mixture of para-aminodimethylaniline and meta-tolylenediamine, toluylene blue, an indamine, being formed as an intermediate product and passing into the red when boiled; and also by the oxidation of dimethylparaphenylenediamine with metatolylenediamine. It crystallizes in orange-red needles and its alcoholic solution fluoresces strongly. It dyes silk and mordanted cotton a fine scarlet. It is known commercially as neutral red. Phenazonium salts are known as safranines. (*See* DYES, SYNTHETIC.)

Phenazone or dibenzopyridazine is an isomeride of phenazine, to which it bears the same relation that phenanthrene bears to anthracene (*qq.v.*). It is formed by reducing diortho-dinitrodiphenyl with sodium amalgam and methyl alcohol. It crystallizes in yellow needles which melt at 156° C. Potassium permanganate oxidizes it to pyridazinetetracarboxylic acid.

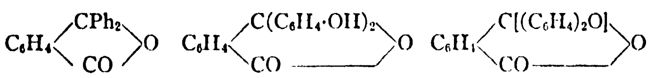


Phenazine Phenazone

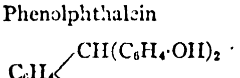
PHENIX CITY, a city of Lee county, Alabama, U.S.A., on the Chattahoochee river, opposite Columbus, Ga. It is on Federal highway 80, and is served by the Central of Georgia railway. Pop. 5,432 in 1920 (85% native white). It is a residential and industrial suburb of Columbus.

PHENOL CONDENSATION PRODUCT: *see* CARBOLIC ACID; BAKELITE.

PHENOLPHTHALEIN, an organic compound of the aromatic series which has two uses: (1) as an indicator for acids and bases in volumetric analysis; (2) as a purgative drug. The phthaleins are prepared by condensing phenols with phthalic anhydride, phenol itself giving rise to phenolphthalein together with a small quantity of fluorane, whilst resorcinol under similar conditions yields fluorescein (*q.v.*). The phthaleins on reduction yield phthalines which are derivatives of triphenylmethane carboxylic acid; thus phenolphthalein itself gives phenolphthaline.



Diphenylphthalide Phenolphthalein Fluorane



Phenolphthaline

Phenolphthalein is obtained when phenol and phthalic anhydride are heated with concentrated sulphuric acid. It crystallizes in colourless crusts (m.p. 250–253° C) and is nearly insoluble in water, but dissolves in dilute solutions of the caustic alkalis with a fine red colour, being reprecipitated from these solutions by the addition of mineral acid. It is to this remarkable colour change that its use as an indicator is due. It dissolves in concentrated caustic alkalis to a colourless solution which probably contains salts of a non-quinonoid character. On fusion with caustic alkali, phenolphthalein yields benzoic acid and para-dihydroxybenzophenone, which shows that in the original condensation the phthalic acid residue has taken the para position to the hydroxyl groups of the phenol.

Fluorane is a by-product of the condensation of phthalic acid and phenol, substitution occurring in the ortho position to the hydroxyl groups of the phenol, so that anhydride formation takes place between these hydroxyl groups. It dissolves in concentrated sulphuric acid with a yellowish-green fluorescence.

Phenolphthalein has extended use as a purgative under such synonyms as purgen, laxoin, laxatol, etc. The official dose is 2 to 5 grains (0·12 to 0·3 grams), but larger doses are given. Phenolphthalein is dissolved in the bile and by the alkali of the intestine, and being irritant to the latter it causes peristalsis. It is partly absorbed and partly excreted by the liver and so acts repeatedly on the intestine, acting for a few days as a mild aperient.

PHENOMENALISM, in philosophy, is a name applied to several different schools of thought which maintain in common that human knowledge (so-called) is confined to phenomena in the broad sense of the term, according to which it denotes generally events or things in space and time. But the schools differ among themselves on the ontological (as distinguished from the epistemological) question relating to the objective source or basis of the phenomena. (1) According to one view it is assumed more or less that there is an objective reality of which the phenomena are the changing appearances, but it is maintained that this ultimate basic reality is beyond the reach of human knowledge, which is limited to the apprehension of appearances adapted to or relative to human powers. In one form or another some such view is maintained by Agnosticism, the critical Philosophy, Empiricism, and Positivism.

(2) Another view is to the effect that there is no permanent substance underlying the ever-changing flux of phenomena; in other words, these ever-changing phenomena are the only reality. This was the view held by Heraclitus among the ancient Greeks, and by Bergson among present-day philosophers, also by others.

(3) Yet a third view would deny the external existence even of phenomena in the ordinary sense of the term (that is, events actually occurring in space and time) and identifies all reality with the mere appearances to or in the mind or mental experiences as such. This view is represented by Shadworth Hodgson, the author of *The Metaphysic of Experience* (1898), and others.

It should be observed that the first kind of phenomenalism (1) is merely epistemological, whereas the other two, (2) and (3), are also ontological. Ontological phenomenalism implies epistemological phenomenalism, but not *vice versa*. *See* METAPHYSICS, and KNOWLEDGE, THEORY OF.

PHENOMENOLOGY denotes a new, descriptive, philosophical method, which, since the concluding years of the last century, has established (1) an a priori psychological discipline, able to provide the only secure basis on which a strong empirical psychology can be built, and (2) a universal philosophy, which can supply an organum for the methodical revision of all the sciences.

I. PHENOMENOLOGICAL PSYCHOLOGY

Present-day psychology, as the science of the "psychical" in its concrete connection with spatio-temporal reality, regards as its material whatever is present in the world as "ego-istic"; *i.e.*, "living," perceiving, thinking, willing, etc., actual, potential and habitual. And as the psychical is known as a certain stratum of existence, proper to men and beasts, psychology may be considered as a branch of anthropology and zoology. But animal nature is a part of physical reality, and that which is concerned with physical reality is natural science. Is it, then, possible to separate the psychical cleanly enough from the physical to establish a pure psychology parallel to natural science? That a purely psychological investigation is practicable within limits is shown by our obligation to it for our fundamental conceptions of the psychical, and most of those of the psycho-physical.

But before determining the question of an unlimited psychology, we must be sure of the characteristics of psychological experience and the psychical data it provides. We turn naturally to our

immediate experiences. But we cannot discover the psychical in any experience, except by a "reflection," or perversion of the ordinary attitude. We are accustomed to concentrate upon the matters, thoughts, and values of the moment, and not upon the psychical "act of experience" in which these are apprehended. This "act" is revealed by a "reflection"; and a reflection can be practised on every experience. Instead of the matters themselves, the values, goals, utilities, etc., we regard the subjective experiences in which these "appear." These "appearances" are phenomena, whose nature is to be a "consciousness-of" their object, real or unreal as it be. Common language catches this sense of "relativity," saying, I was thinking *of* something, I was frightened *of* something, etc. Phenomenological psychology takes its name from the "phenomena," with the psychological aspect of which it is concerned: and the word "intentional" has been borrowed from the scholastic to denote the essential "reference" character of the phenomena. All consciousness is "intentional."

In unreflective consciousness we are "directed" upon objects, we "intend" them; and reflection reveals this to be an immanent process characteristic of all experience, though infinitely varied in form. To be conscious of something is no empty having of that something in consciousness. Each phenomenon has its own intentional structure, which analysis shows to be an ever-widening system of individually intentional and intentionally related components. The perception of a cube, for example, reveals a multiple and synthesized intention: a continuous variety in the "appearance" of the cube, according to differences in the points of view from which it is seen, and corresponding differences in "perspective," and all the difference between the "front side" actually seen at the moment and the "backside" which is not seen, and which remains, therefore, relatively "indeterminate," and yet is supposed equally to be existent. Observation of this "stream" of "appearance-aspects" and of the manner of their synthesis, shows that every phase and interval is already in itself a "consciousness-of" something, yet in such a way that with the constant entry of new phases the total consciousness, at any moment, lacks not synthetic unity, and is, in fact, a consciousness of one and the same object. The intentional structure of the train of a perception must conform to a certain type, if any physical object is to be perceived as there! And if the same object be intuited in other modes, if it be imagined, or remembered, or copied, all its intentional forms recur, though modified in character from what they were in the perception, to correspond to their new modes. The same is true of every kind of psychical experience. Judgment, valuation, pursuit, these also are no empty experiences having in consciousness of judgments, values, goals and means, but are likewise experiences compounded of an intentional stream, each conforming to its own fast type.

Phenomenological psychology's comprehensive task is the systematic examination of the types and forms of intentional experience, and the reduction of their structures to the prime intentions, learning thus what is the nature of the psychical, and comprehending the being of the soul.

The validity of these investigations will obviously extend beyond the particularity of the psychologist's own soul. For psychical life may be revealed to us not only in self-consciousness but equally in our consciousness of other selves, and this latter source of experience offers us more than a reduplication of what we find in our self-consciousness, for it establishes the differences between "own" and "other" which we experience, and presents us with the characteristics of the "social-life." And hence the further task accrues to psychology of revealing the intentions of which the "social life" consists.

Phenomenological-psychological and Eidetic Reductions.—The Phenomenological psychology must examine the self's experience of itself and its derivative experience of other selves and of society, but whether, in so doing, it can be free of all psycho-physical admixture, is not yet clear. Can one reach a really pure self-experience and purely psychical data? This difficulty, even since Brentano's discovery of intentionality, as the fundamental character of the psychical, has blinded psychologists to the possibilities of phenomenological psychology. The psychologist finds his self-consciousness mixed everywhere with "external" experience, and non-psychical realities. For what is experienced as external belongs not to the intentional "internal," though our experience of it belongs there as an experience of the external. The phenomenologist, who will only notice phenomena, and know purely his own "life," must practice an ἐποχή. He must inhibit every ordinary objective "position," and partake in no judgment concerning the objective world. The experience itself will remain what it was, an experience of this house, of this body, of this world in general, in its particular mode. For one cannot describe any intentional experience, even though it be "illusory," a self-contradicting judgment and the like, without describing what in the experience is, as such, the object of consciousness.

Our comprehensive ἐποχή puts, as we say, the world between brackets, excludes the world which is simply there! from the subject's field, presenting in its stead the so-and-so-experienced-perceived-remembered-judged-thought-valued-etc., world, as such, the "bracketed" world. Not the world or any part of it appears, but the "sense" of the world. To enjoy phenomenological experience we must retreat from the objects posited in the natural attitude to the multiple modes of their "appearance," to the "bracketed" objects.

The phenomenological reduction to phenomena, to the purely psychical, advances by two steps: (1) systematic and radical ἐποχή of every objectifying "position" in an experience, practised both upon the regard of particular objects and upon the entire attitude of mind, and (2) expert recognition, comprehension and description of the manifold "appearances" of what are no longer "objects" but "unities" of "sense." So that the phenomenological description will comprise two parts, description of the "noetic" (νόεω) or "experiencing" and description of the "noematic" (νόημα) or the "experienced." Phenomenological experience, is the only experience which may properly be called "internal" and there is no limit to its practice. And as a similar "bracketing" of objective, and description of what then "appears" ("noema" in "noesis"), can be performed upon the "life" of another self which we represent to ourselves, the "reductive" method can be extended from one's own self-experience to one's experience of other selves. And, further, that society, which we experience in a common consciousness, may be reduced not only to the intentional fields of the individual consciousness, but also by the means of an inter-subjective reduction, to that which unites these, namely the phenomenological unity of the social life. Thus enlarged, the psychological concept of internal experience reaches its full extent.

But it takes more than the unity of a manifold "intentional life," with its inseparable complement of "sense-unities," to make a "soul." For from the individual life that "ego-subject" cannot be disjoined, which persists as an identical ego or "pole," to the particular intentions, and the "habits" growing out of these. Thus the "inter-subjective," phenomenologically reduced and concretely apprehended, is seen to be a "society" of "persons," who share a conscious life.

Phenomenological psychology can be purged of every empirical and psycho-physical element, but, being so purged, it cannot deal with "matters of fact." Any closed field may be considered as regards its "essence," its εἶδος, and we may disregard the factual side of our phenomena, and use them as "examples" merely. We shall ignore individual souls and societies, to learn their a priori, their "possible" forms. Our thesis will be "theoretical," observing the invariable through variation, disclosing a typical realm of a priori. There will be no psychical existence whose "style" we shall not know. Psychological phenomenology must rest upon eidetic phenomenology.

The phenomenology of the perception of bodies, for example, will not be an account of actually occurring perceptions, or those which may be expected to occur, but of that invariable "structure," apart from which no perception of a body, single or prolonged, can be conceived. The phenomenological reduction reveals the phenomena of actual internal experience; the eidetic reduction, the essential forms constraining psychical existence.

Men now demand that empirical psychology shall conform to

the exactness required by modern natural science. Natural science, which was once a vague, inductive empiric, owes it modern character to the a priori system of forms, nature as it is "conceivable," which its separate disciplines, pure geometry, laws of motion, time, etc., have contributed. The methods of natural science and psychology are quite distinct, but the latter, like the former, can only reach "exactness" by a rationalization of the "essential."

The psycho-physical has an a priori which must be learned by any complete psychology, this a priori is not phenomenological, for it depends no less upon the essence of physical, or more particularly organic nature.

II. TRANSCENDENTAL PHENOMENOLOGY

Transcendental philosophy may be said to have originated in Descartes, and phenomenological psychology in Locke, Berkeley and Hume, although the latter did not grow up primarily as a method or discipline to serve psychology, but to contribute to the solution of the transcendental problematic which Descartes had posed. The theme propounded in the *Meditations* was still dominant in a philosophy which it had initiated. All reality, so it ran, and the whole of the world which we perceive as existent, may be said to exist only as the content of our own representations, judged in our judgments, or, at best, proved by our own knowing. There lay impulse enough to rouse all the legitimate and illegitimate problems of transcendence, which we know. Descartes' "Doubting" first disclosed "transcendental subjectivity," and his "Ego Cogito" was its first conceptual handling. But the Cartesian transcendental "Mens" became the "Human Mind," which Locke undertook to explore; and Locke's exploration turned into a psychology of the internal experience. And since Locke thought his psychology could embrace the transcendental problems, in whose interest he had begun his work, he became the founder of a false psychologistical philosophy which has persisted because men have not analysed their concept of "subjective" into its twofold significance. Once the transcendental problem is fairly stated, the ambiguity of the sense of the "subjective" becomes apparent, and establishes the phenomenological psychology to deal with its one meaning, and the transcendental phenomenology with its other.

Phenomenological psychology has been given the priority in this article, partly because it forms a convenient stepping-stone to the philosophy and partly because it is nearer to the common attitude than is the transcendental. Psychology, both in its eidetic and empirical disciplines, is a "positive" science, promoted in the "natural attitude" with the world before it for the ground of all its themes, while transcendental experience is difficult to realize because it is "supreme" and entirely "unworldly." Phenomenological psychology, although comparatively new, and completely new as far as it uses intentional analysis, can be approached from the gates of any of the positive sciences: and, being once reached, demands only a re-employment, in a more stringent mode, of its formal mechanism of reduction and analysis, to disclose the transcendental phenomena.

But it is not to be doubted that transcendental phenomenology could be developed independently of all psychology. The discovery of the double relativity of consciousness suggests the practice of both reductions. The psychological reduction does not reach beyond the psychical in animal realities, for psychology subserves real existence, and even its eidetic is confined to the possibilities of real worlds. But the transcendental problem will include the entire world and all its sciences, to "doubt" the whole. The world "originates" in us, as Descartes led men to recognize, and within us acquires its habitual influence. The general significance of the world, and the definite sense of its particulars, is something of which we are conscious within our perceiving, representing, thinking, valuing life, and therefore something "constituted" in some subjective genesis.

The world and its property, "in and for itself," exists as it exists, whether I, or we, happen, or not, to be conscious of it. But let once this general world, make its "appearance" in consciousness as "the" world, it is thenceforth related to the subjective, and all its existence and the manner of it, assumes a new dimension, becoming "incompletely intelligible," "questionable." Here, then, is the transcendental problem; this "making its appearance," this "being for us" of the world, which can only gain its significance "subjectively," what is it? We may call the world "internal" because it is related to consciousness, but how can this quite "general" world, whose "immanent" being is as shadowy as the consciousness wherein it "exists," contrive to appear before us in a variety of "particular" aspects, which experience assures us are the aspects of an independent, self-existent world? The problem also touches every "ideal" world, the world of pure number, for example, and the world of "truths in themselves." And no existence, or manner of existence, is less wholly intelligible than ourselves. Each by himself, and in society, we, in whose consciousness the world is valid, being men, belong ourselves to the world. Must we, then, refer ourselves to ourselves to gain a worldly sense, a worldly being? Are we both psychologically to be called men, subjects of a psychical life, and yet be transcendental to ourselves and the whole world, being subjects of a transcendental world-constituting life? Psychical subjectivity, the "I" and "we" of everyday intent, may be experienced as it is in itself under the phenomenological-psychological reduction, and being eidetically treated, may establish a phenomenological psychology. But the transcendental subjectivity, which for want of language we can only call again, "I myself," "we ourselves," cannot be found under the attitude of psychological or natural science, being no part at all of the objective world, but that subjective conscious life itself, wherein the world and all its content is made for "us," for "me." We that are, indeed, men, spiritual and bodily, existing in the world, are, therefore, "appearances" unto ourselves, parcel of what "we" have constituted, pieces of the significance "we" have made. The "I" and "we," which we apprehend, presuppose a hidden "I" and "we" to whom they are "present."

To this transcendental subjectivity, transcendental experience gives us direct approach. As the psychical experience was purified, so is the transcendental, by a reduction. The transcendental reduction may be regarded as a certain further purification of the psychological interest. The universal is carried to a further stage. Henceforth the "bracketing" includes not the world only but its "souls" as well. The psychologist reduces the ordinarily valid world to a subjectivity of "souls," which are a part of the world which they inhabit. The transcendental phenomenologist reduces the already psychologically purified to the transcendental, that most general, subjectivity, which makes the world and its "souls," and confirms them.

I no longer survey my perception experiences, imagination-experiences, the psychological data which my psychological experience reveals: I learn to survey transcendental experience. I am no longer interested in my own existence. I am interested in the pure intentional life, wherein my psychically real experiences have occurred. This step raises the transcendental problem (the transcendental being defined as the quality of that which is consciousness) to its true level. We have to recognize that relativity to consciousness is not only an actual quality of our world, but, from eidetic necessity, the quality of every conceivable world. We may, in a free fancy, vary our actual world, and transmute it to any other which we can imagine, but we are obliged with the world to vary ourselves also, and ourselves we cannot vary except within the limits prescribed to us by the nature of subjectivity. Change worlds as we may, each must ever be a world such as we could experience, prove upon the evidence of our theories and inhabit with our practice. The transcendental problem is eidetic. My psychological experiences, perceptions, imaginations and the like remain in form and content what they were, but I see them as "structures" now, for I am face to face at last with the ultimate structure of consciousness.

It is obvious that, like every other intelligible problem, the transcendental problem derives the means of its solution from an existence-stratum, which it presupposes and sets beyond the reach of its enquiry. This realm is no other than the bare subjectivity of consciousness in general, while the realm of its investigation

remains not less than every sphere which can be called "objective," which considered in its totality, and at its root, is the conscious life. No one, then, can justly propose to solve the transcendental problem by psychology either empirical or eidetic-phenomenological, without *petitio principii,* for psychology's "subjectivity" and "consciousness" are not that subjectivity and consciousness, which our philosophy will investigate. The transcendental reduction has supplanted the psychological reduction. In the place of the psychological "I" and "we," the transcendental "I" and "we" are comprehended in the concreteness of transcendental consciousness. But though the transcendental "I" is not my psychological "I," it must not be considered as if it were a second "I," for it is no more separated from my psychological "I" in the conventional sense of separation, than it is joined to it in the conventional sense of being joined.

Transcendental self-experience may, at any moment, merely by a change of attitude, be turned back into psychological self-experience. Passing, thus, from the one to the other attitude, we notice a certain "identity" about the ego. What I saw under the psychological reflection as "my" objectification, I see under the transcendental reflection as self-objectifying, or, as we may also say, as objectified by the transcendental "I." We have only to recognize that what makes the psychological and transcendental spheres of experience parallel is an "identity" in their significance, and that what differentiates them is merely a change of attitude, to realize that the psychological and transcendental phenomenologies will also be parallel. Under the more stringent ἐποχή the psychological subjectivity is transformed into the transcendental subjectivity, and the psychological inter-subjectivity into the transcendental inter-subjectivity. It is this last which is the concrete, ultimate ground, whence all that transcends consciousness, including all that is real in the world, derives the sense of its existence. For all objective existence is essentially "relative," and owes its nature to a unity of intention, which being established according to transcendental laws, produces consciousness with its habit of belief and its conviction.

Phenomenology, the Universal Science.—Thus, as phenomenology is developed, the Leibnitzian foreshadowing of a universal ontology, the unification of all conceivable a priori sciences, is improved, and realized upon the new and non-dogmatic basis of phenomenological method. For phenomenology as the science of all concrete phenomena proper to subjectivity and inter-subjectivity, is *eo ipso* an a priori science of all possible existence and existences. Phenomenology is universal in its scope, because there is no a priori which does not depend upon its intentional constitution, and derive from this its power of engendering habits in the consciousness that knows it, so that the establishment of any a priori must reveal the subjective process by which it is established.

Once the a priori disciplines, such as the mathematical sciences, are incorporated within phenomenology, they cannot thereafter be beset by "paradoxes" or disputes concerning principles: and those sciences which have become a priori independently of phenomenology, can only hope to set their methods and premises beyond criticism, by founding themselves upon it. For their very claim to be positive, dogmatic sciences bears witness to their dependency, as branches, merely, of that universal, eidetic ontology, which is phenomenology.

The endless task, this exposition of the universum of the a priori, by referring all objectives to their transcendental "origin," may be considered as one function in the construction of a universal science of fact, where every department, including the positive, will be settled on its a priori. So that our last division of the complete phenomenology is thus: eidetic phenomenology, or the universal ontology, for a first philosophy; and second philosophy as the science of the transcendental inter-subjectivity or universum of fact.

Thus the antique conception of philosophy as the universal science, philosophy in the Platonic, philosophy in the Cartesian, sense, that shall embrace all knowledge, is once more justly restored. All rational problems, and all those problems, which for one reason or another, have come to be known as "philosophical," have their place within phenomenology, finding from the ultimate source of transcendental experience or eidetic intuition, their proper form and the means of their solution. Phenomenology itself learns its proper function of transcendental human "living" from an entire relationship to "self." It can intuite life's absolute norms and learn life's original teleological structure. Phenomenology is not less than man's whole occupation with himself in the service of the universal reason. Revealing life's norms, he does, in fact, set free a stream of new consciousness intent upon the infinite idea of entire humanity, humanity in fact and truth.

Metaphysical, teleological, ethical problems, and problems of the history of philosophy, the problem of judgment, all significant problems in general, and the transcendental bonds uniting them, lie within phenomenology's capability.

Phenomenological philosophy is but developing the mainsprings of old Greek philosophy, and the supreme motive of Descartes. These have not died. They split into rationalism and empiricism. They stretch over Kant and German idealism, and reach the present, confused day. They must be reassumed, subjected to methodical and concrete treatment. They can inspire a science without bounds.

Phenomenology demands of phenomenalists that they shall forgo particular closed systems of philosophy, and share decisive work with others toward persistent philosophy.

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PHENOMENON, in ordinary language a thing, process, event, etc., observed by the senses (Gr. *φαινόμενον,* a thing seen, from *φαίνεσθαι,* to appear). Thus the rising of the sun, a thunderstorm, an earthquake, are natural "phenomena." From this springs the incorrect colloquial sense, something out of the common, an event which especially strikes the attention; hence such phrases as "phenomenal" activity. In Greek philosophy phenomena are the changing objects of the senses as opposed to essences (*τὰ ὄντα*) which are one and permanent, and are therefore regarded as being more real, the objects of reason rather than of senses which are "bad witnesses." In modern philosophy the phenomenon is the "thing-in-itself," or the noumenon (*q.v.*) or object of pure thought, but the thing-in-itself as it appears to the mind in sensation (*see* especially KANT; and METAPHYSICS). In this sense the subjective character is of prime importance. Among derivative terms are "Phenomenalism" and "Phenomenology." Phenomenalism is either (1) the doctrine that there can be no knowledge except by phenomena, *i.e.* sense-given data, or (2) the doctrine that all known things are phenomena, *i.e.* that there are no "things-in-themselves." "Phenomenology" is the science of phenomena: every special science has a special section in which its particular phenomena are described. The term was first used in English in the 3rd edition of the *Ency. Brit.* in the article "Philosophy" by J. Robison. Kant has a special use of the term for that part of the *Metaphysic of Nature* which considers motion and rest as predicates of a judgment about things.

PHERECRATES, Greek poet of the Old Attic Comedy, was a contemporary of Cratinus, Crates and Aristophanes. At first an actor, he seems to have gained a prize for a play in 438 B.C.

The only other ascertained date in his life is 420, when he produced his play *The Wild Men.* Like Crates, whom he imitated, he abandoned personal satire for more general themes, although in some of the fragments of his plays we find him attacking Alcibiades and others. He invented a metre, called after him Pherecratean, which occurs in the choruses of Greek tragedies and in Horace.

A considerable number of fragments from his 16 (or 13) plays has been preserved, collected in T. Kock, *Comicorum Atticorum Fragmenta,* i. (1880), and A. Meineke, *Poetarum Comicorum Graecorum Fragmenta* (1855).

PHERECYDES OF LEROS, Greek mythographer, *fl. c.* 454 B.C. He is probably identical with Pherecydes of Athens, although the two are distinguished by Suidas (also by I. Lipsius, *Quaestiones logographicae,* 1886). Numerous fragments of his genealogies of the gods and heroes, variously called Ἱστορίαι, Γενεαλογίαι, Αὐτόχθονες have been preserved (*see* C. W. Müller's *Frag. hist. graec.* vol. i., pp. xxxiv., 70; Jacob, *Frag. d. gr. Historiker* I., p. 58).

See Christ-Schmid, *Geschichte der griechischen Litteratur* (bibl.).

PHERECYDES OF SYROS, Greek philosopher (or rather philosophical theologian), flourished during the 6th century B.C. He was sometimes reckoned one of the Seven Wise Men, and is said to have been the teacher of Pythagoras. With the possible exception of Cadmus (*q.v.*) of Miletus, he was the first Greek prose-writer. He belonged to the circle of Peisistratus at Athens, and was the founder of an Orphic community. He was credited with having originated the doctrine of metempsychosis (*q.v.*), while Cicero and Augustine assert that he was the first to teach the immortality of the soul. Of his astronomical studies he left a proof in the "heliotropion," a cave at Syros which served to determine the annual turning-point of the sun.

In his cosmogonic treatise on nature and the gods, called Πεντέμυχος (Preller's correction of Suidas, who has ἑπτάμυχος from the five elementary principles: aether, fire, air, water, earth), he enunciated a system in which science, allegory and mythology were blended. A fragment of the "sacred marriage" of Zas and Chthonië has been found on an Egyptian papyrus.

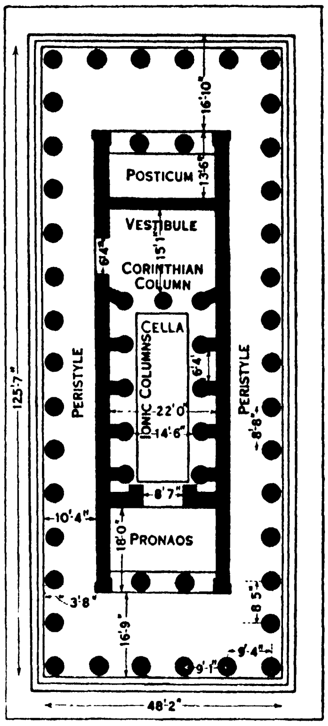
See H. Diels, *Fragmente der Vorsokratiker,* Bd. II. (4th ed., 1922); also O. Kern, *De Orphei, Epimenidis Pherecydis theogoniis* (1888); D. Speliotopoulos, Περὶ Φερεκύδου τοῦ Συρίου (Athens, 1890); T. Gomperz, *Greek Thinkers* (Eng. trs., 1901); B. P. Grenfell, *New Classical Fragments* (1897); H. Weil, *Études sur l'antiquité grecque* (1900).

PHIGALIA or PHIGALEIA (Φιγάλια or Φιγαλεία; mod. *Pavlitsa*), an ancient Greek city on the river Neda in the south-west angle of Arcadia, among some of the highest mountains in the Peloponnesus—Mt. Cotylium and Mt. Elasum.

In 659 B.C. Phigalia was taken by the Spartans, but soon after recovered its independence by the help of the Orasthasians. During the struggle between Achaeans and Aetolians in 221 B.C. it was held by Dorimachus, who left it on the approach of Philip V. of Macedon. In common with other cities of Arcadia, it appears to have fallen into utter decay under Roman rule. Several curious cults were preserved near Phigalia, including that of the fish-tailed goddess Eurynome and the Black Demeter with a horse's head, whose image was renewed by Onatas. No autonomous coins of Phigalia are known. Nothing remains above ground of the temples of Artemis or Dionysus and the works of art which existed in the time of Pausanias. A great part of the city wall remains, 2 m. in circuit built in fine Hellenic masonry, with a large square central fortress with a circular projecting tower.

Not at Phigalia itself, but at Bassae, 5 or 6 m. away, on the slope of Mt. Cotylium is a well-preserved temple of Apollo Epicurius. It commemorates relief from a plague in the 5th century. Pausanias (viii. 41) notes it as (next to that of Tegea) the finest in the Peloponnesus, "from the beauty of its stone and the symmetry of its proportions." It was designed by Ictinus, joint architect with Callicrates, of the Parthenon at Athens. Visited earlier by Chandler, Dodwell, Gell and other English travellers, the temple was explored and measured in 1811–1812 by C. R. Cockerell, the internal sculptured frieze of the cella being found almost perfect. This and other fragments of sculpture are now in the British Museum. The colonnade of the temple has been recently restored by the Greeks.

The temple is of the Doric order, but has an internal arrangement of its cella which is unique. Probably to suit the ground, it lies north and south but the vestibule has a door to the east. It is hexastyle, with fifteen columns on its flanks; thirty-four out of the thirty-eight columns of the peristyle are still standing, with the greater part of their architrave. The internal columns of the cella are very strangely placed, apparently without symmetry, as regards the interior, though they are set regularly opposite the voids in the peristyle.



PLAN OF THE TEMPLE AT BASSAE

With the exception of one at the south end, which is Corinthian, the internal columns are of the Ionic order, and are engaged with the cella-wall, forming a series of recesses, which may have been designed to contain statues. Another peculiarity of this interior is that these columns reach to the top of the cella in one order, not in two as was Doric fashion. These inner columns carried an Ionic entablature, of which the frieze now in the British Museum formed a part. The pediments and external metopes of the peristyle appear to have contained no sculpture, but the metopes within the peristyle on the exterior of the cella had sculptured subjects. The position occupied by the great statue of Apollo is disputed. Cockerell, with much probability, placed it facing the eastern side door, so that it would be lighted by the rising sun. The main entrance is at the northern end through the pronaos, once defended by a door in the end of the cella and a metal screen, of which traces were found on the two columns of the pronaos. There was no door between the posticum and the cella. The general proportions of the fronts resemble those of the Theseum at Athens, except that the entablature is less massive, the columns thicker, and the diminution less. In plan the temple is long in proportion to its width—measuring, on the top of the stylobate, 125 ft. 7 in. by 48 ft. 2 in., while the Theseum (built probably half a century earlier) is about 104 ft. 2 in. by 45 ft. 2 in.

The material is a fine grey limestone (once covered with painted stucco), but the roof-tiles, the capitals of the cella columns, the architraves, the ceilings and the sculpture, are of white marble. The roof-tiles, specially noticed by Pausanias, are remarkable for their size, workmanship, and the beauty of the Parian marble. They measure 2 ft. 1 in. by 3 ft. 6 in., and are fitted together in the most careful and ingenious manner. Unlike those of the Parthenon and the temple of Aegina, the ἁρμοί or "joint-tiles" are worked out of the same piece of marble as the flat ones, for the sake of more perfect fitting and in order to provide greater security against wet.

Traces of painting on various architectural members were found by Cockerell, but they were too much faded for the colours to be distinguished. The designs are the usual Greek patterns—the fret, the honeysuckle, and the egg and dart.

The sculpture is of the greatest interest, as being designed to decorate one of the finest buildings in the Peloponnesus in the latter half of the 5th century B.C.

The frieze, now in the British Museum, is complete; it is nearly 101 ft. long by 2 ft. high, carved in relief on twenty-three slabs of marble $4\frac{1}{2}$ to 5 in. thick. The subjects are the battle of the Lapithae and the Centaurs, and that between the Amazons and the Greeks, the two favourite subjects in Greek art of the best period. They are designed with wonderful fertility of invention, and life-like realism and spirit; the composition is arranged so

as to form a series of diagonal lines or zigzags *M*, thus forming a pleasing contrast to the unbroken horizontal lines of the cornice and architrave. The various groups are skilfully united by some dominant line or action, so that the whole subject forms one unbroken composition.

The relief is very high, more than 3½ in. in the most salient parts, and the whole treatment is quite opposite to that of the Parthenon frieze, which is a very superior work of art to that at Bassae. Many of the limbs are quite detached from the ground; the drill has been largely used to emphasize certain shadows, and in many places, for want of due calculation, the sculptor has had to cut into the flat background behind the figures. From this it would appear that no finished clay-model was prepared but that the relief was sculptured with only the help of a drawing. The point of sight, more than 20 ft. below the bottom of the frieze, and the direction in which the light fell on it have evidently been carefully considered. Many parts, invisible from below, are left comparatively rough. The workmanship throughout is unequal, and the hands of several sculptors can be detected. On the whole, the execution is not equal to the beauty of the design, and the whole frieze is somewhat marred by an evident desire to produce the maximum of effect with the least possible amount of labour—very different from the almost gem-like finish of the Parthenon frieze. Even the design is inferior to the Athenian one; most of the figures are ungracefully short in their proportions, and there is a great want of refined beauty in many of the female hands and faces. It is in the fire of its varied action and its subtlety of expression that this sculpture most excels. The noble movements of the heroic Greeks form a striking contrast to the feminine weakness of the wounded Amazons, or the struggles with teeth and hoofs of the brutish Centaurs; the group of Apollo and Artemis in their chariot is full of grace and dignified power. The marble in which this frieze is sculptured is somewhat coarse and crystalline; the slabs appear not to have been built into their place but fixed afterwards, with the aid of two bronze bolts driven through the face of each.

Of the metopes, which were 2 ft. 8 in. square, only one exists nearly complete, with eleven fragments; the one almost perfect has a relief of a nude warrior, with floating drapery, overcoming a long-haired bearded man, who sinks vanquished at his feet. The relief of these is rather less than that of the frieze figures, and the work is nobler in character and superior in execution.

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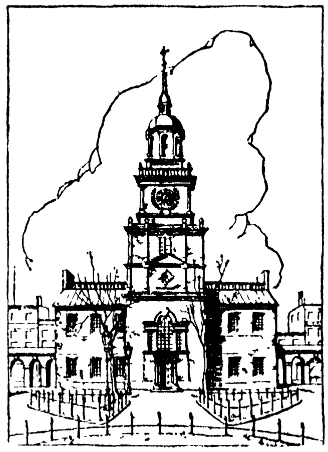
PHILADELPHIA, the Greek name of the ancient Rabbath-Ammon, in Eastern Palestine, commemorating Ptolemy Philadelphus (285–246 B.C.), mod. 'Ammān. Alexander Jannaeus (102–76 B.C.) although lord of the rest of the land east of the Jordan never conquered Philadelphia. With the coming of Pompey (63 B.C.) Philadelphia was made a member of the Decapolis. When Trajan set up the *Provincia Arabia* (A.D. 106) he assigned the town to the new province and Philadelphia advanced with Bostra to greater might and prosperity. Its extensive ruins include a Byzantine basilica, baths, theatre, citadel, temple, etc. (E. Ro.)

PHILADELPHIA, the first city of the State of Pennsylvania, and third in population and manufactures in the United States. It was planned by William Penn and other members of the Society of Friends partly, if not chiefly, as a haven of refuge for persecuted peoples, who like themselves, wished to be guided by the "inner light" of conscience. They called their town Philadelphia (from the Greek Φιλαδέλφεια, brotherly love), borrowing a place-name of sectarian significance in Lydia, Asia Minor, seat of one of the seven early churches.

Philadelphia was the Proprietary capital of the Province until 1776; capital of the State until 1799; capital of the United Colonies until 1781; capital of the United States under the Articles of Confederation from 1781 to 1789 and under the Constitution from 1790 to 1800.

Independence Hall, Philadelphia's most celebrated structure, which is a few squares east by south of the city-hall, is in lat. 39° 56′ 57·54″ N.; long. 75° 8′ 57·5″ W. Chestnut street pier is 101·6 m. from the Atlantic. An official tabulation of point-to-point airline distances between the Philadelphia Municipal air port and five well-known places follows: New York, 79 m.; Baltimore, 81 m.; Washington, D.C., 119 m.; Pittsburgh, 260 m.; Boston, 283 miles.

Geography.—Between the Delaware river and the nearest mountains, the Kittatinny range, is the 60 m. wide Philadelphia Piedmont plateau, invitingly fertile, and, in early days, heavily timbered with oak, hickory, chestnut, tulip-poplar, beech, dogwood and laurel. As the city has had much to do with the development of its "back country" so, conversely, the Philadelphia Piedmont plateau, with its many cities, towns and rich townships has contributed greatly to the growth of Philadelphia. And as the Delaware comes down from the north-east, or Minisink country, so the lesser Schuylkill, with its numerous tributaries, comes down from the north-west, out of the anthracite coal-fields, bisecting the Piedmont diagonally, breaking over the last score or more of falls at tidewater and joining the greater stream at the obviously strategic point of the whole region—the Coaquannock of the Indians; the Ft. Beversrede of the fur-trading Dutch; the Tacony-Tinicum of the Swedes and the Philadelphia of to-day.



BY COURTESY OF UNDERWOOD AND UNDERWOOD
INDEPENDENCE HALL, PHILADELPHIA

Topography.—All of old Philadelphia, with the main part of the new, lies on the peninsula of dry land between the Delaware and Schuylkill—a Dutch word meaning hidden river, or, more literally, skulking creek; the Indian name was Manayunk. But the city spreads south-westward beyond the Schuylkill, over the dike-protected Tinicum lowland (in places 5 ft. below high tide) to Darby and Muckinpalus creeks and extends westward across rising ground from 100 to 200 ft. high, as far as Karakung creek, now Cobb's. Thus the city is both longer (24½ m. from the extreme south-west on Bow creek to the extreme north-east point of Poquessing creek and Frankford avenue) and broader (15 m. from Northwestern avenue, and the Schuylkill, Roxborough, to Poquessing creek and Delaware river, Torresdale), than the peninsula, which has three levels—the lowland (Passyunk) section of mud, blue clay and gravels; the elevated section from Spring Garden street to the northern boundary; and the elevated west Philadelphia section to the western boundary.

Sewerage.—Sewerage profits by the natural drainage of small valleys and their watersheds, which involve the utilization of many creeks. It comprises (1928) 1,647·66 m. of sewers, of which 479·73 m. are main sewers and 1,167·93 are branches. Their diameter ranges from 1 to 24 ft. So great is the volume of water in some of these creek-sewers (for instance, the Cohocksink and Mill creek) that costly blow-outs have occurred. A new oval-shaped sewer in the bed of Mill creek, big side down, permits a freer flow. Subway building has caused much sewer reconstruction and metropolitan development in the old city has necessitated great changes. Since 1910, two extensive sewerage disposal plants have been built. In the lowlands, sewers are clogged by mud brought in by flood tides. The part of the Schuylkill delta below its lowermost reach is cut into by tidal estuaries, forming numerous islands. In this section (40th ward), the sewage problem presents difficulties. But in 1925 work was begun on the Mingo pumping system, by which the sewerage, drained into a central basin, is pumped at the rate of 1,000,000 gal. daily into the 40th ward disposal plant. Prior to the establishment of the Mingo system there were great numbers of unsewered houses in the 40th ward. Throughout the city these now (1928) total 10,000, as against 60,939 on Jan. 1, 1911.

Water-supply.—Philadelphia built the first municipal waterworks in America. Councils authorized a "Wholesome Water" loan ($203,001.70); and ground for reservoirs was broken on the site of the old British fort at Fairmount, March 12, 1799. The first water was sent through the pipes—then of wood, a little later of cast-iron—on Jan. 27, 1801. Up to 1902, the city's expenditure for water from the Delaware and Schuylkill had been $56,498,000. Then it became necessary, on account of river pollution to provide for the present comprehensive sand filtration system. There are five filter plants: Torresdale, 52 ac., capacity 240,000,000 gal.; Queen Lane, 16 ac., 111,000,000; Belmont, 14 ac., 50,000,000 (under reconstruction, 75,000,000); Upper Roxborough, 5·6 ac., 20,000,000; Lower Roxborough, 2·7 ac., 8,000,000; East Park distribution reservoir, three basins, capacity, 688,618,000 gal.; Oak Lane reservoir, 2 basins, 70,000,000; Belmont, 40,000,000; five clear-water basins, 127,000,000; four raw-water reservoirs, 609,-350,000. At the 12 pumping stations are 46 electric or steam-driven pumps, with a total capacity of 2,310,000,000 gal. in 24 hours. Much artesian well water is used in the city and out.

City Plan.—Philadelphia was built on a plan. Penn wanted an open-spaced, well-shaded town, with every dwelling in the centre of its plot. There was eventually a complete departure from this idea. Brick buildings, standing wall to wall and so much alike that a man hardly knew his own house, filled large sections of the 19th century city. Another of Penn's ideas was to have "a promenade on the high bank of the river-front the whole length of the city—a top-common from end to end," after the manner of the celebrated Bomb Quai at Rotterdam. But this detail of the original plan was likewise unexecuted. Penn wanted a 10,000 ac. city; Thomas Holme, his surveyor-general, succeeding Penn's cousin, Capt. William Crispen, used less than a third of that space in the original urban section, making up their due allotment to the first purchasers, or adventurers, by assigning them much larger additional lots in the adjoining Northern Liberties. Penn expected the Delaware and Schuylkill halves of his city to meet at Centre square; but necessity, or convenience, caused the development to be along the Delaware, up and down, rather than in the wooded westward parts of the area plotted by Holme. This area—the nucleus and heart of the present city—was a parallelogram in shape, a mile north and south, and two miles east and west from river to river, with a Delaware front street and a Schuylkill front street. The Broad street of to-day, which extends for 11·7 m. from League island to township line and York road, is 113 ft. wide. At Centre square, Market street, 100 ft. wide, crosses Broad, halving the city, north and south.

The most conspicuous object in Philadelphia is the architecturally much criticized City hall, French Renaissance style, designed by John M. Arthur, Jr., with its tower, 547 ft. 11 in. high, topped by Alexander Calder's colossal bronze statue of William Penn. With its courtyard, it occupies an area of 4½ ac. The public buildings commission—authorized Aug. 5, 1870, abolished July 1, 1901—erected it at a cost of $25,000,000 (not without public scandal). The foundation stone was laid on Aug. 18, 1872. Here are housed the State and county courts and municipal and county offices. Across the plaza to the north-east is the new City Hall annex, an office building harmonizing with the adjacent Wanamaker and Widener buildings. Old ferry and township roads in Southwark, Passyunk and Moyamensing have been modernized into diagonal avenues, running south-west and north-east. In 1928 the urban area was 129·714 square miles.

Streets and Bridges.—Philadelphia has 2,000 streets Houses are numbered decimally, 100 numbers being allotted to each square. Asphalt paving is used chiefly; with vitrified, granite or wood block; total urban mileage, 1,368.

Floating bridges were erected in the 18th century over the Schuylkill; in the 19th century permanent bridges. White and Hazard's foot bridge was the first wire bridge in the world. Until recently, Girard avenue bridge was the widest. Ellet's suspension bridge was the first American bridge of the kind. Chestnut street bridge is the largest cast-iron arch-bridge. Below Walnut street the bridges are "swings" and bascules. Spring Garden bridge, like that of Girard avenue, is of wrought-iron, Whipple-truss type. Green Lane (under construction), is of re-enforced concrete. A fine concrete arch-bridge spans the Wissahickon at Walnut Lane. The Philadelphia-Camden bridge is (1928) the longest suspension bridge in the world; construction began Jan. 6, 1922; it was opened July 1, 1926; cost, $37,196,971. Total length, 1·81 m.; main span, 1,750 ft. between towers; height of towers, 385 ft. mean high water; overall width, 125 ft. 6 in.

Parks.—There are 140 parks and playgrounds, covering 7,000 ac. Playgrounds and recreation centres are supervised by the bureau of recreation, and small parks and squares by the bureau of city property. The Fairmount park commission (15 members, appointed by the common pleas judges) has charge of Fairmount park, 3,597 ac. and 22 other parks, with an acreage of 1,407, of which the largest, Pennypack park, has 1,097 ac.; Cobb's Creek, 621; League Island, 275; Roosevelt Boulevard, 250; Hunting park, 86; Wister's Woods, 44; and Bartram's garden, 37. Fairmount park (with the parkway) is practically continuous from City Hall to the county line on the Wissahickon. It originated in June 1812, with the acquisition of a 5 ac. tract (summer-home of Robert Morris, financier of the Revolution) and was repeatedly enlarged by other purchases, until in addition to Letitia Cottage, it now contains 15 historic mansion houses, two surviving structures of the Centennial Exposition (Memorial hall and the Horticulture building) and hundreds of miles of driveways, avenues, footpaths and bridle paths, beautified at many points of vantage with over 50 bronze groups and figures.

Periods and Landmarks.—There have been four phases in the development of Philadelphia: (1) The well-built, though ill-paved, Colonial trading-town of English Quakers and Episcopalians, Welsh Quakers and Baptists, Germans of various sects, Scotch-Irish Presbyterians and inter-colonial migrants. (2) The rapidly growing city of Franklin and Girard, with its shipyards, ropewalks, fleets and fast-sailing ships, its rich merchants, its skill in handicraft and its undemocratized social order. (3) The 19th century brick-paved, red-brick city that was revolutionized by the application of steam-power to many industries—a period of mill, rail and mine development and of a heavy inpouring of Irish and German immigrants, with skilled workers from British industrial districts. (4) The city that has been transformed during the last quarter of a century by such modern agencies as electricity, steel and concrete, and the extensive use of capital.

The earliest city was centred about High street hill (Second and Market); with its long-vanished "Great Towne House," built in 1707 in the middle of the street. Annexed were the covered markets. Nearby was the Friends' meeting house. The slate-roof house and many two- and three-storey brick dwellings with dormer windows were close at hand. Some of these dwellings still stand. Much like the early proprietary town was the revolutionary city, which had grown five squares westward to the Statehouse.

This building, designed by the famous lawyer Andrew Hamilton and built between 1732 and 1741 became Independence Hall, where the Liberty bell once rang, and is now housed. The bell was made by Thomas Lister of Whitechapel, London, but was twice recast because of brittleness, and was hung in April, 1753. It was cracked, July 8, 1835, while tolling a knell for Chief Justice John Marshall, of the U.S. Supreme Court. This court first sat in an adjoining building (built in 1791) of the same group, later the mayor's office, at the south-west corner of Fifth and Chestnut streets. At the south-east corner of Sixth and Chestnut is the hall (built 1791) where the first U.S. congress sat. City councils, until transferred, used Independence Hall. These buildings (much dwarfed at the present day by massive structures east, south and west, including the Curtis block) have been set apart as public monuments. The Statehouse yard of 1729, or Independence square, belongs to the group; and adjoining is Washington square. Associated with Independence Hall is Carpenters' Hall, owned by the company of Master Carpenters, used as a meeting place by the First Continental Congress (1774–75). This well preserved sample of the brick-layer's art was built in 1770–71.

Other shrines are Franklin's grave (south-east corner Fifth and Arch), the Betsy Ross flag-house (239 Arch), the site of the house in which Jefferson wrote the Declaration of Independence (south-

west corner Seventh and Market), the site of the Philadelphia residence of Gen. Washington (528 Market) and the Chew Mansion, "Cliveden" (Johnson street and Germantown avenue), scene of the critical action at the Battle of Germantown, Oct. 4, 1777.

The 19th century city retained much of its 18th century aspect —uniform houses, with pressed brick fronts, white or green shutters and marble steps and trimmings. These were multiplied, row on row; but not until 1850 was there noteworthy growth west of Broad street. That development came after the Consolidation act. Girard avenue was then Franklin avenue. It was crossed by the northward-growing city, which reached and passed Columbia avenue prior to the International Exposition of 1876 (Centennial). This world's fair greatly aided Philadelphia's industries. The 19th century city continued its expansion along residential lines until the period of latter-day small house demolition and sky-scraper development.

Architecture.—Early dwelling houses and halls reflected English ideas. Something of Sir Christopher Wren's manner is traceable in such structures as Christ church (1727–47), Dr John Kearsley, amateur architect, and St Peter's (1761); and Inigo Jones's influence is seen (from prints found in Sir Wm. Chambers's *Treatise on Civil Architecture*) in the street fronts of brick. Many Georgian houses of the 18th century are preserved, Independence Hall being typical. Philadelphia architects in the 20th century have sought to recapture the spirit of colonial times; but the best Georgian restorations and reproductions are not as often seen in the city itself as in the suburban places closely associated with early American history. Grecian influence was shown just before the opening of the 19th century in the works of William Strickland, Thomas Ustic Walter and their followers. Much of Strickland's work has disappeared, save in prints, but the old U S. Mint, at Chestnut and Juniper, was an example of it; and the Custom house (1824) is a surviving specimen. Pseudo-classic structures—the Bank of the United States, Third street (1795); the first Chestnut street theatre; the church of St Luke and Epiphany; St. Andrew's P E church; St. Patrick's church; and, especially Girard college and Ridgway library—belong to this period.

Latter-day buildings of like impressiveness—the U S. mint, the art museum, the free library—would seem to be improvements upon the models of the time of Strickland and Walter. Following these designers there was an architectural "dark age" in Philadelphia until the Centennial Exposition caused an awakening The T-Square club (1883), the school of architecture at the university of Pennsylvania and the Philadelphia Chapter, American institute of Architects, have accomplished much in community, city and regional planning and in influencing architectural designs

Art, Science and Letters.—Long after its loss of precedence in population, Philadelphia preserved its leadership in art, letters and science. Art development began in the period of Benjamin West, the Peales (Charles Willson, Raphael and Rembrandt), Stuart, Sully and Allston, and continued through the 19th century, with J. W. Jarvis, Henry Inman, C. R. Leslie, Paul Weber, H. J. Thouron, J. R. Lambdin, S B Waugh, Thomas Eakins, Thomas P. Anschutz, J. M. Hamilton, John Sartain and Charles Grafly The Academy of Fine Arts, oldest art institution in the United States, dates officially from 1805, but it actually originated in 1791, growing out of Charles Willson Peale's activities in starting the Columbianum (1794), which next year held an exhibition in Independence Hall. Philadelphia now has 37 art associations, museums, schools and collections, public and private.

On the leveled top of Fairmount, at the point where the parkway joins the park, and looking up the Schuylkill, stands the new $20,000,000 Pennsylvania Art museum, opened on March 26, 1928. In situation and design, this group suggests the Parthenon and the Acropolis—an impressive Greek imitation, of severity and dignity. This building, in which delicate curves instead of straight lines are used, is of Minnesota stone. The architectural details in the cornice, as well as the 4 ac. of roofs, are of glazed polychrome terra-cotta. Colour is much used. The seven strata in the dolomite quarry from which the stone was secured vary from a pinkish yellow to a yellowish-grey. The museum is the home of important collections of paintings hitherto inadequately housed. It also offers educational facilities, providing a panoramic history of art for its students and visitors in a series of 37 "period" rooms, in which works of art are shown in their appropriate surroundings.

The American Philosophical society, an outgrowth of Franklin's "Junto" (1727) and the American Society for Promoting and Propagating Useful Knowledge (1766), was organized in 1769. It is housed in Independence square (Frankliniana, 14,000 vol.; library, 45,000). Other scientific societies are the Franklin institute (1824), essentially a society for the promotion of applied science; the Academy of Natural Sciences (1812); the Wagner institute (1855), primarily a society for spreading science among the people; the Spring Garden institute (1851), for teaching useful arts to wage-earning youths; the Commercial museum, containing exhibits illustrating world-wide industrial progress; and the Geographical society

Early publishers, 17th and 18th centuries, issued Bibles—in German, as well as English,—newspapers, almanacs and magazines. The Ephrata, Saur and Aitken Bibles, Franklin's *Poor Richard's Almanac,* many Quaker books, the early Bradford publications, early magazines (especially Joseph Dennie's Portfolio 1801–37), Pennsylvania histories by Thomas, Budd, Smith and Proud, and Charles Brockden Brown's novels are notable publications. Tom Moore, the poet, and Edgar Allan Poe lived in the city, which was also for a time the home of Longfellow, Holmes, Whittier and Lowell. Godey's (1850–77), Graham's (1840–59) and Sartain's magazines as well as Robert Walsh's *American Quarterly Review* (1827–37) were successful publications; and Mathew Cary, George Lippard, Robert Montgomery Bird, with the Hopkinsons—Francis and Joseph—and the Neals—Alice and Joseph C—won notable names. Later, Walt Whitman, Bayard Taylor, George H. Boker, T Buchanan Reed and Charles G. Leland were of literary consequence They were succeeded by S. Weir Mitchell, Frank Stockton, R. H Davis, Horace Howard Furness, F E Schelling, Owen Wister and Agnes Repplier. To-day there are about 200 publishers, including Lippincotts of the third generation.

The leading newspapers of to-day are *The Public Ledger* (Rep., 1836); *The Evening Ledger; The Record* (Ind. Dem., 1870); *The Inquirer* (Rep., 1829) and *The Evening Bulletin* (1847). Outstanding editors: Poulson, Chandler, Forney, McClure and G W Childs (*q v.*).

Theatres and Music.—Philadelphia has 51 theatres (1928) and 167 moving picture houses. One of the London Hallams, Lewis, was the founder of the Philadelphia stage, in 1754. The original Chestnut street theatre (1793) was burned The oldest theatre in the United States, Walnut (capacity 1,512), dates from 1809, and was the scene of the triumphs of Wheatley, Cooke, the Wallacks, Kean, Forrest, the Booths, Clarke, Charlotte Cushman and Rachel. The Arch street theatre (1828) was associated with the Drews and Joseph Jefferson, as well as with W. E. Burton and the Davenports. For a generation, the most noted performers appeared at J. F. Zimmerman's Chestnut street opera house (capacity 1,864), which marked the passing of the old stock company system (1880) and the coming of travelling attractions.

The 17th century German immigrants brought over their music; the Moravians had their organs (called "whistle boxes"). Christ church (Protestant Episcopal), and St. Joseph's (Roman Catholic) helped in the 18th century musical development. The Musical Fund society was organized in 1820; and Musical Fund hall was opened in 1824 All the famous European singers who visited America sang there, and at Concert hall, until the opening of the Academy of Music (capacity, 2,729) in 1857. The Metropolitan opera house seats 3,482.

Philadelphia has a vigorous musical life, with 65 societies—the St. Cecilia, 1824; Anacreontic, 1830; Apollo, 1833; Maennerchor, 1835; Cecilian, 1875; Orpheus, 1877; Mendelssohn, 1876; Philadelphia Music Festival association, 1882; Treble Clef and Eurydice, 1886 The Philadelphia orchestra was organized in 1900, the Presser Foundation dates from 1916. The Curtis Institute of Music gives free instruction.

Clubs.—Of the 2,000 clubs in Philadelphia the oldest is the

Schuylkill Fishing company of the State in Schuylkill, which was organized in 1732. The University, Art and Engineers' are notable clubs. There are many of the literary, journalistic and Bohemian cast—Poor Richard, Franklin Inn, Sketch, Plastic, and Pen and Pencil. The New Century, Civic, City and Colonial Dames are women's clubs. The Philadelphia (1834) is the most exclusive club; the Union League (1862), the most famous.

Churches, Charities and Hospitals.—Philadelphia has 1,032 churches, of which 102 are Baptist; 123 (synagogues and congregations), Hebrew; 37, Lutheran; 120, Methodist Episcopal; 117, Presbyterian; 123, Protestant Episcopal; 140, Roman Catholic; 7 Hicksite Meetings and 5 Orthodox meetings. Society of Friends, Dunkers, Mennonites, Moravians, Schwenkfelders and other sects of Penn's time, still thrive. Philadelphia is the cathedral city of the arch-diocese of Philadelphia, which has 374 parishes and 979 priests of all orders. Five denominations have Divinity schools.

There are 2,500 religious and humanitarian societies in Philadelphia. There is a record of the charitable work of secular societies from the year 1749, and of church societies from 1761 to 1928. The Federation of Charities began in June, 1921. The Welfare Federation embraces 128 non-sectarian philanthropic agencies in the city and suburbs—homes and hospitals for children, dispensaries, emergency aids, day nurseries, settlements, sanitariums, shelters, etc. In 1928 the sum of $3,289,673.60 was subscribed for the Federation. The Jewish Federation raises a similarly large sum. The 27 Catholic charitable institutions are less closely federated.

Philadelphia has been a medical-surgical centre from early days. Its first hospital, the Pennsylvania, which occupies a square in the old city, was chartered on May 11, 1751. The first school of anatomy was established in 1762; and the first medical college (*see* PENNSYLVANIA, UNIVERSITY OF, which now has several affiliated hospitals) in 1765. The first medical society was organized in 1768 and the first College of Physicians in 1787. Its Mütter pathological collection is especially notable. Its library contains 100,000 volumes. Other early institutions are Will's Eye hospital (1832); Pennsylvania hospital of the Insane (Kirkbride's, 1836); Homeopathic Medical college (Hahnemann's, 1848); and the Woman's Medical college (1850). Blockley, long in disrepute, has been erased from the map, and a modern City hospital erected in its place, at a cost of $4,000,000. Among the larger hospitals are Lankenau, Methodist Episcopal, Misericordia, Jefferson and Presbyterian. There are 90 hospitals in the city.

Education.—Enoch Flower was the first school-master (1683) in Philadelphia. In 1689, George Keith started the Friends' Public grammar school, called "Friends' Free," being like the English (but unlike the latter-day American) "public school"; it was chartered in 1701, and became the existing William Penn Charter school. Church and community schools followed. Christopher Dock, who came from Germany in 1714 and who published the first American book on teaching, was the most noted early 18th century teacher. Though the Pennsylvania Constitutions of 1776 and 1790 declared for "free schools," they were charity (called "Ragged") schools; and not until 1818 did the present public school system emerge.

Meantime, numerous academies were established such as Germantown (1760) and Episcopal academy (1785). Other institutions developed: College of Pharmacy (1821); Jefferson Medical college (1825); Woman's Medical college (1850); Protestant Episcopal Divinity school (1862); Lutheran Theological seminary (1864); La Salle college (Roman Catholic, 1867); St. Vincent's Roman Catholic Theological seminary (1868); Medico-Chirurgical college (1881), now affiliated with the university of Pennsylvania and Hahnemann Medical college (1888); the Williamson Free school of Mechanical Trades (1888); Drexel institute (1891); and Temple university with a large student-body and many schools, at Broad and Berks. Gratz college (1893) and Dropsie college (1907), were founded in furtherance of Hebrew learning. The university of Pennsylvania (*q.v.*) is the largest educational institution in the city. (*See* ART and SCIENCE for other educational institutions. For Girard college, *see* GIRARD, STEPHEN.)

Public Schools.—In 1818 the old board of control gave way to the board of education, and the Lancasterian plan to the common schools. The first Central high dates from 1838; Girl's high, 1859 and Girl's high and normal, 1876. At the end of the 19th century, it was manifest that the blight of politics was on the public school but reforms were successfully inaugurated. Two high schools have been succeeded by 13, with 18 junior high schools. There are evening high schools, evening elementary schools, classes in English and citizenship, classes for handicapped children, vocational schools and summer schools. In 1927 the total enrolment was 301,490 and the disbursements amounted to about $40,000,000. There are 241 public schools, in 363 school buildings; of these, 207 are elementary.

Libraries.—Several growths of increasing vigour sprang from the seed sown by Franklin in the "Junto" period of the 18th century—the American Philosophical society, already noted, the university of Pennsylvania and the Library company of Philadelphia, organized on July 1, 1731. Franklin was its London agent, 1760–75. It absorbed the association and union libraries and, in 1792, became trustee for the library of James Logan, which, through the benefaction of Dr. James Rush, was nobly housed (1868) in a granite structure of the classic order. The Library company, with its noted collections—Philadelphia material, Civil War books and Americana—has 275,000 volumes. Other libraries (in addition to those noted under *Science* and *Art*) are those of the Pennsylvania hospital, 1761; the College of Physicians, 1789; the Athenaeum, 1813; the German society, 1817 and the Apprentices', 1820. The Free library of Philadelphia, chartered in Feb. 1891, has a main building, 29 branches and four deposit stations in various parts of the city; 23 of the branch libraries occupy structures erected from Andrew Carnegie's gift to the city of $1,500,000. The Free library had in 1928 706,160 vol., 73,858 pamphlets and 480,786 unbound documents. The art and music departments are especially rich. There is also a library for the blind. The Law library in the City Hall dates from 1802. The Biddle Law library is at the university of Pennsylvania, which, besides the general library (1749)—noted for its Danteana, American and Spanish drama and incunabula—has 13 special sub-libraries. The Mercantile library (224,762 vol.), is notably strong in Irish literature, Shakespeare and Junius letters. The Special Libraries council of Philadelphia lists 155 libraries in the city and environs, with 15 private collections, accessible to students upon application. Historical and genealogical students from all parts gather at the library of the Historical Society of Pennsylvania.

Port.—Transatlantic, coastwise and West Indian trade developed early. Grain, flour and lumber were exported. In 1725, 140 vessels arrived and cleared; in 1735, 427. During the Revolution, Philadelphia became an interstate port, profiting by the imposition of import taxes on goods brought in for trans-shipment. Marine construction grew apace; and Philadelphia ships and sailors won high repute. The Humphrey model revolutionized frigate building. The old navy yard gave place (1876) to the League island yard. In the Girard epoch (1775–1831) came fast clippers; and, after the Fisk-Fulton-Rumsey-Evans period of steamboat experimentation, came the Liverpool packet service of Thomas P. Cope. Then Peter Wright and Son handled Liverpool boats. The Cope, Winsor, Clyde, Ericsson lines identified themselves with the river. The Corn Exchange (1854) became the Commercial Exchange (1868). Pilot service was established on Oct. 4, 1788. The station for pilot boats is at Overfalls light, 89 m. from Chestnut street pier. The Philadelphia-to-the-sea 35 ft. channel was near completion in 1928. The Schuylkill channel is 30 ft. deep. Delaware avenue, the riverfront street, originally 25 ft. wide, has a present width of from 150 to 250 ft., and a length of 20 miles. In the middle of this marginal street are four railroad tracks, including the Belt line, which affords direct track connection for three trunk roads, by means of sidings, with all piers. There are 15 piers belonging to the city and 26 under corporate or private ownership, besides the U.S. Government piers. The main triple-decked tide-water terminal is 1,500 ft. long, can simultaneously berth 15 steamships,

and has 1,000,000 sq.ft. storage space. At Port Richmond, the Philadelphia Electric company occupies 3,000 ft. of river frontage with one of the largest steam-electric plants in the world. The Reading company's Port Richmond terminal has a river frontage of 1 m., a trackage of 60 m. and storage for 6,000 cars. It is said to be the largest tide-water terminal in the world. It has a perishable produce terminal, a large grain elevator and also electrically operated ore-loading machinery with a capacity of 1,200 tons per hour. The Pennsylvania railroad has elevators at Girard point. The Greenwich point coal plant handles 500 cars a day. The water front extends 37·21 m., of which 16·89 m. are in use; 100 deep-draught steamships can be docked at once.

Industries.—Industrially, early Philadelphia led all other colonial towns. Diversification was the keynote then, as it is now. Weavers, knitters, wheel-wrights, glass-blowers and other craftsmen came with the early German immigration. Germantown set the industrial example. The Quakers, Welsh as well as English, fed the city, and handled much of the money. They were successful merchants, shipowners and ship-builders. They manufactured paper, cordage and canvas. Streams were readily dammed near Philadelphia, and there were mills on 16 main creeks. Before the Revolution the Wissahickon had 11 mills. Power for mills was drawn in 1829 by the building of Flat Rock dam on the Schuylkill; and Manayunk came into being. Iron was made at Germantown in 1717. The first Philadelphia carpets were made in 1775. Subsequently English weavers came in great numbers. An industrial north-west section, as well as a great north-east section, was developed. Philadelphia, near water but unswept by strong breezes, has a moist climate peculiarly suitable for textile manipulation.

Manufactures.—Philadelphia's pre-war (1917) products amounted to $784,500,000; in 1925, they had grown to $1,890,990,199. In the whole city, there were, in 1925, 1,040 textile plants, giving employment to 89,113 workers. Metals and metal products employed 67,002; paper and printing, 33,030; food, 23,148; chemicals and allied products, 18,693; leather and rubber goods, 11,422; tobacco, 9,100; lumber, 7,891; clay, glass and stone, 3,519. The Baldwin locomotive works (removed from the heart of the city to Eddystone) has 6,430 employees; Disston's, 2,017; the Budd company, 5,578; Electric Storage, 4,050; the Atlantic Refining company, 6,783, and numerous concerns employ over 1,000.

Transportation.—Philadelphia is the headquarters of the Pennsylvania railroad. The Philadelphia and Reading and Baltimore and Ohio have great terminals in Philadelphia.

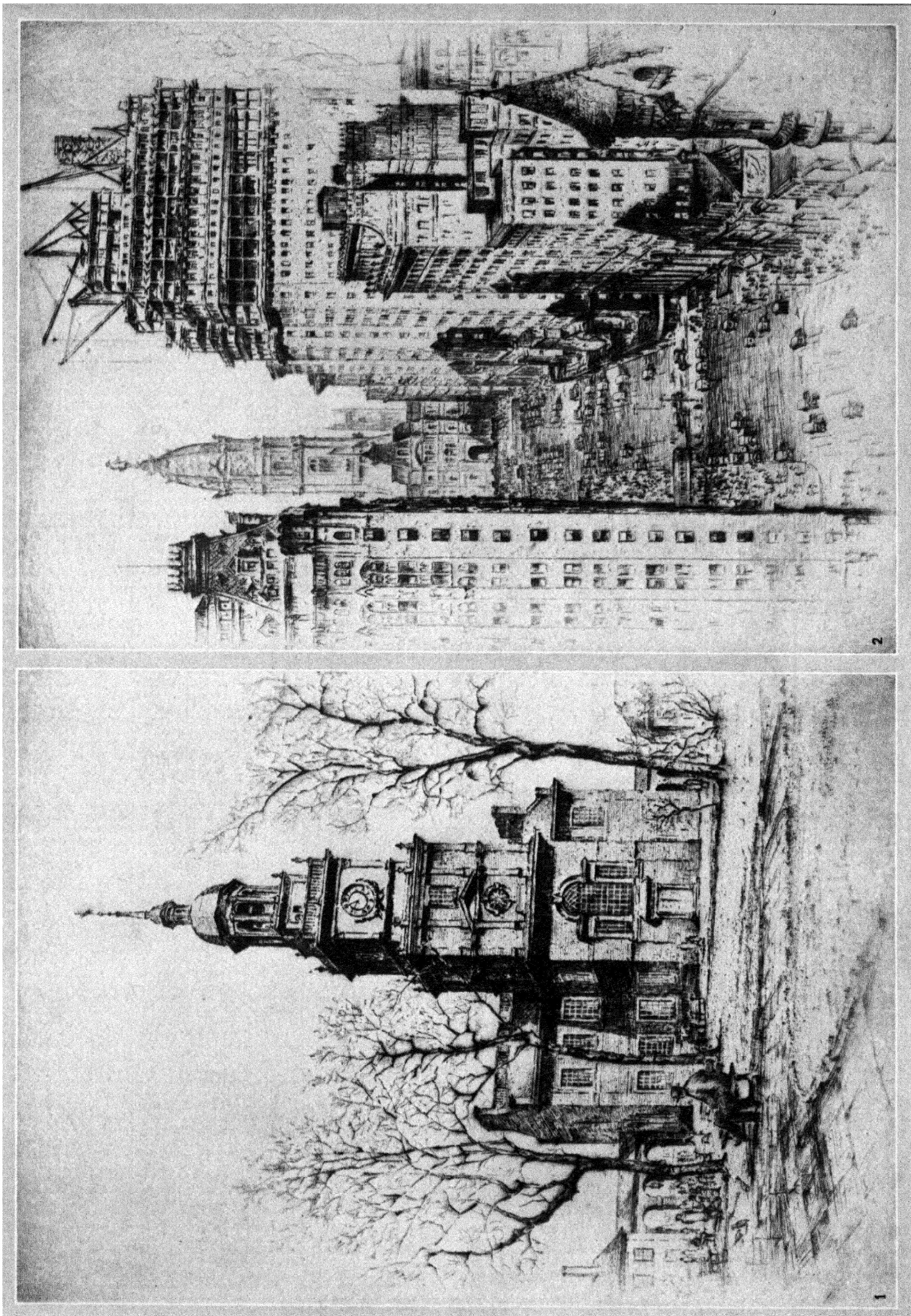
Intra-urban transit is by electric-subway and elevated trains, or by surface trolley cars. All intra-urban roads are operated by the Philadelphia Rapid Transit company under contract with the city since July 1907. The Frankford "L" was built and equipped by the city at a cost of $15,603,992 and leased to P.R.T. in 1923. Subways built by the city are similarly leased. The city-built North Broad street subway was completed in 1928, at a cost of $100,000,000. The Philadelphia Rapid Transit operates urban and suburban taxicabs and motor-buses. Fifty companies, with 750 buses operate between the heart of the city and 150 outlying towns.

Finances.—The first bank in the United States (Pennsylvania bank) was organized in 1781. The Bank of North America was chartered by the Continental Congress in 1784. The first building and loan association in the United States was the Oxford Provident and Building association, organized in Frankford (now 35th ward) Jan. 3, 1831. Of the 12,525 building and loan associations in the United States (1927), Philadelphia had 3,428, with 1,875,089 members, and assets of $743,312,024. There were, in 1927, 94 institutions under the commonwealth of Pennsylvania; 28 operating under Federal charter; and numerous private banking houses. Of those that report to the State secretary of banking, the capital stock paid in totalled $81,736,177; surplus and undivided profits, $192,856,327; deposits, $1,245,774,592; liabilities, $1,582,702,408. The Federal Bank reports showed these totals: Capital, $31,275,000; surplus and undivided profits, $87,556,170; due to the banks and bankers, $182,707,356; liabilitie $865,462,877. Philadelphia is the headquarters of a Feder Reserve district.

City Government.—An act of the Assembly, approved ‹ June 25, 1919, regulates the present government of Philadelphi The mayor, chosen for four years, and 70 other officials (includi 30 judges and 28 magistrates, with the receiver of taxes, ci treasurer, city controller, district attorney and sheriff) are electe from the city at large. The 22 councilmen, now paid officia serving for four years, are elected from eight State senatori districts, one for every 40,000 assessed voters. The Council the chief tax-levying body: it fixes the annual budget and po sesses legislative powers including the right to override the mayor veto. Council business is transacted through committees. The are 12 departments of city government, with numerous boar and commissions: public safety, public works, public healt public welfare, wharves, docks and ferries, city transit, city trea urer, city controller, law, civil service commission, departme of receiver of taxes and department of supplies. The first s (known as "cabinet" departments) are the major administrati units, directly under the supervision of the mayor, who appoin the directors. Under the director of public safety are six bureau: (*a*) police, 5,221 officers in 28 districts; (*b*) fire, 69 engine, truck and 19 other companies, including river service, and six i surance patrols; (*c*) electrical bureau; (*d*) elevator inspectio (*e*) boiler inspection and (*f*) building inspection. Under the dire tor of public works, are bureaux that have charge of water su ply and distribution, highways and city property, including supe vision of 10 curb markets and 87 small parks and squares. Und the director of public health are the bureaux of health and ho pitals, with many divisions and dispensaries; and under the dire tor of public welfare are the bureau of recreation, supervising playgrounds and 34 swimming pools and two other bureaux dea ing with charities and legal aid. Certain offices are known county offices—those held by the controller, treasurer, distri attorney, sheriff, coroner, clerk of quarter sessions, prothonotar register of wills and recorder of deeds. In 1928 there we 19,701 city and 2,565 county employees. Many courts sit the city—Federal or State; and six kinds, including the m nicipal court organized for special purposes, have jurisdictio coterminous with the city and county. Five registration co missioners, appointed by the governor, have charge of the regi tration of voters, appointing four district registrars in each the 1,471 election divisions of the city. Two of the five mu belong to the minority party. One of the three elective commi sioners, who administer the election machinery, must belong the minority party. An important aid to city government is t privately supported citizen's agency, the bureau of municipal r search (organized 1908, incorporated 1910), which is managed a board of trustees. The assessed valuation of real estate returned to the city controller by the board of revision of taxe Jan. 27, 1928, totalled $3,325,584,643; and the personal propert $1,128,974,564.28. On Jan. 1, 1925, the gross funded outstan ing debt was $225,967,200, of which the sinking fund he $58,117,900; the interest and sinking fund amounted in 1925 three-eighths of the tax levy.

Light and Power.—The city's first gas works date from Fe 8, 1836. After the consolidation, the combined gas plants we placed under the management of trustees. Political scandals aro and the works were transferred to a bureau of gas; then, lease, to the United Gas Improvement company, which renew the lease, Jan. 1, 1928, for ten years, at a rental of $4,200,0 a year, or 7% on $60,000,000. The Philadelphia Electric co pany, now consolidated with the United Gas Improvement co pany, supplies the electric current for light and power. Work the $52,000,000 hydro-electric plant of the company at Con wingo, Md., was begun in March 1926 and on March 1, 192 the first power from its turbines was sent to Philadelphia ov two 220,000 volt three-phase lines.

Population.—The population of Philadelphia on July 1, 192 was 2,064,200, according to the U.S. Census Bureau estimate First Philadelphia population figures were: (1753) 14,563; (176



Two views of Philadelphia from etchings by Anton Schutz: 1. Independence Hall, built between 1732 and 1741, and used as the Statehouse until 1799. The Declaration of Independence was signed in this building in 1776. 2. Broad Street, the principal thoroughfare north and south, looking toward the City Hall, the business centre of modern Philadelphia

28,043. Philadelphia's official figures, by decades, follow: (1790) 28,522; (1800) 41,220; (1820) 63,802; (1840) 93,665; (1860, after consolidation) 565,529; (1880) 847,170; (1900) 1,293,697; (1910) 1,549,008; (1920) 1,823,779. In 1920, foreign-born whites numbered 397,927; negroes, 134,229. There has been a marked increase since 1920 in the percentage of negroes.

Twentieth Century Development.—Philadelphia's 20th century growth is measured by its demolitions—a paradox readily understood when it is explained that, in the part of the city planned by Penn, during five years (1923–27 inclusive) 3,242 dwellings and 868 other houses were demolished to make room for larger buildings, mainly commercial, and wider streets About 80% of the population live in dwellings, but for several years a change to apartments has been noticeable. This began when the Market street subway-elevated electric railway was constructed.

The Philadelphia of to-day has many times more Federal offices and employees than it had when it was the Federal city. The U S. Government has increased its property holdings tenfold since 1900. Its postal business has grown so fast that, though 1,883 employees then sufficed, 4,832 were required in 1925. The Mint, the arsenals and the supply and equipment stations have increased in efficiency. Site and plant at League island navy yard are valued at $100,000,000, the buildings number 549 The aircraft factory is the largest in the world—46 acres. There are three dry-docks, one of which is 1,064 ft. long and 210 ft. wide. The naval storehouse covers 10½ acres.

Metropolitan (Tri-state) Area.—The central city is a relatively small area but its influence expands in a series of widening circles—10-mile radius, pop. (1927, estimate) 2,322,316; 20-mile, 2,708,184; 40-mile, 3,465,894, 80-mile, 5,349,255 This covers a Tri-State region with 41 towns and cities, 21 in Pennsylvania, 18 in New Jersey and 2 in Delaware Trenton is the largest of the included cities with a pop of 140,283; Camden has 133,814; Wilmington, 119,422; Chester, 64,355; Atlantic City, 50,631; Lancaster, 58,943; Norristown, 35,841; Lebanon, 27,329 and Pottstown, 19,330. The Metropolitan area includes 22% of the area and 49% of the population of the Third Federal Reserve district; produces ⅔ of the manufactures, and has 71% of the wholesale, and 58% of the retail, trade. (G Mn)

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PHILADELPHIANS, a sect of religious mystics, founded in London in the latter part of the 17th century. In 1652 Dr. John Pordage (1607–1681), rector of Bradfield, Berkshire, gathered together a few followers of Jakob Boehme, the chief of whom was Jane Lead or Leade (1623–1704) Mrs Leade had been from girlhood of a mystical temperament, and experienced phantasms which she recorded in a diary entitled *A Fountain of Gardens*, beginning in 1670, in which year the Philadelphian society was definitely organized. In 1693 some of Mrs. Leade's writings were translated into Dutch, and by this means and her acquaintance with Francis Lee (1661–1719), an Oxford scholar who studied medicine at Leyden and became her son-in-law, a connection was opened up with Germany and Holland. In 1703 the Philadelphians drew up their confession, but they made no further progress and soon declined, the Dutch branch withdrawing and the English government forbidding the society to meet

PHILAE, an islet in the Nile above the First Cataract, of great beauty and interest, but since the completion of the Aswan dam in 1902 submerged except for a few months yearly, when the water is allowed to run freely through the sluices of the Aswan dam. Philae marks also the end of the cataract region. Ancient graffiti abound in all this district, and on Bigeh, a larger island adjoining Philae, there was a temple as early as the reign of Tethmosis III. About 350 B C. Nekhtnebf, the last of the native kings of Egypt, built a temple to Isis, most of which was destroyed by floods. Ptolemy Philadelphus reconstructed some of this work and began a large temple which Ptolemy Euergetes I. completed, but the decoration, carried on under later Ptolemies and Caesars, was never finished. The little island won great favour as a religious resort, not only for the Egyptians and the Ethiopians and others who frequented the border district and the market of Aswan, but also for Greek and Roman visitors. One temple or chapel after another sprang up upon it dedicated to various gods, including the Nubian Mandulis Ergamenes (Arkamane), king of Ethiopia, shared with the Ptolemies in the building. Besides the temple of Isis with its birth-temple in the first court, there were smaller temples or shrines of Arsenuphis, Mandulis, Imuthes, Hathor, Harendotes (a form of Horus) and Augustus (in the Roman style), besides unnamed ones There were also monumental gateways, and the island was protected by a stone quay all round with the necessary staircases, etc , and a Nilometer. The most beautiful of all the buildings is an unfinished kiosque inscribed by Trajan, well known under the name of "Pharaoh's Bed" The decree of Theodosius (A D 378) which suppressed pagan worship in the empire, was of little effect in the extreme south It was not till the reign of Justinian, A D. 527–565, that the temple of Philae was finally closed, and the idols taken to Constantinople Remains of Christian churches were disclosed by the thorough exploration carried out in 1895–1896 in view of the Barrage scheme, under the direction of Captain Lyons. The accumulations of rubbish on the island were cleared away and the walls and foundations of the stone buildings were all repaired and strengthened before the dam was completed. The annual flooding now appears to be actually beneficial to the stonework, by removing the disintegrating salts and incrustations The tops of most of the buildings and the whole nucleus of the temple of Isis to the floor remained all the year round above the water level until the dam was raised another 26 ft —a work begun in 1907 —when the temples were entirely submerged except during July–October But the beauty of the island and its ruins and palm trees, the joy of travellers and artists, is almost gone.

PHILANTHROPY. Almsgiving is as old as man. In the Egyptian *Book of the Dead*, as ancient as the Nile pyramids, there is found this memorial ascription "He gave bread to the hungry, water to the thirsty, raiment to the naked; he gave a boat to the man who had none" Similarly in the ancient Hebrew scriptures we read (Deuteronomy xv. 7 and 8): "If there be with thee a poor man, one of thy brethren, within any of thy gates in thy land which Jehovah thy God giveth thee, thou shalt not harden thy heart, nor shut thy hand from thy poor brother; but thou shalt surely open thy hand unto him, and shalt surely lend him sufficient for his need" And of all the parables to be found in the New Testament none is better known or more deeply burnt into the conscience of Western civilization than that of the Good Samaritan The Muslim world in like manner preserves the maxim· "Prayer carries us half way to God, fasting brings us to the door of his palace, and alms gains us admission" While the spirit of benevolence that animates all philanthropy is unmistakably reflected from the remote past, it is evident that there has been an evolution in the technique of giving. Various groups of the modern social order resent the idea of alms, regarding such forms of assistance as undemocratic. So the use of the word charity is often avoided. Present day benevolence, philanthropy, no longer content with the cure of human ills after they arise, strives ever to prevent them, and, as a final goal, seeks through constructive effort the positive achievement of health and happiness throughout the world. It is a curious fact that the word philanthropy, which in origin means simply "love to mankind," has

no exact equivalent or synonym in our language. Further, its employment as an English word is comparatively recent, one of its earliest appearances in its present form occurring about 1650 in a sermon by Jeremy Taylor. Moreover, the use of the word to designate some humanitarian activity as "a philanthropy" is a development of the last 50 years.

The purpose of this article is not to discuss the history of ancient and mediaeval benevolence, various aspects of which are treated in the article CHARITY, but to indicate the chief developments that have characterized modern philanthropy since about the beginning of the 19th century.

The Nineteenth Century.—Between 1775 and 1800 there were significant beginnings of that notable philanthropic activity which was to characterize the 19th century. Conspicuous among its forerunners in England were John Howard, pioneer in prison reform, and Sir Samuel Romilly, who sought to abolish the barbaric features of British criminal law. In France Charles Michel Epée laid the foundations of modern instruction for the deaf and dumb, and Jean F. Oberlin laboured effectively for social improvement. Another leader was the American scientist, Benjamin Thompson, afterwards Count Rumford, who organized in Bavaria (1785–95) a system of workshops, called houses of industry, thereby largely suppressing begging.

The change from the domestic to the factory system of manufacture at the beginning of the 19th century brought about a great shift of the labouring population, accompanied by a phenomenal growth of cities, nowhere more striking than in Great Britain between 1800 and 1850 and in the United States between 1850 and 1900. In 1800 London was the only city in Great Britain with a population of over 100,000. The next largest cities were Manchester, Birmingham and Glasgow, each of which had about 75,000 inhabitants. Yet at the end of the century all these places, including London, had multiplied in size from more than seven to nearly ten times. In 1800 Philadelphia, then the largest city in the United States, had a population of 28,000, as contrasted with about 150 American cities of equal or greater population in 1900. Similar urban growth took place in Germany, Belgium and other industrial countries of Europe.

This rapid and unparalleled transfer of people from rural to urban conditions gave rise to problems in social adjustment of immense range and complexity. Accompanied by the progress of democracy, the advance of popular education, the increasing sense of civic responsibility, the application of scientific methods and, above all, the ever-widening permeation of the humanitarian spirit, these social transformations formed the background for the development of the great outstanding philanthropies of our time. Most notable among the results of the philanthropic spirit were the great advance in industrial welfare, the abolition of human slavery, improved housing in cities, enlightened care for the defective classes, immense extension of free public education, the organization of the Red Cross society, the charity organization movement, the social settlement movement, the child welfare movement and the establishment of scientifically equipped hospitals.

Among the most notable philanthropists (on each of whom will be found a biographical article under his name) were: Robert Owen, famous for his model mills at New Lanark and later for his communities in England and America; Jeremy Bentham and the Quaker educator, William Allen (1770–1843). Other leading figures were William Wilberforce whose life-effort was finally crowned in 1833 by the passage of an act abolishing slavery in the British dominions, and Elizabeth Fry, in England, who carried on the cause of prison reform initiated by John Howard.

In the United States Dr. Samuel Gridley Howe advanced the education of the blind, and Thomas Gallaudet, with his sons Thomas and Edward Gallaudet, performed equally conspicuous service in the training of the deaf and dumb. In 1833 Anton Frederic Oxinam, a zealous Roman Catholic student at the Sorbonne, with the aid of Père Sylvain Bailly, organized in Paris the Society of St. Vincent de Paul. Within the century this society expanded into a world-wide agency of Catholic beneficence, whose principles and practices of poor relief influenced the charitable practice of our time, in Protestant as well as in Catholic countries. In the same year (1833) Theodor Fliedner, a pastor in Rhenish Prussia, established the Protestant order of Deaconesses, at whose first school in Kaiserswerth Florence Nightingale was trained as a nurse. Shortly before (1827) Miss Catherine McAuley established in Dublin the Sisters of Mercy, whose hospitals and schools have become widespread in English-speaking and other countries.

Lord Shaftesbury's long life is the continuous story of factory acts, child labour acts, mining reform, lunatic asylum reform, public health improvement and housing reform. In 1856 Baroness Burdett-Coutts, who devoted a long life and a large fortune to many-sided philanthropy, began building model lodging-houses at Bethnal Green. In 1862 George Peabody, an American banker living in London, gave a fund of £150,000, later enlarged to £500,000, for the construction of dwelling houses for London working men. In 1864 Octavia Hill began her remarkable housing work at Marylebone with funds advanced by John Ruskin.

The English nurse, Florence Nightingale, by heroic service with the British army in the Crimean War (1854–56), revolutionized the care of sick and wounded soldiers in military hospitals. Further reflecting the humane spirit of the age, the Swiss philanthropist, Henri Dunant, provided aid for wounded soldiers on the battlefield by organizing, in 1864, the Red Cross Society. Under the leadership of Clara Barton the American Red Cross Society was established in 1881 and its function later extended (1906) to provide relief in natural calamities. Henry Bergh, of New York, founded, in 1874, the Society for the Prevention of Cruelty to Children. In 1853 Charles Loring Brace founded the Children's Aid Society of New York city, a pioneer organization in the child welfare movement. In 1867 Dr. Thomas John Barnardo opened in Stepney Causeway, London, the first of the so-called "Barnardo homes" for destitute children.

In 1869 a group of prominent men in England, including the earl of Shaftesbury, J. H. Newman and Wm. E. Gladstone, formed in London the first Charity Organization Society in the world. With a group of Oxford men, Canon S. A. Barnett in 1885 founded in Whitechapel, London, the first university settlement, Toynbee Hall. Dr. Stanton Coit in 1886 established in New York the Neighborhood Guild which later became the University settlement. In 1889 Jane Addams began her work at Hull House, Chicago, and in 1893 two nurses, Lillian D. Wald and Mary M. Brewster, established in New York city the now widely known Henry Street settlement.

In the 19th century, also, the political and economic emancipation of the Jewish peoples of western Europe led to a complete reorganization of Jewish benevolence, accompanied by many outstanding achievements in modern philanthropic endeavour. Among these were the notable activities of Sir Moses Montefiore, of England, in ameliorating the lot of unfortunate co-religionists in lands where they were still oppressed, and also the munificent benefactions of Baron Maurice de Hirsch. The latter established the Jewish Colonization Society, which he endowed with some £11,000,000, making it one of the greatest modern philanthropic trusts; in addition, he contributed extensively to hospitals and other charities in London and elsewhere, the total of his benefactions amounting to about £18,000,000.

In the latter half of the century began the philanthropic efforts to advance higher education in the United States, the individual donations eventually exceeding in size those made for any other single beneficent purpose. These benefactions included an immense number of substantial sums to countless institutions, but most conspicuous were endowments of princely magnitude for the more important colleges and universities. Notable among the early benefactors of American education were Peter Cooper, Ezra Cornell, Matthew Vassar and Johns Hopkins. Later Leland Stanford and John D. Rockefeller made munificent gifts for the establishment of universities and the spread of higher education.

Following the Civil War and the emancipation of the slaves, the education of the American negroes in the Southern States became and still remains an especially worthy object of philanthropic endeavour. Prominent among early contributors of funds or of important personal service to the cause of negro education

were George Peabody, donor of the Peabody Fund; John F. Slater, founder of the Slater fund; General O. O. Howard, commissioner of the Freedmen's bureau; Samuel Chapman Armstrong, founder of Hampton Institute and a leader in negro education; and Booker T. Washington, a conspicuously successful negro educator, who founded Tuskegee Institute.

Another notable expression of educational philanthropy during the latter half of the century was the establishment of free public libraries on an unprecedented scale, especially in the United States. Important among earlier gifts for library foundations were those of John Jacob Astor, James Lenox and Samuel J. Tilden, in New York, and John Crerar, in Chicago. Later came individual gifts for great library buildings, as that of Enoch Pratt to the city of Baltimore and of P. A. B. Widener to Philadelphia, and also gifts for thousands of lesser buildings in smaller cities and towns, for the construction of a large number of which Andrew Carnegie made very numerous donations aggregating more than $60,000,000.

Recent Philanthropy.—At the opening of the 20th century the philanthropic agencies in effective operation immensely exceeded in number, diversity and scope those of any earlier period. Despite the World War there was a substantial advance in every important field of philanthropic endeavour during the first quarter of the new century. In connection with the many phases of this growth two distinctive features developed. One of these was the assumption by the British, French and other European governments of a vast range of social relief which formerly was administered only through private charitable agencies. By parliamentary enactment in Great Britain in 1908 a system of old age pensions was set up. In 1911 came the National Insurance Act, providing against sickness, invalidity and unemployment. Further, in 1928, by the Widows, Orphans and Old Age Pensions Act, a still larger group previously aided through private charity was brought under the scheme of national social insurance.

The second distinctive feature of this period has been the creation of many great philanthropic trusts, especially in the United States. Their underlying constructive purpose is somewhat parallel to that of the British governmental system of social relief. These trusts seek permanent, substantial and far-reaching results through the use of ample funds, efficient organization and modern methods of administration. In the United States alone, where the establishment of such trusts has become a favourite method of the bestowal of large bequests, the total of such funds runs into the thousand millions of dollars. Many philanthropists disapprove of the efforts made by certain benevolent trusts and foundations to perpetuate themselves by restricting their enterprises and expenditures to the interest on invested capital and not only leaving the principal untouched but even adding from time to time to it from unused income. In consequence, various trusts, as the Julius Rosenwald Fund, provide definitely for the expenditure of the entire fund capital as well as income within a specified period.

Among other distinctive gains made in the 20th century have been the effective attacks on disease, as yellow fever, typhoid and tuberculosis; the marked progress in numerous phases of child welfare, and the wide establishment of the juvenile court system in treating youthful delinquents. Important also have been the efforts to promote amicable international relations, as reflected in the Rhodes Scholarships, established (1902) by Cecil J. Rhodes, and (1910) the Carnegie Endowment for International Peace.

The magnitude of philanthropic expenditure in recent years is vastly greater than ever before recorded. In 1926 the British Government distributed, in maintaining its public social service in England and Wales, a total of £313,000,000, of which about £80,000,000 was derived from sums received from contributions from or levies on individuals and companies. In addition to this huge sum—over one-third of the gross income of the British Government—other contributions of large amounts were made to religious, educational and charitable organizations. In Great Britain in 1927 there were recorded 35 private bequests of £40,000 and upwards, the average bequest in this group being £105,000.

In the United States the private donations for philanthropic (including religious) uses estimated at approximately $1,719,000,000 for 1921 rose to $2,330,600,000 for 1928, the average exceeding $2,000,000,000 per year. While the greater number and bulk of all American donations go to religious bodies, charitable organizations and hospitals, as they do likewise in Great Britain, the chief recipients of the largest bequests are universities and colleges. Of 340 major benefactions made in 1928, averaging over $500,000 each, 57% of the total amount went to institutions of higher education. In consequence of the tendency to give generously to higher education, there were in the United States in 1929 about 100 colleges and universities whose endowments were $2,000,000 or more each; the total endowment of this group exceeded $875,000,000.

Further indicative of the trend of recent American contributions to philanthropic purposes, aside from the major objects mentioned above, there were in 1927 donations for the institutional care of children, $94,300,000; for the institutional care of the aged, $64,400,000; for negro education, $30,900,000; for scholarships for needy children, $19,300,000; for public health nursing, $11,800,000; for medical research, $13,000,000; for health education, $6,500,000; for play and recreation, $19,300,000, and for the fine arts, $25,700,000. There were also donations for relief in foreign lands, including Armenia and the Near East, China, Russia, Poland, Austria, Ireland and other countries, amounting to $214,500,000.

The United States.—Philanthropic endeavour in America differs from that of other countries in its greater variety and in the larger proportion undertaken through private initiative as compared with that carried on by the State, while that performed directly under religious auspices is much less. Moreover, as little poverty exists and there is no pauper class, welfare work is conducted in a more confident spirit, with the expectation of making social relief ultimately needless. Again, all forms of public and private relief, including the care of the sick, defective, insane, criminal or indigent, are more and more thought of as parts of a complicated but interrelated system, to be planned for and administered as such. There is also the American readiness to discard old methods, mechanisms and plants and to install new and better devised ones.

The emphasis on prevention has greatly stimulated research into social conditions, and several heavily endowed foundations, as the Russell Sage, the Rockefeller and the Carnegie, include research as a special function. The results of surveys made by research institutions have stimulated the older social service organizations to undertake a greatly widened range of constructive activities and rehabilitations instead of simple relief. Training schools for social workers have been established, and training courses in social work are offered by colleges and universities.

The trend toward prevention is seen also in the changed methods of handling criminals. Reformation, not merely retribution or punishment, has become generally emphasized in the treatment of adult as well as juvenile offenders. Such features as probation, indeterminate sentence, special courts for children and specialized treatment for women and children, which were novelties at the beginning of the 20th century, now characterize the penal and correctional systems of most States.

A noteworthy development is seen in the growing co-ordination of social agencies, the mutual exchange of records and information, and wide-spread co-operation in formulating working plans and programmes. An important outcome of this co-operation has been the founding of financial federations, which have become a basic feature of social welfare work in many American cities. The Jewish charities were the first to inaugurate this plan successfully, but in 1921 some 30 important cities had adopted this method of raising a community chest or community fund, and subsequently the plan became widely prevalent. In 1929 about 350 urban communities were using it.

There has also been a marked tendency toward increased dependence upon government in the field of social welfare. Boards of health have extended their control over infectious diseases, established clinics and maintained nurses and physicians to visit and give instruction to the poor in their homes. Public schools

have added physicians, nurses, dentists and psychiatrists to their regular staffs. In more than three-fourths of the States there is an organized bureau of child welfare, and in most of the States there is some provision for the payment of widows' pensions or mothers' allowances. The Federal Government has granted financial aid for vocational education; the Department of Agriculture has done social work in rural communities, and a children's bureau is maintained by the Department of Labor.

Industrial welfare work, largely a development of the first quarter of the century, beginning in many instances with the installation of a rest room, lunch room and first-aid appliances in mercantile and industrial establishments, has expanded to include gymnasiums, playgrounds, medical counsel and care, summer camps, company stores, mutual benefit societies; in fact, practically everything that may promote the well-being and efficiency of the workers and promote co-operation and good-will between the employers and the employed. (J. Ros.)

PHILANTHROPIC ENDOWMENTS

The accumulation of great fortunes in the United States and the peculiar appropriateness of benevolence in a democracy have been accompanied by an exceptional development of endowed philanthropies.

Benjamin Franklin (1706–90) wrote in his will: "Having myself been . . . assisted to set up my business . . . by kind loan of Money . . . which was the foundation of my Fortune, and of all the utility in life that may be ascribed to me, I wish to be useful even after my Death, if possible, in forming and advancing other young men that may be serviceable to their Country." To that end he left £1,000 to the town of Boston and an equal amount to the city of Philadelphia, to be lent at interest to young, married artificers of good character. Estimating that each of these gifts would have increased to £131,000 after 100 years, Franklin requested the expenditure at that time of £100,000 in public works of useful, convenient and agreeable character, and the accumulation of the remainder for another century, when the whole was to be distributed—one-fourth by the city and three-fourths by the State. In 1891, largely because there had been few borrowers, the Philadelphia accumulation amounted only to $90,000. Of this, $20,000 was left to accumulate for another century; the remainder, accumulated to $133,000 in 1908, was then added to the endowment of the Franklin Institute, which had been founded in 1824, for the promotion of science and the useful arts. Of the Boston accumulation of $391,000 in 1891, $62,000 was left to accumulate for another century; the remainder, accumulated to $408,000 in 1904, was then used to build the Franklin Union, an industrial school, an equal sum being given for its endowment by Andrew Carnegie.

George Peabody (1795–1869), a merchant and banker, of Danvers, now Peabody, Mass., and later of London, established, among many benevolences, an institute, with a library, art museum and conservatory of music, in Baltimore, Md., in 1859; a Museum of Archaeology and Ethnology at Harvard college in 1866; an Academy of Science at Salem, Mass., in 1867; and gave £500,000 for the erection of workmen's dwellings in London in 1864, and $3,000,000 to the Peabody Education Fund in 1867, for "intellectual, moral or industrial education among . . . the Southern and Southwestern states." The fund established and developed public schools until they were taken over by towns and cities; encouraged rural schools and the development of State systems of public education; and promoted the training of teachers by scholarships, and by founding at Nashville, Tenn., in 1875, the Peabody Normal college, which became in 1913 the George Peabody College for Teachers and received the remaining resources of the Peabody Education Fund at its conclusion in 1914.

Andrew Carnegie (1835–1919) carried out his "Gospel of Wealth" by distributing nine-tenths of his fortune in countless gifts—for 8,000 church organs, 3,000 libraries and 500 universities and colleges. Two-thirds of his total distribution of $350,000,000 went toward the establishment and endowment of eight large, permanent foundations. (For full particulars of these foundations see CARNEGIE TRUSTS.)

John D. Rockefeller (1839–) and John D. Rockefeller, Jr. (1874–) have given for philanthropic and charitable purposes more than $550,000,000, together with $45,000,000 to the University of Chicago. The larger portion of this was given for the establishment and endowment of four large foundations. (For full particulars of these foundations see ROCKEFELLER BENEFACTIONS.)

Other large foundations are: (1) the Milbank Memorial Fund, incorporated in 1905, by Elizabeth Milbank Anderson, with $10,000,000, especially for studies and demonstrations of child welfare, mental hygiene and individual and community health; (2) the Russell Sage Foundation, established in 1907 by Mrs. Russell Sage, with $10,000,000, later increased by $5,000,000, for the improvement of social and living conditions in the United States, especially through the organization of charity, education, recreation, remedial loans, social legislation, and through libraries, research, surveys, statistics, exhibits and publications; (3) the Commonwealth Fund, established in 1918 by Mrs. Stephen V. Harkness, with $38,000,000, "for the welfare of mankind," especially through clinics and demonstrations of child health, guidance and mental hygiene; the training of social workers; rural hospitals; and educational fellowships, research and publications; (4) the Juilliard Musical Foundation, of New York, established in 1919 by a bequest of $20,000,000 from Augustus D. Juilliard, for the musical education of gifted students and of the public; (5) the Duke Endowment, established in 1924, by James B. Duke, with $40,000,000, increased by bequest in 1925, for Duke university, other universities and colleges, hospitals, the building and maintenance of churches, pensions for clergymen, and the care of orphans in North and South Carolina; (6) the Julius Rosenwald Fund, established in 1912 and amounting in 1928 to $20,000,000, for the health and education of negroes, other backward races and persons of small means, with the proviso that both the principal and interest be expended within 25 years after the death of the donor. Mr. Rosenwald has in addition made large contributions of time and money to other civic, philanthropical educational enterprises, including Y.M.C.A.'s and Y.W.C.A.'s for negroes. More recent endowments for educational and other philanthropic foundations have been made by Frank Munsey, Payne Whitney, Milton Hershey and Henry E. Huntington.

There are in the United States perhaps 100 endowed philanthropies that are smaller than the large foundations already mentioned but yet larger, more comprehensive, and more independent than the countless separate endowments of specific activities that have been given to religious and charitable organizations, hospitals and other health agencies and to universities, colleges, schools and educational associations. Following the Cleveland Foundation (see COMMUNITY TRUSTS), established in Cleveland, Ohio, in 1914, there have come into existence some fifty community foundations, funds or trusts that are cared for by trust companies and disbursed by committees selected by public officers and representative associations. While no one of these community organizations has as yet been entrusted with permanent resources approaching those of the larger foundations, a number of them have been very useful in conducting surveys and distributing current gifts.

The fears concerning the power of wealth concentrated in foundations and their indefinite continuance of the wishes of their founders, which were formulated by the French economist, Turgot, in 1776, have not been fulfilled. Religious, philanthropic and educational endowments in the United States represent less than 1% of the national wealth; a score of life insurance companies have larger resources than any foundation; a hundred banks have incomes greater than the total new endowments in any year. The "imposition of the dead hand" is prevented and desirable freedom is assured by such provisions as Mr. Carnegie's for spending the income of his endowments for purposes other than those he specified, or Mr. Rockefeller's for spending the principal as well as the income of his gifts, and by legislative

provisions in foundation acts of incorporation or charters that these may be altered or repealed at any time.

Meanwhile the resources of the foundations have given them independence and freedom to concentrate upon particular problems, to carry out comprehensive and continuing studies, experiments and demonstrations. Eminent men have guided them as trustees, and distinguished scholars have collaborated in their studies. Gifts from foundations have greatly encouraged giving to worthy causes; their discriminations have elevated educational standards; their activities have been taken advantage of by many voluntary associations, sundry States and the Federal Government. In fine, the public has come to expect from these privately endowed yet representative foundations much of the aid and guidance that are furnished by government in other countries.

An annotated bibliography of the literature concerning American foundations was issued by the Russell Sage Foundation in 1915, 1920, 1922, 1924 and 1926. (C. Fu)

PHILARET [Theodore Nikitich Romanov] (?1553–1633), patriarch of Moscow, was the second son of the boyar Nikita Romanovich. During the reign of his first cousin Theodore I (1584–98), Theodore Romanov distinguished himself both as a soldier and a diplomatist. On the death of the childless tsar, he was the popular candidate for the vacant throne; but he acquiesced in the election of Boris Godunov, who compelled him, three years later, to take monastic vows under the name of Philaret. Philaret was confined to the Antoniev monastery, but when the pseudo-Demetrius overthrew the Godunovs he released Philaret and made him metropolitan of Rostov (1605) In 1609 Philaret fell into the hands of pseudo-Demetrius II., who named him patriarch of all Russia, though, in fact, his jurisdiction was very limited On June 2, 1619, he was enthroned patriarch of Moscow. Henceforth, till his death, there were two sovereigns, Tsar Michael and his father, co-regents.

Philaret replenished the treasury by a more equable and rational system of assessing and collecting the taxes. His most important domestic measure was the chaining of the peasantry to the soil, a measure directed against the ever increasing migration of the down-trodden serfs to the steppes, where they became free-booters instead of tax-payers The taxation of the tsar's *slyuzhnuie lyudi,* or military tenants, was a first step towards the proportional taxation of the hitherto privileged classes Philaret formed the nucleus of the subsequently famous Patriarchal Library, and commanded that every archbishop should establish a seminary for the clergy, himself setting the example. He also reorganized the Muscovite army with the help of foreign officers. His death in October 1633 put an end to the Russo-Polish War (1632–33), withdrawing the strongest prop from an executive feeble enough even when supported by all the weight of his authority.

See R. N. Bain, *The First Romanovs* (London, 1905); S. M. Solovev, *Hist of Russia* (Rus), vol ix. (St Petersb 1895, etc).

PHILATELY. Postage stamps afford a simple and effective means of collecting fees paid, or required to be paid, for the transmission of matter sent by post. In 1653 the *petite poste* (local post) in Paris set up by M (afterwards Comte) de Villayer, as a private enterprise, but with royal sanction, sold letter-covers or wrappers bearing a distinctive mark, at two *sous* (one penny) each Letters enclosed in such wrappers and dropped in letter-boxes, were collected and delivered by *laquais* (footmen), who removed the wrappers on delivery. These wrappers were the first printed franks, comparable to the stamped envelopes and covers of modern times. In 1818 stamped sheets of paper served to collect a tax (not postage) on correspondence in Sardinia. Lieut. C. G. Treffenberg proposed stamped wrappers for the prepayment of postage in Sweden in 1823, but the plan was not adopted. Kindred proposals made in Great Britain (1830–39) prepared the way for the adoption of stamps to serve for the collection of postage under Rowland Hill's uniform postage plan in 1840. Two years in advance of Great Britain New South Wales issued embossed letter sheets, for penny local letters, and sold them at 1s. 3d. a dozen; they were not popular even when reduced to 1s a dozen.

Introduction of Postage Stamps.—The two kinds of stamps issued in Great Britain in 1840 were: (1) A stamped envelope or wrapper bearing a design by Wm Mulready R A., (2) adhesive postage stamps, small rectangles of paper, with the device of the queen's head, backed with gum The Mulready covers and the 1d. and 2d. adhesive postage stamps all came into use on May 6, 1840, some were sold on May 1, but they were not authorized for use before May 6. By May 12, Rowland Hill recognized that the covers were not in great demand. Stocks of the Mulready envelopes and letter-sheets were withdrawn and destroyed when new and simpler envelopes and sheets bearing the embossed stamp of the queen's head were issued in 1841

Adhesive postage stamps, owing to their small size and great variety, are the chief interest of the stamp-collector. The 1d. black and 2d blue stamps of Great Britain, 1840, bear a design ¾ in. wide by ⅞ in. high, printed from engraved steel plates. The queen's head was drawn by Henry Corbould from Wm Wyon's "City Medal" The engraving of this on steel was entrusted to Charles Heath, but was probably executed by his son Frederick Heath The die was transferred to steel plates, each of 240 repetitions, and from these plates, Perkins, Bacon and Petch, afterward Perkins, Bacon and Co. Ltd , printed the stamps The addition of perforations is due to an Irish inventor, Henry Archer, in 1854

The two stamps were subjected to changes in 1841, the 1d. being then printed in red instead of black, as the black stamps did not afford sufficient safeguard against the removal of postmarks The change in the 2d. blue consisted in the introduction of uncoloured lines under the words "postage" and "twopence "

Spread of the Stamp System.—Britain's first stamps attracted attention abroad, but a considerable period elapsed before the system was adopted extensively. A private "City Despatch Post" of New York, conducted by an Englishman, Henry T. Windsor, issued a 3 cent stamp in 1842. The Swiss cantons of Zurich and Geneva, and Brazil followed in 1843 The first Geneva stamp was a divisible one, the whole being used on cantonal letters (10 centimes) and the half for local postage within one commune Brazil's first stamps, known to collectors as "bulls-eyes" (the designs are elliptical), bear large numerals of value, proposals to use the effigy of Dom Pedro being abandoned as it was thought obliterating the portrait would show a want of respect for that sovereign The canton of Basle, and several postmasters in the United States issued stamps in 1845 The postmasters of New York and St. Louis issued adhesive stamps for the convenience of their customers, and to increase their incomes (which depended on postage collections); and the postmaster of New New Haven, Conn , issued stamped envelopes Other postmasters followed their example before the U S. Government issued postage stamps in 1847. Some of the "postmasters' stamps" are of the greatest rarity, notably those of Alexandria, Va , Annapolis, Md , Baltimore, Md , Boscawen, N H., Brattleboro, Vt., Lockport, N.Y , Millbury, Mass , New Haven, Conn , and St. Louis, Mo

In 1847 the first British colony to follow England's lead was Mauritius, where a local watchmaker engraved the earliest stamps on the back of a small copper plate, which had been used as an advertisement card for a local hotel Those were the 1d orange-red and 2d blue stamps lettered "Post Office" at the left side, and bearing the effigy of the queen, fewer than 30 copies of the two stamps are known The United States issued its first governmental postage stamps on July 1, 1847; the 5 cent stamp bore the effigy of Franklin, and the 10 cent that of Washington

In 1848 the postmaster of Bermuda issued a stamp, after the manner of the U S postmasters The next two years witnessed the extension of the system in Europe and elsewhere with stamps from Bavaria, Belgium, France (1849), Austria, British Guiana, Hanover, New South Wales, Prussia, Saxony, Schleswig-Holstein, Spain, Switzerland, Victoria (1850). Every year (1851–1909) new countries or colonies were added to the list, and no country with any claims to organized government is without postage stamps of some kind.

The Extensive Field for Collections.—Postage stamps were already attracting collectors in the '50s; by 1860–62 a great

wave of popular interest spread in Europe and America, and the extensive literature of stamp-collecting began. Mount Brown's catalogues published in 1862–64 list 1,200 varieties known to him in May 1862, and 2,400 in his last edition in March 1864. The *Standard Catalogue* (1928), which lists only main varieties of Government stamps, presents a total of 46,969. The more detailed catalogues, inclusive of minor varieties (Gibbons, Scott, Kohl, etc.) may be estimated as recording 170,000 to 180,000. Even these high figures refer only to adhesive postage stamps issued by Governments; if the stamps of municipal, local and private posts were added, the number would be much larger.

The first lists of postage stamps for the use of collectors were privately circulated in manuscript in 1860 by Oscar Berger-Levrault, a printer of Strasbourg, and in Aug. 1861 he issued a thin quarto 12-page list printed by autolithography. Alfred Potiquet, of Paris, had the benefit of these lists when he compiled his first catalogue, published in 1861. The earliest English catalogues (Booty, Mount Brown, Dr. Gray) appeared in 1862. Booty, a young artist, produced the first illustrated stamp catalogue (his 3rd ed.), pictures and text being drawn by himself on the lithographic stone (Aug. 1862). In America the first publication of the kind, A. C. Kline's *Stamp Collector's Manual* (Dec. 1862), was a pirated copy of Mount Brown's catalogue. Periodical literature began with the *Monthly Intelligencer* (Sept. 1862), but by 1863 journals which remain of reference value were started in the *Stamp Collector's Magazine* (England), *Timbre Poste* (Belgium) and *Magazin für Briefmarken-Sammler* (Germany). The first printed stamp albums were designed by a Frenchman, Justin Lallier, and published in France and England in 1862.

The development of the study of stamps, as distinct from mere collecting, dates from about 1867, when M. Berger-Levrault in *Les Timbres Poste, Catalogue méthodique et descriptif de tous les timbres-poste connus* gave details of dates of issue, methods of printing, shades, varieties of paper, watermark and perforation. These were the outcome of the "French school" of collecting, favoured by leading English and German collectors. The name philately had been given to the study in 1864, derived from the Greek φίλος (loving) and ἀτελής (free of tax), the intention of the originator, M. Herpin, being to indicate a fondness for things (stamps) exempt from tax.

Forming a Collection.—The vast output of stamps enables the beginner to start with a greater variety than was possible in the 19th century. Packets containing 1,000 to 10,000 different stamps are regularly stocked by dealers; they form the cheapest basis for starting a collection. The principal sources of supply for adding to collections are the stamp trade, auctions and exchange with other collectors. Stamps are arranged under countries, in the chronological order of issue. The loose-leaf album allows greater freedom for arrangement and expansion of the collection.

In addition to the stamp dealers established in many cities who hold large stocks of old and modern stamps for collectors, stamp auctions are held frequently in London, Paris, Berlin and New York, at which collectors and dealers bid in competition. An important source of supply of modern issues is the "Philatelic Agency," the first of which was started by the United States as a department of its post office at Washington (1921) to supply current stamps, and such stamps of older issues as may be available, at face value, to collectors and dealers; similar agencies were set up in Canada (Ottawa, 1923), the Canal Zone (Balboa Heights, 1924), Netherlands and colonies (Amsterdam, 1925), Denmark (Copenhagen, 1926), Sweden (Stockholm, 1927).

The stamps are generally removed from any back paper before mounting in the album; the mounting is done in a special way to permit the examination of a stamp, back and front, without removal from the album, and the removal of the stamp for transference to another place. This is done by means of hinges, consisting of small strips of paper, gummed on one side. This little strip, folded, gummed side outwards, forms the hinge, one arm of which is lightly fixed to the back of the stamp, while the other arm holds the stamp in position in the album.

Factors in stamps which the collector requires to examine are: (1) Paper, its colour, texture and watermark (if any); (2) design, subject, character of the impression (typographed, lithographed, engraved or embossed) and colour; (3) gum; (4) margins or gutters, with particular reference to the perforation (if any).

Watermarks in stamps are of great variety. In some cases an elaborate or large design is "watermarked in the sheet," and only part of it shows on a detached stamp. Where the watermarked devices are small, and correspond with the arrangement of the stamps in a sheet, they are "single watermarks." "Multiple" watermarks are small and separate devices as in the "single," but set so closely together that parts of two or more show in each stamp.

Perforations are punched out of the paper along the gutters between the stamps on a sheet. If instead of being punched out they are merely pricked by a wheel or raised printer's rule they are called "roulettes." Perforations and roulettes are measured on a system based on the number of perforations made in a length of 2 cm. (20 mm.). Thus, if a stamp be described as "perf. 12" it means that there are 12 perforations to the 2 cm. along any of its margins. To save counting a gauge is used consisting of a printed range of dots and lines set within a column 2 cm. wide. By running the stamp up or down this gauge it is easy to find a line where the dots fit neatly into the curves of the perforation; the number at the side denotes the perforation measurement.

The Scope of Philately.—The specialist seeks to show in his collection the full history of the stamps under consideration. Where obtainable he will show the artist's original drawings, engravers' and printers' proofs, colour trials, essays (proposed stamps which were submitted, but rejected, or altered before adoption). The principal portion of the collection, however, consists of the actual stamps as issued and used. Good condition of the specimens is of first importance. Unused stamps should be as near "mint" or "post-office" state as possible, that is to say, in the state they were in at the time of manufacture and issue. Used and unused stamps, especially old imperforate issues, are much sought after in unsevered pairs, strips or blocks, in which state they are often of added value. Used stamps of early date are of special interest if preserved on the original letter or envelope. The philatelist distinguishes successive printings or editions of stamps of one type by variations in shade, impression, paper, watermark or perforation. Postmarks, especially where they bear dates, help to place such editions in their proper sequence. Various phases of the use of the stamps are illustrated by postmarked copies, including, in many cases, stamps of one country used in another; *e.g.*, "British used abroad," also French, German, United States and other stamps used extra-territorially.

The World War provided interesting issues, like the British and other war issues for Samoa, New Britain, Baghdad, Bushire and Togo. The period of the armistice and post-war reconstruction brought many new countries within the sphere of philatelic interest, *e.g.*, Estonia, Latvia, Lithuania, Czechoslovakia, etc., and produced stamps which serve to recall the plebiscites, the mandated territories and the League of Nations; while in 1929, the issue of stamps which the Papacy formerly made, was restored.

With the advancement of aeronautical transport, mails are now regularly sent by air along many routes, and since Italy issued a special stamp for use on letters sent by an experimental air-mail between Rome and Turin in May 1917, the United States, Austria, Germany and many other countries have issued airpost stamps. In addition to interesting the general stamp collector, these have attracted new collectors who limit themselves to stamps of aeronautical associations. They pay particular attention to "flown covers," *i.e.*, letters or cards actually sent by air-mail. Such letters carried on historic flights like the transatlantic flights by Hawker (April 1919), Sir J. Alcock (June 1919), Marquis de Pinedo (1927) command high prices; there are elaborate special priced catalogues of air stamps (*see* Bibliography).

Expressions other than those used in a strict dictionary sense are: *Bisect,* half a stamp used as half the value of the whole stamp. *Block,* an unsevered group of stamps. *Control,* a letter or number, or both, on margin for checking purposes, or a device stamped on the front or back to prevent forgery or misuse. *Error,*

an incorrect stamp, either in design, colour or paper, etc. *Essay,* a proposed stamp, not adopted, or adopted only after some modification. *Imperforate* (imperf.), without perforation. *Local,* a stamp whose validity is limited to a town or district. *Mint,* in perfect unused condition (in the United States the same is described as *Post-office state*). *Pre-cancel* (*led*), stamps sold by the post-office already cancelled to firms mailing postal matter in bulk. *Reprint,* a fresh printing from original plates or stones after an issue has become obsolete. *Surcharge,* an overprint affecting the designation of value. *Tête-bêche,* an unsevered pair of stamps, one being upside-down.

National Collections.—The great collections founded by early collectors are all dispersed, except the important one which was the late T. K. Tapling's bequest to the British Museum. It is nearly complete up to 1890 in adhesive stamps and postal stationery. Only the adhesives are fully exhibited in the king's library at the museum, in cases with glazed, vertical slides, protected against deterioration from light and dust. Among the greatest rarities are: the full set and duplicates (12 in all) of the Hawaiian islands, Oct. 1, 1851, including the two types of the 2 cent ones, the second type being one of three copies known; British Guiana, 1851, 2 cent on rose used, 1856, 4 cent on dark blue (four copies); Mauritius, 1847, so-called post-office stamps, 1d. orange-red used on the original letter, 2d. blue unused, and an original document, being the engraver's estimate for making these stamps; Canada, 12d. black, an unused pair, and single copies, one used, one unused; Cape of Good Hope, 1d. and 2d., "wood-block" errors of colour; Ceylon, 4d. rose, imperforate; Moldavia, 17 copies of the first issue, including four of the 81 *parales;* Nevis, 1867, 1s. green on laid paper; India, 4 annas inverted frame; Western Australia, 4d. inverted swan. Great Britain occupies 55 slides of 220 large cards; the United States, 40 slides, including postmasters' stamps of Baltimore, Brattleboro, New Haven, St. Louis (10 copies), New York, and in the general issues all three values of the inverted centres of 1869 issue.

The Berlin postal museum contains an extensive collection with many rare items, including first issues of Mauritius, Hawaii and other celebrated rarities, but is especially strong in stamps, and documents relating thereto, of the old German States. Among its greatest rarities is one of three known copies of the 9 kreutzer Baden printed in black on green, instead of rose-coloured, paper. The Swedish Postal museum at Stockholm has an important collection, greatly extended by the generosity of Hans Lagerloef of New York, who in 1927 added the two denominations of the "post-office" Mauritius. A great collection of Dutch stamps forms the basis of a postal museum collection at The Hague. The U.S. national stamp collection, in the Smithsonian Institution, Washington, contains a fine historical collection of U.S. stamps, and representative collections of stamps of all countries. The New York public library acquired in 1924 a very complete collection of U.S. stamps collected by B. K. Miller, of Milwaukee. Other important public collections are installed at Dublin (Science and Art museum), Manchester (Whitworth Institute), Calcutta (Victoria Memorial Hall) Sydney, N.S.W. (Mitchell library), etc.

Famous Collectors and Their Collections.—King George V., patron and former president of the Royal Philatelic Society, London, started collecting stamps in his midshipman days, and his interest increased rather than abated in his later life. The King has a great range of rare specimens, original sketches, proofs, etc., including the unissued 2d. Tyrian plum, King Edward, and stamps overprinted for use of Government departments such as "I. R. Official" 1902–04, 6d. dull purple, 5s. carmine, 10s. ultramarine and £1 green, and "Board of Education" 1s. green and carmine, in singles and in pairs. Of every colony the royal collection is practically complete; Mauritius, with the two "post-office" stamps, 1d. used, and 2d. unused (the latter the finest copy known), is especially rich in rarities; British Guiana lacks only the 2 cents, 1850, and the 1 cent, 1856. The Barbados, Nevis, Hong Kong, Grenada, Bermuda, Trinidad, Turks islands and other portions of the King's collections have been shown at exhibitions or meetings.

The greatest private collection ever formed was that of Philippe la Rénotière von Ferrari, who died at Lausanne in 1917. The greater part of his collection was in Paris and was sequestrated by the French Government, and sold by auction in 1922–25. In 14 sales, covering 39 days, the stamps realized 26,482,964 francs or £402,965, calculated at the rate of exchange prevailing at the different periods of the sales. Many record prices were obtained for great rarities, among them:—British Guiana, 1856, 1 cent (unique), £7,343; 1850, 2 cents, pair £5,250; Hawaiian islands, 1851, 2 cents, £3,900; Mauritius, 1847, 2d., £2,338, 1d., £2,090; Baden, 9 kreutzer green (error) £1,816; France, 1849, 15 cents, *tête-bêche* pair £837, 1 franc (Vervelle) *tête-bêche* in a block of four, £2,706; United States postmasters' stamps: Boscawen, 1846, 5 cent (unique), £2,625, Lockport, 1846, 5 cent (unique), £1,875.

The most valuable collection of modern times is that of Arthur Hind of Utica, N.Y., who acquired a large proportion of the famous gems from the Ferrari sales, and has made extensive purchases in other directions; *e.g.,* Duveen collection of Mauritius, Griebert collection of Spain. He is the owner of the most celebrated stamps of which only single specimens are known; viz., British Guiana, 1 cent magenta, the Boscawen and Lockport postmasters' stamps; and in addition to two perfect unused "post-office" Mauritius (Duveen collection) he paid the record sum of £11,000 for an envelope on which the 1d and 2d. "post-office stamps" had been used together to prepay a 3d. rate of postage.

Organizations.—Philatelic societies are to be found in the chief cities of most countries. The Royal Philatelic Society, London, founded in 1869, was granted the prefix "Royal" by Edward VII. in 1906. The Junior Philatelic Society, founded in 1899, inaugurated a widespread movement which has extended throughout the world, assisting the beginner and medium collector; it organized the international philatelic exhibitions of London in 1912 and 1923. Between 70 and 80 societies in Britain and the colonies are affiliated in the Philatelic Congress of Great Britain, which meets annually. America has its similar institutions headed by the Collectors' club (New York), with flourishing societies in cities from Boston to San Francisco. The American Philatelic Society is a national body holding an annual convention; the Association for Stamp Exhibitions, Inc., organized the New York international exhibitions of 1913 and 1926.

BIBLIOGRAPHY.—The literature of philately is very extensive, and great libraries on the subject are accessible at the British Museum, London, the Collectors' club, New York, etc. *See* E. D. Bacon, *Catalogue of the Philatelic Library of the Earl of Crawford, K.T.* (1911), supplement (1926). The library is at the British Museum, bequeathed to the nation. *The Philatelic Index* to principal articles in philatelic journals, compiled by a committee of the Philatelic Congress of Great Britain (1925). General and introductory: A. B. Creeke, *Stamp Collecting: A Guide for Beginners* (1913); R. P. Croom-Johnson, *Postage Stamp Collecting: A Practical Guide* (1923); F. J. Melville, *Chats on Postage Stamps* (1920, bibl.); Philatelic Institute, *New A.B.C. of Stamp Collecting* (1922, bibl.), *Boys' Own Guide to Stamp Collecting* (1923); *Rare Stamps: How to Recognize Them* (1922) and *The Complete Philatelist* (1924, bibl.); F. B. Warren, *Pageant of Civilization* (1926). Advanced text-books (general); F. J. Melville, *Postage Stamps in the Making* (1916); A. J. Sefi, *An Introduction to Advanced Philately* (1926). Special groups: D. B. Armstrong, *British and Colonial Postage Stamps* (1920); T. Champion, *Catalogue historique des timbres de la Poste Aérienne* (1928); D. Ingram, *Postage Stamps of the Red Cross* (1919); F. J. Melville, *The Postage Stamp in War* (1914), *Aero Stamp Collecting* (2nd ed., 1924). Forgeries and Frauds: Rev. R. B. Earee, *Album Weeds* (1906), gives detailed descriptions of difference between genuine and forged specimens; F. J. Melville, *Phantom Philately* (1923), describes and illustrates bogus stamps; *i.e.,* stamps intended to deceive. *See* also the handbooks and pamphlets on stamps published in most countries, and the catalogues, illustrated and priced, published by dealers and revised annually or at frequent intervals; an up-to-date edition is indispensable as a guide to what stamps there are, and their approximate values. Collectors will use the catalogues published in their respective countries; viz., Stanley Gibbons, Bright and Son, Whitfield King and Co., in Great Britain and colonies; Scott Stamp and Coin Co., in the United States; Yvert-Tellier-Champion, in France and on the Continent in general; Senf, Michel and Kohl, in Germany; Galviz, in Spain and Spanish America, etc. (F. J. ME.)

PHILEMON (*c.* 361–263 B.C.), Greek poet of the New Comedy, was born at Soli in Cilicia, or at Syracuse. He settled at Athens early in life, and his first play was produced in 330

He was a contemporary and rival of Menander, whom he frequently vanquished in poetical contests. He lived at the court of Ptolemy, king of Egypt, for some time. Plutarch (*De Cohibenda Ira*, 9) relates that on his journey he fell into the hands of king Magas of Cyrene, whom he had formerly satirized. Magas treated him with contempt, and finally dismissed him with a present of toys. Various accounts of his death are given. Of ninety-seven plays, the titles of fifty-seven and considerable fragments have been preserved. Some of these may have been the work of his son, the younger Philemon.

See A Meineke, *Menandri et Philemonis reliquiae* (1823, including Bentley's emendations); T. Kock, *Com. graec. frag*, vol. iii (1884).

PHILEMON, EPISTLE TO, a New Testament book A short personal note by the apostle Paul has been preserved, which owes its origin to a romantic episode in the life of a slave, called Onesimus. For some reason he had run away from his master Philemon, a prosperous Christian citizen; it may be inferred that he had also been guilty of pilfering (ver. 18). For either offence he was liable by law to be crucified In some unexplained way he had come across Paul and been converted to Christianity This opened a difficult situation. The apostle boldly solved the problem by sending Onesimus back along with Tychicus, who was going to Colossae with Paul's letter to the local church; "I send him with Onesimus, that faithful and beloved brother, who is one of yourselves" (Col iv 9). But, not content with this certificate in favour of the converted and penitent slave, Paul sends also a note to his master, bespeaking his Christian interest in Onesimus It is a brief letter, tactful and charming, in which the apostle, after greeting Philemon and his wife and the local church that met in his house, rejoices over Philemon's character, which, he says, emboldens him to enter a plea for poor Onesimus, now returning to his duty, a very different man from what he was when he ran away Paul delicately suggests that he would like to have kept the slave beside him, and offers to be responsible for any debts incurred by Onesimus. He hints that this generous action on the part of Philemon will be a personal kindness to himself as well as to the slave "You count me a partner? Then receive him as you would receive me, and if he has cheated you of any money or owes you any sum, put that down to my account. This is in my own handwriting 'I Paul promise to refund it'—not to mention that you owe me, over and above, your very soul. Come, brother, let me have some return from you in the Lord Refresh my heart in Christ."

Where the letter was written, we do not know Rome was a natural place of refuge for runaway slaves, who could lose themselves in the huge population easily, if Colossians was written from Rome, so was this note. Where Philemon stayed is also uncertain; he may have been resident at Laodicea or at Ephesus, for though Onesimus accompanied the letter to the Colossian church, it does not follow that Colossae was the seat of his master; indeed as Philemon was converted by Paul, that cannot have taken place at Colossae, which Paul had never visited Still, Philemon may have shifted his quarters to Colossae

The letter appears in two second century canons, that of Marcion and the Muratorian, though its lack of dogmatic importance as well as its brevity threw it afterwards into some disfavour among certain circles of the Church

Bibliography —The letter is edited in most commentaries on Colossians (*q v*), and by Dr M R Vincent in his edition of Philippians (*International Critical Commentary*, 1897) There are special editions by Rothe (*Pauli ad Philemonem epistolae interpretatio historico-exegetica*, Bremen, 1844), van Oosterzee (Eng Tr New York, 1868), Oesterley (*Expositor's Greek Testament*, 1910), and others The social problems of the letter are discussed by Lightfoot in his Commentary on Colossians; by J. H. Bernard in Hastings' *Dictionary of the Bible* (iv. 832f), and in Renan's *L'Antéchrist* (pp 95 f). (J. Mof.)

PHILEMON AND BAUCIS, in Ovid (*Metam.*, viii. 610 ff.) a pious Phrygian couple, who hospitably received Zeus and Hermes (for their combined cult in Lycaonia cp. *Acts*, 14, 12), when their richer neighbours turned them away, they being disguised as wayfarers. As a reward, they were saved from a flood which drowned the rest of the country; their cottage was turned into a temple, and at their own request they became priest and priestess of it, and long after ended their lives at the same moment, being turned into trees. The story which is a *Märchen* of a well-known type, *e.g.*, *Grimm Kinder- und Hausmärchen*, 87, with the commentary of Bolte-Polivka, combined here with a version of the flood-myth, is perhaps really of local origin, *see* Calder in *Discovery*, 1922, p. 207 ff.

PHILES, MANUEL (*c.* 1275–1345), of Ephesus, Byzantine poet. At an early age he removed to Constantinople, where be was the pupil of Georgius Pachymeres, in whose honour he composed a memorial poem. Having offended one of the emperors by indiscreet remarks published in a chronography, he was thrown into prison and only released after an abject apology. Philes' character, as shown in his poems, is that of a begging poet, always pleading poverty, and ready to descend to the grossest flattery

Editions. the natural history poems in F. Lehrs and F. Dübner, *Poetae bucolici et didactici* (Didot series, 1846); *Manuelis Philae Carmina inedita*, ed A Martini (1900), *Manuelis Philae Carmina*, ed E Miller (1855–57). *See* also C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897).

PHILETAS of Cos, Alexandrian poet and critic, flourished in the second half of the 4th century B C. He was tutor to the son of Ptolemy I of Egypt, and to Theocritus and the grammarian Zenodotus. His thinness made him an object of ridicule, according to the comic poets, he carried lead in his shoes to keep himself from being blown away. His elegies, chiefly singing the praises of his mistress Battis (or Bittis), were much admired by the Romans. Philetas was also the author of a vocabulary called Ἀτακτα, explaining the meanings of rare and obscure words, and of notes on Homer, severely criticized by Aristarchus

Fragments cited by N Bach (1828) and T. Bergk, *Poetae Lyrici Graeci; see* also E. W Mande, *De tribus Philetae carminibus* (1895)

PHILIDOR, FRANÇOIS ANDRE DANICAN (1726–1795), French composer and chess-player, was born at Dreux, on Sept. 7, 1726 He spent many years in travelling on the Continent and in England, meeting and defeating the most noted players of the time, and was regarded as the strongest player and greatest theoretician of the 18th century. Returning to France in 1754, he devoted himself seriously to music, and after producing several works of minor importance brought out at Paris, in the year 1759, his successful light opera, *Blaise le Savetier*, which was followed by a number of others. He died in London on Aug 31, 1795.

PHILIP, one of the 12 apostles *See* Apostle

PHILIP, "the evangelist," is mentioned in Acts vi. 5, as one of "the seven" chosen to superintend certain secular business of the Jerusalem Church, in consequence of dissension between the Aramaic-speaking and Greek-speaking disciples. Luke by mentioning the common meals wishes his readers to connect these officials with the later diaconate, but they seem to have been originally parallel among the Hellenistic Jews to the Twelve among the Hebraists Philip's was a ministry of the word He went to Samaria and preached with much success, Simon Magus being one of his converts. He afterwards instructed and baptized the Ethiopian eunuch on the road from Jerusalem to Gaza. His missionary journey ended at Caesarea (Acts viii). Here he entertained Paul and his companions on their last journey to Jerusalem (xxi. 8). (W. K. L. C)

PHILIP I. (1052–1108), king of France, eldest son of Henry I of France and Anne, daughter of Jaroslav I. (d 1054), grand duke of Kiev, came to the throne, when a child of eight, by the death of his father on Aug. 4, 1060. He had been crowned at Reims May 23, 1059 His minority came to an end in 1066. In the long reign that followed he showed no great ability or energy, and a looseness of morals which embroiled him with the Church Before he was fifty years of age he became "fond of nothing but good cheer and sleep." But he increased the lands of his house around Paris, maintained order in them, and held his own against William I. and William II. of England, whose power in France far exceeded his own. This he accomplished for the most part by taking advantage of the quarrels among his vassals. During the years 1070–74 he greatly strengthened his position in Flanders by these means. In the struggle between Fulk Rechin and his brother Geoffrey the Bearded for the inheritance of their uncle, Geoffrey Martel (d. 1060), count of Anjou, Philip received

rom Fulk in 1069, as the price of his neutrality, Château Landon ınd the Gatinais. This acquisition linked the county of Sens, ıcquired in 1055, with the rest of the domain round Paris, Melun ınd Orleans. War with William I. and William Rufus was chronic ɔut intermittent. In his last years Philip left the duty of repelling hė attacks of his Norman and other enemies to his son Louis, ıssociating him with himself, as "king-designate," some time ɔetween May 24, 1098, and Sept. 25, 1100.

It was his second marriage which was the cause of Philip's ;reatest difficulties. On May 15, 1092, he carried off Bertrada, laughter of Simon, baron de Montfort, wife of Fulk Rechin, and ɔrepared to marry her, though his wife Bertha was still living. The bishops, headed by Ivo, bishop of Chartres, refused to attend he ceremony of marriage, but one was found to perform it. Philip's open simony had long been a cause of friction with the ɔapacy. When he added bigamy and adultery, Urban II. excomnunicated him. Philip was reconciled with the Church in 1104, ınd took an oath not to have any converse or society with Bertrada except in the presence of "non-suspect" persons. But hey seem to have gone on living together, and even visited Fulk Rechin (Bertrada's husband) in company on Oct. 15, 1106. Philip lied at the end of July 1108.

His reign is chiefly remarkable for the steady growth of the ·oyal domain. By his first queen he had four children: Louis VI., who succeeded him; Henry, who died young; Charles; and Con- stance, who married Hugh I., count of Champagne, and later Bohemund I., prince of Antioch. By Bertrada de Montfort he had hree children: Philip, count of Montes; Fleury or Florus, who narried the heiress of Nangis; and Cecilia, who married, first Tancred, prince of Galilee and Antioch, and secondly Pons de Saint Gilles, count of Tripoli.

See the *Recueil des actes de Philippe I.*, ed. M. Pron (1908), and B. Monod's *Essai sur les rapports de Pascal II. avec Philippe I.* (Paris, 1907). For notices of the principal chronicles of the time *see* A. Molinier, *Les Sources de l'histoire de France* (II., esp. p. 307 *et seq.*).

PHILIP II. (1165–1223), known as PHILIP AUGUSTUS, king ɔf France, son of Louis VII. and Adela, daughter of Theobald II., count of Champagne, was born on Aug. 21, 1165. On Nov. 1, 1179, he was associated with his father as king by being crowned ıt Reims, and at once his father's illness threw the responsibility ɔf government on him, the death of Louis on Sept. 19, 1180, leavng him sole king. His long strip of royal domain was hemmed n by the Angevin Empire on the west and by the kingdom of Arles on the south-east. Henry II. of England was feudal lord ɔf the greater part of France, practically all west of a line which ɔegan at Dieppe and ended at the foot of the Pyrenees more han half-way across to the Mediterranean, while at one point t nearly touched the Rhone. Philip's predecessors had consoliated the Capetian power within these narrow limits, but he himself was overshadowed by the power of his uncles, William, archbishop of Reims; Henry I., count of Champagne; and Theobald V., count of Blois and Chartres. He secured an ally against them, ınd an addition to the royal domain, by marrying, on April 28, 1180, Isabella or Elizabeth, daughter of Baldwin V., count of Hainaut, and of Marguerite, sister of Philip of Alsace, the reigning count of Flanders, who ceded, as Isabella's dowry, the district ıfterwards called Artois. On June 28, 1180 Philip made a treaty with Henry II. at Gisors, but from 1181 to 1185 he had to struggle against a feudal league of his Champagnard uncles and other great barons, whose most active member was Stephen I., count of Sancerre (1152–1191). Having secured his position at home, the king turned against Henry II., and by the truce of Châteauroux in June 1187, gained Issoudun and the seigniory of Fréteval in the Vendômois. Though the truce was for two years, Philip assembled an army in 1188 to invade Normandy, demanding Gisors and the conclusion of the marriage which had been arranged between his sister Alice and Richard of England, who had meanwhile deserted his father. But Richard took the cross, and Philip seized the county of Berry, part of his dukedom. Further reconciliations and conferences followed, and Henry II., just before his death, did homage and surrendered the territories of Graçy and Issoudun. Henry died two days later. Pledges of mutual good faith and fellowship were exchanged between Philip and Richard of England on Dec. 30, 1189, and they both prepared to go on the crusade.

The Crusade.—Before setting out Philip arranged for the government of France during his absence by the testament of 1190, by which he proposed to rule France as far as possible from Palestine. On the way to Palestine the two kings quarrelled. At the siege of Acre Philip fell ill, and he returned to Paris at Christmas 1191, having concluded on his way an alliance with the emperor Henry VI. against Richard, despite his pledges not to molest his lands. Philip did his utmost by offers of money to prolong Richard's captivity, and, allied with the English king's brother John, attacked Richard's domains. But upon Richard's return the Normans rallied to him, and Philip was defeated at Fréteval on July 3, 1194. He continued the war, generally with ill success, for the next five years. Again a formidable coalition was formed against him, including Baldwin IX., count of Flanders and Hainaut, Renaud of Dammartin, count of Boulogne, Louis, count of Blois, and Raymond VI., count of Toulouse. In Germany, Otto of Brunswick, afterwards the emperor Otto IV., allied himself with Richard, while Philip was supported by Otto's rival, Philip of Swabia. Richard's death, in April 1199, removed his archenemy, and Richard's successor, John, concluded the treaty of Le Goulet with Philip on May 22, 1200, ceding to him the county of Evreux, Graçy and Issoudun, and the suzerainty of Berry and Auvergne. John renounced his suzerainty over Brittany and the guardianship of his nephew, Arthur; he engaged not to aid the count of Flanders or Otto IV. without Philip's consent, paid him a relief of 20,000 marks, and recognized himself as his vassal for his continental fiefs.

Conquest of Normandy.—But in 1202 the war was renewed. At an interview at Le Goulet on March 25, Philip demanded the cession of Anjou, Poitou and Normandy to his ward, Arthur. John refused; he was summoned to Paris before the royal judges, and failing to appear was sentenced at the end of April 1202 to lose all his fiefs. Brittany, Aquitaine and Anjou were conferred on Arthur. Philip invaded Normandy, took Lyons-la-Forêt and Eu, and, establishing himself in Gournay, besieged Arques. But John, joined by William des Roches and other lords of Maine and Poitou, jealous at the increase of Philip's power, defeated and took Arthur prisoner at Mirebeau. Philip abandoned the siege of Arques in a fit of fury, marched to the Loire, burning everywhere, and then returned to Paris. But John soon alienated the Poitevin barons, and William des Roches signed a treaty with Philip on March 22, 1203. Then Philip continued his great task, the conquest of Normandy, capturing the towns around the fortress of Château-Gaillard which Richard had built to command the valley of the Seine. Pope Innocent III. tried to bring about peace, but Philip was obdurate, and after murdering Arthur of Brittany John took refuge in England in December 1203. The fall of Château-Gaillard, after a siege which lasted from September 1203 to April 1204, decided the fate of Normandy. Rouen, bound by ties of trade to England, resisted for forty days; but it surrendered on June 24, 1204 The conquest of Maine, Touraine, Anjou and Poitou in 1204 and 1205 was little more than a military promenade, though the castles of Loches and Chinon held out for a year. Philip secured his conquest by lavishing privileges on the convents and towns. He left the great lords, such as William des Roches, in full possession of their feudal power. In 1206 he marched through Brittany and divided it amongst his adherents. A truce for two years was made on Oct. 26, 1206, by which John renounced all claims in Normandy, Maine, Brittany, Touraine and Anjou, but it did not last six months. Then Poitou was thoroughly subdued, and another truce was made in 1208, little more than southern Saintonge and Gascony being left in the hands of John. Philip had reduced to a mere remnant the formidable continental empire of the Angevins, which had threatened the existence of the Capetian monarchy.

Philip then undertook to invade England. He had collected 1,500 vessels and summoned all his barons when Innocent III., having sufficiently frightened John, sent Pandulf with the terms of submission, which John accepted on the 13th of May.

Disappointed of his hopes of England, Philip turned his arms against Ferdinand, count of Flanders. He invaded Flanders and took the chief towns within a week; but he had part of his fleet burned by the English at Damme, and had to burn the rest to save it from falling into their hands. He returned to Paris, and Ferdinand retook most of the towns which had been taken by the king. A war of fire and pillage began, in which Philip and his son Louis burned their way through Flanders, and Ferdinand did the same through Artois.

The Victory of Bouvines.—In 1214 came the great crisis of Philip's life. A league including his rebel vassals, Renaud of Dammartin, count of Boulogne, and Ferdinand, count of Flanders, with the emperor Otto IV. and a number of German princes of the Rhine region, had been formed in the north-east, while John of England made one more attempt to recover his heritage at the head of an army of mercenaries, aided by the fickle baronage of Poitou. John landed at La Rochelle on Feb. 10, 1214, and was at first successful. On June 19 he laid siege to La Roche-aux-Moines, the fortress which defended Angers and commanded the Loire valley; but on the approach of a royal army under Prince Louis on July 2 his Poitevin barons refused to risk a pitched battle, and he fled hastily to La Rochelle. The Angevin Empire in France was lost. Meanwhile Philip himself won his greatest victory at the bridge of Bouvines, among the morasses of Flanders. At first taken by surprise, he turned the abortive attack into a complete rout. Renaud and Ferdinand were taken prisoner, and Otto IV. fled from the battlefield. The army of the allies was utterly destroyed (July 27, 1214). The battle of Bouvines, a decisive battle for the history of Germany as well as for France and England, sealed the work of Philip Augustus. The expedition of his son Louis to conquer England can hardly be considered as an incident of his reign, though he was careful to safeguard the rights of the French Crown. More important was the Albigensian crusade, in which he allowed Louis to take part, though he himself, preoccupied with the king of England, had refused time after time to do anything. He treated Simon de Montfort as if he were a royal *bailli;* but it was not in virtue of any deep-laid scheme of his that in the end Amaury de Montfort, Simon's son, resigned himself to leave his lands to the Crown of France, and gave the Crown a power it had never before possessed in Languedoc.

Organisation of France.—Philip II. surrounded himself with clerks and legists of more or less humble origin, who gave him counsel and acted as his agents. His *baillis,* who at first rather resembled the itinerant justices of Henry II. of England, were sent into the royal domain to supervise the conduct of the *prévôts* and hear complaints, while in the south local feudal magnates were given similar powers with the title of *sénéchal.* Feudal service was more and more compounded for by a money payment, and additional taxes were raised. The extension of the system of *sauvegarde,* by which abbeys, towns or lay vassals put themselves under the special protection of the king, and that of *pariage,* by which the possessor surrendered half the interest in his estate to the king in return for protection or some further grant, increased the royal power. The small barons were completely reduced to submission, whilst the greater feudatories could often appoint a castellan to their own castles only after he had taken an oath to the king.

It has been said with some justice that Philip II. was the first king of France to take the bourgeoisie into partnership. He favoured the great merchants, granting them trade privileges and monopolies. The Jews he protected and plundered by turns, after the fashion of mediaeval kings. Amongst the subject towns administered by *prévôts* a great extension of the "custom of Lorris" took place during his reign. Philip was the ally and protector of the communes. Before him they were resisted and often crushed; after him they were exploited, oppressed, and finally destroyed. In the case of Senlis he extended the jurisdiction of the commune to all crimes committed in the district. It is true that he suppressed some communes in the newly conquered fiefs, such as Normandy, where John had been prodigal of privileges, but he erected new communes in his own private domain, quite contrary to the custom of other kings. He seems to have regarded them as a kind of garrison against feudal unruliness, while the rents they furnished increased his financial resources. He created no new types of commune, however, except Peronne, which received a maximum of political independence, the twenty-four electors, who named the *jurés* and other officers, being elected by the *corps de métiers.*

Philip's policy of building up a strong monarchy was pursued with a steadiness of aim which excluded both enthusiasm and scruple. He shrank from no trickery in carrying out his ends, and had no room for pity. He could not even trust his own son with any power, and was brutal in his relations with his queen, Ingeborg. As the result of his steadiness of aim and patient sagacity, at the end of his reign the Crown was victorious over the feudal nobility and the royal domain extended to the frontiers along with royal authority. Artois, the Amienois, Valois, Vermandois, the greater part of the Beauvaisis, Normandy, Maine, Anjou, Touraine, and an important part of Poitou and Saintonge, were added to the domain during his reign. The number of *prévôtés* was increased from thirty-eight to ninety-four, and the royal revenue increased from 19,000 livres a month to 1,200 livres a day.

Philip Augustus died on July 14, 1223. He was thrice married. His first wife, Isabella, by whom he had one son, Louis, died in 1189 or 1190. After her death he married Ingibjörg or Ingeborg (*q.v.*), daughter of Valdemar I. of Denmark, whom he soon repudiated. In 1196, in defiance of the pope, he married Agnes, daughter of Bertold IV., duke of Meran. This led to his excommunication and brought the interdict upon France, and did more to weaken him than any other act of his. In 1200 he was forced to put away Agnes and to recognize Ingeborg as his lawful wife, but he kept her in prison until 1213. By Agnes (d. 1201) he had a son Philip, called "Hurepel," count of Clemont, and a daughter Mary, who married Philip, count of Namur (d. 1213), and then Henry II., duke of Brabant. Ingeborg lived until 1236.

See A. Luchaire in E. Lavisse's *Histoire de France,* tome iii. 83–284 (Paris, 1904), and literature there indicated; L. Deslisle, *Catalogue des actes de Philippe Auguste* (Paris, 1856 and 1901); A. Cartellieri, *Philipp II. August,* Bd. I. *Bis zum Tode Ludwigs VII.* (Leipzig, 1899), Bd. II *Der Kreuzzug* (1906); and W. H. Hutton, *Philip Augustus* (in the Foreign Statesmen series, London, 1896). A. Molinier, *Les Sources de l'histoire de France* (tome iii. pp. 1–38), gives a complete bibliography of the sources for Philip's reign, including the history of the Third Crusade.

PHILIP III. (1245–1285), surnamed "the Bold" (*le Hardi*), king of France, son of Louis IX. and Margaret, daughter of Raymond-Bérenger IV., count of Provence, was born on April 3, 1245. His funeral monument at St. Denis depicts a man with beardless, square-cut features, but lacking character and animation. The authenticity of this effigy is fairly well borne out by what is known of him from other sources. He had many of the virtues of St. Louis, but neither decision of character nor devotion to duty. He was pious, charitable, of unimpeachable morality, quick-tempered but placable, no great scholar, and only energetic as a hunter. The absence in him of the qualities that fit a man to rule made his court the arena of intriguing factions, which in reality ruled France during his reign of fifteen years. Matthew of Vendôme, abbot of St. Denis, an old servant of Louis IX., acted as Philip's counsellor, so the chroniclers state, throughout the reign; but it was probably with administration, and not policy, that Matthew was chiefly concerned. Philip began his reign in 1270 by falling entirely under the influence of Pierre de la Brosse, who had been surgeon and valet-de-chambre to his father whom he made lord (sieur) of Langeais, Chatillon-sur-Indre and Damville. His influence lasted until Philip's second marriage in 1274 with Marie, daughter of Henry III., duke of Brabant. She supplied a centre for the enemies of the favourite, who, in 1278, was charged with various crimes, including one of poisoning the king's eldest son, and hanged at Montfaucon. His death left the parties of Marie, the queen, and Margaret, the queen-mother, to struggle for the mastery. The settlement of the claims of the king of England in Aquitaine by the treaty of Amiens in 1279 was a victory for the party of Margaret.

Agenais and southern Saintonge, which fell to the Crown by

the death of Alfonse of Poitiers in 1276, as part of his vast possessions in Aquitaine and Languedoc, were ceded to Edward I. of England in accordance with the treaty of Paris in 1259. Another portion of the heritage of Alfonse, the Venaissin, was ceded to the papacy to redeem an old promise. In general the strong will of Charles of Anjou directed Philip's policy. He secretly urged his nephew's candidature for the imperial crown, left vacant by the death of Richard of Cornwall, king of the Romans, in 1272, but without success. In May 1275 the party of Marie secured for Philip, the king's second son, the hand of Jeanne, the heiress of Navarre and Champagne, along with the guardianship of the kingdom of Navarre during the minority of Jeanne. But early in 1276 Jeanne's mother, Blanche, the widow of Henry III. of Navarre and Champagne, married Edmund, first earl of Lancaster, brother of Edward I.; and she and her English husband kept Champagne until, in 1284, Jeanne came of age.

An expedition of Philip against Castile in aid of the children of his sister, Blanche, proved abortive Regardless of this warning, he was induced in 1284 to take up the quarrel of his uncle Charles in Sicily, after the Sicilian Vespers in 1282. Two assemblies of barons and prelates were held at Bourges in November 1283 and February 1284 to deliberate on the question This was a mere matter of form; Marie of Brabant and her party had decided the matter beforehand, and the crown of Aragon, which the French pope Martin IV had declared forfeited by Peter, was accepted for Charles of Valois, Philip's third son The project was strongly opposed by Matthew of Vendôme, who was in correspondence with the king of England on the subject It was the first warlike expedition undertaken by the house of Capet outside France It proved a disastrous failure. Philip died during a retreat from Gerona on Oct 5, 1285

Philip was twice married On May 28, 1262 he married Isabella, daughter of James I, king of Aragon, who died in 1271. By her he had four children. Louis, who died in 1276; Philip, born in 1268; Charles of Valois, born on March 12, 1270; and Robert, who died young By his second wife, Marie (d 1322), daughter of Henry III of Brabant, whom he married in 1274, he had three children: Louis, count of Evreux; Margaret, who married in 1299 Edward I, king of England; and Blanche, who married Rudolph III, duke of Austria

See Ch V. Langlois, *Le Règne de Philippe le Hardi* (Paris, 1887); and in E. Lavisse's *Histoire de France*, tome iii, ii 113–117 (Paris, 1901), Fr. Walter, *Die Politik der Kurie unter Gregor X* (Berlin, 1894); Registers of Gregory X. and Nicholas III, published by the French school at Rome; R. Sternfeld, *Ludwigs des Heiligen Kreuzzug nach Tunis und die Politik Karls I von Sizilien* (1896); P Fournier, *Le Royaume d'Arles* (Paris, 1891). For complete bibliography of sources *see* A Molinier, *Les Sources de l'histoire de France*, tome iii. 171–187 (Paris, 1903)

PHILIP IV. (1268–1314), called *"le Bel"* or "the Fair," king of France, was the son of Philip III and his wife, Isabella of Aragon His reign, which began in October 1285, is one of the most momentous in the history of mediaeval Europe, yet it belongs rather to the history of France and to that of the papacy than to the biography of the king. Little is known of the personal part played by Philip in the events associated with his name, and later historians have been divided between the view which regards him as a handsome, lethargic nonentity and that which paints him as a master of statecraft who, under a veil of phlegmatic indifference and pious sentiment, masked an inflexible purpose, of which his ministers were but the spokesmen and executors. The first view seems to be borne out by the language of contemporary chroniclers Yet this was the king who brought the papacy under his yoke, carried out the destruction of the powerful order of the Temple, and laid the foundations of the national monarchy of France In this last achievement Finke finds the solution of a problem which Langlois had declared to be insoluble. In 1302, in the midst of a hostile assembly, Philip cursed his sons should they consent to hold the Crown of any one but God[1]; and in this isolated outburst he sees the key to his character. "Philip was not a man of violent initiative, the planner of daring and fateful operations; otherwise there would have been some signs of it. His personality was that of a well-instructed, outwardly cold, because cool and calculating man, essentially receptive, afire for only one idea. the highest possible development of the French monarchy, internally and externally, as against both the secular powers and the Church. His merit was that he carried through this idea in spite of dangers to himself and to the state. A resolution once arrived at he carried out with iron obstinacy" Certainly he was no *roi fainéant.* His courage at the battle of Mons-en-Pévèle was the admiration of friend and foe alike. It was against the advice of his tutor, Aegidius Colonna, that on coming to the throne he chose as his counsellors men of the legal class, and the names of his great ministers—Guillaume de Nogaret, Enguerrand de Marigny, Pierre Flotte (d. 1302)—attest the excellent quality of his judgment He was, too, one of the few monarchs who have left to their successors reasoned programmes of reform for the state

The greatest event of the reign was the struggle with Pope Boniface VIII. (*q v*). The pope went so far in 1296 as to forbid any lay authority to demand taxes from the clergy without his consent. When Philip retaliated by a decree forbidding the exportation of any coin from France, Boniface gave way to save the papal dues, and the bulls issued by him in 1297 were a decided victory for the French king There was a truce until 1301. After the arrest, by Philip's orders, of Bernard Saisset (*q v*), bishop of Pamiers, in that year, the quarrel flamed up again. To ensure the support of his people the king had called an assembly of the three estates of his kingdom at Paris in April 1302; in the following year Guillaume de Nogaret seized the person of the pope at Anagni, an event immortalized by Dante Boniface escaped from his captors only to die (Oct 11), and the short pontificate of his saintly successor, Benedict XI, was occupied in a vain effort to restore harmony to the Church. The issue of the conclave that met at Perugia on his death was ultimately determined by the diplomacy and gold of Philip's agents, and the new pope, Clement V, was the weak-willed creature of the French king When in 1309 the pope installed himself at Avignon, the new relation of the papacy and the French monarchy was patent It was the beginning of the "Babylonish captivity" of the popes. The most notable of its first-fruits was the hideous persecution of the Templars (*q v*), which began with the sudden arrest of the members of the order in France in 1307, and ended with the suppression of the order by Pope Clement at the council of Vienne in 1313

In 1294 Philip IV attacked Edward I of England, then busied with the Scottish War, and seized Guienne Edward won over the counts of Bar and of Flanders, but they were defeated and he was obliged to make peace in 1297 Then the Flemish cities rose against the French royal officers, and utterly defeated the French army at Courtrai in 1302 The reign closed with the French position unimproved in Flanders, except for the transfer to Philip by Count Robert of Lille, Douai and Béthune, and their dependencies Philip died on Nov 29, 1314 His wife was Jeanne, queen of Navarre (d 1304), through whom that country passed under the rule of Philip on his marriage in 1284; three of his sons, Louis X., Philip V. and Charles IV, succeeded in turn to the throne of France, and a daughter, Isabella, married Edward II. of England.

See the *Chronique* of Geoffrey of Paris, edited by M. Bouquet, in vol. xxii. of the *Recueil des historiens des Gaules et de la France.* Of modern works *see* E. Boutaric, *La France sous Philippe le Bel* (1861), G Digard, *Philippe le Bel et le Saint-Siège* (1900); C V. Langlois in E Lavisse's *Histoire de France*, vol. iii. (1901); K. Wenck, *Philipp der Schöne von Frankreich* (Marburg, 1905); H. Finke, *Papsttum und Untergang des Templerordens*, 2 vols. (Münster i. W. 1907), esp. I ch. ii

[1]Wenck, p 49.

PHILIP V. (*c.* 1294–1322), "the Tall," king of France, second son of Philip the Fair and Jeanne of Navarre, received the county of Poitiers as an appanage, and was affianced when a year old to Jeanne, daughter and heiress of Otto IV., count of Burgundy. The marriage took place in 1307 when he was thirteen years of age. When his elder brother, Louis X., died, on July 5, 1316, leaving his second wife, Clemence of Hungary, with child, Philip was appointed regent for eighteen years by the parliament

of Paris, even in the event of a male heir being born. Clemence's son lived only four days, and Philip proclaimed himself king (Nov. 19, 1317). The barons all did homage except Edward II. of England, and Philip's position was secured. The war with Flanders, which had begun under Philip IV. the Fair, was brought to an end on June 2, 1320. The revolt of the Pastoureaux who assembled at Paris in 1320 to go on a crusade was crushed by the seneschal of Carcassonne, whither they marched. One of the special objects of their hatred, the Jews, were also mulcted heavily by Philip, who extorted 150,000 livres from those of Paris alone. He died at Longchamp on the night of Jan. 2, 1322.

Philip was a lover of poetry, surrounded himself with Provençal poets and even wrote in Provençal himself, but he was also one of the most hard-working kings of the house of Capet. The insecurity of his position made him seek the support of national assemblies and of provincial estates. He published a series of ordinances organizing the royal household and affecting the financial administration, the "parlement" and the royal forests. He abolished all garrisons in the towns except those on the frontier, and provided for public order by allowing the inhabitants of his towns to arm themselves under the command of captains. He tried hard to procure a unification of coinage and weights and measures, but failed owing to the opposition of the estates. Philip as a reformer was in many ways before his time, but his people failed to understand him, and he died under the reproach of extortion.

See P. Lehugeur, *Histoire de Philippe le Long* (Paris, 1897); E. Lavisse, *Histoire de France* (Tome III., 2); and sources indicated in A. Molinier, *Répertoire des sources de l'histoire de France* (Paris, 1903).

PHILIP VI. (1293–1350), king of France, was the son of Charles of Valois, third son of Philip III., the Bold, and of Margaret of Sicily, and was thus the nephew of Philip IV., the Fair, whose sons, Louis X., Philip V. and Charles IV., died successively without leaving male heirs. He succeeded to the throne on the death of his cousin, Charles IV., in 1328. Before his accession Philip had enjoyed considerable influence, for he was count of Valois, Anjou, Maine, Chartres and Alençon. He had married in 1313 Jeanne (d. 1348), daughter of Robert II. of Burgundy, a determined woman who was long known as the real ruler of France.

When Charles IV. died, in Feb. 1328, his wife was enceinte, and it became necessary to appoint a regency until the birth of the child, who would, if a son, succeed to the throne. At the assembly of barons called to choose a regent, Edward III. of England, the nephew and nearest male relation of Charles IV., put in a claim. Edward III., however, descended from the royal house of France by his mother Isabel, and the barons, probably actuated by an objection to the regency of an English king, decided that neither a woman, "nor by consequence her son, could succeed to the kingdom of France," and Philip of Valois, in spite of his belonging to a junior branch of the family, was elected regent. On the birth of a girl to the queen widow the regency naturally led to the throne of France, and Philip was crowned at Reims on May 29, 1328. Navarre had not accepted the regency, that kingdom being claimed by her husband for Jeanne, countess of Evreux, the eldest daughter of Louis X., the count of Evreux himself being, like Philip of Valois, a grandson of Philip the Bold. The new king secured the friendship of the count by allowing Jeanne's claim to Navarre, in return for a renunciation of any right to Champagne. Edward III. of England, after more than one citation, reluctantly fulfilled (1320–22) the formalities of homage for part of Guienne. Meanwhile Philip VI. had won a victory, which he turned into a massacre, at Cassel (Aug. 23, 1328) over Bruges and the other towns of West Flanders, which under the leadership of Jakob van Artevelde had thrown off the authority of their count, Louis of Nevers. The count of Flanders was reinstated, and maintained his authority by a reign of terror.

Philip VI. enjoyed powerful alliances. In Italy he was allied with his uncle, Robert of Anjou, king of Sicily, and with his former enemy, Galéas Visconti; in the north with the duke of Brabant and the princes of the Netherlands; on the east with the reigning princes of Lorraine and Savoy; with the king of Bohemia and with Pope John XXII. at Avignon, and his successor, Benedict XII. In 1336 it seemed that the Crusade, for which Philip VI. had long been preparing, would at last start; but the relations with Edward III. of England, always strained, became worse, and within a year France was embarked on the struggle of the Hundred Years' War. The causes which led to war, the conflict for commercial supremacy in Flanders, disputed rights in Guienne, the help given by France to the Scots, and the unnatural situation of an English king who was also a vassal of the French Crown are dealt with elsewhere. (*See* FRANCE: *History.*) The immediate rupture in Flanders was due chiefly to the tyranny of the count of Flanders, Louis of Nevers, whom Philip VI. had reinstated. Edward III. had won over most of Philip's German and Flemish allies, and the English naval victory at Sluys (June 24, 1340), in which the French fleet was annihilated, effectually restored English preponderance in Flanders. A truce followed, but this was disturbed after a short duration by the disputed succession to the duchy of Brittany (*q.v.*). A truce made at Malestroit in 1343, at the invitation of the pope, was rudely broken by Philip's violence. Olivier de Clisson, who with fourteen other Breton gentlemen was suspected of intrigue with Edward III., was invited to a great tournament in Paris. On their arrival they were seized by Philip's orders, and without form of trial beheaded. Then followed Edward III.'s invasion of Normandy and the campaign of Créçy (*q.v.*). Philip's army was destroyed; he himself was wounded and fled from the field. He sought in vain to divert Edward from the siege of Calais by supporting the Scots in their invasion of England; but eventually a truce was arranged, which lasted until 1351. Philip VI. died at Nogent-le-roi on Aug. 12, 1350.

Philip VI. met his necessities by the imposition of the hated gabelle or salt tax, which was invented by his legal advisers and he obtained heavy subsidies from the various provinces. Towards the close of his reign he acquired from Humbert II., comte de Vienne, the province of Dauphiné, and Montpellier from the king of Majorca. Philip married a second wife, Blanche of Navarre. By his first wife he left two sons—his successor, John II., and Philip of Orleans, count of Valois.

See *Continuations de la chronique de Guillaume de Nangis* edited in 1843 by Géraud for the *Soc. de l'hist. de France; Grandes chroniques de Saint Denis*, vol. v. (1837), edition by Paulin Paris; E Déprez, *Les préliminaires de la guerre de cent ans, 1328–1342* (Paris, 1902), based on texts from the English Record Office and the Vatican; Paul Viollet, *Histoire des institutions politiques de la France* vol. ii. (Paris, 1898); and E. Lavisse, *Hist. de France*, vol. iv. pt. i. (1902), by A. Colville. Further references will be found in Nos. 3,095–3,112 and 3,165–3,240 of A. Molinier's *Sources de l'histoire de France*, vol. iv. (Paris, 1904).

PHILIP (*c.* 1177–1208), German king and duke of Swabia, the rival of the emperor Otto IV., was the fifth and youngest son of the emperor Frederick I. and Beatrix, daughter of Renaud III., count of Upper Burgundy, and brother of the emperor Henry VI. He entered the church, was made provost of Aix-la-Chapelle, and in 1190 or 1191 was chosen bishop of Würzburg. Philip forsook his ecclesiastical calling and was made duke of Tuscany in 1195 receiving an extensive grant of lands. In 1196 he became duke of Swabia, on the death of his brother Conrad; and in May 1197 he married Irene, daughter of the eastern emperor, Isaac Angelus, and widow of Roger II., king of Sicily. Philip appears to have been designated as guardian of the young Frederick, afterwards the emperor Frederick II., in case of his father's early death. In 1197 he had set out to fetch Frederick from Sicily for his coronation when he heard of the emperor's death and returned at once to Germany. He found growing hostility to the kingship of a child, and the absence of the two Welf claimants, Otto and Henry, the sons of Henry the Lion, made possible Philip's own election as German king at Mühlhausen on March 8, 1198. He was crowned at Mainz on Sept. 8.

Meanwhile a number of princes hostile to Philip, under the leadership of Adolph, the archbishop of Cologne, had elected an anti-king in the person of Otto, second son of Henry the Lion, duke of Saxony. War followed, in which Philip drew his principal support from south Germany. In 1199 he received further accessions to his party and carried the war into his opponent's territory. In March 1201 Innocent III. placed Philip and his associates

under the ban, and began to work for Otto. Otto, aided by Ottakar I., king of Bohemia, and Hermann I., landgrave of Thuringia, drove him from north Germany, and compelled him to seek, in vain, reconciliation with Innocent. The submission of Hermann of Thuringia in 1204 marks the turning-point of Philip's fortunes, and he was soon joined by Adolph of Cologne and Henry I., duke of Brabant. On Jan. 6, 1205, he was crowned again by Adolph at Aix-la-Chapelle, though it was not till 1207 that his entry into Cologne practically brought the war to a close. Philip was then loosed from the papal ban. He was preparing to crush the last flicker of the rebellion in Brunswick when he was murdered at Bamberg, on June 21, 1208, by Otto of Wittelsbach, count palatine in Bavaria, to whom he had refused the hand of one of his daughters. He left four daughters, one of whom, Beatrix, afterwards married his rival, the emperor Otto IV. Philip was a brave and handsome man, and contemporary writers, among whom was Walther von der Vogelweide, praise his mildness and generosity

See O Abel, *König Philipp der Hohenstaufen* (1852); E. Winkelmann, *Philipp von Schwaben und Otto IV von Braunschweig* (Leipzig, 1873–78), *Regesta imperii V*, ed J. Ficker (Innsbruck, 1881); R Schwemer, *Innocenz III. und die deutsche Kirche während des Thronstreites von 1198–1208* (Strasbourg, 1882).

PHILIP I., king of Macedonia, a semi-legendary prince, son of Argaeus, was, according to Herodotus (viii 137–139) and Thucydides (ii 100), the third of the Macedonian kings There is, however, no real evidence for his existence.

PHILIP II. (382–336 B C), king of Macedonia, the son of Amyntas II and the Lyncestian Eurydice, reigned 359–336 At his birth the Macedonian kingdom, including the turbulent peoples of the hill country behind, was very imperfectly consolidated. In 370 Amyntas died, and the troubled reign of Philip's eldest brother, Alexander II, was cut short in 368 by his assassination His murderer, Ptolemy of Alorus, ruled as regent for the young Perdiccas, Amyntas's second son In 367 Philip was delivered as a hostage to the Thebans, then the leading power of Greece, where he got to know Epameinondas, whom he greatly admired and whose influence may be traced in Philip's military reforms When he returned to Macedonia (364) Perdiccas had succeeded in getting rid of Ptolemy, but he fell in 360–359 before an onslaught of the hill tribes instigated by the queen-mother Eurydice, leaving only an infant son Pretenders sprang up and the kingdom fell into confusion. Philip seized the throne and drove back his rivals He now began the great task of his life—the creation of the Macedonian national army. Cavalry, the famous "companions," he already had; his work was to produce an efficient force of infantry This new force of his making consisted of the *hupaspistai* who may have been peltasts on Iphicrates's model, and the phalanx, which in its use for shock tactics on the wing in conjunction with the cavalry shows the influence of Epameinondas, but was less densely packed, and was armed, unlike Greek troops, with a long pike The first experiment he made with this new organism was brilliantly successful. The hill tribes were broken by a single battle in 358, and Philip established his authority inland as far as Lake Ochrida. In the autumn of the same year he took the Athenian colony Amphipolis, which commanded the gold-mines of Mt. Pangaeus Their possession was all-important for Philip, and he set there a new city, Philippi Athens was temporarily pacified by assurances that Amphipolis would be handed over to her later on.

He avoided as yet a forward policy, and having taken Pydna and Potidaea soon after Amphipolis, he made them over to the Olynthian confederation (*see* OLYNTHUS) His marriage with the fierce witch-woman, Olympias, daughter of the Epirote king, falls in this period, and in 356 she bore him his greater son, Alexander In 353 Philip was ready for strong action. He first attacked Abdera and Maroneia, on the Thracian sea-board, and then took Methone, which belonged to Athens An overt breach with Athens was now inevitable. In the same summer he invaded Thessaly, where the Aleuadae of Larissa ranged themselves on his side against the *tagos* Lycophron, "tyrant" of Pherae. Pherae called in the help of the Phocian mercenaries, who had profaned Delphi, and Philip was twice heavily defeated. But next year the Macedonian army won a complete victory over the Pheraeans and Phocians. This battle made Philip *tagos* of Thessaly, and he annexed Magnesia, which included Pagasae But on advancing further he found the Athenian expedition which had failed to secure Pagasae holding Thermopylae, and withdrew. From 352 to 346 Philip did not again come south. He was active in completing the subjugation of the Balkan hill-country to the west and north, and in reducing the Greek cities of the coast as far as the Hebrus (Maritza) Then, in 349, he opened war upon Olynthus. Athens sent no adequate forces, in spite of the upbraidings of Demosthenes (*see* his *Olynthiacs*), and in the spring of 347 Olynthus fell Macedonia and the regions adjoining it having now been securely consolidated, Philip celebrated his "Olympian" games at Dium In 347 Philip advanced to the conquest of the eastern districts about the Hebrus, and compelled the submission of the Thracian prince Cersobleptes Meanwhile Athens had made overtures for peace (*see* the *De falsa legatione* of Demosthenes), and when Philip, in 346, again moved south, peace was sworn in Thessaly.

The Phocians, who still dominated Delphi and held Thermopylae, now furnished a pretext to Philip as the champion of Pan-Hellenism and Apollo The Phocian mercenaries at Thermopylae were bought off and Philip crossed into central Greece Here he made Thebes his ally and visited the Phocians with crushing vengeance The Pythian games of 346 were celebrated at the delivered Delphi under Philip's presidency Pan-Hellenic enthusiasts already saw Philip as the destined captain-general of a national crusade against Persia (Isocrates, *Philippus*, about 345) And such a position Philip had determined to secure; the Macedonian agents continued to work throughout the Greek states and in the Peloponnesus Sparta soon found herself isolated Euboea, too, submitted to Macedonian influence.

But more work had to be done in the Balkan highlands In 344, or one of the following years, the Macedonian arms were carried across Epirus to the Adriatic and Thessaly was completely reorganized In 342 Philip led a great expedition north "comparable to nothing in antiquity since Darius' famous march to Scythia" Meanwhile he continued to foster diplomatic relations with various Greek states, and, by conciliatory measures, to support the efforts of the pro-Macedonian party in Athens But Demosthenes eventually carried the day, and Philip came more or less openly to blows with Athens over Diopeithes's behaviour in the Chersonese. Athens then supported the revolt of Philip's allies in Propontis, and struck a heavy blow at his prestige when his sieges of Perinthus and Byzantium failed in 339 But before marching south he led another expedition across the Balkans into the country now called Bulgaria, and returned to Pella with much spoil but severely wounded in the thigh.

In 338 he once more crossed into central Greece The pretext was the contumacy shown by the Locrian town Amphissa to the rulings of the Amphictyonic council Philip's fortification of Elateia filled Athens with alarm Thebes was induced to join Athens, so were some of the minor Peloponnesian states, and the allies took the field against Philip This opposition was crushed by the epoch-making battle of Chaeroneia, which left Greece at Philip's feet. Thebes was occupied by a Macedonian garrison. Athens, which had expected a fight to the death, was treated generously. In the following year (337) Philip was in the Peloponnesus and held a congress of the Greek states at the isthmus (from which, however, Sparta held sullenly aloof) The states attending were organized into an Hellenic league, with a constituent council and a supreme judicial court (the Amphictyonic council), acknowledging the military command of Philip and sending contingents for the expedition against Persia that was next in his plans Philip returned to Macedonia to complete his preparations, an advance force was sent into Asia in the spring of 336. Philip was murdered that year during the marriage festival of his daughter at Aegae, the old capital of Macedonia He left, however, in the Macedonian army a splendid instrument which enabled his son within ten years to change the face of the world

See the authorities under GREECE: *History*. A vivid and masterly sketch of Philip's personality and work is given in D. G Hogarth's

Philip and Alexander (1897). For economic policy, A. B. West in *Numism. Chron.* (1923) 169.

PHILIP III. [ARRHIDAEUS], king of Macedonia, was the feeble-minded son of Philip II. of Macedonia by a Thessalian wife. He was chosen by the Macedonian army at Babylon in 323 to be nominal king conjointly with the infant Alexander, and was killed in Macedonia by order of Olympias (317). (*See* MACEDONIAN EMPIRE.)

PHILIP IV., king of Macedonia, was the son of Cassander, king of Macedonia; he reigned only one year (296–297).

PHILIP V., king of Macedonia, son of Demetrius II. and Chryseïs, was an infant at his father's death in 230–229. His cousin, Antigonus Doson, administered the kingdom as regent till his death in 221–220, when Philip was eighteen years old. Philip now ascended the throne and reigned till 179. His reign was occupied in the vain struggle to maintain the old Macedonian supremacy in the Balkan Peninsula, which became hopeless after the intervention of Rome and the decisive battle of Cynoscephalae (197). *See* ROME: *History.* (E. R. B.)

PHILIP I., the Handsome (1478–1506), king of Spain, son of the emperor Maximilian I., was born at Bruges on July 22, 1478. In 1482 he succeeded to the Burgundian possessions of his mother, Mary, daughter of Charles the Bold. In 1496 he married Joanna, daughter of Ferdinand and Isabella. He died suddenly at Burgos on Sept. 25, 1506.

PHILIP II. (1527–1598), king of Spain, son of the emperor Charles V. and Isabella of Portugal, born at Valladolid on May 21, 1527. Philip was educated in Spain. The emperor, as he moved from one part of his wide dominions to another and in the camps of his armies, watched his heir's education from afar. The trend of his letters was to impress on the boy a profound sense of the high destinies to which he was born, the wisdom of distrusting counsellors, and the necessity for keeping his nobles apart from all share in the conduct of the internal government of his kingdom. Philip grew up grave, self-possessed and distrustful. He was beloved by his Spanish subjects, but utterly without the power of attracting men of other races. Though accused of extreme licentiousness, Philip was probably less immoral than most kings of his time, and he was rigidly abstemious. His power of work was unbounded, and he had an absolute love of reading, annotating, and drafting dispatches. Unhappily for Spain, Charles decided to transmit the Netherlands to his son. In 1543 Philip had been married to his cousin Mary of Portugal, who bore him a son, the unhappy Don Carlos, and who died in 1545. In 1554, Charles summoned Philip to Flanders and arranged the marriage with Mary, Queen of England, in order to form a union of Spain, the Netherlands and England against France. The marriage proved barren. The abdication of his father (Jan. 16, 1556) constituted Philip sovereign of Spain with its American possessions, of the Aragonese inheritance in Italy, Naples and Sicily, of the Burgundian inheritance—the Netherlands and Franche Comté—and of the duchy of Milan. It was a legacy of immense responsibilities and perils, for France was bound to endeavour to ruin a power which threatened her independence. France was beaten at St. Quentin and Gravelines, and forced to make the Peace of Cateau Cambrésis (April 2, 1559). But the death of Mary of England (Nov. 17, 1558) and the establishment of Elizabeth on the English throne, put on the flank of Philip's scattered dominions another power, forced no less than France by political necessities to be his enemy. His marriage with Elizabeth of Valois (June 22, 1559), and the approach of the wars of religion, gave him a temporary security from France. Nevertheless, when Philip went back to Spain, in August 1559, he was committed to a life-long struggle, in which he could not prove victorious except by the conquest of France and England.

External and internal influences alike drove Philip into conflict with the Netherlands, France and England. The conflict became one between Protestantism and Roman Catholicism, in which Philip appeared as the champion of the Church. It was a part he rejoiced to play. His persecutions hardened the obstinacy of the Dutch, exasperated the English and provoked a revolt of the Moriscoes. No experience of the failure of his policy could shake his belief in its essential excellence. Philip had a high ideal of his duty as a king, and had no natural preferences for violent courses. His strong measures in Aragon in 1591 were provoked by extreme misconduct on the part of a faction. When he enforced his claim to the crown of Portugal (1579–1581) he preferred to placate his new subjects by guarding their privileges. He even made dangerous political concessions to win over the gentry. In private life he was orderly and affectionate to his family and servants. He was slow to withdraw the confidence he had once given. In the painful episode of the imprisonment and death of Don Carlos, Philip behaved honourably. He died at the Escorial on Sept. 13, 1598.

As an administrator Philip had all the vices of his type, that of the laborious, self-righteous man, who thinks he can supervise everything, is capable of endless toil, and jealous of his authority. He set the example of the unending discussions in committee and boundless minute writing which choked the administration.

See M. H. Forneron, *Histoire de Philippe II.* (Paris, 1881); M. Hume, *Philip II.* (1897); *Documentos inéditos para la historia de Espana* (1842, etc.), vols. i., iii., vi., vii., xv., xxi., xxiv., xl., xcviii., ci., ciii., cx., cxi.; L. P. Gachard, *Actes des états généraux des Pays Bas, 1576–1585* (Brussels, 1861–66); *Calendars of State Papers, Foreign Series Elizabeth* (1863–1901); M. Hume, *Two English Queens and Philip* (1908); C. Bratle, *Philippe II., roi d'Espagne* (1912); F. Pérez R. Mínguez, *Psicología de Felipe II.* (1925).

PHILIP III. (1578–1621), king of Spain, son of Philip II., and Anne, daughter of Maximilian II., born at Madrid, April 14, 1578. He inherited the beliefs of his father, but no share of his industry. He left the direction of government entirely to his favourite, the duke of Lerma, and, after the latter's overthrow in 1518, to the new favourite, the duke of Uceda, Lerma's son. Philip's own life was passed amid court festivities, on which enormous sums of money were wasted, or in the practice of childish piety. It was said that he was so virtuous as hardly to have committed a venial sin. He died at Madrid, March 31, 1621.

See R. Watson and W. Thompson, *History of Philip III.* (2 vols., 1876, 1808).

PHILIP IV. (1605–1665), king of Spain, eldest son of Philip III. and Margaret, sister of the emperor Ferdinand II., born at Valladolid April 8, 1605. His reign, after a few years of barren successes, was a long story of political and military decay and disaster. A fine horseman, a keen hunter, and a patron of art and letters, he indulged in these pastimes, leaving the government to his favourite Olivares. When, in 1643, the disasters falling on the monarchy led to the dismissal of Olivares, Philip had lost the power to devote himself to hard work. After a brief attempt at directing the administration of the most extensive and the worst organized monarchy in Europe, he returned to his pleasures and was governed by other favourites. His political opinions were those he had inherited from his father and grandfather. He thought it his duty to support the German Habsburgs and the cause of the Roman Catholic Church against the Protestants, to assert his sovereignty over Holland, and to extend the dominions of his house. The utter exhaustion of his people in a hopeless struggle with Holland, France and England was seen by him with sympathy, but he considered it unavoidable. His court was grossly vicious. Philip IV. died on Sept. 17, 1665.

See A. Cánovas del Castilo, *Estudios del reinado de Felipe IV.* (Madrid, 1889), and the introduction by F. Silvela to the *Cartas de Sor Maria de Ágreda y del rey Felipe IV.* (Madrid, 1885–86).

PHILIP V. (1683–1746), king of Spain, founder of the present Bourbon dynasty, was the son of the dauphin Louis and Maria Anna, daughter of Ferdinand Maria, elector of Bavaria. Born at Versailles, Dec. 19, 1683, he was named heir by the will of Charles II. Carefully educated as duke of Anjou by Fénelon, he was all his life strongly adverse to the moral laxity of most of the princes of his time, and greatly under the influence of his two wives, Maria Louisa of Savoy (d. Feb. 1714), whom he married in 1702, and Elizabeth Farnese of Parma, whom he married in Dec. 1714. His strongest passion was to secure his succession to the throne of France, and in this pursuit he indulged in many intrigues against the house of Orleans, even abdicating in 1724. But when his son Louis died a few months later, he resumed the throne.

See Coxe, *Memoirs of the Kings of Spain of the House of Bourbon* (London, 1815).

PHILIP, Landgrave of Hesse (1504–1567), son of the landgrave William II., was born at Marburg on Nov. 13, 1504. He became landgrave on his father's death in 1509, and having been declared of age in 1518, was married in 1523 to Christina, daughter of George, duke of Saxony. In 1522 and also in 1523 he assisted to quell the rising of Franz von Sickingen (*q.v.*), who had raided Hesse five years previously, and in 1525 he took a leading part in crushing the rebellion of the peasants in north Germany, being mainly responsible for their defeat at Frankenhausen. About this time Philip adopted the reformed faith. His plans to protect the reformers rested upon two main principles—unity among the Protestants at home and military aid from abroad. The schemes he put forward as one of the heads of the league of Schmalkalden, aimed primarily at overthrowing the house of Habsburg. Envoys were sent to seek aid from France, England and Denmark; Turkey and Venice were looked to for assistance; the jealousy felt towards the Habsburgs by the Bavarian Wittelsbachs was skilfully fomented. Before the formation of the league of Schmalkalden Philip was intimate with Zwingli. In 1526 he had aided John the Constant, elector of Saxony, to form an alliance of reforming princes; and in 1529 he called together the abortive conference at Marburg, hoping thus to close the breach between Lutherans and Zwinglians. Deceived by the forgeries of Otto von Pack (*q.v.*), he believed in the existence of a conspiracy to crush the reformers, and was only restrained from attacking his enemies, in 1528, by the influence of John of Saxony and Luther. In 1529 Philip signed the "protest" presented to the diet at Spires, being thus one of the original "Protestants"; in 1530 he subscribed the Augsburg confession, and helped to form the league of Schmalkalden.

He next restored Ulrich, duke of Württemberg (*q.v.*) to his duchy. Württemberg had passed into the possession of the Habsburgs, and after Philip's brief and victorious campaign in 1534 it was said that the landgrave had done more for Protestantism by this enterprise than a thousand of Luther's books would do. The Concord of Wittenberg, made in 1536, was preparatory to a general attack on the Habsburgs, but war was prevented by the illness of the landgrave and other circumstances. At this point he took a fatal step. His union with Christina was unhappy, and, having fallen in love with Margaret von der Saal (d. 1566), he obtained an opinion from Protestant theologians that bigamy was not forbidden by Holy Writ. Luther and Melancthon at length consented to the marriage, but stipulated that it should be kept secret, and it was celebrated in March 1540. The marriage became known, and Philip's friends deserted him. He objected to Luther's counsel to deny the existence of a second marriage. But the general hostility compelled him to come to terms, in 1541, with Charles V. at Regensburg; he undertook to break off relations with France and England and loyally to support the emperor.

From 1526 onwards Philip had been forwarding the progress of the Reformation in Hesse. Catholic worship was suppressed, and the secularized church revenues supplied an endowment of the new university of Marburg. Peace between the emperor and the landgrave was soon broken. In 1542 Philip persuaded the league of Schmalkalden to attack Henry II., duke of Brunswick-Wolfenbüttel, ostensibly in the interests of the Protestant towns of Brunswick and Goslar. The duchy was quickly overrun, and Henry—a Catholic prince—driven out; but the good understanding between the emperor and the landgrave was destroyed, and the relations between Protestants and Catholics became worse than before. Nor was the fissure in the Protestant ranks closed, and Charles took advantage of this disunion to conquer Gelderland and to mature his preparations for overthrowing the league of Schmalkalden. Unlike John Frederick of Saxony, Philip divined, or partly divined, the emperor's intentions, and urged repeatedly that the forces of the league should be put in order. This advice passed unheeded, and when Charles suddenly showed his hand, and in July 1546 issued the imperial ban against the landgrave and the elector, it was seen that the two princes were almost isolated. Fighting began along the upper Danube, and when indecision and want of funds had ruined the league's chances of success, Philip returned to Hesse and sought help from foreign powers; while in defeat the landgrave was induced to surrender to Charles in June by his son-in-law, Maurice, now elector of Saxony, and Joachim II., elector of Brandenburg, who promised Philip that he should be pardoned, and were greatly incensed when the emperor refused to assent to this condition. Philip was sentenced to detention for 15 years, but he was released in 1552, and after the Peace of Passau in this year he returned to Hesse. The landgrave continued the work of reforming and organizing the Church in Hesse. In 1562 he aided the Huguenots with troops, and he was frequently in communication with the insurgents in the Netherlands; but his efforts to form a union of the Protestants were fruitless. Philip, who is sometimes called the *Magnanimous*, died at Cassel on March 31, 1567.

See *Briefwechsel Landgraf Philipps mit Bucer*, ed. M. Lenz (Leipzig, 1881–90); *Politisches Archiv des Landgrafen Philipp*, ed. F. Küch (Leipzig, 1904); W. W. Rockwell, *Die Doppelehe des Landgrafen Philipp von Hessen* (Marburg, 1904); K. Varrentrapp, *Landgraf Philipp von Hessen und die Universität Marburg* (Cassel, 1904); and *Philipp der Grossmütige, Beiträge zur Geschichte seines Lebens und seiner Zeit*, published by the *Historischer Verein für das Grossherzogtum Hessen* (Marburg, 1904).

PHILIP, King (*c.* 1639–1676), chief sachem of the Wampanoag Indians in America, and the son of Massasoit (d. 1662). To Massasoit's two sons, Wamsutta and Metacomet, the English gave the names respectively of Alexander and Philip. Alexander succeeded his father as sachem, and in the same year, while in Marshfield, whither he had gone to explain certain alleged unfriendly acts toward the English, was taken ill; he died on his way home. Philip, who succeeded Alexander, suspected the English of poisoning his brother. The English had grown stronger and more numerous, and had begun to meddle in the internal affairs of the Indians. In 1671 the Plymouth authorities demanded that the Wampanoags should surrender their arms; Philip consented, but his followers failed to comply, and measures were taken to enforce the promise. Philip thereupon went before the general court, agreed to pay an annual tribute, and not to sell lands or engage in war with other Indians without the consent of the Plymouth government. In 1674, when three Wampanoags were executed at Plymouth for the alleged murder of Sassamon, an Indian convert who had played the part of informer to the English, Philip could no longer hold his followers in check. There were outbreaks in the middle of June 1675, and on June 24, the massacre of whites began.

The colony of Connecticut took quick measures of defence, guarded its frontier, maintained its alliance with the Mohegans, and suffered little injury. Massachusetts and Plymouth were slower in acting and suffered great loss. Rhode Island raised no troops, and suffered severely. Early in the autumn Philip went nearly as far west as Albany in an unsuccessful attempt to get aid from the French and the Mohawks and supplies from the Dutch traders. At Deerfield on Sept. 18, about 60 English were killed and the settlement was abandoned. In the spring of 1676 it became evident that the Indian power was waning. The warriors had been unable to plant their crops; they were weaker numerically and more poorly armed than the English, and the latter had also made an alliance with the friendly Naticks and the Niantics. On Aug. 1, 1676 Philip's wife and nine-year old son were captured, and on Aug. 11, an Indian traitor guided the English to the sachem's hiding place in a swamp at the foot of Mount Hope (in what is now the township of Bristol, R.I.) where early the next morning he was surprised, and while trying to escape was killed by an Indian. The head of Philip was sent to Plymouth and set on a pole in a public place, where it remained for a quarter of a century. The struggle was now over in southern New England, but it continued along the north-eastern frontier till the spring of 1678.

See George M. Bodges, *Soldiers in King Philip's War* (Leominster, Mass., 1896); John Gorham Palfrey, *History of New England*, vol. iii. (Boston, 1864); and especially George W. Ellis and John E. Morris, *King Philip's War* (1906). *See* also *Entertaining Passages Relating to King Philip's War* (Boston, 1716; new ed. with notes by H. M. Dexter, Boston, 1865), the account by Col. Benjamin Church (1639–1718).

PHILIP, JOHN (1775–1851), British missionary in South

he joined John Campbell in his second journey to South Africa to inspect the stations of the London Missionary Society, and in 1822 the Society appointed him superintendent of their South African stations. His anger was aroused by the barbarities inflicted upon the Hottentots and Kaffirs (by a minority of the colonists), and he set himself to remedy their grievances. His influence was seen in the ordinance of 1828 granting all free coloured persons at the Cape every right to which any other British subjects were entitled. During 1826–1828 he was in England, and in the last-named year he published *Researches in South Africa.*

One of Philip's ideals was the curbing of colonial "aggression" by the creation of a belt of native states around Cape Colony. In Sir Benjamin D'Urban, Philip found a governor anxious to promote the interests of the natives. When, however, at the close of the Kaffir War of 1834–35, D'Urban annexed the country up to the Kei River, Philip's hostility was aroused. He came to England in 1836, and agitated against the Cape government. D'Urban was dismissed, and Philip returned to the Cape as unofficial adviser to the government on all matters affecting the natives. He died on Aug. 27, 1851.

See South Africa: *History;* G. M'C. Theal's *History of South Africa since 1795* (London, ed. 1908); *Missionary Magazine* (1836–51); R. Wardlaw's *Funeral Sermon,* 1852.

PHILIPPA OF HAINAUT (*c.* 1314–1369), queen of the English king Edward III., was the daughter of William the Good, count of Holland and Hainaut, and his wife Jeanne de Valois, granddaughter of Philip III. of France. By a special dispensation of the pope, Philippa was married to her cousin Edward III. by proxy at Valenciennes in October 1327, and landed in England in December. She joined Edward at York, where she was remarried on Jan. 30, 1328. Her marriage dower had been seized by the queen dowager Isabella to pay a body of Hainauters, with whose help she had compassed her husband's deposition. The alliance ensured for Edward in his French wars the support of Philippa's influential kindred; and before starting on his French campaign he secured troops from William the Good, as well as from the count of Gelderland, the count of Julich, and the emperor Louis the Bavarian.

Before 1335 Philippa had established a small colony of Flemish weavers at Norwich, and she showed an active interest in the weaving trade by repeated visits to the town. She also encouraged coal-mining on her estates in Tynedale. Her eldest son, Edward the Black Prince, was born in 1330, and she subsequently bore six sons and five daughters. In November 1342 she became guardian of John of Gaunt and her younger children, with their lands. The anecdotes of her piety and generosity prove her popularity. On a famous occasion her prayers saved the citizens of Calais from Edward's vengeance. There is a generally accepted story, based on the chronicles of Jehan le Bel and Froissart, that she summoned the English forces to meet the Scottish invasion of 1346, and harangued the troops before the battle of Neville's Cross.

Philippa was the patron and friend of Froissart, who was her secretary from 1361 to 1366. Queen's College, Oxford, was not, as is stated in Skelton's version of her epitaph, founded by her, but by her chaplain, Robert of Eglesfield. Her chief benefactions were made to the hospital of St. Katharine's by the Tower, London. She died on Aug. 15, 1369.

See Agnes Strickland, *Lives of the Queens of England,* vol. i. In addition to the account given in his *Chroniques,* Froissart wrote a formal eulogy of her, which has been lost.

PHILIPPEVILLE, a seaport of Algeria, chief town of an arrondissement in the department of Constantine, and 54 m. N. by E. of that city, on the Bay of Stora, in 36° 53′ N. 6° 54′ E. The population is 29,242, of whom 19,288 are Europeans (16,461 French). It is connected by railway with Constantine, Batna and Biskra. The town derives its importance from being the port of Constantine. From Cape Skikda, on the east, a mole or breakwater projects 4,592 ft. to the west-north-west, while from Château Vert, on the west, another mole runs out 1,312 ft. to the north, leaving an entrance to the port about 656 ft. wide. The protected area comprises an outer and an inner basin. The depth of water at the entrance is about 33 ft., by the quays about 20 ft

Philippeville occupies the site of successive Phoenician anc Roman cities. By the Romans it was named Rusicada. Som parts of the Roman theatre remain. The modern town was founde by marshal Valée in 1838.

PHILIPPI (Turk. *Filibejik*), a city of ancient Macedonia, o a steep hill near the river Gangites (mod. *Angista*), overlookin an extensive coastal plain on the highway between Neapolis (Ka valla) and Thessalonica. Originally called Crenides (Fountains) it was fortified by Philip II. of Macedon, to command the neigh bouring gold mines. In 42 B.C., after the defeat of Brutus anc Cassius here by Octavius and Antony, it became a Roman colony *Colonia Julia Philippensis,* probably increased after the battle o Actium (*Col. Aug. Julia Phil.*), with the Jus Italicum, and th rank of a "first city." It was twice visited by St. Paul, whos Epistle to the Philippians was addressed to converts here. Th site, now uninhabited, is marked by ruins of an amphitheatre anc a great temple with inscriptions. To the east is the huge monu ment of C. Vibius, known to the Turks as Dikelitashlar and t the Greeks as the Manger of Bucephalus.

See Heuzey and Daumet, *Mission arch. en Macédoine,* Paris (1865) and other authorities in bibliography of Macedonia; *Corp. Insc Lat.* iii. 1.; S. Casson, *Macedonia, Thrace and Illyria* (1926).

PHILIPPIANS, EPISTLE TO THE, a book of the Nev Testament. Though Philippi was the first place in Europe wher St. Paul preached the gospel, the letter to the local church was on of the last he wrote. Ever since he founded the church, he kep in touch with it (iv. 15f); indeed he had accepted a gift of mone from it. But the present letter is an answer to one written b the Philippian Christians, who had enquired anxiously about hi health and prospects, assuring him of their prayers, and wonder ing when he would be able to revisit them (i. 25f). Epaphroditus who had brought the money, had fallen ill, and the apostle appar ently sends him back reluctantly, perhaps with the present lette It is a friendly missive, which falls into two parts. The firs begins by relieving their anxiety about himself, assures them tha he hopes to return before very long, and warns them, in the mean time, to preserve their unity (i.–ii.). At this point there is sudden change in tone. The letter swerves into a passionat denunciation of some errorists or agitators (iii. 1f), after whic the writer resumes (iv. 1–7) his counsels to the community. Th closing appeal (iv. 8f) is for harmony.

Modern criticism of the epistle is no longer concerned wit supposed traces of gnosticism in ii. 6f. The two engrossing ques tions are (*a*) the place from which the letter was written, and (*b* whether or not it is a literary unity.

The former problem is raised by those who point out that th Greek term "praetorium" ("palace" in the English version of i 13) does not necessarily mean the Roman barracks of the prae torian guard at Rome, but might conceivably, for example, refe to the palace of Herod at Caesarea (Acts xxiii. 35) or to judicia authorities at a centre like Ephesus, where we know Timotheu was living (Acts xix. 22), and where the apostle was once im prisoned. The data indicating Rome as the place of compositio cannot be hastily set aside, *i.e.,* the considerations which involv the latter part of the two years confinement at Rome (Acts xxviii 30) as the period when the letter was written.

The second problem starts from the abrupt change in iii. 2. I is thought by some (*e.g.,* by B. W. Bacon, *The Story of St. Paul* pp. 367f) that iii. 2f represents an earlier letter, written in repl to the gift of money, and subsequently added to the later i. i.- iii. 1, as 2 Corinthians x.–xiii. has been added to an epistle whic chronologically it preceded. The partition theories, of whic this is the simplest form, imply that two letters have been muti lated and transposed; otherwise, the hiatus at iii. 2 is inexplicabl But the writer may have been interrupted at iii. 1, or somethin may have occurred which moved him to turn aside sharply In iv. 4 he echoes the note sounded in iii. 1, and the intervenin outburst may be psychologically explained without recourse t any theory of transposition.

He associates Timotheus with him in the address (i.1), owin to his local ties with Philippi (ii. 22 and Acts xvi. 3f), but th

apostle writes in the first person throughout, even in iv. 21; indeed he speaks of his companions as distinct from himself, and iii. 17 is no real exception to this. The letter is an affectionate personal message from St. Paul in the evening of his life to a church with which his relations had been exceptionally friendly. Their troubles were not connected with doctrine; the great passage in ii. 5f is introduced as a motive to humility, not as specific instruction on the person of Christ. These Macedonian Christians had a naturally affectionate temperament, which affected their religion; the apostle's chief prayer for them is that their emotional warmth may ripen into insight and understanding (i. 9f), and his concern for them is solely for their Christian principles of conduct.

The earliest definite traces of the letter in second century literature occur in Polycarp, who had some close interest in the church of Philippi. It passed at once into the early canons of Scripture, and soon was quoted by church fathers like Irenaeus, Clement of Alexandria and Tertullian.

Bibliography.—In English the older commentaries by Ellicott (5th edition, 1888) and Lightfoot (6th edition, 1891) may be supplemented by H. A. A. Kennedy's in the *Expositor's Greek Testament* (1903), M. R. Vincent's in *The International Critical Commentary* (1897), and a commentary on the English text by M. Jones (*Westminster Commentaries*, 1918). The latest German editions are by Lohmeyer (Gottingen, 1928), P. Ewald in Zahn's *Commentar* (1923), and M. Dibelius (in Lietzmann's *Handbuch*, 1913), but A. Klöpper's (1893), Von Soden's (1903), and R. A. Lipsius's (*Handcommentar*, 1892) are by no means superseded. General studies of the epistle will be found in R. R. Smith's *The Epistle of St. Paul's First Trial* (1899), in Sir W. M. Ramsay's *St. Paul the Traveller* (chapters x. and xv.), and in Weizsäcker's *Apostolic Age* (vol. i. pp. 218f, 279f). Weizsäcker dealt the deathblow to the older view that the epistle was non-Pauline, the last traces of which are to be found in van Manen's article in the *Encyclopaedia Biblica* (3703f). (J. Mof.)

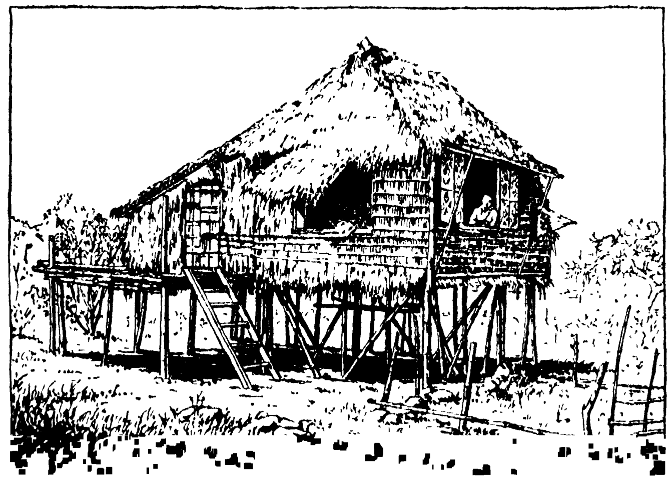
PHILIPPICS. Properly, certain speeches delivered by Demosthenes against Philip II. of Macedon; hence Cicero's speeches against Antony (Cicero *ad Brutum*, II. 3, 4; 4, 2); hence, in modern use, any impassioned invective.

PHILIPPICUS, East Roman emperor (711–713), became distinguished as a soldier under Justinian II. His proper name, which indicates his Armenian origin, was Bardanes. He made some pretensions to the throne on the outbreak of the first rebellion against Justinian; these led to his banishment, by order of Justinian, to Cherson. Here Bardanes successfully incited the inhabitants to revolt, and on the assassination of Justinian assumed the purple. Among his first acts was the summoning of a *conciliabulum* of Eastern bishops, which momentarily restored monotheletism. His domains were attacked at once by Terbelis king of the Bulgarians in Europe, and the Saracens in Asia. The reign of Philippicus was ended by a military conspiracy.

See Gibbon, *Decline and Fall of the Roman Empire* (ed. Bury, 1911), v. 195–6.

PHILIPPINE ISLANDS, an archipelago, named after Philip II. of Spain, of approximately 7,083 islands, belonging to the United States, about 500 m. off the S.E. coast of Asia, between lat. 4° 41′ and 21° 10′ N., and long. 116° 40′ and 126° 34′ E. To the west and north is the stormy China sea, east the Pacific ocean, and south the Sea of Celebes and the coastal waters of Borneo. They extend north and south about 1,152 m. and east and west about 688 m., their shape, if bounded by straight lines, being about that of an isosceles triangle, and their area 114,400 sq.m., or about 7,000 sq.m. less than that of Great Britain. The northernmost island, Y'Ami, is 65 m. from Formosa, while the southernmost, Saluag, is 30 m. E. of Borneo. Of the islands only 462 have an area of 1 sq.m. or over and only 2,441 have names. Eleven islands have an area of over 1,000 sq.m. each, namely, Luzon, the most northerly of the large islands, 40,814 sq.m.; Mindanao, the most southerly, 36,906 sq.m.; Samar, 5,124 sq.m.; Negros, 4,983 sq.m.; Palawan, 4,500 sq.m.; Panay, 4,448 sq.m.; Mindoro, 3,794 sq.m.; Leyte, 2,799 sq.m.; Cebu, 1,695 sq.m.; Bohol, 1,534 sq.m.; and Masbate, 1,255 square miles. In addition to the large islands and those with distinct names are various groups, among which may be noted the Babuyanes and Batanes, north of Luzon; the Bisayas (or Visayas) between Luzon and Mindanao; the Cagayan and the Calamian groups, respectively islands, the chief of which is Jolo.

Physical Features.—The irregular configuration of the archipelago, the coastline of over 12,500 m., the great extent of mountainous country with the mountains lying close to the sea in many places, the narrow and interrupted coastal plains, the generally northward trend of the river systems and the lakes, comprise the salient physical features of the Philippines. The islands are



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS
A PHILIPPINE HUT NEAR GUADALUPE, MANILA, BUILT ON STILTS TO AVOID FLOODING FROM HEAVY RAINS

partly of volcanic and coral or other formation. The mountain ranges for the most part run in the general direction of the main axes of the islands. The Cordillera Central of Luzon, running north to the Pacific ocean from the northern boundary of the central plain, is the most prominent chain. It consists of two, and, in places, of three, parallel ranges, each of which averages 5,900 ft. in height. The narrow Ilocos or Malaya Range, lying close along the narrow west coast, rises in places to over 5,000 ft., and the Sierra Madre, fringing the north-east coast, to over 5,000 ft., and is seldom less than 3,500 feet. It is largely volcanic. This range and the Cordillera Central coalesce in Nueva Vizcaya forming the Caraballo mountains. North of the latter and between the two ranges is the fertile Cagayan valley, about 50 m. wide. In the south-western part of northern Luzon are the rugged Zambales mountains, which consist of more or less isolated old volcanic stocks. The central plain of northern Luzon is about 150 by 50 m. and only about 100 ft. above sea-level except near its centre. The greater part of Southern Luzon is occupied by isolated volcanoes and irregular masses of hills and mountains. The highest peak is Mayon (7,900 ft.) near Legázpi in Albay Province. Through Palawan (about 15 m. wide) extends a range with an average height of 4,000 to 5,000 feet. Each of the Bisayan islands, except Samar and Bohol, is traversed longitudinally by a single range with occasional spurs. Several peaks in Panay reach an altitude of 6,000 ft. or over. In Negros is Mt. Canlaon, a volcano of 7,800 ft., and other peaks reach an altitude of over 6,000 feet. There are several important ranges in Mindanao, the Diuata Range along the eastern coast being the most prominent.

West of this lies the fertile Agusan valley, 40 or 50 m. wide. Farther west and south-west is the valley of the Río Grande de Mindanao, the largest river in the island, and below the lower course of this river and the southern coast lies a range trending north-west and south-east. On the southern border of the basin of the above river is Mt. Apo (9,610 ft.), the highest peak in the Philippines. About Lake Lanao are a number of volcanic peaks. A low cordillera extends into Zamboanga Province. Many of the mountains are covered with dense forests in which are many valuable hardwood timbers. In northern Luzon, the principal mountain tree is the pine. In many places where the forests have been burned away, their place has been taken by cogón or other coarse grasses. The plains lying amid the mountains, *e.g.*, the central plain of Luzon, the Bikol plain of south-eastern Luzon, the Cagayan plain of northern Luzon, the central plain of Panay

densest populations of the islands except in Cebu, where the people live mostly on the coastal plain, as the interior is high and rugged. The most important rivers are the Cagayan, Agno, Pampanga, Pasig and Bikol in Luzon; and the Río Grande de Mindanao and Agusan in Mindanao. The Cagayan flowing northward through northern Luzon, and draining about one-fourth of the island, is the largest river. This river and the Río Grande de Mindanao and the Agusan are each over 200 m. long. The Pasig is a most important river commercially. The largest lake in the archipelago is Laguna (Lake) de Bay, located very near Manila.

Geology.—Mountain building is still in progress and evidence of the recent vertical movement of various portions of mountain mass can be measured. The archipelago is the crumpled edge of the Asiatic continental platform. However, the structure is a complex one, for besides faulting and folding, volcanic actions of diverse kinds have taken place. Prior to the Tertiary period there seems to have been a period of intense deformation, when some of the schists were formed. Toward the end of the Miocene period, the Vigo and Batan formations were generally folded, in some places being intensively crumpled and faulted. Another less pronounced period of folding occurred in the Pliocene or early Pleistocene period. The islands were subjected to a great uplift during the Pliocene, Pleistocene and recent periods. A striking similarity exists between the formation in the Philippines and the western coast of America. Practically all the rock types are found in the islands, as well as areas of coral limestone.

Volcanoes and Earthquakes.—The volcanoes are the most conspicuous feature of the landscape, but there is less volcanic activity in the whole group than in a single Hawaiian island. However, all gradations of volcanoes can be seen, from the almost perfect cone of Mayon to old, worn down volcanic stocks whose present form gives little indication of their origin. The several distinct volcanic areas are that of south-western Luzon (the provinces of Rizal, Cavite, Laguna, Batangas and a portion of north-western Tayabas); that of south-eastern Luzon; the mountain region in Camarines Norte; Negros; Mindanao; Jolo; and a few others. Seismic disturbances are common.

Climate.—The mean annual temperature is 26·9° C (80·4° F). There are seven months (April to October) with a mean monthly temperature of 26·9° to 28·1° C, and five (November to March) with 25·4° to 26·5° C. May is the warmest and January the coolest month. During the period 1903–18, the highest absolute temperature for Luzon was 42·2° C and the lowest, 12·1° C, and the highest and lowest for the Bisayas and Mindanao, 38·2° C and 13·3° C respectively. The Philippines would have little difference of climate if the rainfall were homogeneous. There are three types of climate The first is characterized by two pronounced seasons, dry (with less than 2 in. of rainfall) in winter and spring and wet in summer and autumn. Cyclonic or summer rainfall prevails. This type occurs in the western part of Luzon, Mindoro, Negros and Palawan, and the western and southern parts of Panay. The second type is characterized by no dry season, has a pronounced maximum of rainfall in winter, and prevails along the eastern part of the archipelago from about the latitude of Manila southward, or in south-eastern Luzon, Samar, eastern Leyte and in Surigao Province, Mindanao. The third or intermediate type has no very pronounced rain period and a short dry period of only one to three months. The average annual rainfall for the archipelago (whose annual mean varies between 181 and 38·9 in.) is about 93·1 inches. The subprovince of Benguet averages the heaviest precipitation—over 157 in. in 1911. The average for the whole archipelago shows 159 rainy days. The floods are usually caused by typhoons. Severe droughts occur at times especially in the west—two remarkable drought periods being those of 1911–12 and 1914–15. In terms of the rainfall there are said to be three seasons: the dry (January to May); the rainy (June to October) and the relatively dry (November to December).

Flora.—About 10 000 species of flowering plants and ferns have been found. The flora is essentially Malaysian, but continental (Himalayan) elements occur in the mountains of northern Luzon, while a few Australian types are found at various altitudes. There is a small percentage of endemic genera and a very high percentage of endemic species (about 60%). The dominant forest species are usually endemic. Among the grasses of the grasslands are lalang (cogón), and other coarse grasses. The vegetation of the coastal regions (including the mangrove swamps) is practically identical with that of similar areas throughout the Malay archipelago. Considerably more than half the land

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A HEMP PLANTATION IN THE PHILIPPINE ISLANDS

area of the islands is covered with forests. There are many valuable hardwoods as well as many of the softer variety. About 1,000 different woods have a commercial value, among which may be noted apitong, camagón, ipil, lauan, mayapis, molave, narra, tangile, tindalo and yacal. Some timber trees attain a huge size which makes them especially adaptable for tables and other large pieces of furniture. There are many useful kinds of palms, including the coco-nut palm, from which the Filipino obtains food, clothing, fibre for export, coco-nut oil, copra, building material and other products. Useful bamboos and rattans abound. About 900 species of orchids occur, some of them very rare. Several hundred fibres are known, among them the abacá, from which manila rope is made. The forests also yield gums including rubber, various fruits, nuts, spices and drugs, oils and other useful substances.

Fauna.—Mammals are scarce, with the exception of shrews, rats, mice and bats. The edentates are represented by the *pangolin* (*Manis javanica*). Red or brown deer (*Rusa*) are found in Basilan, Mindanao, Leyte, Samar and the Calamian islands. The mouse deer or chevrotain (*Tragalus nigricans*) is found in Balabac and Palawan. The timarau (*Bubalus mindorensis*), a small buffalo, is peculiar to Mindanao. Carnivores are represented by mongooses (*Mungos palawanus* and *M. parvus*), the binturong (*Arctictis whitei*), an otter (*Aonyx cinerea*), civet cats (*Viverra* and *Paradoxurus*) and a small wildcat (*Felix minuta*) which is also found in Java. At least 56 species of bats are known, many being peculiar to the Philippines. The flying lemur (*Cynocephalus volans*) and tarsiers (*Tarsius*) range from Basilan to southern Luzon. Large fruit bats live in colonies and are sometimes hunted for their flesh and fur. Only one genus of monkey (*Pithecus*) has been found but it is represented by five species. Five new genera of small mammals (*Celaenomys, Chrotomys, Rhynchomys, Batomys* and *Carpomys*) representing 15 species were discovered some years ago on a small plateau on the top of Mt. Data in northern Luzon, at an altitude of about 3,200 feet. There are about 760 species of birds which show rather strong relationship to those of Borneo. Reptiles and batrachians also abound.

The marine fauna is one of the most abundant known, more than 1,000 species having been found, three-fourths of which at least are used as food. Sharks and rays are caught for their fins, which are prepared for the Chinese market. The fresh-water fish fauna is relatively unimportant. Terrestrial and marine molluscs are very abundant, the Philippines having the richest molluscan fauna of any equal area in the world, and many of the shells are of great beauty. Many of the molluscs are edible and of considerable local importance. Pearl oysters abound and the pearls

of the Sulu archipelago have an international reputation. The shells of *Placuna placenta* are a welcome substitute for window glass. Land molluscs are found in great variety and are remarkable for their beauty. The best sponges of the southern islands are equal to those of the Mediterranean. Coral beds are numerous.

Population.—The population in 1903 was 7,637,426 and in 1918, when the second census was taken, 10,314,310, of whom 9,381,357 were Christians. The computed population in 1928 was about 12,000,000. Excluding Manila (where there were 20,379 to the square mile), the most densely populated province was Ilocos Sur (492 inhabitants to the square mile) and the provinces of Nueva Vizcaya in Luzon and Agusan in Mindanao, the least (each with 10 to the square mile). Cebu (with 855,065 inhabitants) was the most populous province, and was followed by the provinces of Leyte (597,950), Pangasinan (565,922), Iloilo (502,949), Occidental Negros (396,636), Samar (379,575), Bohol (358,387) and Batangas (340,199). Based on the total of 9,492,328 (census of 1918 of regularly organized provinces and subprovinces), races were represented as follows: brown, 9,386,826; yellow 50,826; white, 12,390; American negro, 185; aeta, 7,438; and mestizo, or mixed blood, 34,663. There were 9,428,291 Filipinos, 5,808 Americans from the United States, 4,032 Spaniards, 1,202 British, 288 Germans, 182 French, 125 Swiss, 44,239 Chinese, 8,294 Japanese and 979 others. Literate Filipino citizens of ten years and over numbered 3,759,138; illiterates, 3,242,627. There were 2,601,299 agricultural labourers; professional, 685,507; domestic service, 1,853,804; commercial, 426,547; industrial, 865,698; unknown, 8,295. There were 7,790,937 Catholics; 1,417,448 Aglipayans; 124,575 Protestants; 443,037 Mohammedans; 508,596 Pagans; 24,263 Buddhists; and 5,454 others. The population of the only two incorporated cities, Manila and Baguio, was respectively 285,306 and 5,464. Cebu, with 65,502 inhabitants, Albay, with 52,756, Iloilo, with 49,114 and Lipa, with 46,547 were the largest municipalities of the first class.

There are 43 ethnographic groups. The Filipinos proper (the descendants of the Malays christianized by the Spaniards) are composed of eight peoples. These are the Bisaya, Bisayans or Visayans (about 4,000,000, several dialectal groups, Bisayan islands); the Tagalog (Central Luzon, about 1,800,000); the Iloko (Ilocanos, in Ilocos Norte, Ilocos Sur and neighbouring provinces, about 1,000,000); the Bikol (Albay, Camarines Norte and Camarines Sur, Luzon, about 700,000); the Pangasinan (about 400,000); the Pampangan (Pampanga and Tarlac, about 350,000); Ibanag (Cagayan, about 156,000); and the Sambal (Zambales, about 56,000). These are all Christians, and other Christian groups, in all about 41,000, exist among other peoples. The classified pagan peoples are represented by 18 groups, the unclassified pagans by 12, and the Moros by 7. Of the 43 languages and dialects, those with an extensive printed literature are the Tagalog, Bisaya, Iloko, Bikol, Pampangan and Pangasinan. The non-Christians are divided into pygmies, Indonesians and Malays. The first are the Negritos (small blacks), who probably represent three quite distinct aboriginal races; viz., the true Negrito; a straight-haired dwarf type of strong mongoloid affinities, to whom the name Proto-Malay has been applied; and the Australoid-Ainu, a dwarf hairy man intermediate between the aboriginal Australian and the Ainu of northern Japan. The three types, however, are now thoroughly mixed. The pygmy types are found in the Apayao swamp regions, the Ilokos mountains, the Luzon mountains, the Bisaya islands and Mindanao.

BY COURTESY OF THE FIELD MUSEUM OF NATURAL HISTORY

SAVAGE MAN AND WOMAN OF THE PHILIPPINE ISLANDS

The Indonesians were immigrants who appear to have mixed extensively with the pygmy peoples, and others. They practised a crude agriculture, but lived mainly by hunting and fishing. They had two types of houses—one built in trees and the other on the ground. Their early speech is gone, but there are remnants of it in the different Philippine languages. They are found now in northern Luzon, the Bisaya islands, Mindoro, Palawan, east and central Mindanao, the Zamboanga peninsula and the Sulu archipelago. Like the pygmies they live in the thinly populated forest regions. The non-Christian Malays are pagan or Mohammedan. The pagan Malays (Tinggians, Bontok, Igorot and Ifugao) live in the mountainous interior of northern Luzon. Their lands are largely deforested and thickly populated. They practise irrigation by an elaborate and extensive system of channels and ditches, some several miles long. The mountain sides of Ifugao form the most extensive terrace system in the world, and this has existed for centuries. About one-half the Tinggians, who live in Abra Province and near by regions, are Christians and have attained a high culture. The Bontok, whose origin is not known, have mixed quite generally with their neighbours and approach the Igorot and the Ifugao in culture. The Igorot inhabit Benguet, Lepanto and Amburayan. They grow and weave cotton, make baskets and have mined gold and copper for centuries. Their culture has been influenced by contact with the Iloko. The Ifugao are the most numerous of all pagan groups. They inhabit Ifugao, Benguet, Bontok and Nueva Vizcaya. They possess a relatively high culture, which seems to have come from south China. The Ifugao are remarkable for their stone-walled terraces, wooden, pyramidal, rat-proof houses, their clan type of social organization and ancestor worship, and private ownership of real property. These peoples were formerly all head-hunters.

The Moros, representing seven ethnographic groups, live almost exclusively in the Sulu archipelago at the southern end of Palawan, and the Mindanao provinces of Zamboanga, Cotobato and Lanao. Many also live in northern Borneo, and it is not uncommon for them to pass to the Philippines. The great majority are apparently descended from native pagans who were mohammedanized subsequent to the 14th century by outsiders from Sumatra and the Malay peninsula, via Borneo. Their descendants still constitute the ruling class and are the strongest adherents to the Mohammedan faith. The Moros have long been famous for their fine metal work, wood-carving and weaving. Only since 1915 have the Moros surrendered their temporal power.

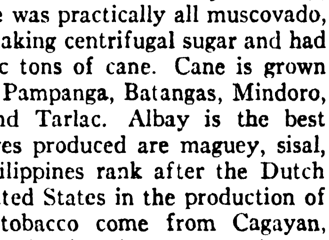
At the time of the Spanish conquest the ancestors of the present Christian peoples had a fairly well defined social and political organization and possessed written alphabets of Hindu derivation. Where Mohammedanism was already strongly established, as among the Moros, it maintained its hold, but the animistic belief of the others yielded easily to Christianity. The ancestors of the present pagans had comparatively little contact with Christianity during the Spanish régime. As a whole, the people have great self respect and personal dignity, are eager for education, musically inclined, hospitable and impressionable. In social contact they are a charming, idealistic race. Their evolution is probably toward a homogeneous people, but the racial cleavages are very apparent and sometimes stand in the way of united and lasting action. Their political development, which has been manipulated by clever politicians, has outstripped their other attainments.

Agriculture.—The total land area is 74,174,000 ac.; commercial forests, 39,762,370 ac.; non-commercial forests, 7,285,832 ac.; cultivated land 9,281,780 ac.; grass and open land, 13,996,492 ac.; mangrove swamps, 677,170 ac.; and unexplored, 3,070,355 acres. Agriculture is the principal occupation, and the peasants are excellent farmers, notwithstanding their crude methods. The census of 1918 showed 1,995,276 farms, with an aggregate area of 11,409,307 ac., of which 6,040,445 ac. were under cultivation. Of these farms, 1,520,026 were privately owned. Americans owned 2,678 farms (35,552 ac., of which 16,605 were cultivated); and Filipinos 1,946,580 farms (11,202,162 ac., 5,962,755 cultivated). There were 741,437 farms of over ·87 ac. each, but less than 2·5 ac., and 3,433 of 250 ac. or over. (These figures do not include the lands cultivated by the pagan or Moro peoples.) The farms were mainly in the provinces of Pangasinan, Cebu,

Ilocos Norte, Ilocos Sur, Bohol, Union, Leyte, Iloilo, Batanes, Camarines Norte, Camarines Sur, Samar, Laguna and Cagayan. The Indonesian peoples of northern Luzon are careful agriculturists, especially the Ifugao, whose rice terraces are among the marvels of the orient. In all parts of the archipelago, one still sees the old destructive caingin method of clearing by which forests are burned and the soil denuded of humus.

The amounts and approximate values of the crops in 1926 were as follows: rice, 2,264,772 short tons, value, $102,025,500; corn, 375,400 short tons, $18,685,000; sugar and sugar products (sugar, 573,650 short tons, raw sugar, 36,120 short tons, basi, 1,136,010 gal., and molasses, 1,568,563 gal.), $40,568,500; coco-nuts, 1,627,379,000 (trees in bearing, 54,650,000; producing 26,161,278 gal. of tuba or sap, 404,670 short tons of copra, 472,-429 gal. of coco-nut oil; desiccated coco-nut and home consumption, 148,759,000 coco-nuts), $40,684,500; abacá 212,520 short tons, $33,248,500; tobacco, 748,920,000 lb., $18,685,000. Rice is the largest crop and is entirely consumed in the archipelago, but additional supplies have always been imported. In 1926, imports of rice cost $4,500,000 and in 1927 only $1,000,000. At the same time there has been an increase in the import of wheat flour. Much land is still available for rice. Corn is grown especially in Cebu. The first sugar was exported to the United States in 1795 (132 long tons). Until the establishment of the first sugar factory, or *central*, in 1910, the sugar made was practically all muscovado, but in 1926 the 34 centrals were making centrifugal sugar and had a daily capacity of 529,993 metric tons of cane. Cane is grown principally in Occidental Negroes, Pampanga, Batangas, Mindoro, Iloilo, Ilocos Sur, Pangasinan and Tarlac. Albay is the best cane producing region. Other fibres produced are maguey, sisal, cotton, kapok, and piña. The Philippines rank after the Dutch East Indies and the Malay Federated States in the production of coco-nuts. The best grades of tobacco come from Cagayan, Isabela and Nueva Vizcaya, which furnish the exports. Among fruits are various citrus fruits, mangoes, bananas (many varieties), nancas, chicos, lanzones, watermelons and guavas. The peanut crop is of increasing importance. Sweet-potatoes are raised in all parts for local consumption. Bamboos are gathered for building purposes, and bamboo buds and shoots are eaten as a salad. The areca nut is an important product, and wrapped in lime and betel leaf constitutes the betel chewed throughout Malaysia.

Timber covers an area about the size of Nebraska. Over 99% of it belongs to the Government and is administered by the bureau of forestry. The volume of the timber is about 192,000,-000,000 bd.ft.; the output for 1926 was 1,140,664 cubic metres. A number of sawmills are in operation in various districts, some of them using water-power. The public forests are developed under a licence system. Among important forest products are nipa, alcohol, rattan, copal, dye-woods and bark, gutta percha and rubber, paper pulp, fibres, nuts, wax, honey and soap bark.

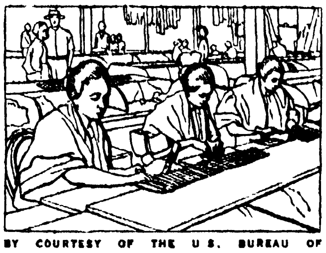


BY COURTESY OF THE U.S. BUREAU OF INSULAR AFFAIRS

PHILIPPINE NATIVES OPENING COCO-NUTS FOR COPRA

The domestic animals include bovine cattle, carabao, horses and mules, hogs, goats and sheep. The rinderpest campaign has had good results but more carabao are needed for the farm work.

Mineral Resources.—Among non-metallic substances are various abrasives (including corundum), alum, bituminous rock (asphalt), cement, clay, coal, gypsum, lime, mica and talc, mineral waters, ochre, salt, sand and gravel, stone and sulphur. Some agate, opal and amethyst have been found and there are rather extensive but little worked guano and phosphate deposits. Of the above substances, coal is the most important. It is found principally on Batan island (Cebu), Cebu island itself, Polillo, Mindanao, Mindoro and Masbate. Very little mining was done until after 1890. Since U.S. occupation, the deposits on Batan have been worked both by private enterprise and by the Government (to which the deposits now belong). The deposit in one field in Cebu is said to amount to at least 7,000,000 tons. Coal occurs in three states: semi-anthracite, sub-bituminous and lignite. Petroleum exists in seepages. The first mention of gas or petroleum was in 1890. Among the many mineral waters some are hot or with marked medicinal properties. Sulphur is found in or near the cone of volcanoes. Metallic minerals include chromite, copper, gold, iron, manganese, lead and zinc, molybdenite, silver and wolframite. There has been practically no production of copper since U.S. occupation. The principal deposit is in the Mankayan properties in Luzon. Gold can be washed out of most of the rivers. Notable deposits are found in the Paracale region in Camarines Norte, near Baguio in Benguet, in Masbate, Mindanao and other regions. Benguet deposits have been worked for centuries. The total production of gold in 1925 was 2,928,003 fine grams, valued at $1,945,989.



BY COURTESY OF THE U.S. BUREAU OF INSULAR AFFAIRS

WOMEN MAKING CIGARS IN MANILA

Lateritic iron deposits in Mindanao are reported to run to 500,000,000 tons. This field is now a Government reservation. The most notable iron deposit (1,200,000 tons) is that of the Angat (Bulacan), which is of high grade hematite. In 1919, about 20,000 tons were mined, but in 1923 this had fallen to 269 tons, and in 1925 to 398 tons valued at $31,295—all coming from Angat. The decline was due to a wharfage duty of two pesos ($1) per ton. The Angat mines belong to and are worked by Filipinos: almost all the output is made into plough points which are esteemed more highly than imported ones. Unexploited manganese occurs in Ilocos Norte, Pangasinan, Bulacan, Tarlac and Masbate. Lead and zinc occur in many places, always associated, and silver is usually found with them. Deposits in Cebu and Masbate are being exploited. There has been no production of molybdenite, but it occurs in Batangas and one or two other localities. Platinum occurs in very small quantities in Luzon and Mindanao. Some native silver is found in Baguio, but usually in conjunction with lead and zinc. Production in 1925 was 2,132,521 fine grams. Wolframite is reported from Antique, Panay.

Manufacturing in 1918 was conducted in 8,354 establishments. Of these 2,663 were sugar mills (capital about $31,204,-000; output $41,073,000) and 452 were rice mills (capital, about $1,698,000; output $21,731,500). In 1918, manufactures for export included alcoholic liquors, beer, candles, tree oil, coco-nut oil, coffee, copra and coco-nuts, embroideries, fruits and nuts, gum copal, hats, maguey, ilang-ilang oil, indigo, knotted hemp, lumber, abacá, metals, old copper, pearl buttons, pearls, raw rubber, rope, dye-wood, shark fins, shells, sugar, trepang or balate and tobacco—the total value approximating $135,194,500.

Household industries are actively fostered by the Government. In 1913, 31 different classes of industry had 500 or more establishments, chief among which (in the order named) were: fibre textile industries (25,701 establishments); spinning (12,080); hats (9,975); spirits (8,315), cotton textiles (8,046); copra drying (5,434); buri mats (5,207); tailoring (4,075); abacá stripping (3,470); cotton burlap (3,212); and fish drying and smoking (2,107).

Fishing and Fisheries.—Of about 1,600 different species of fish only about 100 kinds are marketed, although the majority of them are edible. The most common are groupers, mackerels, snappers, sea basses, porgies, pampanos, mullets, anchovies, barracudas, tunas, bonitos and eels. Fish ponds are of recent development; the first was established in 1863 in Malabon near Manila. Now they exist everywhere about Manila bay and the Gulf of Lingayen. Fish exports amounted to 873,180 lb. in 1926 ($116,-750), consisting principally of beche-de-mer and shark fins. Other marine products include coral, pearls, shells and sponges; but comparatively few pearls are exported. In 1926, exported shells were valued at over $500,000. Among the shells and shell products are mother of pearl, trocha, tortoise, green snail shells, shell used for windows and pearl buttons.

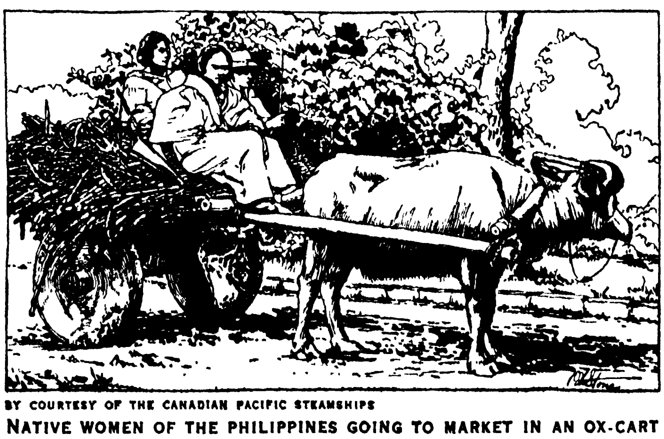
Communications and Transportation.—Since U.S. occupa-

tion, good roads and bridges have been built and maintained everywhere. In 1926 there were 3,630·8 m. of first class roads. In 1926, there were 791 m. of public railways (659 m., narrow gauge in Luzon, 72 m. in Panay, and 60 m. in Cebu).

The Manila Electric Co. operates about 55·9 m. of street railways in and near Manila. At the close of 1927 there were 579 mail routes, 943 post offices, 557 money order offices, 916 postal savings banks, 444 telegraph stations (including radio stations), and 61 postal stations. There is free mail delivery. The average time for passenger vessels from Manila to Seattle is 24 days; to San Francisco, 28 days; to New York via the Panama or Suez Canal, 45 days; to London, via the Suez Canal, 35 days. The Radio Corporation of the Philippines inaugurated trans-Pacific radio service to San Francisco and direct communication with nearby oriental countries and with Berlin in 1926. Radio service with British North Borneo had been inaugurated on April 9, 1920. Cable service is furnished by the Eastern Extension Australia and China Telegraph Co. Ltd., and the Commercial Pacific Cable Company. There are docks at Cebu, Iloilo, Jolo and Zamboanga where ships can moor, but Manila is the only port with adequate facilities. There are in all about 200 ports of call for inter-island shipping.

Cultural and Social Life.—During the early years of the U.S. occupation, Gregorio Aglipay, a former Roman Catholic secular priest, together with a layman, Isabelo de los Reyes, established a new cult known as the Aglipayan Church. The Jesuits were expelled in 1769 and did not return until 1859, when they entered as a missionary and teaching organization. They founded the Manila Ateneo, which was the best institution of high school rank established during the Spanish régime. In the 19th century the Capuchins and the Benedictines established themselves in Manila. Since 1898 a Belgian missionary order and the Christian Brothers have established themselves. In 1901, Methodists, Presbyterians, Baptists, United Brethren and Congregationalists formed an evangelical union and apportioned the mission field as the friar orders had done several centuries before. The census of 1918 shows 2,771 Roman Catholic, 540 Aglipayan and 486 Protestant churches.

There were no public schools until 1863, when they were established by royal decree. In 1866, it was reported that over 230,000 children were attending the public schools. Before 1600 a school had been established by private bequest, which in 1601 became the College of San José and was in charge of the Jesuits. The Jesuits also established the college of San Ignacio, and the



BY COURTESY OF THE CANADIAN PACIFIC STEAMSHIPS

NATIVE WOMEN OF THE PHILIPPINES GOING TO MARKET IN AN OX-CART

religious orders had seminaries and primary schools. More pretentious was the college of Santo Tomás, founded by the Dominicans early in the 17th century; it was declared a royal university in 1645, and still exists—the oldest university under the American flag. In the same century the Dominicans founded the school of San Juan de Letrán, which still exists. English was made the medium of instruction in 1923.

Very soon after the U.S. occupation, the first American public schools were opened, the first teachers being soldiers. In 1901, 1,000 teachers were sent from the United States to teach and to train Filipino teachers. Instruction has been from the beginning in English, with the consequence that now more Filipinos use English than used Spanish during the old régime. The vice governor is the secretary of public instruction, and under him is the bureau of education. During the American period over 600,000 children have completed the primary grade, about 170,000 the intermediate grades, and over 16,000 have graduated from the high schools. A prominent feature has been vocational and industrial training, compulsory after the first grade. In 1925–26, there were 7,459 public schools (enrolment, 1,108,955). That year there were 311 American teachers (112 male) and 25,193 Filipino teachers (14,840 male). In 1927, the total enrolment in 5,993 primary and 1,242 intermediate schools was 1,097,127. The University of the Philippines was founded by virtue of an act of the Philippine legislature of June 18, 1908. (*See* MANILA.) In 1926, there were 699 private schools, with a total enrolment of 88,001 (50,276 males). Among the more pretentious non-sectarian institutions are the Far Eastern college, the University of Manila and the National university. (*See* MANILA.) There are now over 4,000 school libraries with almost 950,000 books. Private and public welfare agencies are supervised by the Public Welfare Board. In 1926, there were 34 Government hospitals, with 45,046 patients; and 943 Government dispensaries, which treated 924,861 people.

Commerce and Business.—In 1897, imports were valued at approximately $9,600,000, and exports at $22,083,000; and in 1926, at $118,299,000 and $136,884,500 respectively. In 1927, the whole foreign trade was valued at $271,500,000. In 1927, the total trade with the United States was valued at $187,500,000 (69·09%). The principal items imported in 1926 were: cotton goods ($28,235,000) and iron and steel ($13,521,000). The principal exports were: sugar ($32,229,500); abacá ($32,142,000); coco-nut oil ($22,345,000) and copra ($18,586,500). In 1913 the Underwood Tariff Act abolished all duties between the United States and the Philippines. In 1926, there were, in addition to the Philippine National Bank, seven other domestic banks and four foreign banks and trust companies. Their resources totalled almost $122,800,000.

Finance and Revenues.—The national wealth of the Philippines was estimated at 5,495,482,000 pesos in 1923. Money is on a gold basis, the unit being the peso, which is stabilized at 50 cents U.S. The parity of the silver peso with the theoretical gold peso (the latter being the unit of value in the Philippine Islands, consisting of $12\frac{9}{10}$ grains of gold, $\frac{9}{10}$ fine) is maintained by the gold standard fund, which must not be less than 15% of the money of the Philippine Islands in circulation and available therefor; a percentage to be increased until it equals 25% of the total circulation. The standard gold fund balance in 1926 was about 21,700,000 pesos. The subsidiary coinage consists of one, five, ten, 20 and 50 centavo pieces (one centavo being equal to U.S. ½ cent). On Dec. 31, 1927, the bonded indebtedness of the insular, provincial and municipal governments was 167,985,000 pesos, and the sinking funds were approximately 38,543,000 pesos. In 1926 insular taxation amounted to approximately 59,232,000 pesos; city of Manila taxation, to 4,998,000; provincial taxation, to 10,946,000; and municipal taxation to 12,222,000 pesos. Customs collections in 1926 were approximately 21,180,000 pesos; internal revenue taxes, 54,544,000; income tax (1925), 2,343,000; and real estate tax, 14,537,000 pesos. The budget estimate in 1927 was: income, 73,153,100 pesos; expenditures 71,918,589. Receipts and expenditures of the Insular Government for 1926 amounted to 83,801,854 and 97,633,642 pesos respectively.

Government and Administration.—When Spain colonized the Philippines the natives were living under loose but fairly well crystallized forms of government, the primary unit of which was called "barangay." Society was composed of three classes, viz., serfs, freemen and nobles, and distinct rules governed each class. The Spaniards with great acumen organized their government partly on the native structure, with a governor general as supreme political chief, an *audiencia* or supreme court, provincial or district governments and municipal governments. Immediately upon conquest, tributes were levied on the natives, who were also given in *encomienda* to the *conquistadores*, officials and favoured

Spaniards. In the 19th century there were rather radical changes in the government. The Philippines were represented in the Spanish Cortes or parliament in 1810, 1812, 1820–23 and 1836–37.

The Spanish colonial government ceased in 1898, and was succeeded by a military government under the United States. In Jan. 1899, President McKinley appointed the Schurman Commission, which advised the reorganization of municipalities. In April 1900, President McKinley appointed the first Philippine Commission, which submitted all proposed laws to the military governor. Among the first 47 proposed by it and passed within the first few months, the fifth provided for a civil service, which was considerably in advance of that in the United States at that time. Military government ceased on July 4, 1901 (except in certain specified regions where it was maintained until July 4, 1902), at which time Judge Taft became the first and only civil governor of the Philippines; after his term the title was changed to governor general. The government was made directly dependent on the secretary of War, who organized the Bureau of Insular Affairs as his immediate agent. This bureau is still in existence and all Philippine matters that need attention in the United States pass through it. In 1901 the membership of the Philippine Commission was increased to seven by the appointment of three additional members, all Filipinos. Shortly afterward, four departments of government were created, viz., interior, commerce and police, finance and justice, and public instruction, each with a member of the Philippine Commission as its secretary. In 1901 and 1902, the organization of provincial and municipal governments continued, and by Nov. 10, 1902, 37 provinces had been organized.


BY COURTESY OF THE FIELD MUSEUM OF NATURAL HISTORY

TINGUIAN WOMAN SEEDING COTTON AND BRUSHING THE THREAD

On July 1, 1902, Congress enacted a provisional enabling or organic act under which the islands were governed until Aug. 29, 1916, when the Jones Bill was passed. The organic act of 1902 provided for a general election and the creation of a popular legislative chamber, the Philippine assembly, which was to become the lower house of a Philippine legislature, the Philippine Commission to be the upper house. An election of members of the Philippine assembly was held on July 30, 1907. All exclusive legislative power was taken from the Philippine Commission and lodged in the legislature, except for territory inhabited by Moros or other Philippine non-Christians. Two resident commissioners were appointed to the Congress of the United States, with power to speak on legislation affecting the Philippines but with no vote. In 1908, the Philippine Commission was increased by one more Filipino member. In Oct. 1913, President Wilson appointed a new commission, composed of five Filipinos and four Americans. On Aug. 29, 1916, the Jones Bill created a legislature with a Senate of 24 members and a House of Representatives of 91 members (now 92) all elected by popular suffrage except two senators and nine representatives, appointed by the governor general to represent the non-Christian provinces of Nueva Vizcaya, Mountain Province, Agusan, Bukidnon, Cotobato, Davao, Lanao, Sulu and Zamboanga. By virtue of the Jones Bill there are now six executive departments, each under a secretary, who is assisted by an under secretary. All these officials except the secretary of public instruction are Philippine citizens. With the exception of the governor general, vice governor (who is also secretary of public instruction), auditor, deputy auditor, the directors of the Philippine constabulary and of the bureaux of education, agriculture, forestry, science, public works, and the coast and geodetic survey, all the departmental secretaries and directors of bureaux are (1929) Filipinos.

With the consent of Governor General Harrison, a Council of State, consisting of the president of the Senate, the speaker of the House, and the six departmental secretaries, was formed to pass on proposed legislation and policies of the Government. During the rest of Harrison's term, this organization was accepted as a legitimate part of the Government, but under Harrison's successor, Maj.-Gen. Wood, it ceased to function, through the resignation of its Filipino members. It was re-established by Governor General Stimson in 1928 and enlarged to include the majority floor leaders of the Senate and of the House, thus making it even more representative than the former Council.

The judiciary consists of a supreme court, composed of a chief justice (a Filipino) and eight associate justices (three Filipinos), all appointed by the president of the United States with the consent of the U.S. Senate; a court of first instance for each of the 26 judicial districts; the municipal court of Manila; and justice of peace courts for each municipality.

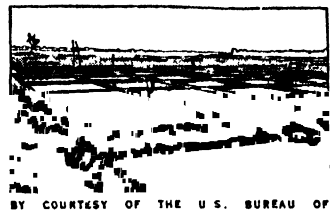
There are 48 provinces and sub-provinces (excluding Manila which has the rank of a province), of which 39 are regularly constituted and governed by an elective governor, who is the executive, and a provincial board composed of two elective members and the provincial treasurer, which is the legislative branch of the province. In the specially organized provinces, the governors and lieutenant governors are appointive officials. The municipal government consists of a president, vice president and a municipal council. In 1918 there were 820 municipalities, 88 townships, 213 municipal districts and 16,307 barrios.

History.—The Philippine archipelago first became known to Europeans on March 16, 1521, through Ferdinand Magellan (*q.v.*). But there are authentic Chinese accounts of trading voyages as early as the 10th and 13th centuries, and the contact probably went back much further. A Hindu influence undoubtedly came by way of the Malay peninsula, Java and other islands nearby, and probably reached back to the early centuries of the Christian era. The Hindus influenced the life of the people intimately. Many Sanskrit words in the languages and dialects of the people of the Philippines and the forms of the letters used at the time of their discovery by the Spanish, indicate this.

The second, third and fourth Spanish expeditions were those of García Jofre de Loaisa, of Alvaro de Saavedra and of Ruy López de Villalobos. The next expedition, that of Miguel López de Legazpi (1564–72) was despatched, like its predecessor, from New Spain, but it was far more carefully planned. Leaving Puerto de Navidad in New Spain, on Nov. 20, 1564, Legazpi reached Cebu in April 1565, where the first permanent settlement was made early in May. But Legazpi, with inadequate forces and resources, meeting prolonged hostility from the Portuguese, who swarmed through the region, at last (1569) moved his main forces to the island of Panay, hoping thereby to have better protection. In 1571 Legazpi made Manila the administrative centre. Thereafter the conquest of Luzon proceeded rapidly, at first principally under Juan de Salcedo, the precocious young grandson of Legazpi. All of the archipelago except the Moro islands of Mindanao, the Sulu archipelago, and Palawan were in fairly peaceful possession of the Spaniards before 1600. In June, 1572, the city of Manila was formally established. In 1574 Manila was attacked by the Chinese Limahong, but he was forced to retire from the island and from the entire group. Several of the provisional governors were churchmen who played into the hands of the ecclesiastics, or catered to their own order.

The Spaniards were accepted easily, even hospitably in many cases, and those coming into closest contact with them began almost immediately to take on the veneer of a superior culture. The conquest was especially easy along the coast and in the low interiors where the Spaniards first went. The principal opposition at Manila in 1570 came from Mohammedans. But that faith was not yet strongly entrenched in Luzon. It was quite different in Mindanao and at various other points in the south. The Spaniards were instinctive enemies of these people, for they had had a seven-century fight in Spain against Mohammedanism. To them the word "Moro" meant Mohammedan, or Moor. Accordingly, they dubbed the Malayan Mohammedans *Moros* and by this name they are still known. In 1574, the Moros of the Rió

Grande de Mindanao offered submission. In 1578–79 Francisco de Sande (1575–80) conducted a fairly successful expedition against the Moros, but the Spaniards were unable to gain any lasting advantage. Until 1837 piratical raids were almost continuous. The Moros ravaged the coasts far and wide, even threatening Manila itself. The Moros joined often with the Dutch after the latter began to infest oriental waters. In 1848, on Balanguingingui island, Governor Narciso Clavería y Zaldua won the most decisive victory ever gained over the Moros. In 1850, Governor Antonio de Urbiztondo y Eguía destroyed the strongholds on Tonkil island and the next year stormed and captured the town of Jolo. This ended the real power of the Moros.



BY COURTESY OF THE U. S. BUREAU OF INSULAR AFFAIRS

SALT WORKS AT MALABON

During the interim between Magellan's discovery and the settlement of Manila, the Portuguese actively contested Spanish right to the archipelago. Their hostility ceased only with the union of Spain and Portugal (1580–1640). In 1577 Sir Francis Drake started on the voyage which brought him to the Philippines at Mindanao. Again, in 1587, Thomas Cavendish sailed to the Moluccas and thence back to California to intercept the rich galleon "Santa Ana." He then went to the Philippines, where he tried in vain to capture the ship-yard at Iloilo.

The Dutch came next. Their primary object was trade rather than colonies. In 1596–97, Admiral Houtman opened trade with Holland, and during the years 1598–1600, the expedition under Neck and Waryck traded in the Moluccas. In 1600, Oliver van Noordt reached Philippine waters, where he committed various depredations. Dutch vessels now traded for spices and other oriental wares in the Moluccas, harried the coasts and waters of the Philippines and attacked Portuguese, Spanish, Japanese and Chinese shipping. In 1610, Governor Juan de Silva defeated and killed the Dutch admiral, Francis de Wittert, at Playa Hondo, near Manila, and captured part of his fleet. In 1640, the Dutch captured Malacca and in 1662 they permanently occupied the Moluccas. Their attacks in the Philippines gradually ceased.

With Legazpi had come five Augustinians; in 1577 came the Franciscans; in 1580, the Jesuits; in 1587, the Dominicans; and 1605, the Augustinian Recollects. It was the intention of Spain to replace the friars by secular parish priests whenever any mission assumed the character of a parish. But the friars, desirous of retaining their holdings and power, fought secularization and it was never carried out in its entirety. The friars became the storm centre of the gradually increasing Filipino demand for change; the insurrection of 1896 was directed principally against them; and during the later insurrection against the United States they suffered many indignities.

In 1762 a British expedition reached Manila on Sept. 22, found the Spanish but ill prepared, and on Oct. 5, captured the city. By the Treaty of Paris in 1763, Manila was restored to Spain.

The last Manila galleon left the Philippines in 1811 and returned in 1815. Thereupon the trade was taken over by private persons, exports to the value of 750,000 pesos were allowed and three other ports besides Acapulco were opened to it, namely San Blas, Guayaquil and Callao. In 1766, however, the crown had allowed direct trade between Spain and Manila by one national vessel annually. In 1785, the Royal Company of the Philippines began to trade between Manila and Cadiz; the company ceased to exist in 1830.

In 1809, an English commercial house was permitted to establish itself in Manila, and in 1814 a like privilege was extended to all foreigners, but as a rule, Spaniards were still jealous of foreigners and reactionary decrees in 1828 and 1840 forbade them to sell goods at retail or to do any business in the provinces. The vacillating Spanish policy is seen again in the opening of seven ports to foreign trade in 1830 and their closing the next year. In 1837, Manila was reopened to foreign trade, Iloilo and Cebu in 1855 and 1863. In 1842 there were 39 Spanish shipping and commercial concerns in Manila and about a dozen foreign houses. Various Governments maintained consuls, among them Great Britain and the United States.

During the first half of the 19th century, there were only 2,000 to 5,000 Spaniards in the archipelago. Spanish was spoken by some of the natives, principally in Manila and a few other important centres, but the friars had made comparatively little effort to inculcate a knowledge of Castilian. There was no homogeneity among the several native peoples, very largely because of the different languages. Partly because of these conditions, insular representation in the Spanish Cortes carried little meaning or a mistaken one to the mass of the population. After the building of the Suez canal, in 1869, ambitious Filipino youths went to Spain and other countries for study. The first daily newspaper was *La Esperanza* (1847). *La Solidaridad* was founded in 1888 in Barcelona, by Graciano López Jaena in the interest of Filipino propaganda, and throughout its course urged reforms both in religion and government. One of its foremost contributors was the precocious Chinese mestizo, José Rizal y Mercado. The Filipinos had had ample grounds for complaint, especially since 1872. That year some 200 native soldiers at the Cavite arsenal revolted, killed their officers and shouted for independence. Plans for a similar demonstration in Manila failed. The insurrection was quickly suppressed, and led to wholesale arrests, life imprisonment and the execution, among others, of three Filipino secular priests, whose connection with the uprising has never been satisfactorily explained.

Meanwhile the gradually expanding idea of Filipino nationality began to manifest itself. The campaign of Rizal, Marcelo del Pilar, López Jaena and Apolinario Mabini, leaders in the "Young Filipino Party," was a protest against both the domination of the friars and economic and administrative caciquism. These aspirations met a sympathetic reception from several governors. But other Spaniards, especially the friars, were diametrically opposed; and much of the old easy and cordial intercourse between the two peoples was changed. Rizal threw himself into the propaganda with eagerness. In 1891 he founded at Hong-kong an organization called the Liga Filipina, and in 1892, formed a branch at Manila. He was arrested in 1896 at Barcelona, returned to the Philippines, given a farcical trial and executed on Dec. 30, 1896. At about the time of Rizal's establishment of the Liga Filipina there was also founded an organization called "Supreme Worshipful Association of the Sons of the People," which is generally called the *Katipunan*. The organization was altogether Tagalog and is said to have numbered anywhere from 100,000 to 400,000 members. On Aug. 26, 1896, the actual insurrection broke out. "The cry of Balintawak" is the name given to the first hostilities by the Filipinos. The centre of the revolt was at Cavite, where Emilio Aguinaldo first came into prominence. Spain sent over reinforcements until there was an army of 28,000 besides a few loyal regiments of native soldiers. A stiff campaign of 52 days brought the defeat of the insurgents, but upon the execution of Rizal, the insurrection broke out again and spread to the provinces of Pangasinan, Zambales and Ilocos. Fernando Primo de Rivera opened negotiations with Aguinaldo and concluded with the insurgents the pact of Biac-na-Bató. Accordingly, Aguinaldo left for Hongkong on Dec. 27, 1897. With the blowing up of the "Maine" on Feb. 15, 1898, actual hostilities broke out between Spain and the United States. (*See* SPANISH-AMERICAN WAR.) The Filipinos, who had declared their independence of Spain on June 12, 1898, proclaimed a provisional republic with Aguinaldo as president, and on Sept. 9, 1898, made their capital at Malolos, with Apolinario Mabini, "the mouthpiece of the revolution," as Aguinaldo's chief adviser. On Sept. 15, a revolutionary assembly met and on the 29th ratified Filipino independence. In November and December, revolutionary tribunals were organized in the Bisayas.

BY COURTESY OF THE U. S. BUREAU OF INSULAR AFFAIRS

A PHILIPPINE POTTER AT WORK

THE PHILIPPINES UNDER THE UNITED STATES

Relations between the Americans and the Filipinos were unfriendly and steadily grew worse. On Jan. 23, 1899, the Malolos Constitution, by virtue of which the Philippines were declared a republic, and which had been approved by the assembly on Nov. 29, and by Aguinaldo on Dec. 23, was proclaimed. Aguinaldo, who had been president of the provisional government, was elected president. On the night of Feb. 4, the inevitable conflict between the Americans and Filipinos surrounding Manila was precipitated. Morning found the Filipinos, who had fought bravely, even recklessly, defeated at all points. While the fighting was in progress, Aguinaldo issued a proclamation of war against the United States. On Feb. 6, the U.S. Senate ratified the treaty, and reinforcements were immediately sent to the Philippines. Antonio Luna, the best trained military man among the Filipinos, was given charge of military operations, but seems to have been greatly hampered by the jealousy and distrust of Aguinaldo, which he fully returned. Luna was murdered, and on March 31, 1899, Malolos was captured by the American forces. The Filipino Government fled northward. In Nov. 1899, the Filipinos resorted to guerrilla warfare, with all its devastating, barbaric features. The capture of Aguinaldo by Gen. Frederick Funston in March 1901 virtually ended the real insurrection, although the last surrender was that of Gen. Miguel Malvar in Samar on April 16, 1902. The major operations of the insurrection were conducted in Luzon, and throughout the army was assisted materially by the Makabebe scouts, who remained loyal to the Americans.

Negotiations looking toward the purchase of friar lands (some 400,000 ac.) were carried on personally with the pope by Mr. Taft. The contract for the purchase for approximately $7,250,000 was signed on Dec. 22, 1903. Since then a considerable portion of the estates—much of them fine agricultural land—have been sold to Filipinos. The papacy also assigned an American archbishop and American bishops to the sees in the archipelago and accepted the doctrine of the separation of state and church. In 1905, Mr. Taft, as secretary of War, and a party of senators and representatives visited the islands. On Oct. 16, 1907, the legislature was convened by Mr. Taft. It voted to continue the use of Spanish jointly with English as an official language until 1913, when English was to become the sole official language. On Aug. 6, 1909, Congress, by the Payne Bill, granted a fuller measure of free trade between the U.S. and the Philippines. The Underwood Tariff Act of 1913 brought in complete free trade between the U.S. and the Philippines.

During the term of W. Cameron Forbes as governor general (Nov. 11, 1909–Oct. 6, 1913), emphasis was laid upon the construction and maintenance of roads and bridges; the extension of education and the construction of concrete schoolhouses; agriculture; the eradication of rinderpest; the development of Baguio as a summer capital; and on health. The proportion of Filipinos in the civil service in 1903 was 49% of the whole, 71% in 1912, almost 79% in 1914, over 94% in 1919, and almost 98% in 1926. Under the first five American governors there were conflicts between the two houses of the legislature, and for two years the Philippine assembly failed to vote an appropriation for carrying on the functions of government.

On his arrival in 1913, Governor General Harrison delivered a message from the president promising that "every step we take will be taken with a view to the ultimate independence of the Islands and as a preparation for that independence." On April 7, 1900, President McKinley had said in his instructions to the Taft Philippine Commission: ". . . the Commission should bear in mind that the government which they are establishing is designed not for our satisfaction or for the expression of our theoretical views, but for the happiness, peace, and prosperity of the people of the Philippine Islands. . . ." Assuming that the time had come to give greater autonomy to the Filipinos, President Wilson by new appointments gave them a majority on the Philippine Commission. On Dec. 31, 1927, there were 470 Americans and 18,246 Filipinos in the Government service.

In 1916, the Government purchased the stock of the Manila Railway Company; and that same year there was created the Philippine National Bank, in which the Government held all but a very small percentage of stock. By an act approved March 10, 1917, the National Coal Company was created as a private company, with the Government owning most of the stock. Other similar organizations were the National Cement, Iron and Petroleum Companies. Power to vote the Government stock was eventually vested in a board of control consisting of the governor general, the president of the Senate and the speaker of the House.

One of President Harding's first acts was to despatch the Wood-Forbes mission to make a survey of existing conditions. It reported that the immediate granting of independence would be premature and advised that the United States should not be left in a position of responsibility without authority—this latter referring specifically to the laissez-faire policy pursued by Harrison. Gen. Wood was made Governor General on Oct. 5, 1921. Until his death (Aug. 7, 1927), he was the centre of many storms.

The Council of State ceased to exist on July 17, 1923, the departmental secretaries, with the exception of the secretary of public instruction (an American), resigning both in their capacity as secretaries and as members of the Council of State. Wood accepted the resignations, and thereafter governed through the under secretaries. After considerable controversy, Wood abolished the board of control of the national companies by an executive order of Nov. 9, 1926. Appeals made to the Philippine and U.S. courts sustained Wood's action.

In 1926 President Coolidge sent Col. Carmi A. Thompson to the islands to make an investigation of conditions. His report, dated Dec. 4, 1926, recommended that the breach between the legislative and executive branches of the government be healed; that the granting of absolute independence be postponed; that an independent department be established for the administration of the Philippine Islands and other overseas territory; that the governor general be provided with the necessary civil advisers to relieve him from the necessity of selecting them from the U.S. army (as Wood had been compelled to do); that Mindanao and Sulu should not be separated from the Philippines but that American control be strengthened in the Moro country; that the Federal Reserve System be extended to the Philippines; that one or more Federal land banks be established to provide loans at reasonable interest to farmers; that the Jones Act be not changed as yet; and that the Philippine legislature should amend the land laws in order to attract capital and business experience to develop production of coffee, rubber and other tropical products. Under the short régime of Governor General Henry L. Stimson a more responsible type of government was instituted and the confidence of Filipino leaders was regained. In August, 1928, Stimson appointed his cabinet from men possessing the confidence of the party that triumphed in the last election, which meant a return to party government. He also re-created the Council of State. Appropriations for the necessary civil advisers were secured, and other aids to cooperation between the executive and legislature were added. He secured the passing of a more liberal corporation law, opposed the demand in the United States for further discrimination in duties against Philippine products, advised a revision of the land laws and the establishment of a budget. Stimson was recalled in March, 1929, to become Secretary of State in the Hoover cabinet and in May President Hoover appointed Dwight W. Davis, former Secretary of War, to succeed him.

The Palmas island arbitration case instituted in 1925 between the Netherlands and the United States was decided in favour of the former country in 1928.

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PHILIPPOPOLIS (Bulg. *Plovdiv*), the second town of Bulgaria, capital of the department of the same name, and seat of an archbishopric, is situated on the right bank of the Maritsa, 96 m. E.S.E. of Sofia, and on the main Belgrade-Constantinople railway. Pop. (1926) 85,188, the majority being Bulgars, the remainder chiefly Turks, Armenians, Jews and gypsies. The former Greek colony is now almost extinct. The city lies on and between seven granite rocks which rise abruptly out of the flat and very fertile plain of the Maritsa; the southern Balkans are distant about 25 m., the northern Rhodopes about twelve. The old Turkish Konak, another park, and the gymnasium are near the Maritsa. The "Gate of Hissara" in the old walls is noteworthy. The new town spreads south and south-west of the old.

Philippopolis is a wealthy commercial city, centre of the trade in tobacco, wheat, silk and attar of roses of south Bulgaria. There is also a growing industry in flour-mills, tobacco factories, beer, soap, leather, ink, furniture and sugar.

History.—Eumolpia, a Thracian town, was captured by Philip of Macedon and made one of his frontier posts; hence its name of Philippopolis. Under the Romans, Philippopolis, or Trimontium, was the capital of Thracia. It is said that 100,000 persons were slain when it was captured by the Goths. In 762 it was in ruins when the Emperor Constantine Copronymus settled large colonies of Armenian Paulicians in and around it as frontier guards. It recovered its prosperity under the later Roman Empire, and excited the admiration of the crusaders. Frederick Barbarossa [sic: "Bar-" at column end] to Renier of Trit. The inhabitants at first welcomed him, but the next year the Greeks declared for the Byzantine emperor, whereupon the Armenians betrayed the city to the Bulgarian tsar, Kaloyan, who massacred its Greek inhabitants, and razed the city to the ground. It recovered again, and became of extreme importance as the centre from which the Bogumils (*q.v.*) derived their doctrines through Armenian teachers. It was retaken by the Greeks in 1262, by the Turks in 1363. It was occupied by Russian troops in 1878, and under the Treaty of Berlin was made capital of the autonomous province of Eastern Roumelia, being united with Bulgaria in 1885 (*see* BULGARIA: *History*). In 1928 it was severely damaged by earthquake.

PHILIPPUS, MARCUS JULIUS, Roman emperor A.D. 244 to 249, often called "Philip the Arab," was a native of Bostra in Arabia Trachonitis. Having entered the Roman army, he rose to be praetorian praefect in the Persian campaign of Gordian III., and, inspiring the soldiers to slay the young emperor, was raised by them to the purple (244). Of his reign little is known except that he celebrated the secular games with great pomp in 248, when Rome was supposed to have reached the thousandth year of her existence. A rebellion broke out among the legions of Moesia, and Decius, who was sent to quell it, was forced by the troops to put himself at their head and march upon Italy. Philip was defeated and slain in a battle near Verona. According to Christian writers, he was a convert to Christianity.

See Aurelius Victor, *Caesares*, 28; Eutropius, ix. 3; Zonaras, xii. 19.

PHILIPS, AMBROSE (*c.* 1675–1749), English poet, was born in Shropshire of a Leicestershire family. He was educated at Shrewsbury school and St. John's college, Cambridge, of which he became a fellow in 1699. His *Pastorals* opened vol. vi. of Tonson's *Miscellanies* (1709), which also contained the pastorals of Pope. Philips was a stanch Whig, and a friend of Steele and Addison. In Nos. 22, 23, 30 and 32 (1713) of the *Guardian* he was injudiciously praised as the only worthy successor of Spenser. The quarrel between Pope and Philips which ensued is described by Samuel Johnson as a "perpetual reciprocation of malevolence." Philips had been made justice of the peace for Westminster, and in 1717 a commissioner for the lottery, and when Boulter was made archbishop of Armagh, Philips accompanied him as secretary. He sat in the Irish parliament for Co. Armagh, was secretary to the lord chancellor in 1726, and in 1733 became a judge. He died in London on June 18, 1749.

His contemporary reputation rested on his pastorals and epistles, particularly the description of winter addressed by him from Copenhagen (1709) to the earl of Dorset. In T. H. Ward's *English Poets*, however, he is represented by two of the simple and charming pieces addressed to the infant children of Lord Carteret and Daniel Pulteney. These were scoffed at by Swift as "little flams on Miss Carteret," and earned for Philips from Henry Carey the nickname of "Namby-Pamby."

Philips's works are an abridgment of Bishop Hacket's *Life* of John Williams (1700); *The Thousand and One Days; Persian Tales* . . . (1722), from the French of F. Pétis de la Croix; three plays: *The Distrest Mother* (1712), an adaptation of Racine's *Andromaque; The Briton* (1722); *Humfrey, duke of Gloucester* (1723). Many of his poems, which included some translations from Sappho, Anacreon and Pindar, were published separately, and a collected edition appeared in 1748.

PHILIPS, JOHN (1676–1708/09), English poet and man of letters, son of Dr. Stephen Philips, archdeacon of Shropshire, was born at Bampton, Oxfordshire, on Dec. 30, 1676. He was educated at Winchester and Christ Church, Oxford. His poem, *The Splendid Shilling,* was called by Addison in *The Tatler* "the finest burlesque poem in the British language." Harley and St. John commissioned him to write a Tory counterblast (*Blenheim*) to Joseph Addison's *Campaign. Cyder* (1708), one of the earliest of the great didactic poems of the 18th century, is modelled on the *Georgics* of Virgil. *Cerealia, an Imitation of Milton* (1706), although printed without his name, may safely be ascribed to him. In all his poems except *Blenheim* he inserted a eulogy of tobacco. Philips died at Hereford on Feb. 15, 1708/09.

See The Whole Works of . . . *John Philips* . . . *To which is pre-*

Philips (1927), ed. M. G. Lloyd Thomas; and Johnson's *Lives of the Poets*.

PHILIPS, KATHARINE (1631–1664), English poet, daughter of John Fowler, a merchant of Bucklersbury, London, was born on Jan. 1, 1631. In 1647 she married James Philips, a Welsh royalist. Her home at the Priory, Cardigan, became the centre of a "society of friendship," the members of which were known to one another by fantastic names, Mrs. Philips being "Orinda," her husband "Antenor," Sir Charles Cotterel "Poliarchus." The "matchless" Orinda, as her admirers called her, posed as the apostle of female friendship. Jeremy Taylor dedicated to her his "Discourse on the Nature, Offices and Measures of Friendship," and Cowley, Henry Vaughan, Roscommon and the earl of Cork and Orrery all celebrated her talent. She died of smallpox on June 22, 1664. The literary atmosphere of her circle is preserved in the excellent *Letters of Orinda to Poliarchus*, published by Bernard Lintot in 1705 and 1709.

See E. W. Gosse, *Seventeenth Century Studies* (1883). *Poems, By the Incomparable Mrs. K. P.* appeared surreptitiously in 1664 and an authentic edition in 1667. *Selected Poems,* edited with an appreciation by Miss L. I. Guiney, appeared in 1904. The best modern edition is in Saintsbury's *Minor Poets of the Caroline Period* (vol. i., 1905).

PHILIP THE BOLD (1342–1404), duke of Burgundy, fourth son of John II. of France and Bonne of Luxemburg, was born on Jan. 15, 1342. He earned his surname by his bravery on the field of Poitiers. He accompanied King John into captivity in England. In 1360 he received the title of duke of Touraine, and in June 1363 was entrusted with the government of Burgundy, which John had united to the crown at the death of the last duke of the Capetian family, Philip of Rouvre, in 1361. In September 1363 John made Philip duke of Burgundy, and first peer of France. The donation was ratified at the accession of Charles V. of France; he took possession of the duchy at the end of 1364. Charles appointed him (in 1366) his lieutenant in Champagne and married him in 1639 to Margaret, daughter and heiress of Louis of Mâle, count of Flanders, and widow of Philip of Rouvre.

Philip proved a faithful ally to Charles. He took part in the almost bloodless campaign against the duke of Lancaster, who had landed at Calais; in 1377 he took several towns in French Flanders from the English; and in 1379 relieved Troyes, which had been besieged by the English. On Charles's death Philip found himself, with his brothers, the dukes of Anjou and Berry, in charge of the government of France in the name of Charles VI., who was a minor; and in the absence of the duke of Anjou, who left France in 1382 to conquer the kingdom of Naples, Philip occupied the most powerful position in the realm. He persuaded the young king to intervene in Flanders, where the citizens of Ghent, whose rebellious spirit had necessitated Philip's intervention in 1379, had again revolted under Philip van Artevelde and had expelled Louis of Mâle. On Nov. 27, 1382, the Franco-Burgundian chivalry crushed the rebels at Rosebecke, and on his return the duke of Burgundy took part in repressing the popular movements which had broken out in Paris and other French towns. In 1383 an insurrection in Flanders supported by England gave rise to another French expedition; but in January 1384 the death of Louis of Mâle made Philip master of the countships of Flanders, Artois, Rethel and Nevers; and in the following year the citizens of Ghent decided to submit. At this period Philip sought to ingratiate himself with the emperor by giving two of his daughters in marriage to two princes of the house of Bavaria; he also took an important part in bringing about the marriage of a princess of the same family, Isabel, to King Charles VI.

Hostilities, however, were renewed between France and England. A formidable expedition was prepared under the direction of the duke of Burgundy, and a fleet of 1,400 sail assembled at Sluys; but the enterprise failed owing to the dilatoriness of the duke of Berry. The fatiguing and inglorious expedition in the Netherlands weakened Philip's credit with his nephew, who on his return declared himself of age and confided the government to the ancient councillors of his father, the "Marmousets." The king's madness (1392) restored his uncles to power, and particularly Philip, who after assuring peace by treating with the duke of Brittany and by concluding a truce of twenty-eight years with England, made strenuous efforts to put an end to the Great Schism, visiting Pope Benedict XIII. at Avignon in 1395 in the hope of obtaining a voluntary resignation from him. For the discords in the king's council *see* CHARLES VI. For a brief period Philip was dispossessed of authority, but he regained it in 1402 and kept it till his death (April 27, 1404). The cathedral of St. Bénigne at Dijon contains his remains, and his tomb (formerly in the Chartreuse of Dijon) is in the Hôtel-de-ville. Philip appears to have governed his territories with sagacity and a certain moderation. He granted numerous privileges to the inhabitants of Dijon, and created in 1386 two *chambres des comptes,* one at Dijon and the other at Lille. He was, in the phrase of a contemporary, "kindly and amiable to high and low and those of middle rank, liberal as an Alexander, noble and pontifical, in court and state magnificent." (R. P.; X.)

PHILIP THE GOOD (1396–1467), duke of Burgundy, son of John the Fearless, duke of Burgundy, and Margaret of Bavaria, was born at Dijon on June 13, 1396, and succeeded his father on Sept. 10, 1419. The assassination of John the Fearless (*q.v.*) drove his successor to the English side. In 1419 Philip signed with Henry V. of England the treaty of Arras, by which he recognized Henry as regent and future heir of the kingdom of France, and in 1420 gave his adherence to the treaty of Troyes. Early in December 1420 Philip entered Paris with the king of England, and subsequently took part in the defeat of the French at Mons-en-Vimeu. By a treaty concluded by Philip at Amiens in April 1423 with the dukes of Brittany and Bedford, John, duke of Bedford, married Philip's sister Anne, and Arthur of Brittany, earl of Richmond, became the husband of Philip's sister Margaret. A few years later discord arose among the allies. When the duke of Bedford besieged Orleans the inhabitants offered to surrender, but to the duke of Burgundy; whereupon Bedford retorted that "he did not beat the bushes for others to take the birds." When this speech reached Philip's ears he withdrew his troops in dudgeon, and concluded a truce with France (1429). Bedford succeeded in conciliating him and in 1430 Philip took part in the campaign against Compiègne.

But another conflict arose between the duke of Burgundy and the English. Jacqueline, countess of Hainaut (*see* JACOBA) the divorced wife of the duke of Brabant and the heiress of Holland and Zeeland, had married the duke of Gloucester, who attempted to take forcible possession of his wife's territories. Philip claimed Brabant as a bequest from his cousin Philip, the late duke, with the result that the Burgundians repulsed the troops of the duke of Gloucester, and Jacqueline was forced to recognize the duke of Burgundy as her lieutenant and heir. Moreover, the duchess of Bedford had died in 1433. Charles VII., who in spite of the efforts of the cardinal of Ste-Croix had hitherto refused to return to France, finally decided to take part in the conferences which were opened at St. Vaast d'Arras on Aug. 6, 1435. Philip agreed to recognize the king of France as his legitimate sovereign on condition that he should not be required to pay him homage during his lifetime. Charles solemnly craved pardon for the murder of John the Fearless and handed over to the duke the counties of Mâcon, Auxerre, Bar-sur-Seine and Ponthieu, and the towns on and near the Somme (Roye, Montdidier, Péronne), reserving the option of redeeming the Somme towns for 400,000 gold crowns. Philip faithfully served the king, aiding him in re-entering Paris and preparing an expedition against Calais, which, however, failed through the ill-will of his Flemish subjects (1436). In 1440 he paid the ransom of Charles of Orleans and married him to Mary of Cleves. In 1442 Philip conspired to give the duke of Orleans a larger share in the affairs of the kingdom.

Philip was frequently disturbed by the insubordination of the Flemish communes. He had to quell seditions at Liége (1430), Ghent (1432 and 1448), Antwerp (1435) and Bruges (1438). Shortly after the final defeat of the citizens of Ghent at Gavre (1453) Philip vowed that he would lead a crusade against the Turks, who had seized Constantinople. The expedition, however, did not take place, and was but a pretext for levying subsidies. In 1459 Philip sent an embassy under the duke of Cleves into Italy to

take part in the conferences preparatory to a fresh expedition against the Turks, but this enterprise likewise fell to the ground. In 1456 the duke of Burgundy had given an asylum to the Dauphin Louis (afterwards Louis XI.), who had quarrelled with his father and had been forced to leave France. Louis repaid his protector by attempting to sow discord in the ducal family of Burgundy, and then retired to the castle of Genappe in Brabant. At Charles VII.'s death, however, Philip was one of the first to recognize the new king, and accompanied him to Paris. During the journey Louis won over the seigneurs of Croy, the principal counsellors of the duke of Burgundy, and persuaded Philip to allow him to redeem the Somme towns for the sum stipulated in the treaty of Arras. This proceeding infuriated Philip's son Charles, count of Charolais, who prevailed upon his father to break his pledge and declare war on the king of France. On April 12, 1465, Philip handed over to his son the entire administration of his estates. The old duke died at Bruges on June 15, 1467.

Philip was a great lover of pomp and luxury and a friend of letters, being the patron of Georges Chastelain, Olivier de la Marche and Antoine de la Salle, and the founder of the collection of mss. known as the "Bibliothèque de Bourgogne" (now at Brussels), and also of the university of Dôle (1421). He administered his estates wisely; promoted commerce and industry, particularly in Flanders; and left his son a well-lined treasury. He was thrice married. in 1409 to Michelle (d 1422), daughter of Charles VI of France; in 1424 to Bonne of Artois (d. 1425); and in 1429 to Isabel (d. 1472), daughter of John I, king of Portugal, when he founded the order of the Golden Fleece. He was succeeded by Charles, afterwards known as Charles the Bold, his only surviving son by Isabel. (R. P.; X.)

PHILISTINES. "Philistine" was the general name for the people of Philistia (Ass. *Palaštu, Pilištu;* Eg. *p-r-s-t*), a district embracing the rich lowlands on the Mediterranean coast from the neighbourhood of Jaffa (Joppa) to the Egyptian desert south of Gaza On the subsequent extension of the name in its Greek form, Palaestina, *see* PALESTINE.

According to biblical tradition the Philistines are the remnant of Caphtor (Jer. xlvii. 4, Amos ix. 7), and the Caphtōrīm drove out the aboriginal Avvim from Gaza and district, as the Horites and Rephaim were displaced by Edom and Ammon (Deut ii. 23). These Caphtōrīm, as well as Ludim (Lydians) and other petty peoples, apparently of the Delta, are once reckoned to Egypt (Gen. x. 14). By Caphtor the Septuagint has sometimes understood Cappadocia, which indeed may be valid for its age, but the name is to be identified with the Egyptian K(a)ptar, which in later Ptolemaic times seems to mean Phoenicia, although the earlier *Keftiu* connoted Crete, and possibly "the south Anatolian coast as far as Cilicia" (Hall). The Cherethites, associated with the Philistine district (1 Sam. xxx. 14, 16, Ezek xxv. 16, Zeph ii. 5 *seq*), are sometimes recognized by the Septuagint as Cretans, and, with the Pelethites, they form part of the royal bodyguard of Judaean kings (2 Sam. viii. 18, xv. 18, xx. 7, 1 Ki. i. 38, 44; in 2 Sam. xx. 23 the Hebrew text has Carites).

The earliest occurrence of the name "Philistines" outside the Old Testament is in Egypt, where the Purasati (Pulesati) are one of a great confederation from north Syria, Asia Minor and the Levant, which threatened Egypt in the 20th dynasty. They are not among the hordes enumerated earlier by Rameses II. or Merneptah, but in the eighth year of Rameses III. (*c.* 1194 B C); the Purasati (Pulesati) take part in a widespread movement on land and sea. The Syrian States were overwhelmed and the advance upon Egypt seemed irresistible. Rameses, however, collected a large fleet and an army of native troops and mercenaries and claimed decisive victories. The Egyptian monuments depict the flight of the enemy. The sequel of the events is not known, though about a century later the Zakaray are found at Dor, and treat with scant respect the suzerainty of Egypt.

The Egyptian monuments represent the Purasati with a very distinctive feather head-dress resembling that of the Lycians and Mycenaeans. Their general physiognomy is hardly Cilician or Hittite, but European, especially Greek. They fought with a broad-sword and carried a round shield. On archaeological grounds the Purasati were not Mycenaeans from Crete, despite tradition, but rather from Asia Minor (Lycia, Caria), though they may have passed some time in Crete.

Palestine and the West.—The Philistines appear in the Old Testament as a Semitic or at least a Semitized people. Both the language and the religion were Semitic. The male god Dagon has his partner Astarte (*qq.v.*), and Baal-zebub, a famous oracle of Ekron (2 Ki. i) resembles the local "baals" of Palestine. Philistia seems to be completely Hellenized after the Persian age; but it is not certain that Greek culture pervaded all classes; foreign influence probably always made itself felt upon the coast-towns The use of the term ἀλλόφυλοι in Maccabaean and later writings (*cf.* the contemptuous hatred of Ben Sira, Ecclesiasticus l. 26, and the author of Jubilees xxiv. 30 *sqq*) expresses the conditions of the Greek age and the Maccabaean wars The Mediterranean coast-land was always exposed to incursions of aliens; Carians appear as royal and temple guards at Jerusalem (2 Ki. xi. 4), and old Greek traditions tell of a Carian sea-power and relations between Philistia and Greek lands. Even the presence of Carians and Ionians in the time of Psammetichus I may be assumed, and as these are planted at Defneh it is noteworthy that this place is also closely associated with a Jewish colony (viz , Tahpanhes, Jer xliii., *seq*). In fact, Palestinian intercourse with the West is fairly continuous; and excavation at Beth-shan, Gezer, and other sites, has shown many important indications of Western influence, so that some authorities even recognize a "Philistine" pottery.

History.—The Philistines form a confederation of five cities (Ashdod, Ascalon [Ashkelon], Ekron, Gath and Gaza), which remained unconquered by the Israelites (Josh. xiii 2 *seq*, Judges iii. 3; contrast Josh. xv. 45–47, xix. 43). The institution of the Hebrew monarchy (*c.* 1025 B C.) follows upon periods of Philistine oppression (Judges iii. 31, x. 7, 11, xiii. 1, 5; *see* SAMSON; ELI; SAMUEL; SAUL; DAVID). Their subjugation is ascribed to Samuel (1 Sam. vii. 13), Saul (xiv 47), and David (2 Sam. viii. 1). They evidently recovered their independence, and twice within a short time the northern Israelites laid siege to the border fortress of Gibbethon (1 Ki. xv. 27, xvi. 15). The interrelations of the south Palestinian peoples follows from the unchangeable geographical conditions, and Judah always depended upon its relations with the Philistines on the west and with the Edomites and Arabian tribes on the south-east. "Philistia," with Edom and Beth-Omri (*i e* , the Israelite kingdom), paid tribute to the Assyrian king, Adad-Nirari III. (*c.* 802 B C). The omission of Judah is noteworthy. In the later Assyrian period Philistia was mixed up in pro- and anti-Assyrian intrigues, and suffered from Tiglath-pileser (734), Sargon (720) and Sennacherib (700). In the 7th century Gaza, Ascalon, Ashdod and Ekron were Assyrian vassals, together with Judah, Moab and Edom—in all, 22 kings of the "Hittites" Herodotus mentions the Scythian invasion and sack of the temple of Aphrodite Urania (Astarte) at Ascalon, also the prolonged siege of Ashdod by Psammetichus, and the occupation of Kadytis (? Gaza) by Necho. But the Babylonian empire followed upon traditional lines and thrust back Egypt, and Nabonidus (553 B C) claims his vassals as far as Gaza The Persians took over the realm of their predecessors, and Gaza grew in importance as a seat of international commerce Nehemiah speaks not of Philistines, but of Ashdodites (iv. 7), speaking an "Ashdodite" dialect (xiii 24); just as Strabo regards the Jews, the Idumaeans, the Gazans and the Ashdodites as four cognate peoples having the common characteristic of combining agriculture with commerce. In southern Philistia, at least, Arabian immigration became more pronounced. In the time of Cambyses Arabs were settled at Jenysos south of Gaza (Herod. iii. 5), and when Alexander marched upon Egypt, Gaza with its army of Arabs and Persians offered a strenuous resistance. On the history of the district *see* further GAZA; JEWS; MACCABEES; PALESTINE.

Traditions of the Philistines.—The Philistines were prominent in popular tradition, and the story of Isaac and the Philistine Abimelech (Gen. xxvi., *cf.* xxi. 32) is of great interest for its unbiased picture of enmity, alliance and covenant. But a parallel story (xx.) is without this *Philistine* background Similarly,

one account of the Israelite invasion conceived a conquest of earlier giant inhabitants (Anāḳīm), who survived in Gaza, Gath and Ashdod (Josh. xi. 21 *seq.*, contrast xiii. 3), but were driven out from Hebron by Caleb (Josh. xv. 14, *cf.* Num. xiii. 22, 28). The Philistines themselves are called the remnant of the Anāḳīm (Jer. xlvii. 5, so the Septuagint), or as Caphtōrīm replace the earlier Avvim (Deut. ii. 23, *see* Josh. xiii. 3). Samuel's great defeat of the Philistines leads to "peace between Israel and the *Amorites*" (1 Sam. vii. 14); and the migration of the Danites is placed after Samson's conflicts with the *Philistines* (Judges xviii. *seq.*), or is due to the pressure of *Amorites* (i. 34). Even in David's fights with the Philistines in Judah, Jerusalem is Jebusite, neighbouring non-Israelite cities are Hivite or Amorite (Josh. ix. 7, 2 Sam. xxi. 2), and his strange adversaries find a close parallel in the semi-mythical sons of Anak (2 Sam. xxi. 16, 18, 20, 22). In another tradition, however, David is on intimate relations with a Philistine king, Achish (or Abimelech, Ps. xxxiv.), *cf.* Isaac, p. 735. Traditions agree that the Israelites had to fight for their freedom, but antagonism between Philistines and Israelites was not persistent.

See further H. R. Hall, *Camb. Anc. Hist.*, iii. ch. xii. (with bibliography); and the articles on "Philistines" in *Reallexikon d. Vorgeschichte* (illustr. by Gallin) and *Ency. Bib.* (G. F. Moore). (S. A. C.)

PHILISTUS, Greek historian of Sicily, was born at Syracuse about the beginning of the Peloponnesian War (432 B.C.). He was a faithful supporter of the elder Dionysius, and commander of the citadel. In 386 he was banished for secretly marrying the tyrant's niece. He commanded the fleet against Dion, but was defeated and put to death (356). He settled at Thurii, but afterwards removed to Adria, where he remained until the death of Dionysius (366). He was then recalled by the younger Dionysius, whom he persuaded to dismiss Plato and Dion. During his stay at Adria, Philistus occupied himself with the composition of his Σικελικά, a history of Sicily in eleven books, down to 363, from which point the work was carried on by Athanas. Cicero (*ad. Q. Fr.* ii. 13) calls him "the miniature Thucydides" (*pusillus Thucydides*).

See Diod. Sic. xiii. 103, xiv. 8, xv. 7, xvi. 11, 16; Plutarch, *Dion.* 11–36; Cicero, *Brutus*, 17, *De oratore*, ii. 13; Quintilian, *Instit.* x. 1, 74; fragments and life in C. W. Müller, *Fragmenta historicorum graecorum*, vol. i. (1841); C. Wachsmuth, *Einleitung in das Studium der alten Geschichte* (1895); E. A. Freeman, *History of Sicily* (1891–94); A. Holm, *Geschichte Siciliens im Altert.* (1870–98).

PHILLIMORE, SIR ROBERT JOSEPH (1810–85), English judge, was born at Whitehall on Nov. 5, 1810. Educated at Westminster and Christ Church, Oxford, where a lifelong friendship with W. E. Gladstone began, his first appointment was to a clerkship in the board of control, where he remained from 1832 to 1835. Admitted as an advocate at Doctors' Commons in 1839, he was called to the bar at the Middle Temple in 1841, and rose very rapidly. He was engaged as counsel in almost every case of importance that came before the admiralty, probate or divorce courts. He was appointed judge of the Cinque Ports in 1855, queen's counsel in 1858, and advocate-general in admiralty in 1862, and succeeded Stephen Lushington as judge of the court of arches five years later. Here his care, patience and courtesy, combined with unusual lucidity of expression, won general respect. He was the last judge of the old court of the lord high admiral; after the Judicature act he continued to sit as judge for the new admiralty, probate and divorce division until 1883. He wrote *Ecclesiastical Law of the Church of England*, a book which still holds its ground, *Commentaries on International Law*, and a translation of Lessing's *Laocoon*.

PHILLIMORE, WALTER GEORGE FRANK PHILLIMORE, 1st BARON (1845–1929), British judge, was born in London on Nov. 21, 1845, the eldest son of Sir Robert Joseph Phillimore, Bart. (*q.v.*). He was educated at Westminster and Christ Church, Oxford, and was called to the Bar in 1868. He was made a judge in 1913, and promoted to the Court of Appeal in 1913. He retired from the bench in 1916, and in 1918 was raised to the peerage. In 1918 he became chairman of the naval prize tribunal. Lord Phillimore was English representative on the commission which sat at The Hague in 1920 to prepare the scheme of a permanent Court of International Justice. He died on March 13, 1929.

Lord Phillimore's publications include *Three Centuries of Treaties of Peace and Their Teaching* (1917); he also revised J. H. Blunt's *Book of Church Law* and several of his father's works.

PHILLIPS, EDWARD (1630–?1696), English author, son of Edward Phillips of the crown office in chancery, and his wife Anne, only sister of John Milton, the poet, was born in Aug. 1630 in the Strand, London. His father died in 1631, and Anne Phillips eventually married her husband's successor in the crown office, Thomas Agar. Edward Phillips and his younger brother, John, were educated by Milton. Edward entered Magdalen Hall, Oxford, in November 1650, but left the university in 1651 to be a bookseller's clerk in London. He was tutor to the son of John Evelyn, 1663 to 1672, and in 1677–79 in the family of Henry Bennet, earl of Arlington. The date of his death is unknown but his last book is dated 1696.

His most important work is *Theatrum poetarum* (1675), a list of the chief poets of all ages and countries, but principally of the English poets, with short critical notes and a prefatory *Discourse of the Poets and Poetry*, which has usually been traced to Milton's hand. He also wrote *A New World in Words, or a General Dictionary* (1658), which went through many editions; a new edition of Baker's *Chronicle*, of which the section on the period from 1650 to 1658 was written by himself from the royalist standpoint; a supplement (1676) to John Speed's *Theatre of Great Britain;* and in 1684 *Enchiridion linguae latinae*, said to have been taken chiefly from notes prepared by Milton. Aubrey states that all Milton's papers came into Phillips's hands, and in 1694 he published a translation of his *Letters of State* with a valuable memoir.

His brother, JOHN PHILLIPS (1631–1706), in 1652 published a Latin reply to the anonymous attack on Milton entitled *Pro Rege et populo anglicano.* He appears to have acted as unofficial secretary to Milton, but he published in 1655 a bitter attack on Puritanism entitled a *Satyr against Hypocrites.* In 1656 he was summoned before the privy council for his share in a book of licentious poems, *Sportive Wit*, which was suppressed by the authorities but almost immediately replaced by a similar collection, *Wit and Drollery.*

An extended, but by no means friendly, account of the brothers is given by Wood, *Athen. oxon.* (ed. Bliss, iv. 764 seq.), where a long list of their works is dealt with. This formed the basis of William Godwin's *Lives of Edward and John Phillips* (1815), with which is reprinted Edward Phillips's *Life of John Milton.*

PHILLIPS, STEPHEN (1868–1915), British poet and dramatist, was born on July 28, 1868, at Somertown near Oxford, the son of the Rev. Stephen Phillips, precentor of Peterborough cathedral. He was educated at Stratford and Peterborough grammar schools, and entered Queen's college, Cambridge; but during his first term at Cambridge, when F. R. Benson's dramatic company visited the town, he joined it, and for six years played various small parts. In 1890 a slender volume of verse was published at Oxford with the title *Primavera*, which contained contributions by him and by his cousin, Laurence Binyon, and others. In 1894 he published *Eremus*, a long poem of loose structure in blank verse of a philosophical complexion. *Poems* (1897) brought him many readers. George Alexander commissioned Phillips to write him a play, the result being *Paolo and Francesca* (1900), produced at the St. James's Theatre in 1901. Other dramas in blank verse followed: *Herod: a Tragedy* (1900), *Ulysses* (1902), *The Sin of David* (1904), and *Nero* (1906). In these plays, three of which were produced by Beerbohm Tree, the poet's avowed aim was to revitalize the method of the Greek drama. *Paolo and Francesca* was the most successful. He died at Deal, Kent, on Dec. 9, 1915.

See a notice by Arthur Symons prefixed to the edition (1927) of his last play, *Harold*, which was first printed in the *Poetry Review*, Jan. and March 1916; also Sir Sidney Colvin in T. Humphrey Ward's *English Poets* (vol. v. 1918).

PHILLIPS, WENDELL (1811–1884), American orator and reformer, was born in Boston on Nov. 29, 1811. His father, John Phillips (1770–1823), a man of wealth and influence, graduated at Harvard college in 1788, and became "town advocate and public prosecutor," and in 1822 first mayor of Boston. Phillips attended the public Latin school, entered Harvard college before he was 16

and graduated in 1831. He graduated at the Harvard law school in 1834, and was admitted to the bar in Boston. He soon came under the influence of the anti-slavery movement, witnessing in 1835 the mobbing, in Boston, of William Lloyd Garrison.

A meeting was held on Dec. 8, 1837, at Faneuil Hall to express the sentiments of the people on the murder of Elijah P. Lovejoy, at Alton (Ill.) for defending his press from a pro-slavery mob. In the course of the meeting a speech was made in opposition to its general current by James T. Austin, attorney-general of the State, who said that Lovejoy had died "as the fool dieth," and compared his murderers to the men who threw the tea into Boston harbour just before the War of Independence. The speech seemed likely to divide the audience, when Wendell Phillips took the platform. "When I heard," he said, "the gentleman lay down principles which placed the murderers of Alton side by side with Otis and Hancock, with Quincy and Adams, I thought these pictured lips (pointing to their portraits) would have broken into voice to rebuke the recreant American, the slanderer of the dead." This appeal not merely determined the sentiment of the meeting; it gave Wendell Phillips his first fame and determined his career.

Although loving his profession, and this especially for the opening it gave in the direction of public life, he lived henceforth the life of an agitator, or, like his father, that of a "public prosecutor." Accepting unhesitatingly the leadership of Garrison, and becoming like him a disunionist, he lived essentially a platform life, interested in a variety of subjects, but first and chiefly an abolitionist. In 1865, however, after the Civil War, he broke with Garrison over the question of discontinuing the Anti-Slavery Society; and from that date until the society was disbanded in 1870, he, instead of Garrison, was its president. Phillips' style of eloquence was direct and brilliant, but eminently self-controlled. He may be said to have introduced the direct and colloquial manner upon the American public platform. His logic, while never obtruded, was rarely at fault, but he loved the flash of the rapier, and was never happier than when he had to face a mob and utterly foil it by sheer superiority in fencing. The two volumes of his speeches, as edited by James Redpath, were fortunately made from verbatim reports, and they wisely enclose in parentheses those indications of favour or dissent from the audience which transformed so many of his speeches into exhibitions of gladiatorial skill. After slavery had fallen Phillips associated himself freely with reformers occupied in other paths. He contended in later years for prohibition, woman suffrage and various penal and administrative reforms. He died in Boston on Feb. 2, 1884.

See his *Speeches, Lectures and Letters* (1892); Lorenzo Sears, *Wendell Phillips, Orator and Agitator* (1909); also George L. Austin, *The Life and Times of Wendell Phillips* (1888); C. E. Russell, *Story of Wendell Phillips: Soldier of the Common Good* (1914); and George Edward Woodbury, *Heart of Man and Other Papers* (1920).

PHILLIPSBURG, a town of Warren county, New Jersey, U.S.A., on the Delaware river, opposite Easton, Pa.; served by the Central of New Jersey, the Lackawanna, the Lehigh and Hudson River, the Lehigh Valley and the Pennsylvania railways. Pop. (1920) 16,923 (86% native white). The city rises from the river bottom to bluffs commanding fine views. It has railroad shops and various other manufacturing industries, making mining and agricultural machinery, silk and many other products. The aggregate output in 1925 was valued at $35,040,492. Phillipsburg was settled about 1750, but it was only a straggling village until the Morris canal was constructed (1825). An iron furnace was established in 1848 and the Central railroad of New Jersey reached the town in 1852. It was incorporated in 1861.

PHILLIPSITE, a mineral of the zeolite group; a hydrated potassium, calcium and aluminium silicate, approximating to $(K_2,Ca)Al_2(SiO_3)_4 \cdot 4H_2O$. It varies somewhat in composition, and a variety ("pseudophillipsite") containing rather less silica has the formula $(K_2,Ca)_2Al_4Si_9O_{18} \cdot 9H_2O$. Crystals are monoclinic, but only complex cruciform twins are known, these being exactly like twins of harmotome (*q.v.*), though the phillipsite crystals are usually smaller and more transparent and glassy. Spherical groups with a radially fibrous structure and bristled with crystals on the surface are not uncommon. The hardness is 4½, and the specific gravity 2·2. The species was named in 1825 after William Phillips; French mineralogists call it christianite (after Christian VIII. of Denmark).

Phillipsite is a mineral of secondary origin, and occurs with other zeolites in the amygdaloidal cavities of basic volcanic rocks; *e.g.*, in the basalt of the Giant's Causeway in Co. Antrim and near Melbourne, Victoria, and in leucitite near Rome; while small crystals of recent formation occur in the masonry of the hot baths at Plombières and Bourbonne-les-Bains, France. Minute spherical aggregates embedded in red clay were dredged by the "Challenger" from the bottom of the central Pacific, where they had been formed by the decomposition of volcanic ash.

PHILLPOTTS, EDEN (1862–), British novelist, poet and dramatist, was born in India on Nov. 4, 1862, and educated at Plymouth. He was a clerk for ten years in the Sun fire insurance office, then studied for the stage, but turned his attention to literature, producing a number of successful novels with a Devonshire setting.

PHILLPOTTS, HENRY (1778–1869), English bishop, was born at Bridgwater on May 6, 1778, and was educated at Gloucester College school and at Corpus Christi college, Oxford. He became a fellow of Magdalen college, Oxford, in 1795, took orders in 1802 and was select university preacher in 1804. For twenty years he was chaplain to Shute Barrington, bishop of Durham. He held in succession important preferments, and was consecrated bishop of Exeter in 1831, holding with the see a residentiary canonry at Durham. In 1819 he had defended the existing poor law and the action of the Government in the "Peterloo massacre." In 1825 he vehemently opposed Catholic emancipation, engaging in a fierce polemic on the subject with Charles Butler (1750–1832). He continued to support the Tory party, even when it passed the Roman Catholic Emancipation Act of 1829. He died on Sept. 18, 1869. "Henry of Exeter," as he was commonly called, had little sympathy with either Evangelicals or Tractarians. The famous Gorham judgment was the outcome of his refusal to institute to the living of Brampford Speke a clergyman George Cornelius Gorham (1787–1857), who had openly disavowed his belief in baptismal regeneration; he denounced the equally famous Tract 90 in his episcopal charge of 1843.

See R. N. Shutte, *The Life of Dr. Phillpotts* (1863).

PHILO, often called PHILO JUDAEUS, Jewish philosopher, appears to have spent his whole life at Alexandria, where he was probably born *c.* 20–10 B.C. His father Alexander was alabarch or arabarch (that is, probably, chief farmer of taxes on the Arabic side of the Nile), from which it may be concluded that the family was influential and wealthy (Jos., *Ant.* xviii. 8, 1). The only event of his life which can be actually dated belongs to A.D. 40, when Philo, then a man of advanced years, went from Alexandria to Rome, to persuade the emperor Gaius to abstain from claiming Divine honour of the Jews Of this embassy Philo has left a full account (*De legatione ad Gaium*).

The Hellenistic Jew.—Philo is the most important representative of Hellenistic Judaism, and his writings give us the clearest view of what this development of Judaism in the diaspora was and aimed at.

Philo appears to have been the greatest of all the Jewish philosophers of the Alexandrian school. On one side he is quite a Greek, on the other quite a Jew. His language is formed on the best classical models, especially Plato. He knows and often cites the great Greek poets, but his chief studies had been in Greek philosophy. His system was eclectic, but the borrowed elements are combined into a new unity with so much originality that he may fairly be regarded as representing a philosophy of his own, which has for its characteristic feature the constant prominence of a fundamental religious idea. Philo's closest affinities are with Plato, the later Pythagoreans and the Stoics. Yet with all this Philo remained a Jew, and a great part of his writings is expressly directed to recommend Judaism to the respect and, if possible, the acceptance of the Greeks. He was not a stranger to the specifically Jewish culture that prevailed in Palestine; in Hebrew he was not proficient, but he had evidently made some study of that language. His method of exegesis is identical in form with that of the Palestinian scribes, and there are coincidences in matter. Philo recog-

nized the Mosaic Scriptures of the Pentateuch as of absolute Divine authority and as containing all truth. The other Jewish Scriptures are also recognized as prophetic, *i.e.*, as the writings of inspired men, but he does not place them on the same lines with the law. Everything that is right and good in the doctrines of the Greek philosophers had already been quite as well, or even better, taught by Moses. Thus, since Philo had been deeply influenced by the teachings of Greek philosophy he actually finds in the Pentateuch everything which he had learned from the Greeks. From these premises he assumes as requiring no proof that the Greek philosophers must in some way have drawn from Moses, a view indeed which is already expressed by Aristobulus. These presuppositions were maintained by an allegorical interpretation of Scripture. With its aid he discovers indications of the profoundest doctrines of philosophy in the simplest stories of the Pentateuch.

His Doctrine of God starts from the idea that God is a Being absolutely bare of quality. All quality in finite beings has limitation, and no limitation can be predicated of God, who is eternal, unchangeable, simple substance, free, self-sufficient, better than the good and the beautiful. To predicate any quality (ποιότης) of God would be to reduce Him to the sphere of finite existence. Of Him we can say only *that* He is, not *what* He is, and such purely negative predications as to His being appear to Philo, as to the later Pythagoreans and the Neoplatonists, the only way of securing His absolute elevation above the world. At bottom, no doubt, the meaning of these negations is that God is the most perfect being; and so, conversely, we are told that God contains all perfection, that He fills and encompasses all things with His being.

A consistent application of Philo's abstract conception of God would exclude the possibility of any active relation of God to the world, and therefore of religion, for a Being absolutely without quality and movement cannot be conceived as actively concerned with the multiplicity of individual things. And so in fact Philo does teach that the absolute perfection, purity and loftiness of God would be violated by direct contact with imperfect, impure and finite things. But the possibility of a connection between God and the world is reached through a distinction which forms the most important point in his theology and cosmology; the proper Being of God is distinguished from the infinite multiplicity of divine Ideas or Forces: God himself is without quality, but He disposes of an infinite variety of Divine Forces, through whose mediation an active relation of God to the world is brought about.

Mediating Forces.—Philo's conception of the nature of these mediating Forces was self-contradictory. On the one hand they are nothing else than Ideas of individual things conceived in the mind of God, and as such ought to have no other reality than that of immanent existence in God, and so Philo says expressly that the totality of Ideas, the *κόσμος νοητός*, is simply the Reason of God as Creator (*θεοῦ λόγος ἤδη κοσμοποιοῦντος*). Yet, on the other hand, they are represented as daemons or angels, hypostases distinct from God, individual entities existing independently and apart from Him. This vacillation, however, as Zeller and others have justly remarked, is necessarily involved in Philo's premises, for, on the one hand, it is God who works in the world through His Ideas, and therefore they must be identical with God; but, on the other hand, God is not to come into direct contact with the world, and therefore the Forces through which He works must be distinct from Him. The same inevitable amphiboly dominates in what is taught as to the supreme Idea or Logos. Philo regards all individual Ideas as comprehended in one highest and most general Idea or Force—the unity of the individual Ideas—which he calls the Logos or Reason of God, and which is again regarded as operative Reason. The Logos, therefore, is the highest mediator between God and the world, the firstborn son of God, the archangel who is the vehicle of all revelation, and the high priest who stands before God on behalf of the world. Through him the world was created, and so he is identified with the creative Word of God in Genesis (the Greek λόγος meaning both "reason" and "word"). Here again, we see, the philosopher is unable to escape from the difficulty that the Logos is at once the immanent Reason of God, and yet also an hypostasis standing between God and the world. The whole doctrine of this mediatorial hypostasis is a strange intertwining of very dissimilar threads; on one side the way was prepared for it by the older Jewish distinction between the Wisdom of God and God Himself, of which we find the beginnings even in the Old Testament (Job xxviii. 12 *seq.;* Prov. viii., ix.), and the fuller development in the books of Ecclesiasticus and Wisdom, the latter of which comes very near to Philo's ideas if we substitute for the term "wisdom" that of (divine) "Reason." In Greek philosophy, again, Philo, as we have seen, chiefly follows the Platonic doctrines of Ideas and the Soul of the World, and the Stoic doctrine of God as the λόγος or Reason operative in the world. In its Stoic form the latter doctrine was pantheistic, but Philo could adapt it to his purpose simply by drawing a sharper distinction between the Logos and the world.

The World and Creation, in Philo's doctrine, rest on the presupposition of an absolute metaphysical contrast between God and the world. The world can be ascribed to God only in so far as it is a cosmos or orderly world; its material substratum is not even indirectly referable to God. Matter (ὕλη, or, as the Stoics said, *οὐσία*) is a second principle, but in itself an empty one, its essence being a mere negation of all true being. It is a lifeless, unmoved, shapeless mass, out of which God formed the actual world by means of the Logos and divine Forces. Strictly, the world is only formed, not created, since matter did not originate with God.

Philo's Doctrine of Man is also strictly dualistic, and is mainly derived from Plato. Man is a twofold being, with a higher and a lower origin. Of the pure souls which fill airy space, those nearest the earth are attracted by the sensible and descend into sensible bodies; these souls are the Godward side of man. But on his other side man is a creature of sense, and so has in him a fountain of sin and all evil. The body, therefore, is a prison, a coffin, or a grave for the soul which seeks to rise again to God. The highest maxim of Philo's ethics is therefore deliverance from the world of sense and the mortification of all the impulses of sense. In carrying out this thought, Philo differs from the Stoics. The Stoics cast man upon his own resources; Philo points him to the assistance of God, without whom man, a captive to sense, could never rise to true wisdom and virtue. Even in this life the truly wise and virtuous is lifted above his sensible existence, and enjoys in ecstasy the vision of God, his own consciousness sinking and disappearing in the Divine light. Beyond this ecstasy there lies but one further step, viz., entire liberation from the body of sense and the return of the soul to its original condition; it came from God and must rise to Him again. But natural death brings this consummation only to those who, while they lived on earth, kept themselves free from attachment to the things of sense; all others must at death pass into another body; transmigration of souls is in fact the necessary consequence of Philo's premises.

Works.—The titles of the numerous extant writings of Philo present at first sight a most confusing multiplicity. More than three-fourths of them, however, are really mere sections of a small number of larger works. Three such great works on the Pentateuch can be distinguished.

I. The smallest of these is the Ζητήματα καὶ λύσεις (*Quaestiones et solutiones*), a short exposition of Genesis and Exodus, in the form of question and answer. The work is cited under this title by Eusebius (*H.E.* iii. 18, 1, 5; *Praep. Ev.* vii. 13), and by later writers, but the Greek text is now almost wholly lost, and only about one-half preserved in an Armenian translation. Genesis seems to have occupied six books. Eusebius tells us that Exodus filled five books. In the Armenian translation, first published by the learned Mechitarist, J. Bapt. Aucher, in 1826, are preserved four books on Genesis and two on Exodus, but with lacunae. A Latin fragment, about half of the fourth book on Genesis (*Phil. Jud. CII. quaestt. . . . super Gen.*), was first printed at Paris in 1520. Of the Greek we have numerous but short fragments in various Florilegia. The interpretations in this work are partly literal and partly allegorical.

II. Philo's most important work is the Νόμων ἱερῶν ἀλληγορίαι (Euseb. *H.E.* ii. 18, 1; Phot. *Bibl.* Cod. 103), a vast and copious allegorical commentary on Genesis, dealing with chaps. ii.–iv., verse by verse, and with select passages in the later chapters. The readers in view are mainly Jews, for the form is modelled on the

rabbinic Midrash. The main idea is that the characters which appear in Genesis are properly allegories of states of the soul (τρόποι τῆς ψυχῆς). All persons and actions being interpreted in this sense, the work as a whole is a very extensive body of psychology and ethics. It begins with Gen. ii. 1, for the *De mundi opificio*, which treats of the creation according to Gen. i., ii., does not belong to this series of allegorical commentaries, but deals with the actual history of creation, and that under a quite different literary form. With this exception, however, the Νόμων ἀλληγορίαι includes all the treatises in the first volume of Mangey's edition.

III. A work of a very different kind is the group of writings which we may call "An Exposition of the Mosaic Law for Gentiles," which, in spite of their very various contents, present on nearer examination indubitable marks of close connection. In them Philo seeks to give an orderly view of the chief points of the Mosaic legislation in the Pentateuch, and to recommend it as valuable to Gentile readers. The method of exposition is somewhat more popular than in the allegorical commentaries, for, though that method of interpretation is not wholly excluded, the main object is to give such a view of the legislation as Philo accepted as historical. This work has three main divisions: (*a*) an Account of the creation (κοσμοποιΐα) which Moses put first to show that his legislation was conformed to the will of nature, and that therefore those who followed it were true cosmopolitans; (*b*) the Biographies of the Virtuous—being, so to speak, the living unwritten laws which, unlike written laws, present the general types of moral conduct; (*c*) Legislation Proper, in two subdivisions—(α) the ten principal chapters of the law, (β) the special laws belonging to each of these ten. An appendix adds a view of such laws as do not fall under the rubrics of the decalogue.

IV. Besides the above-named three great works on the Pentateuch, Philo was the author of a number of isolated writings, of which the following have reached us either in their entirety or in fragments. (1) Περὶ βίου Μωσέως (*Vita Mosis*, lib. i.–iii., M. ii. 80–179). (2) Περὶ τοῦ πάντα σπουδαῖον εἶναι ἐλεύθερον (*Quod omnis probus liber*, M. ii. 445–470). The genuineness of the writing now possessed by us is not undisputed: but *see* Lucius, *Der Essenismus* (1881), pp. 13–23. (3) Εἰς Φλάκκον (*Adversus Flaccum*, M. ii. 517–544) and (4) Περὶ ἀρετῶν καὶ πρεσβείας πρὸς Γάϊον (*De legatione ad Gaium*, M. ii. 545–600). These two works have a very intimate connection. In the first Philo relates how the Roman governor, Flaccus, in Alexandria, towards the beginning of the reign of Caligula, allowed the Alexandrian mob to persecute the Jews. In the second he relates the persecution under Caligula that divine honours should be everywhere accorded to him, and how the Jews of Alexandria in vain sought relief by a mission to Rome which was headed by Philo. These were parts of a larger work, in five books. (5) Περὶ προνοίας (*De providentia*). This work has reached us only in an Armenian translation, which has been edited, with a Latin translation, by Aucher (*see* below), 1822. It is mentioned by its Greek title in Eusebius (*H.E.* ii. 18, 6; *Praep. Ev.* vii. 20 fin., viii. 13 fin., ed. Gaisford). (6) Ἀλέξανδρος ἢ περὶ τοῦ λόγον ἔχειν τὰ ἄλογα ζῶα (*De Alexandro et quod propriam rationem muta animalia habeant;* so Jerome, *De Vir. Ill.* c. 11); the Greek title is given in Euseb. *H.E.* ii. 18, 6. This also now exists only in an Armenian translation, which has been edited by Aucher. Two small Greek fragments occur in the *Florilegium* of Leontius and Johannes (Mai, *Scr. vet. nov. coll.* vii. 1, pp. 99, 100a). (7) Ὑποθετικά, a writing now known to us only through fragments preserved in Euseb., *Praep. Ev.* viii. 6, 7. (8) Περὶ Ἰουδαίων, a title met with in Euseb. *H.E.* ii. 18, 6. The writing is no doubt the same as Ἡ ὑπὲρ Ἰουδαίων ἀπολογία, from which a quotation is given in Euseb. *Praep. Ev.* viii. 11. To this place also, perhaps, belongs the *De nobilitate* (M. ii. 437–444), which treats of that true noblesse of wisdom which the Jewish people does not lack.

V. *The doubtful treatises:* (1) Περὶ βίου θεωρητικοῦ ἢ ἱκετῶν ἀρετῶν (*De vita contemplativa*); the sole original account of an ascetic community known as the Therapeutae (*q.v.*) having their home on the shores of Lake Mareotis. (2) Περὶ ἀφθαρσίας κόσμου (*De incorruptibilitate mundi*), declared unauthentic by Z. Frankel and J. Bernays, has been defended by F. Cumont. (3) Περὶ κόσμου (*De mundo*). It is generally agreed that, in L. Cohn's words, this is "nothing but a compilation from various portions of the περὶ ἀφθαρσίας κόσμου and other Philonic works." (4) Two discourses, *De Sampsone* and *De Iona*, extant only in Armenian, are unauthentic. (5) Περὶ το πάντα σπουδαῖον εἶναι ἐλεύθερον (*Quod omnis probus liber sit*) may be an early work of Philo, which P. Wendland believes to be the case. (6) Περὶ προνοίας (*De providentia*), which we possess as a whole only in an Armenian version, consists of two books, the first of which appears to be in a Christian recension, but there is no reason for denying its Philonic origin.

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PHILOCTETES, son of Poeas king of the Malians of Mt. Oeta, a celebrated hero of the Trojan War. Homer merely states that he was distinguished for his prowess with the bow; that he was bitten by a snake on the journey to Troy and left behind in the island of Lemnos; and that he subsequently returned home in safety. In the post-Homeric accounts, Philoctetes or his father had been given the bow and arrows of Heracles (*see* HERCULES) as a reward for kindling the fire on Mt. Oeta, on which the hero immolated himself. Philoctetes remained at Lemnos till the tenth year of the war. An oracle having declared that Troy could not be taken without the arrows of Heracles, Odysseus and Diomedes (or Neoptolemus) were sent to fetch Philoctetes. On his arrival before Troy he was healed of his wound by Machaon, and slew Paris; shortly afterwards the city was taken. On his return to his own country, finding that a revolt had broken out against him, he again took ship and sailed for Italy, where he founded Petilia and Cremissa. He fell fighting on the side of a band of Rhodian colonists against some later immigrants from Pallene in Achaea. His tomb and sanctuary were shown at Macalla, on the coast of Bruttium.

See Homer, *Iliad*, ii. 718, *Odyssey*, iii. 190, viii. 219; Sophocles, *Philoctetes*, and Jebb's *Introduction;* Diod. Sic. iv. 38; Dio Chrysostom, 52, 59; Philostratus, *Heroica*, 6; Strabo vi. 254; Hyginus, *Fab.* 36, 102.

PHILODEMUS, Epicurean philosopher and poet, was born at Gadara in Coele-Syria early in the 1st century B.C., and settled in Rome in the time of Cicero. He was a friend of Calpurnius Piso, and was implicated in his profligacy by Cicero (*in Pisonem*, 29), who, however, praises him warmly for his philosophic views and for the *elegans lascivia* of his poems (*cf.* Horace, *Satires*, 1. 2. 120). The Greek anthology contains thirty-four of his epigrams. Thirty-six treatises attributed to Philodemus were recovered from a villa at Herculaneum.

The *Rhetoric* has been edited by Sudhaus (1892–95); the *De Ira* and the *De Pietate* by Gomperz (1864–65); the *De Musica* by Kempke (1884); *De Vitiis* by Ussing (1868); *De Morte* by Mekler (1886). See *Hercul. Volum.* (Oxford, 1824 and 1861); Mayor on Cicero's *De Natura deorum* (1871); Überweg, *Grundriss der Gesch. der Philosophie*, Bd. I. (1926).

PHILOLAUS (b. *c.* 480), Greek philosopher of the Pythagorean school, born at Tarentum or at Crotona (so Diog. Laërt. viii. 84), was probably a teacher of Democritus. After the death of Pythagoras great dissensions prevailed in the cities of lower Italy. According to some accounts, Philolaus, obliged to flee, took refuge first in Lucania and then at Thebes, where he had as pupils Simmias and Cebes, who subsequently, being still young men, were present at the death of Socrates. Before this Philolaus had returned to Italy, where he was the teacher of

Archytas. He entered deeply into the Pythagorean number theory, particularly dwelling on the properties inherent in the decad—the sum of the first four numbers, consequently the fourth triangular number, the *tetractys* (see *Vit. Pythag.* ap. *Phot. Bibl.* p. 712)—which he called great, all-powerful, and all-producing. The great Pythagorean oath was taken by the sacred *tetractys.* The discovery of the regular solids is attributed to Pythagoras by Eudemus, and Empedocles is stated to have been the first who maintained that there are four elements. Philolaus, connecting these ideas, held that the elementary nature of bodies depends on their form, and assigned the tetrahedron to fire, the octahedron to air, the icosahedron to water, and the cube to earth; the dodecahedron he assigned to a fifth element, aether, or, as some think, to the universe (*see* Plut. *de Pl. Ph.* ii. 6, *ἐκ δὲ τοῦ δωδεκαέδρου τὴν τοῦ παντὸς σφαῖραν* and Stob. *Ecl. Phys.* i. 10, *ὁ τᾶς σφαίρας ὁλκός*). This theory, however superficial from the standpoint of observation, indicates considerable knowledge of geometry and gave a great impulse to its study. Following Parmenides, Philolaus regarded the soul as a "mixture and harmony" of the bodily parts; he also assumed a substantial soul, whose existence in the body is an exile on account of sin.

Philolaus was the first to propound the doctrine of the motion of the earth; some attribute this doctrine to Pythagoras, but there is no evidence in support of their view. Philolaus supposed that the sphere of the fixed stars, the five planets, the sun, moon and earth, all moved round the central fire, which he called the hearth of the universe, the house of Zeus, and the mother of the gods (*see* Stob. *Ecl. Phys.* i. 488); but as these made up only nine revolving bodies he conceived, in accordance with his number theory, a tenth, which he called counter-earth, *ἀντίχθων*. He supposed the sun to be a disk of glass which reflects the light of the universe. He made the lunar month consist of 29½ days, the lunar year of 354, and the solar year of 365½ days. He was the first who published a book on the Pythagorean doctrines, a treatise used by Plato in the composition of his Timaeus and to which the mystical name Βάκχαι is sometimes given.

For fragments *see* Ritter and Preller, *Hist. Phil. Graecae* (1898) and H. Diels, *Die Fragmente der Vorsokratiker,* Bd. I. (4th ed., 1922). *See* also Boeckh, *Philolaus des Pythagoreers Lehren nebst den Bruchstücken seines Werkes* (1819); Schaarschmidt, *Die augenblicke Schriftstellerei des Philolaus* (1864); Chaignet, *Pythagore et la philosophie pythagoricienne, contenant les fragments de Philolaus et d'Architas* (1873); Th. Gomperz, *Greek Thinkers* (Eng. trans., 1901), i.; J. Burnet, *Early Greek Philosophy* (3rd ed., 1920); Überweg, *Grundriss der Gesch. der Philosophie,* Bd. I. (1926); also art. PYTHAGORAS.

PHILOLOGICAL ARTICLES. In addition to the general article PHILOLOGY and an outline of the ramifications of Comparative Philology, the subject of GRAMMAR is exhaustively treated. All the main languages of the world have articles of their own, *e.g.,* ARABIC LANGUAGE; CHINESE LANGUAGE; ENGLISH LANGUAGE; FRENCH LANGUAGE; GERMAN LANGUAGE; GREEK LANGUAGE, ANCIENT and GREEK LANGUAGE, MODERN; HEBREW LANGUAGE; ITALIAN LANGUAGE; JAPANESE LANGUAGE; LATIN LANGUAGE; MANCHU LANGUAGE; MONGOLIAN LANGUAGE; POLYNESIAN LANGUAGES; RUSSIAN LANGUAGE; SERBO-CROAT LANGUAGE; SPANISH LANGUAGE; TURKISH LANGUAGE. This is by no means an exhaustive list as many little-known languages are included, *e.g.,* BUSHMAN LANGUAGES. In the event of a language not receiving discussion under its own name it may be discovered under the name of the family to which it belongs, *e.g.,* INDO-EUROPEAN LANGUAGES; CELTIC LANGUAGES; TIBETO-BURMAN LANGUAGES; etc. There is an article on PHONETICS and another on PRONUNCIATION.

PHILOLOGY. The word philology is here taken as meaning the science of language, *i.e.,* the study of the structure and development of languages, thus corresponding to linguistics (Fr. *linguistique* and Ger. *Sprachwissenschaft*), but differing from philology, as it is generally understood on the Continent and sometimes in England where it means literary or classical scholarship; to the philologist in the latter sense language is one of the means to the comprehension of the whole culture of some nation, but not an object of study for its own sake, as it is to the philologist in the sense in which the word is here used. Though there has been, and still here and there may be, some antagonism between the two lines of study, they cannot properly be separated without an injurious onesidedness, as language is closely bound up with the development and expression of the whole cultural life of any nation or race.

Before A.D. 1800.—Though languages were studied in a scientific spirit for many centuries, it is not till the beginning of the 19th century that we see the rise of philology as it is now understood, with the chief stress laid on comparison of related languages and the historical development of their structures.

The Chinese had, centuries before our era, elaborate dictionaries of their own language. Similarly the Assyrians compiled lists of words and syllables with grammatical explanations. But they did not penetrate so deeply into the understanding and analysis of their own language as did the early Indians, whose grammatical investigations have had a far-reaching influence on European philology, especially in the 19th century. It was occupation with the sacred hymns and notably the *Rigveda* that gave the chief impulse to the study: each little detail was handed down with religious fidelity and was therefore carefully examined. We find in India painstaking investigations into phonetics with a minute description of each sound and its formation; further, precise accounts of the changes of sounds in the inflection and formation of words. What was studied was not only the rôle of sounds in isolated words, but also the modification which sounds underwent when words were pronounced in connected speech (*sandhi*). Each word was analysed into its elements: root, affixes to form stems, and inflectional endings, and statistics were given of the occurrence of each of these elements. In this way the earliest contributions were given to the building up of an etymological science. Among the Indian grammarians Pāṇini ranks first; his work has been called "the most complete grammar existing for any language, dead or living."

In Greece philosophers discussed the ultimate origin of language, some holding that words had come into existence by nature, others that they were due to convention. Incidentally they indulged in the wildest etymological guesses. Aristotle gives the first beginnings of a division into parts of speech, and this was further developed by the Stoics, to whom are due those names of the different cases which in their Latin translations are still in use with us. The Alexandrians are of importance through their scholarly treatment of the old classical literature. But the horizon was bounded: no "barbarous" tongue was thought worthy of study, and therefore no true insight into the essence of language could be gained. Roman grammarians did very little beyond imitating their Greek predecessors. Nor did the middle ages produce anything worthy of mention in this brief survey.

From the 16th century onwards we find a growing number of descriptions of single languages, but very little was done for a comparative investigation of languages, except perhaps for the Semitic family. The foolish superstition, however, that all languages descended from Hebrew as the language spoken in the garden of Eden, gave rise to many absurd etymologies. Leibniz was one of the first to entertain saner ideas with regard to the division of languages according to their relationship; like some of his contemporaries he was also interested in the idea of a universal language for scientific purposes. Among valuable works of the 18th century we shall here mention only the comprehensive, but uncritical collections of words and specimens from all the then known languages; the best of them are due to Pallas (1786, 1791) and to Hervas y Panduro (1784, 1800–05); these were superseded by Adelung's *Mithridates* (1806–17). D. Jenisch's *Philosophisch-kritische Vergleichung . . . von vierzehn Sprachen Europens* (1796) is a comparative appraisement of languages chiefly from an aesthetic point of view and thus totally different from what we now understand by comparative philology.

Rise of Comparative Philology.—The discovery of Sanskrit gave a mighty impulse to linguistic studies, though the work of the French Jesuit missionary Coerdoux (1767) with its comparison of Sanskrit with Latin was not printed till 40 years later. More importance was attached at the time to Sir William Jones's often quoted words (1796) in which he drew the conclusion from the grammatical structure of Sanskrit, Greek and Latin that they

had "sprung from some common source, which perhaps no longer exists." This paved the way for the recognition of the great Aryan or Indo-European family of languages, and in 1799 Gyármathi proved that Magyar (Hungarian) was related to Finnic and thus laid the foundation of Finno-Ugric philology.

In the beginning of the 19th century these sporadic hints were worked up in a more systematic way. The chief impulses came about the same time from three men of genius, the Dane, Rasmus Rask, and the two Germans, Franz Bopp and Jacob Grimm. Rask saw the importance of sound laws and formulated the Germanic consonant shift before Grimm; he classified not only Aryan, but also Finno-Ugric and Dravidian languages and gave an excellent exposition of the methodological principles of the new science Bopp started from Sanskrit, but successively submitted a greater and greater number of the Aryan languages to penetrating study and wrote the first comprehensive comparative grammar of all these languages—a work which exercised an enormous influence on linguistic studies all over Europe. Grimm was chiefly occupied with the Germanic group and brought out a very important grammar of all the languages of that group with the main stress laid on historic development. Bopp and Grimm had a great number of followers, chiefly in Germany—of the elder generation only one scholar can be mentioned here. Pott, whose etymological investigations cleared much new ground Chairs of comparative philology were founded in many universities, and periodicals were devoted to the science, the most important for a long time being Kuhn's *Zeitschrift für vergleichende Sprachforschung* The new points of view (comparative and historical) soon affected all branches of linguistics, and a number of special "philologies" came into existence with similar objects and methods, Romanic philology headed by Diez, Slavic by Schleicher and Miklosich, Keltic by Zeuss. For the classical languages Georg Curtius's researches were of very great importance

The chief leader in Aryan philology about 1860 was August Schleicher, whose *Compendium der vergleichenden Grammatik* (1st ed 1861) had far-reaching influence, especially through its insistence on regularity of sound-changes and through its bold attempts at reconstructing theoretical forms of primitive Aryan, which he took as the starting points for his explanations of forms actually existing But the system was too rigid and rectilinear to do justice to the complexity of linguistic life; the whole was vitiated by the dogmatic assumption that primitive Aryan had a very simple structure with only three vowels (*i, a, u*), and that the whole evolution had taken place in prehistoric times through three periods, a root-period, a period of agglutination, and finally one of inflection, while the historic period had witnessed only decay.

New Views.—A new era may be dated from about 1875, when a series of important discoveries profoundly modified the views of scholars about the primitive structure of our family of languages The way had to some extent been paved through the sober discussions of the nature of language in general found in the works of J N Madvig and W. D. Whitney; of still greater importance was the study of phonetics, which now came to be more generally recognized as the necessary basis of all linguistic investigation. The study of the complicated phonetic systems of living languages shattered the belief in the extreme simplicity of primitive Aryan The realization of the extremely important part played by analogy formations in the evolution of modern languages led to a wider application of the principle of analogy to the explanation of forms in the older stages. Thus a great many seemingly exceptional forms were explained in a natural way; and a new school of comparativists triumphantly proclaimed that phonetic laws admitted of no exceptions; sound laws and analogy sufficed between them to account for the historic development of forms.

The most important discovery of that period was the "palatal law," by which certain consonantal peculiarities were used to prove that Sanskrit in prehistoric times had had a vocalic system similar to that of Greek, with *e* and *o* in definite cases where Sanskrit as we know it has uniformly *a*. The belief in the absolute primitivity of Sanskrit, which had been a dogma in the first period, could thus be maintained no longer, and some features of European languages, which had been supposed to be later developments, were now seen to be remnants of the oldest accessible form of the Aryan languages. The theory of the vowel alternation found, for instance, in Greek λείπω, λέλοιπα, ἔλιπον and still surviving in English *drink, drank, drunk* (*ablaut*, gradation or apophony) was completely reversed, the grade *lip* being now considered a weakening of *leip*, instead of being taken as the original stage, of which *leip* was an expansion Karl Verner discovered the astonishing fact that differences in Germanic consonants, like that between German *t* in *Vater* and *d* in *Bruder*, found their explanation in primeval accent-conditions preserved in their oldest form in Sanskrit only, and that the difference between *s* in English *was* and *r* in *were* was connected with the fact that the singulars of perfect tenses in Sanskrit are stressed on the root, but plurals on the ending. All this opened new vistas and gave fresh impulses to Aryan philology. A codification of Aryan grammar according to the new views was given in Brugmann's *Grundriss der vergleichenden Grammatik der indogermanischen Sprachen* (2nd ed. 1897–1916), while the theoretical basis was worked out in H. Paul's *Prinzipien der Sprachgeschichte* (4th ed. 1909) and B Delbruck's *Einleitung in das Sprachstudium* (5th ed. 1908), Delbruck also wrote the first comprehensive Aryan syntax (*Vergleichende Syntax der indogermanischen Sprachen*, 1893–1900).

Aryan Languages.—For several decades there had been no doubt as to what languages were Aryan, and the relation to it even of Albanian and Armenian had now been settled. But the 20th century has brought the discovery of new languages belonging at any rate peripherically to the Aryan family, namely Tokharian (really two different languages) and one of the Hittite languages. These present several features not paralleled in the other Aryan languages and not yet sufficiently cleared up in spite of the keen interest and labours of several scholars. Attempts have also been made to demonstrate a more remote affinity between the Aryan and two other great families of languages. that with the Finno-Ugric family seems highly probable.

A most interesting attempt has recently been made to prove a primitive relationship between Aryan and Sumerian (C. Autran, *Sumérien et Indo-Européen*, Paris, 1925). Some of the similarities adduced are very striking, but there are so many difficulties in the grammatical structure of the two languages that the kinship must at present be considered an open question.

Outside the Aryan languages much excellent work has been done, especially since the methods developed in Aryan philology have penetrated into the other domains. In many of them historical research is made impossible by the fact that we have only recent texts and descriptions; but sometimes the co-existence of several related languages permit us to some extent to draw conclusions backwards to a state in which the now separate languages formed one whole. thus with regard to primitive Bantu ("Ur-Bantu"). Some languages found in old inscriptions have baffled all attempts at comprehension, among them Etruscan.

Language and Racial Psychology.—While most of those who have dealt with the general problems of the nature of language and its development have started, as was natural, from the European languages and the great family of languages to which they belong, there have been other scholars whose endeavours have been especially directed towards the understanding of the psychology of language and who have therefore to a great extent gone outside the languages spoken by civilized nations to ascertain relations between the language of a race and its culture and mental characteristics. A pioneer in that direction was Wilhelm v. Humboldt, whose great work on the Kawi language was prefaced by a profound investigation into the differences in structure of the various human languages and their influence on the mental development of man (1836–40). His chief disciple was H Steinthal, who in numerous works treated of the relation between language, logic and psychology. His best work, *Charakteristik der hauptsächlichsten Typen des Sprachbaues* (1860), was completely remodelled in 1893 by F Misteli and in this shape is still a most useful survey of the grammatical structure of

some of the most outstanding languages with psychological interpretation. Excellent work was done in the same direction by H. C. von der Gabelentz and his son Georg, both of them possessing wide linguistic knowledge and psychological acumen. A small, but very valuable work is F. N. Finck, *Die Haupttypen des Sprachbaus* (Leipzig, 1910), with its analysis of eight select linguistic structures on the basis of one text from each language.

In 1900 the well-known German philosopher W. Wundt, employing the whole apparatus of modern psychologists and part of that of linguists, made an attempt to present a consistent comprehensive survey of linguistic phenomena (*Völkerpsychologie, I. Die Sprache*), but his views met with little acceptance on the part either of philologists (Delbrück, Sütterlin) or of philosophers (Marty). A recent school in Germany, headed by K. Vossler, tries to connect grammar with the state of civilization in general and of literature in particular, interpreting linguistic developments and grammatical peculiarities in terms of national psychology.

The psychological aspect and the emotional importance of language in general has been studied recently with great ardour. Among those who have lately contributed to this side of philology are: F. Mauthner, A. Marty, Ch. Bally, E. Cassirer, J. van Ginneken and H. Delacroix.

Language and History.—Linguistic research has very often been invoked to assist in settling historical questions. Important results have been arrived at through investigation of place-names (*q.v.*). The history of a nation's culture can be illustrated through a study of successive strata of loan-words. (*See* LANGUAGE.) The question of the Scandinavian origin of the Russian empire has been definitely settled through the names in the oldest sources. It is now possible to speak of linguistic archaeology as a separate branch of science, *see* especially such important works as V. Hehn, *Kulturpflanzen und Haustiere* (6th ed., Berlin, 1894); O. Schrader, *Sprachvergleichung und Urgeschichte* (3rd ed., Jena, 1906); O. Schrader, *Reallexikon der indogermanischen Altertumskunde* (2nd ed. 1917); J. Hoops, *Waldbäume und Kulturpflanzen im germanischen Altertum* (Strasbourg, 1905); S. Feist, *Kultur, Ausbreitung und Herkunft der Indogermanen* (1913).

Languages of the World.—A survey of all the known languages of the inhabited earth with short grammatical sketches and brief specimens was given in Friedrich Müller's *Grundriss der Sprachwissenschaft* (4 vols., Wien, 1876–88). The attempt has never been renewed on so extensive a scale. F. N. Finck, *Die Sprachstämme des Erdkreises* (Leipzig, 1909), gives a bare enumeration of the names of languages, but the great work *Les Langues du Monde* by A. Meillet et Marcel Cohen (Paris, 1924) does not content itself with this, but gives valuable discussions on many problems connected with the present state of linguistic science with regard to some, at least, of the linguistic groups. An extremely bold attempt at proving relationship between all existing languages and thus establishing the monogenesis of human language is found in various works by A. Trombetti, most elaborately in *Elementi di Glottologia* (Bologna, 1923); most philologists prefer not to commit themselves either to this theory or definitely to the opposite theory of polygenesis, but to leave the question open as impossible of solution at present. An equally bold attempt is made in the recent book by Father W. Schmidt, *Die Sprachfamilien und Sprachenkreise der Erde* (Heidelberg, 1926): he tries to group all known languages genetically and then to show intimate connection between a series of phenomena—phonetic traits, such as the distinction between voiced and voiceless consonants, initial and final sounds and sound-groups, morphological peculiarities (number, exclusive and inclusive pronouns, gender, numeral systems), syntactical features (place of genitive and adjective)—on the one hand and on the other hand ancient centres and migrations of cultural phenomena: totemism, agriculture, matriarchy, etc.

BIBLIOGRAPHY.—History of Philology: O. Jespersen, *Language*, Book I. (1922); W. Streitberg, *Die Erforschung der indogermanischen Sprachen* (only two volumes of a planned great work have appeared, dealing with Greek, Latin, Keltic, Slavic and Albanian, 1916–17); *Stand und Aufgaben der Sprachwissenschaft, Festschrift für W. Streitberg* (1924); H. Pedersen, *Sprogvidenskaben i det 19. Aarhundrede* (1924); V. Thomsen, *Geschichte der Sprachwissenschaft* (1927).

For general bibliography *see* the two works mentioned above, *Les Langues du Monde*, and W. Schmidt, *Die Sprachfamilien. See* also under LANGUAGE and GRAMMAR. (O. J.)

PHILO OF BYZANTIUM, Greek writer on mechanics, flourished during the latter half of the 2nd century B.C. (according to some, a century earlier). He was the author of a large work (Μηχανική σύνταξις), of which considerable portions remain.

See ed. by R. Schöne (1893), and W. Schmidt *De Ingeniis Spiritualibus* (Latin tr. of Arabic version of a lost original, 1899).

PHILO OF LARISSA, Greek philosopher of the first half of the 1st century B.C. During the Mithridatic wars he left Athens and took up his residence in Rome. He was a pupil of Clitomachus, whom he succeeded as head of the Third or New Academy. According to Sextus Empiricus, he was the founder of the Fourth Academy, but other writers refuse to admit the separate existence of more than three academies (*see* ACADEMY, GREEK). In Rome he lectured on rhetoric and philosophy, and collected many eminent pupils, amongst whom Cicero was the most famous.

See Grysar, *Die Akademiker Philo und Antiochus* (1849); Hermann, *De Philone Larissaeo* (Göttingen, 1851 and 1855); and Überweg, *Grundriss der Gesch. der Philosophie*, Bd. I. (1926).

PHILOPATRIS, the title of a dialogue formerly attributed to Lucian, but now generally admitted to be spurious. The scene is laid at Constantinople. A certain Triephon, who has been converted to Christianity by a bald, long-nosed Galilaean, who was carried up through the air into the third heaven (an evident allusion to St. Paul), meets a friend, Critias, who is in a state of great excitement. Triephon inquires the reason, and the invocation of Zeus by Critias leads to a discussion on paganism and Christianity, in which all the gods proposed by Critias are rejected by Triephon, who finally suggests that Critias should swear by the Trinity. Critias goes on to relate how he had been introduced to a gathering of pessimists, who predicted all kinds of disturbances in the empire and defeat at the hands of its enemies. The *Philopatris* was for a long time regarded as an attack upon Christianity, and assigned to the time of Julian the Apostate (emperor 361–363). Chronological indications led Niebuhr to ascribe it to the reign of Nicephorus Phocas (963–969), a view now generally supported.

BIBLIOGRAPHY.—Editions by J. M. Gesner (1715) and C. B. Hase in the Bonn *Corpus scriptorum hist. byz.* (1828), vol. xi.; also included in Jacobitz's edition of Lucian (1839). *See* B. G. Niebuhr, "Ueber das Alter des Dialogs Philopatris" in his *Kleine historische Schriften*, vol ii. (1843); R. Crampe, *Philopatris. Ein heidnisches Konventikel des siebenten Jahrhunderts zu Constantinopel* (1894); C. Stach, who shows its late origin by linguistic tests, *De Philopatride* (Cracow 1894); S. Reinach, *Revue archéologique*, vol. i. (1902); and, for further authorities, article by Von Dobschütz in Herzog-Hauck *Realencyklopädie für protestantische Theologie* (1904).

PHILOPOEMEN (253–184 B.C.), Greek general, was born at Megalopolis, and educated by the academic philosophers Ecdemus and Demophanes or Megalophanes. In 233–2 Philopoemen skilfully evacuated Megalopolis before the attack of Cleomenes III., and distinguished himself at Sellasia (222). The next eleven years he spent as a condottiere in Crete. Elected commander of the League's cavalry on his return, he reorganized that force and defeated the Aetolians on the Elean frontier (210). Appointed to the chief command two years later, he introduced heavy armour and close formation for the infantry, and with a well-trained army beat Machanidas of Sparta, near Mantinea. The new "liberator" was now so famous that Philip V. of Macedon attempted to poison him. In 202–1 Philopoemen drove Nabis, the Spartan tyrant, from Messene and routed him off Tegea. After another long sojourn in Crete he again received the command against Nabis. Though unsuccessful at sea, he almost annihilated Nabis's land force near Gythium, but was prevented by the Roman Flamininus from taking Sparta. In 190 Philopoemen protected Sparta, which meanwhile had joined the League and thereupon seceded, but punished a renewed defection so cruelly as to draw the censure of Rome. At Messene he likewise checked a revolt (189), but when that city again rebelled, in 184, he was captured in a skirmish and promptly executed. Philopoemen's great merit lies in his having restored

that military efficiency without which the Achaean League (*q.v.*) could never stand.

Polybius' *Histories* (x.–xxiii.) are our chief authority. These and a special treatise on Philopoemen (now lost) were used by Plutarch (*Philopoemen*), Pausanias, (viii. 49–51), Livy (xxxi.–xxxviii.), and indirectly by Justin (xxx.–xxxiv.).

PHILOPONUS, JOANNES (JOHN THE GRAMMARIAN), Greek philosopher of Alexandria, lived in the later part of the 5th and the beginning of the 6th century of our era. The surname *Grammaticus* he assumed in virtue of his lectures on language and literature; that of *Philoponus* owing to the large number of treatises he composed. He was a pupil of Ammonius Hermiae, and is supposed to have written the life of Aristotle sometimes attributed to his master. To Philoponus are attributed a large number of works on theology and philosophy. It is said that he was at first a Christian.

The more certain writings of Philoponus consist of commentaries on Aristotle. These include works on the *Physica*, the *Prior* and the *Posterior Analytics*, the *Meteorologica*, the *De anima*, the *De generatione animalium*, the *De generatione et interitu* and the *Metaphysica*. He wrote an attack on Proclus and probably two treatises on mathematics *A Commentary on the Mathematics of Nicomachus*, edited by Hoche (1864 and 1867), and a *Treatise on the Use of the Astrolabe*, published by Hase, the most ancient work on this instrument.

PHILOSOPHICAL ARTICLES. The most important philosophical articles contained in this Encyclopædia may be enumerated in three groups, namely (1) the key articles dealing either with the whole field or with one of the main divisions of philosophy; (2) articles devoted to particular philosophical schools or tendencies in the history of philosophy; and (3) articles dealing with special philosophical problems or topics. In addition to the articles here enumerated there are some 300 shorter articles dealing with various philosophical subjects, and about 400 articles of varying lengths devoted to individual philosophers:—

(1) **Key Articles.**—PHILOSOPHY, HISTORY OF; METAPHYSICS; KNOWLEDGE, THEORY OF; LOGIC; LOGIC, HISTORY OF; LOGISTIC; ETHICS; ETHICS, HISTORY OF; COMPARATIVE ETHICS; SOCIAL PHILOSOPHY; PSYCHOLOGY; PSYCHOLOGY, HISTORY OF; AESTHETICS; VALUE, THEORY OF.

(2) **Articles on Philosophical Schools and Tendencies.**—ACADEMY, GREEK; ARABIAN PHILOSOPHY; CAMBRIDGE PLATONISTS; CARTESIANISM; COMMON SENSE PHILOSOPHY; CYNICS; CYRENAICS; DUALISM; ECLECTICISM; EGOISM; ELEATIC SCHOOL; EMPIRICISM; HEDONISM; HOLISM; IDEALISM; INDIAN PHILOSOPHY; IONIAN SCHOOL OF PHILOSOPHY; JEWISH PHILOSOPHY; MATERIALISM; MEGARIAN SCHOOL; MONISM; NEO-HEGELIANISM; NEO-KANTIANISM; NEO-PLATONISM; NEO-PYTHAGOREANISM; PANTHEISM; PERIPATETICS; PESSIMISM; PHENOMENALISM; PLURALISM; PRAGMATISM; RATIONALISM; REALISM; SCEPTICISM; SCHOLASTICISM; SOPHISTS; SPIRITUALISM; STOICS; TRANSCENDENTALISM; UTILITARIANISM.

(3) **Articles on Special Problems.**—ABSOLUTE; ACCIDENT; ANALOGY; BELIEF; BODY AND MIND; CASUISTRY; CATEGORY; CAUSALITY; DURATION; EMERGENCE; EXPLANATION; FORM; FREEWILL; IMMANENCE; INDUCTION; INFINITE; INNATE IDEAS; INTUITION; LOGOS; METEMPSYCHOSIS; NATURE; PERSONALITY; PROBABILITY; QUALITIES: *Primary, Secondary and Tertiary;* RELATIVITY: PHILOSOPHICAL CONSEQUENCES; SUBCONSCIOUS; SCIENTIFIC METHOD; SPACE AND TIME; SUBSTANCE; THOUGHTS, LAWS OF; TRUTH.

(*See* also PSYCHOLOGICAL ARTICLES, and Articles on RELIGION and THEOLOGY.)

PHILOSOPHY, HISTORY OF. An adequate account of the history of philosophy would have to include not only the history of ethics, logic, psychology, metaphysics, etc., but also an account of the early history of science. For obvious reasons such a thing cannot be attempted here. Moreover, the histories of ethics, logic, and psychology have separate articles devoted to them, and the articles on aesthetics and theory of knowledge also contain the essentials of their history. As there are also separate articles dealing with the chief schools of philosophy and with the leading philosophers, the present article will only attempt to be a general guide to the study of the history of philosophy.

ANCIENT PHILOSOPHY

To all intents and purposes ancient philosophy is essentially Greek philosophy. This is not to deny the reality and value of Eastern philosophy. It is significant that even Greek philosophy commenced in the Eastern colonies, in Ionia, in Asia Minor, and that it was Ionian philosophers who introduced philosophy into other parts of Greece. It is also significant that Greek traditions refer to the influence of Egyptian teachers upon Thales, Pythagoras, Democritus, Plato and other Greek thinkers. Moreover, India, China and Persia, as well as Egypt, are known to have developed more or less independent world-views of their own. Students of oriental thought can trace therein counterparts of all, or nearly all, the main tendencies of Western philosophy—Monism and Dualism, Materialism and Idealism, Atheism and Pantheism, Pragmatism and what not. One may even point to certain direct oriental influences on Western philosophy in the case of Neo-Platonism in ancient times, in the case of Arabian or Moorish influences in the middle ages, and in the acknowledged influence of Buddhism on so modern a philosopher as Schopenhauer. But, it remains true that Western philosophy from Thales onwards is sufficiently self-contained to warrant separate treatment. And when the ground to be covered is enormous and difficult, it is a great convenience to be able to deal with the main stream of philosophy by itself. But there are separate articles dealing with Brahmanism, Buddhism, Indian philosophy, Arabian philosophy, Jewish philosophy, etc., for those readers who wish to go farther afield.

EARLY GREEK PHILOSOPHY

Ionian Philosophers.—A group of Ionian thinkers first raised the question as to the nature of the substance of which all things are composed, from which they originate, and into which they are dissolved again. Moreover they raised and answered this question in a non-mythological, impersonal manner. They considered *what*, not *who*, had produced all these things. Their answers were always in terms which we may be tempted to describe as *material*. But that would not be quite correct, because as yet no hard and fast line was drawn between the mental and the material. The ultimate matter of which they thought was a living matter—they were consequently not materialists but hylozoists. The Ionian group consisted of the following Milesians:

Thales (?640–550 B.C.) regarded water or moisture as the primary stuff or principle of things. In the then state of knowledge many physical phenomena must have appeared to bear out this view. For water is found in the form of gaseous vapour and of solids as well as in liquid form. In the phenomena of rising vapour and of sunbeams people saw the sun and other fiery bodies "drawing water" for their sustenance, so that water seemed capable of changing into fire. In the earth's absorption of rain, in the formation of deltas, in the alluvial deposits left by torrents, water appeared to be changed into earth. In the formation of dew and in the rising earth mists, earth seemed to change into moisture. And moisture was, of course, realized to be necessary for all living things. In these various phenomena Thales probably thought that he observed examples of the whole cosmic process from water and back into water.

Anaximander (?610–545 B.C.) was impressed by the conflicting character of such natural qualities as hot and cold, dry and wet, etc., and could not believe that water could generate things with qualities opposed to its own. He held that primary matter must be something different from any of the known determinate kinds of matter which have resulted from it. He accordingly identified primary matter with the "unlimited," by which he probably meant something indeterminate, out of which the determinate things, earth, water, air and fire, differentiated or "separated out." These four kinds, according to Anaximander, arranged themselves in successive layers with earth at the centre, followed by rings of water, air and fire in turn. The sun, moon and stars he regarded as masses of fire, flung off by the world's outer ring of fire, surrounded partly by husks or envelopes of air similarly flung off by the cosmic ring of air. Eclipses, he explained as due to temporary obstructions in the apertures of the air husks of the sun

and moon. Our world, which is only one of many, is cylindrical in form, and swings free in space.

Anaximenes (?590–525 B.C.) identified primary matter with air, because it has the greatest mobility and is indispensable to life. He was the first to attempt to explain the process by which primary matter gives rise to the vast variety of things. The processes he suggested are condensation and rarefaction. By condensation air is changed into water or earth; by rarefaction it is changed into fire. (*See* IONIAN SCHOOL OF PHILOSOPHY.)

Pythagoreanism.—The early Ionian or Milesian school of philosophy was brought to an abrupt end by the Persian conquest of Ionia. This calamity was followed by a revival of Orphic and similar mystery religions which influenced some of the philosophers, and so led to the foundation of the Pythagorean school.

Pythagoras (?570–500 B.C.) was a kind of philosophical revivalist. Influenced by the reawakening of religious interest among his contemporaries, Pythagoras endeavoured to combine religion with philosophy, and founded at Kroton (in southern Italy) a kind of religious brotherhood with a philosophic bias—something between a cloister and a college, in fact, the prototype probably of the mediaeval universities of Europe. In the history of thought the most noteworthy feature of the teaching of Pythagoras and his school is to be found in the stress laid on "form" rather than "matter," as the ultimate principle of things. The study of music taught Pythagoras that the concordance of a succession of notes depends on certain proportions between the lengths of the strings on which they are produced He was greatly impressed by this discovery of the importance of proportion And the discovery was applied in all sorts of directions. For example, one proportion of the elementary qualities of the body (hot and cold, dry and wet) constitutes health; another disease. It was also used as the key to the riddle of the universe. Numerical proportion thus came to be treated as the "principle" of things, in the same kind of way as the earlier philosophers had treated water, fire, etc., as primary matter. The Pythagorean view was expressed in the dictum that "all things are numbers." In order to understand this seemingly odd dictum, it is necessary to realize first of all how numbers were thought of at that time, and how easily numbers were then confused with geometrical figures. Numbers used to be represented by means of dots arranged in geometrical patterns, as they still are on cards and dominoes, *e.g.;* and numbers were described as triangular, or square, or oblong according to the geometrical arrangement of the dots representing them. Next, it will be observed that this custom rather encouraged the identification of the unit of number with the dot or point. And since lines can be analysed into the points, and planes into the lines, and solids into the planes that bound them, it could easily appear that it is the points that make the lines, that make the planes, that make the solids. And once the point was identified with the unit of number, it could be easily supposed that all things are constructed out of numbers. The Pythagorean doctrine is of importance chiefly because its idea of proportions or configurations was responsible partly for Plato's doctrine of "Ideas" and Aristotle's theory of "Forms." (*See* PYTHAGORAS.)

The Eleatic School, like the Pythagorean school, was founded in southern Italy by an Ionian refugee. Its centre was in Elea. Unlike the founder of Pythagoreanism the founder of the Eleatic school seems to have been nettled rather than carried away by the religious revival of the time, especially by the superstition which accompanied it. But the importance of the school lies in its metaphysics—it has, indeed, been described as the first really metaphysical school.

Xenophanes of Colophon (?570–480 B.C.), the founder of the Eleatic school, is chiefly noteworthy for his very scathing attack on the Homeric, Hesiodic and similar anthropomorphic conceptions of the gods. "Mortals," he remarked, "believe that the gods come into being as they themselves do, that they have senses, voice, body. . . . But if oxen or lions had hands, oxen would make gods like oxen, horses would make gods like horses." He himself believed in one God, altogether different from man. "There is one supreme God . . . like to mortals neither in body nor in thought." In fact, Xenophanes was a pantheist, as seems clear from his reported utterance: "The All is One, and the One is God." At all events this conception of the unity of Being or of ultimate reality, became the leading tenet of his school.

Parmenides of Elea (?540–480 B.C.) was the most important member of the Eleatic group. He is reported to have considered things "from the standpoint of the notion," that is, presumably, from the standpoint of their being intelligible or thinkable. The chief doctrines ascribed to him are expressed in the statements: "only Being is"; "birthless it is and deathless . . . for ever it stands a continuous One"; "all is full of being . . . no defect is there in it." Apparently he considered it unthinkable that anything should come into being out of nothing or pass into nothing. So he regarded reality as eternal—uncreated and imperishable. There is no empty space, "all is full of being," and so there is no possibility of motion. Reality was apparently a finite, spherical, motionless, continuous plenum, and change, movement and the very existence of ordinary discrete things illusory.

Zeno (?490–420 B.C.) supplied the best known arguments in support of Eleatic monism. His famous paradoxes were intended to show the absurdities involved in the position of pluralism, that is the view that reality is not one but a multiplicity, a many In opposition to the Pythagorean conception of reality as a multiplicity of spatial units, he argued that if so even a line must consist of an infinite number of points, and if each point has no magnitude then any thing must be infinitely small, but if the point has magnitude then each thing is infinitely great.

Melissus (?440 B.C) modified the teaching of Parmenides to the extent of regarding reality as infinite His contention was that if the real were finite it could only be bounded by empty space. Hence Parmenides' rejection of empty space really committed him to the view that reality is infinite Similarly, he regarded the non-existence of empty space as a reason for the impossibility of the existence of a multiplicity of discrete things. Being is one and immutable and can only be apprehended by thought. (*See* ELEATIC SCHOOL)

The arguments of Zeno and Melissus were largely directed against the views of Heraclitus, Anaxagoras and Empedocles.

Heraclitus (?540–475 B.C) held that fire is the primal matter The naturalistic trend of thought is very marked in Heraclitus, as is evident from the following fragment. "This one order of all things was created by none of the gods, nor yet by any of mankind, but it ever was, and is, and shall be—eternal fire—ignited by measure and extinguished by measure." Matter as conceived by Heraclitus is always changing and always moving, though its movements often elude our observation.

The world "begins" as a mass of fire, some changing partly into water. The water changes partly into earth and partly into vapour. The vapour returns to fire. The earth changes back to water, and from water to vapour and thence to fire again. And then the cycle of changes begins all over again, each complete stage being marked by a mass of fire at the beginning and at its end. The greatest service rendered by Heraclitus consists in his insistence on what may be called universal law—all changes begin "by measure." As regularity was naturally regarded as a sign of intelligence, Heraclitus posited the existence of "universal reason" side by side with primal matter, or as part of it, and regarded it as the one thing that is permanent in the ceaseless flux of changes. Another idea for which Heraclitus is noteworthy is that of the struggle for existence, which he conceived to characterize all things, and to be good for them.

Anaxagoras (?500–428 B.C) held that originally there was not one kind of primal matter but a multiplicity of all sorts of parts or "seeds" of things. These were all mixed up in chaotic confusion. But they were sorted out and arranged in an orderly manner by the "intelligence" or "reason" which pervades the universe. This reason is omniscient and omnipotent, but was still conceived by Anaxagoras in a semi-material fashion. This doctrine of the multiplicity of "seeds," through new combinations of which new things come into being, and by the separation of which they cease to be, paved the way for the atomic theory. The conception of "mind" or "reason" as introducing order into things was subsequently adapted by Aristotle. Most important, per-

haps, is the fact that Anaxagoras went to Athens about 462 B.C. and so helped to transplant Ionian philosophy to the city of Pericles.

Empedocles of Agrigentum (?483–430 B.C.) regarded reality as eternal, but not as one. It is composed of a multiplicity of elements or "roots." Of such "roots" there are four kinds, namely, earth, water, air and fire. These four kinds of elements combine to form the various things there are, and which cease to be when the component elements separate again. In order to account for the combination and separation, Empedocles postulated two entities or principles, namely, attraction and repulsion, or "love" and "hate." And as a physiologist he compared the relation of these two entities to the "roots" with the relation of air and blood to the living body. His quaint biological speculations are noteworthy for their implicit assumption of the conception of the "survival of the fittest."

The Atomists.—The pluralist opposition to the Eleatic conception of reality as a static, immutable One, culminated in the atomic theory This was first formulated by Leucippus (?500–430 B.C.), who first insisted on the reality of empty space, which used to be regarded as "non-being" But the atomic theory is chiefly associated with the name of his disciple, Democritus, who is commonly described as "the father of physics."

Democritus (?460–370 B C) is the most important Greek exponent of the atomic theory and the mechanistic method of explanation which is intimately associated with it. According to Democritus atoms and space are the only ultimate realities The atoms were conceived by him to be of various sizes and shapes. And all the main differences in composite bodies were reduced to differences in the (*a*) size and shape, (*b*) position, and (*c*) arrangement of the atoms composing them. The atoms may thus be described as the alphabet of the universe, and Aristotle actually illustrates these distinctions of Democritus by means of letters of the alphabet Using Roman instead of Greek letters, the above distinctions may be illustrated as follows. (*a*) The letters A and M are different in size and in shape; (*b*) the letters M and W are different in respect of position; (*c*) The syllables AM and MA are different in respect of arrangement The last distinction (*c*) is clearly reminiscent of the "Figure" or "Form" of the Pythagoreans. It is especially worth noting that the Atomists held that the atoms are naturally endowed with motion, and so avoided the problem, which perplexed all subsequent ages until the time of Newton, as to how passive matter was set in motion. The natural mobility of atoms seemed to require a void or empty space for them to move in. Hence the recognition by the Atomists of the existence of space Now the atoms flitting about in all directions collide, some of them get hooked together and combine in various ways owing to their various shapes; then the larger constellations of them enclose other atoms or smaller clusters of them, and so all sorts of things are produced, including whole systems or worlds Under certain conditions the various clusters break up again into separate atoms The systematic attempt to explain everything in terms of matter and motion necessitated then, as subsequently, the denial of the ultimate reality of the so-called secondary qualities—colour, sound, taste, smell, etc So the atomists dismissed them as mere "conventions," that is, as the effects of human intervention, or as merely subjective or illusory appearances. (*See* DEMOCRITUS)

THE GOLDEN AGE OF GREEK PHILOSOPHY

The Sophists.—After their victory over the Persians, the Greeks experienced something similar to the change of general outlook that was brought about by the great World War 24 centuries later. The desire for the good things of life spread among wider circles of people. And there was an increased desire for knowledge, at once as a good thing in itself, as a social and political aid, and possibly as a means to a new orientation after the shock to traditional beliefs and habits which is generally caused by a great upheaval like a war. The general demand for knowledge naturally produced a supply of popular teachers. And so the Sophists came into being These "wise men," or teachers of wisdom, rendered valuable services to the cause of general education. They not only helped to create a wider interest in philosophical and other problems but by their criticisms compelled greater thinkers to probe more deeply into the questions raised. Except among reactionaries, who, then, as always, showed hostility to the enlightenment of the people, the Sophists enjoyed a good repute among their contemporaries; it was only long afterwards that the term Sophist became derogatory. The most famous of the Sophists were Protagoras, Georgias, Hippias, and Prodicus. As teachers of the art of debate it was their business to show how to make the best of even a weak case In order to make a public display of their own skill in the art of defence it would have been futile merely to defend generally accepted views—anybody might do that. They could give much better proof of their skill by defending lost causes, paradoxes, views that seemed strange or even absurd at first—they had to "make the worse case appear the stronger," as Aristophanes complained The effect of all this was sure to be demoralizing upon some of the young Athenians And their criticism of existing social and political institutions was no doubt distasteful to some of the propertied and influential people. Hence their unpopularity with some In the history of philosophy their importance consists mainly in the interest which they aroused in ethical problems and in problems of knowledge The most important doctrine associated with their name is that enunciated by Protagoras in the dictum. "Man is the measure of all things." By this he meant that there is no such thing as universally valid knowledge Different people have different views, and for each person that is true which he, honestly and to the best of his ability, believes to be true Similarly with moral goodness In a world of merely relative standards, some of the Sophists maintained, it was no good pursuing truth, better to adapt oneself to the practical needs of life in the environment in which he finds himself. (*See* SOPHISTS)

Socrates (469–399 B C) was counted by his contemporaries among the Sophists For he, too, was interested in educating young people by means of discussions (though he taught without pay), he also was interested in problems of human conduct rather than in problems about the ultimate nature of reality; and he also did not see absolute truth in the opinions commonly entertained But, unlike the Sophists, he did believe in the possibility of knowledge, provided it were pursued in the right way And the way which he proposed is that known subsequently as the Socratic Method (*q v*) This method consisted essentially in checking one's ideas by constant reference to relevant instances until they are transformed into universally valid concepts or ideas. In essence it is an inductive method proceeding by elimination, though Socrates applied it to a sphere of problems in which the relevant data could be obtained by merely cross-examining people Ideas checked and corrected in this way so as to agree with the relevant facts are true, and altogether above the merely fluctuating opinions of men based on bare sense-perception, or tradition, or hearsay So convinced was Socrates of the possibility of real knowledge, and so impressed with its importance, that he based all else upon it, identifying moral good, or virtue, with knowledge By thus identifying virtue with knowledge, he may have thought that he also cured morality of the mere relativity which the Sophists had found in it Yet he was condemned as a corrupter of the young, and died as the first known martyr in the cause of philosophy (*See* SOCRATES)

The Successors of Socrates.—As Socrates had never given formal instruction and, moreover, left no writings behind him, it was easy and natural for different people to have different impressions of his teaching.

Aristippus and the Cyrenaics laid stress on the cheerfulness of Socrates and his capacity for reasonable enjoyment when an opportunity presented itself. They taught accordingly, a hedonistic ethic, with pleasure as the highest good (*See* CYRENAICS.)

Antisthenes and the Cynics on the other hand, were impressed chiefly with Socrates' indifference to hardships of every kind, his readiness to go without things when necessary. They accordingly preached the simple life, and *Diogenes* carried it so far as to reduce it almost to the life of a dog. (*See* CYNICS)

Euclid and the Megarians were interested mainly in Socrates'

conception of the nature of real knowledge, namely, that it consists of properly formed concepts, as distinguished from mere opinions based on mere observation. Accordingly, they adopted a rather sceptical attitude towards sense-perception and sense-objects, and developed, in connection with this sceptical propaganda, a form of disputation or eristic which became notorious for its excessive subtlety. But by far the most important of the informal disciples of Socrates was Plato, who, to some extent, shared the views of the Megarians. (*See* MEGARIAN SCHOOL.)

Plato (427–360 B.C.) first studied philosophy under a follower of Heraclitus. At the age of 20 he came under the influence of Socrates and remained in close touch with him until his death in 399. Plato then travelled for a while in southern Italy where he came into contact with the Pythagoreans. All these influences may be discerned in his philosophy, which they helped to shape. When in 387 Plato opened a school (the Academy) in Athens, the Pythagorean spirit betrayed its presence in the inscription: "Let no one who knows no Geometry come under my roof."

Plato's philosophy is one of epistemological and ontological idealism. The way in which he arrived at it may be briefly indicated as follows: He agreed with Heraclitus that all objects of sense-perception are in ceaseless flux, undergoing incalculable changes. No universal truth can therefore be asserted about this "ever-rolling stream." On the other hand, Plato also agreed with Socrates that real knowledge is possible, but only in the form of concepts or universal truths. So he concluded that the objects of real knowledge are not the ever-changing things of the sensible world, but supra-sensible objects which are immutable and eternal. These supra-sensible, eternal, immutable objects he called "Ideas" or "Forms." The world of change is not, indeed, a mere illusion. But it consists of things that have only a lower degree of reality, things that are but poor imitations of the corresponding "Ideas" after which they are named. Plato thus distinguished two principal types of object and two principal types of cognition corresponding to them. Real knowledge (or science, or the higher kind of cognition) has "Ideas" for its objects. Sense-perception is but "opinion," a lower kind of cognition, which has the world of change for its objects. Or, again, knowledge is concerned with the world of (eternal) Being; "opinion" is concerned with the world of mere "becoming" and passing away.

It is possible that what Plato really meant by his "Ideas" was the "laws" of things and events; that when he described the ordinary things of the sensible world as "copies" of the "Ideas" he simply meant that they conform more or less to those laws; and that the "copies" are poor in the sense that their conformity to law is only approximate, not exact. However this may be, Plato's conception of the world is that of a real *system*. But it is a teleological system, not a merely mechanical system. He gives expression to this conception by identifying the essence of the universe with "the Good." The conception was probably the result of Socratic influence. Socrates had identified the real character, or essence, of a thing with what it is good for. He had made enemies by his insistence that rulers and generals, etc., are not merely people who catch enough votes to be elected to office, but people who really know the business of a ruler, or of a general, etc., who really are "good for" the end in view. By extending this conception to all things, Plato conceived all things as adapted to various ends, these ends as subordinated or adapted to higher ends, and so on to a final end, "the Good," which is the purpose or ultimate end of the universe as a whole. (*See* ACADEMY, GREEK; ETHICS, HISTORY OF; KNOWLEDGE, THEORY OF; PSYCHOLOGY, HISTORY OF.)

Philosophy is an attitude of mind as well as a system of ideas. As an inspirer of the philosophic attitude Plato has never been surpassed, and but rarely equalled, if at all. Philosophy needs both the ideas and the attitude. Great philosophic ideas, indeed, are impossible without the philosophic attitude. But there is a kind of enthusiastic attitude that seems to be possible without ideas. And the teaching of philosophy has often suffered from it.

Aristotle. (384–322 B.C.) is in some ways the most important thinker in the history of ancient philosophy. It was he who gave to philosophy the articulation which it has retained more or less ever since. His writings (even in the incomplete and imperfect form in which they have been transmitted to us) contain contributions, and very important contributions, to all the main departments of philosophy, of most of which he may be regarded as the founder. And besides being the great architect of the whole structure of philosophy, and the most comprehensive or versatile of all philosophers, he also gathers up practically all that was best in ancient philosophy.

For 20 years Aristotle studied in Plato's Academy (367–347), and his own philosophy, though different in many ways from that of Plato, contains important Platonic elements. Undoubtedly Aristotle was more realistic, more empirical than Plato; and that will account for most of the other differences between them. But even that primary difference must not be exaggerated.

The general tendency of Plato's philosophy was to divide the universe into two parts, the relation between which he did not make clear. On the one hand, there was the world of becoming, of change, of sense, enjoying an inferior sort of reality; on the other hand, the world of being, the world of ideas, eternal and supremely real, and only remotely "copied" by the inferior world of change. Such, at all events, was Aristotle's interpretation of Plato, and he did not agree with such a disruption of the cosmos. While agreeing with Socrates and with Plato on the importance of ideas in the sense of concepts, if there is to be real knowledge, he felt that Plato's conception of "Ideas," and their aloofness from the particular objects of sense-perception, offered no explanation at all, for the relation of "copying" was a mere metaphor. Yet the primary business of "ideas" is to explain the world of experience, not merely to constitute an additional world.

The fundamental ontological conceptions in the philosophy of Aristotle are those of *Matter* and *Form*. The term *Form* is essentially equivalent to Plato's "Idea," which was itself an offspring of the Pythagorean "Form." The early Ionians were only concerned with the problem of primary *matter;* Pythagoras had been so preoccupied with "Form" that he almost forgot matter, or regarded "Form" as the primal matter or stuff of all things; Plato had removed the "Forms" or "Ideas" from the material world into a heaven of their own; Aristotle endeavoured to get a right conception of both matter and form, and of the relation between them. The conclusion at which he arrived was that form is immanent in matter, the ideal is immanent in the material, the universal is immanent in the particular; they are not generally divorced from each other, they are distinguishable but not separable. To understand Aristotle's view it is well to remember that he was the greatest biologist of antiquity, perhaps of all times. Plato was a geometrician, and that before the invention of co-ordinate geometry. His preoccupation was with ideal geometrical figures, eternal and static. His "Ideas" were conceived by his mind after the pattern of these eternal and static figures. Aristotle was a biologist preoccupied with the phenomena of growth and development, the transition from the potential to the actual, from the seed to the embryo, and from the embryo to the fully developed form of animal.

Aristotle, accordingly, was not perplexed by phenomena of change, and did not consider process incompatible with reality. And so he distinguished in all things matter from form, the relatively raw stuff from the relatively finished product. He applied the distinction all round, not to material things only. The distinction naturally cannot be quite the same in all cases, and it is relative in more senses than one. The "form" of a statue is a "shape" as distinguished from the marble which constitutes its "matter"; the "form" of a human character is a certain "organisation" of the instincts and impulses which constitute the raw material before they have been "licked into shape"; the "form" of a plant, an animal, a man consists of a certain "function"—nutrition, sensibility, and reason respectively—which distinguishes it from what is below it in the scale of existence; and so on. Again, nothing is entirely without "form." Even the block of marble has some shape before it becomes a statue; impulses and instincts have some sort of co-ordination at every stage in the process of character formation; and the things which in virtue of their several highest functions are plants, or animals, or men would still be something even in the absence of those functions, only

they would be different; that is, they would have different forms.

In the last resort, even the crudest kind of matter, the so-called four elements (earth, water, air, fire), recognized by Greek philosophers since the time of Empedocles (?483–430), were not regarded by Aristotle as pure formless matter, but as primal matter which had assumed different "forms" in consequence of the different combinations of their ultimate qualities (hot, cold, dry, moist). Pure, formless matter was simply a limiting conception. The whole state of any thing still capable of further development was regarded as "matter" in relation to the process, or function, etc., which would complete it, and which was called its "form"; yet within that so-called "matter" one would as naturally distinguish a "form" or something which distinguished it from a still less developed state or condition (actual or imaginary). In most cases, however, this series of relative distinctions has its limits. A material object, *e.g.*, cannot have less "form" than the four elements have. But there is usually also a limit to the highest "form" which certain kinds of matter can assume. A block of marble may become a statue or an image of some kind; it cannot become a plant, or an animal, etc. An acorn may become a sapling, and this sapling may grow into an oak, but it cannot grow into anything else. Still, though Aristotle believed in the fixity of species, he could compare the great and wonderful variety of things, and arrange them imaginatively in a kind of ascending series or "scale of nature."

Such a scale beginning with the lowest types of matter, with their suggestion of mere "formless" matter as an imaginary limiting case, and ascending through the various forms of life the "matter" of which becomes richer and richer in "forms" (when regarded from below) naturally suggested an upper limiting case; namely, some being who has realized the highest perfection or completeness, who cannot therefore be regarded as "matter" for further development, but only as "form." This highest being Aristotle identified with God. Like Plato's "Good," Aristotle's God was an "Idea" in Plato's sense (the only Platonic idea that Aristotle accepted), and the "end" or final cause of the universe. Aristotle conceived of all things as being somehow drawn towards God, and as going through the various processes of change and motion in consequence of this attraction. In this way, he conceived, God may, by His mere presence, cause all the changes and movements of things without Himself either moving or changing—He is the Unmoved Mover of the universe. For Aristotle, however, God is not the Creator of the universe. For the universe is eternal. Matter is eternal; and all the Forms are eternal, because there is no break in the succession of each Form's individual embodiments in matter. The effect of God's presence in the universe is that as the object of the world's desire He induces the already existing "matter" to develop its potentialities by assuming higher "forms." (*See* ARISTOTLE; LOGIC, HISTORY OF; ETHICS, HISTORY OF; KNOWLEDGE, THEORY OF; PSYCHOLOGY, HISTORY OF.)

ANCIENT PHILOSOPHY AFTER ARISTOTLE

Greek philosophy continued to flourish more or less for several centuries after the death of Aristotle. But its character was changed in some important respects. Plato and Aristotle attached supreme value to theoretical reflection as such. This is evident from their conception of God, for whom they could conceive no higher activity than thought. But Greek conditions in the latter part of the 4th century B.C. were not favourable to such disinterested thought. After the battle of Chaeronea, in 338 B.C., the Greeks lost their independence, and the Macedonian ascendancy, even if it was not an unmixed evil, created too many practical problems to leave much scope for abstract speculations. People who turned to philosophy did so mainly in search of some kind of moral or religious tonic. Hence the subordination of theoretical to ethical discussions in post-Aristotelian philosophy. The most important of the Greek schools of philosophy after Aristotle were the Epicureans, the Stoics and the Sceptics. They were all interested mainly in the moral problems of human life, and their history belongs chiefly to the history of ethics.

Epicurus (?341–271 B.C.) *and the Epicureans* put no intrinsic value on knowledge. Its value, according to them, consists entirely in its usefulness for practical purposes. The study of nature is useful mainly because it emancipates us from groundless fears and superstitions. The study of human nature also has some value as an aid to self-control. But most other studies they despised as learned lumber. Under the circumstances, they were not likely to make any valuable contributions to metaphysical theory. Yet we owe them something. As a reaction against the idealism and teleology of Plato and Aristotle, the Epicureans embraced the atomic theory of Democritus with its mechanistic explanations of all things. Even the soul was regarded as corporeal, "composed of fine particles dispersed all over the body, most nearly resembling wind with an admixture of heat"; for, says Epicurus, "it is impossible to conceive anything incorporeal except empty space"; "hence those who call soul incorporeal talk foolishly." In the 2nd century B.C. Epicureanism obtained a foothold in Rome, and there produced its most famous exponent in *Lucretius* (95–51 B.C.), whose poem, *On the Nature of Things,* contains the classic account of ancient atomism. In ethics they developed the hedonism of the Cyrenaics. While regarding pleasure as the only good, they distinguished different kinds, as well as degrees of pleasure, valuing mental pleasures, especially those resulting from the practice of virtue, above all others. (*See* EPICURUS; HEDONISM; ETHICS, HISTORY OF.)

Zeno (?336–264 B.C.) *and the Stoics* also attached no intrinsic importance to knowledge. They valued it only as an aid to virtue and judged truths pragmatically. Just as the Epicureans adopted the atomist philosophy instead of evolving a philosophy of their own, so the Stoics adopted, with modifications, the philosophy of Aristotle, which they changed into a pantheistic view. Substituting the concepts "body" and "soul" for the Aristotelian "matter" and "form," they conceived the universe as an organic whole, having both body (or matter) and soul (or force, or reason). All things are but parts of the one organic universe, which pursues a rational course and directs the development of all its parts. So completely rational and in conformity with universal law was the "One and All" conceived to be that no room was left for arbitrariness or caprice. It is at once God and Nature, Providence and Destiny. A hymn composed by the Stoic *Cleanthes* (?331–233 B.C.) is one of the most famous expressions of pantheism in the history of literature. With such a conception of nature the Stoics naturally identified virtuous conduct with life according to nature, and this it could only be by being in harmony with the universal reason pervading nature. Rational self-control was set up as the only good, because it makes one independent of external circumstances, free and contented. As with Epicureans so with the Stoics, one of their most celebrated members was a Roman—the Emperor *Marcus Aurelius* (121–180 A.D.). (*See* STOICS; ETHICS, HISTORY OF; LOGIC, HISTORY OF; PANTHEISM.)

Pyrrho (?360–270 B.C.) *and the Sceptics* were much more interested in philosophic theory than were the Epicureans or the Stoics. They paid special attention to epistemology. But the conclusions they arrived at were not flattering to human knowledge so-called. Pyrrho was of opinion that things are too incalculable and unaccountable to warrant any conviction whatever, so that the right attitude of mind is one of sceptical neutrality. Such an attitude has its advantages, for it is conducive to peace of mind. Most troubles, he held, are disappointments resulting from rash judgments and anticipations. Those who renounce all claims to knowledge might attain to the same equanimity which the Epicureans and Stoics sought to attain with the aid of knowledge. The most important of the Sceptics was *Carneades* (213–129 B.C.). He carried on a systematic campaign against the dogmatic assumptions of his predecessors and contemporaries, attacking more especially the tendency of the Stoics and others to identify cosmic regularity with a cosmic reason, the widespread habit of ascribing human attributes to God, the entirely insufficient evidence on the strength of which God's existence was believed in, and the habit of ignoring the existence of unmerited evil in order to exonerate God from all responsibility for it. Even Hume (1711–1776) and other modern sceptics did little more than adapt the arguments of Carneades. (*See* SCEPTICISM.)

Ethically, the three schools, Epicureans, Stoics and Sceptics,

were really very similar. They all regarded peace of mind as the highest good attainable, and they all emphasized the need of emancipating oneself from the bondage of external circumstances.

Philo (?25 B.C.–A.D. 50) *and the Neo-Platonists.* One result of Macedonian ascendancy has already been pointed out in explanation of the predominance of ethics in post-Aristotelian philosophy. Another effect it had was that it tended to break down national barriers. The different nationalities under Macedonian sway were thrown together, and Greek thinkers were brought into touch with the East. The cosmopolitanism of the Stoics was probably influenced by this. But Neo-Platonism is a more obvious result of the contact between East and West. Alexandria was the great intellectual centre where East and West met together. The East needed more philosophy, the West more religion, and Neo-Platonism was an attempt to make the best of both. The philosophy which had a very marked religious side was that of Plato. The new movement, accordingly, was first regarded as a form of Platonism. Eventually, however, it was re-named Neo-Platonism. Of the early Neo-Platonists the best known is *Philo Judaeus* of Alexandria. He was the head of a group of cultured Jews who tried to harmonize Hebrew religion with Greek philosophy. By interpreting the Bible allegorically, Philo sought to read Platonism into Hebraism and Hebraism into Platonism. But Neo-Platonism owes its success mainly to *Plotinus* (A.D. 204–270) and *Proclus* (410–485). This school also may claim a distinguished Roman as one of its adherents; namely, the Emperor *Julian the Apostate* (reigned 361–363).

According to Plotinus, the ultimate source of all things is God, of whom it is impossible to predicate anything, because He is logically prior to anything that can be predicated. Now, God, acting on a creative impulse, created a Spirit (νοῦς) somewhat like Himself. This Spirit, acting on a like impulse, created another, namely the World-Soul. This created other souls, and so on until the series of productions in accordance with the law of diminishing spiritual returns ends in that extremely low kind of souls called matter. The process of creation is usually conceived as a kind of emanation, analogous to the sun's emission of light; sometimes, however, creation seems to be reduced to a logical or quasi-logical relationship. The World-Soul (the creation of the first Spirit created directly by God) is conceived as a group or system of spirits very like the Platonic "Ideas," at once thoughts and objects, but perfect and immutable. As the creations or emanations are held to be immanent in the creators, the Neo-Platonist universe in really one spiritual system, all the parts of which are spiritual though in varying degrees. The human soul has fallen from a higher grade of spirituality, and can only regain this by a training in asceticism and mysticism and after a series of successive births. The Neo-Platonism of Plotinus, with its system of graded spiritual emanations from God, was readily adapted to the then prevalent Polytheism and belief in spirits and spectres of all sorts. Greek paganism thus received a new lease of life under Julian the Apostate. Plotinus also criticized the Christian exaggeration of man's place in the universe and of the importance of prayer without work. (*See* NEO-PLATONISM; PHILO; PLOTINUS; PROCLUS.)

Cicero (106–43 B.C.) *and the Eclectics.* Philosophers who neither construct a system of their own nor embrace an existing system as a whole, but adopt and combine parts belonging to different systems, are called eclectics or syncretists. The term Eclecticism is sometimes applied with great latitude so as to include even such comparatively harmonious systems as Neo-Platonism, but is more usually restricted to the less systematic and more loose jointed philosophies. In 146 B.C. Greece became a Roman province, and Rome developed philosophic ambitions without ever succeeding in constructing an independent philosophic system. It was probably in keeping with the essentially practical mentality of the Romans to refrain from speculation beyond a certain point, and to trust their common sense instead of following theoretical adventure "whithersoever it may lead." The most famous eclectics of antiquity were Cicero and Seneca (A.D. 5–65). Both showed marked leanings towards the epistemology of the Sceptics of the New Academy and the ethics of the Stoics. Cicero also leaned somewhat towards Stoic pantheism, and Seneca has impressed many people as remarkably Christian for a pagan. Of course, there were eclectics outside Rome. Perhaps the best known of them was the Greek, *Plutarch* (A.D. 50–120). (*See* CICERO; SENECA; PLUTARCH.)

The End of Ancient Philosophy.—In A.D. 529 the Emperor *Justinian* closed the school of philosophy and so brought to an end the first main period in the history of philosophy. During the dark ages, which followed, the writings of the eclectics, and especially those of Cicero, did much to keep alive a knowledge of ancient philosophy and an interest in philosophical problems.

MEDIAEVAL PHILOSOPHY

Greek philosophy had started as a rational reaction against the mythologies of popular religion, and in Athens at least three Greek philosophers (Anaxagoras, Socrates and Aristotle) suffered persecution, one of them even death, on account of their alleged hostility to popular religion. In the middle ages the tables are turned. Popular religion has the upper hand, and philosophy becomes the handmaid of theology. There is no independent mediaeval philosophy. It is not original but borrowed from the past; and it is not free, but subordinate to authority—the authority of books or of an organized Church. This is true more or less not only of Christianity, which played the leading rôle in the middle ages, but also of Judaism and of Islam. When philosophy was not simply denounced and ignored, it was exploited in the interests of the Christian, Jewish or Mohammedan epic, not to say mythology. Some would go so far as to refuse the name philosophy to thought so restricted. But it is impracticable to draw a hard and fast line. On the one hand, even Greek philosophy was, perhaps, never entirely purged of elements of mythology. On the other hand, even mediaeval thinkers, by a subtle use of allegorical interpretation, managed to fit Scripture to their philosophy instead of modifying their philosophy to fit Scripture, and so gained a measure of freedom of thought.

PATRISTIC PHILOSOPHY

Mediaeval philosophers were for the most part Christian theologians, and a detailed history of their views belongs to the history of Christian dogma rather than to the history of philosophy. Here our business is only with the limited philosophical aspect of that complex and interesting story. Christianity did not set out to be a philosophy, but a moral and religious stimulus. Its interest was in the lowly rather than in the "high-brow." It was suspicious of philosophy and uttered a warning against it. "Take heed lest there shall be any one that maketh spoil of you through his philosophy" (Col. ii., 8). And at least one Apostolic Father (Tertullian) not only did not mind it if his faith was unphilosophical, but was almost proud of it—*credo quia absurdum.* In course of time, however, it was found necessary to make use of philosophy partly in order to repel the attacks of hostile philosophers, partly in order to spread the gospel among philosophically-minded heathens, and partly in order to satisfy the needs or tastes of Christians with a turn for philosophy. Early in the 2nd century already Alexandrian Christians, like Alexandrian Jews, resorted to allegorical Neo-Platonist interpretations, as is clear from the "Logos" doctrine in the so-called *Gospel of St. John.* Some of the "Gnostics" even tried to combine loyalty to Jesus with loyalty to Pythagoras, Plato and Aristotle. For some time, however, the chief use made of philosophy was for purposes of defence (apologetics). This was the case with the Church Fathers, notably *Justin Martyr* (d. 167), *Tertullian* (150–220), *Clemens of Alexandria* (d. 215), *Origen* (185–254), and, above all, *Augustine* (354–430).

The Patristic period, as it is called, is characterized by its Platonic or Neo-Platonist tendency, for which the influence of Augustine secured a certain predominance in Christian thought for a long time afterwards. Augustine had been a sceptic, among other things, before he became a saint, so he felt it necessary to refute scepticism before attempting a constructive philosophy. His method was that adopted later by *Descartes.* There are many things, he said, that are dubious. But there is one thing that is indubitable even in the state of doubt, namely, the actual

experience of doubting. And one could not doubt unless he was alive and thinking, and aware that there is such a thing as truth. So we are certain of something. But how? Not by external perception but by inner intuition. Augustine next proceeds, like Plato, to distinguish two types of reality—an "intelligible world" (of "ideas" or "forms") which is apprehended by intuition, and a "sensible world" (of mere "copies" or "imitations" of the "ideas") which is apprehended in sense-perception. Intuition affords real "knowledge"; sense-perception, mere opinion. Eternal truths (like those of mathematics, for example) are objective and transcendental. They are emanations or radiations from God. The human soul may apprehend them, but does not create them. God, then, is the source of the eternal truths. He creates things by thinking them; and He has created the world out of nothing. But things were not all made by Him directly. God only created matter and endowed it with the seeds of further development. With such changes time came into being; but God is beyond time —He is eternal. Temporal things only endure so long as God maintains them by continuous creation. Man is a miraculous union of an "intelligible" and a "sensible" substance. The soul, as the possessor of eternal truths, is immortal.

Patristic philosophy attained its climax in Augustine, and little else of the thought of that period, and for several centuries afterwards, is of sufficient philosophical interest to be worth mention in a mere outline of the history of philosophy. As a whole Christendom relapsed into intellectual darkness, and did not open its eyes again until several centuries afterwards.

ARABIAN AND JEWISH PHILOSOPHY

Arabian and Muslim Philosophy.—When the Athenian schools of philosophy were closed in 529 many of the teachers migrated to Syria and Persia and stimulated philosophical interest in the Muslim world. This interest was intensified when in 641 the Arabs captured Alexandria, which was then the greatest seat of learning, with a long and honourable tradition behind it. By 711 the Muslims had swept through Arabia, Syria and Mesopotamia, and even along the African coast of the Mediterranean as far as the straits of Gibraltar, and went into Spain. (The "Moors" of Spain were Arabs from Mauretania, that is, North Africa.) In this way philosophy was kept alive in Islam and in due course brought back to Christendom. The most important Muslim philosophers were Al Kindi (d. 870), Alfarabi (d. 950) and Avicenna, or Ibn Sina (980–1037) of Baghdad, and Averroes (1126–1198) of Cordova, in Spain. They were familiar with nearly all the works of Aristotle, and with several of Plato's treatises. Their philosophy was Aristotelian in the main, but blended with Platonism. The most interesting feature in Avicenna is his discussion of the problem which subsequently became one of the most burning questions among the Christian Scholastics, namely, the problem of the relation of the universal to the particulars of which it is predicated—the bone of contention between the so-called Nominalists and Realists of Scholasticism. And his solution was this. Universals existed in the thought of God already before the corresponding particulars came into existence; but they were then embodied in the particulars; and are derived by the human mind from these by a process of abstraction.

Averroes was the most Aristotelian of all the Muslim philosophers, and the most important. According to Averroes, there is a sub-lunar world of imperfection and change, and another, higher, eternal world beyond the stars. Matter is eternal, and contains from the first certain seminal "forms" which develop it from the merely potential to the actual, or final, state, under the influence of the higher "forms," or "intelligences," or in the last resort, of God. The human soul is inseparable from the body, or rather the brain, and perishes with it; but the "reason" that dwells in man is immortal, and by cultivating it man may enter into union with the universal "active reason." (*See* ARABIAN PHILOSOPHY.)

Jewish Philosophy.—Already in pre-Christian times there existed among the Jews a kind of philosophical mysticism which resembled Neo-Platonism in some respects. It is possible that Philo, the Jewish founder of Neo-Platonism, came under its influence at one time. This mystical doctrine is known as the *Kabbalah* (Hebrew for "traditional lore"). But it is difficult to trace its history with accuracy, as its two principal documents—the *Yepher Yetzirah* ("Book of Creation") and the *Zohar* ("Book of Splendour")—are compilations which are not much earlier than 900 and 1300 respectively. Side by side with this movement, however, there grew up, a more genuine philosophy under the influence of Plato and Aristotle. This movement had two interesting periods, namely, the Alexandrian period, about the beginning of the Christian era, in which Philo and various other Egyptian Jews flourished, and the Spanish period, from about the 10th till the 14th century, when many Jews vied with the Moors in the cultivation of Platonic and Aristotelian philosophy.

The favourable conditions under which Jews lived, during these centuries, throughout the Muslim world encouraged their participations in the interest which Islam then took in philosophy. In Baghdad and in Cairo, in Cordova and Toledo, they kept abreast of their Muslim neighbours. Numerous as were the Mohammedan schools and sects produced by the study of Greek philosophy, almost every one of them was reflected in contemporary Jewish thought. Traditionalism and anti-traditionalism, rationalism and dogmatism, fatalism and voluntarism, Platonism and Aristotelianism—all these and other tendencies had their Jewish counterparts, and almost every Muslim philosopher of repute had his Jewish double. This does not argue imitation but a similar susceptibility to similar influences. During the 10th and 11th centuries Platonism and Aristotelianism were about equal in favour. The chief Jewish thinkers of this period were Israeli (between 850 and 950), the author of a treatise *On the Elements;* Seadiah (892–942), author of *Faith and Philosophy;* and Bachyah Ibn Pakuda (?1000–1050), who wrote a *Guide to the Duties of the Heart.* To this period belongs also the Jewish Neo-Platonist and poet Ibn Gabirol (?1020–1070), whose *Fons Vitae* ("Fountain of Life") was probably the first book to re-introduce Greek philosophy into the West after the close of the dark ages. During the 12th century, Aristotelianism gained in influence, and enjoyed almost undisputed supremacy during the 13th and 14th centuries. The most important Jewish thinkers of this period were Maimonides (1135–1204), author of the *Guide of the Perplexed;* Gersonides (1288–1344) author of *The Wars of the Lord;* and Crescas (1340–1410), author of *The Light of the Lord.*

These Jewish philosophers served the interests of subsequent philosophy in two principal ways. They helped to make the works of Plato and Aristotle accessible to the Scholastics by helping to get them translated from the Arabic versions into Latin, frequently through the medium of Hebrew. (The transmission was thus very roundabout, as the Arabic versions were in their turn usually based on Syriac translations made by the Nestorians from the Greek originals.) But some of them also exercised a more direct influence on the Scholastics. Avicebron's *Fons Vitae* (the Jewish origin of which was not suspected for many centuries) had no small share in moulding the thought of Duns Scotus, among others. And Maimonides exercised an equally strong influence on others, among them the two most important Scholastics, Albertus Magnus and Thomas Aquinas. Maimonides and Crescas also influenced Spinoza in some ways, and both are referred to by him. (*See* JEWISH PHILOSOPHY.)

SCHOLASTICISM

In the meantime various tendencies were preparing the way for a re-awakening of Christian interest in philosophy. The schools founded throughout France by Charles the Great, in the 8th century, were sufficiently developed in the 9th and 10th centuries to take up some philosophic problems, a faint interest in which had been just kept alive by various mystics and Neo-Platonists. The teachers who taught the so-called seven liberal arts at these schools were known as *doctores scholastici.* (The seven liberal arts were grammar, logic, rhetoric, arithmetic, geometry, astronomy and music.) But the name was applied later to all who taught philosophy and theology, especially at the new universities of Paris, Bologna, Salerno, Oxford and Cambridge, which were all founded during the 11th and 12th centuries.

The chief aim of the Scholastics was to reconcile Christian theology with philosophy. The first prominent Scholastic was John Scotus Erigena (810–877). He insisted on the harmony of Christian dogma with reason, as God is the author of both. Under the influence of a kind of Neo-Platonic mysticism he teaches the idealistic doctrine that things only exist in so far as they are known, that the universal ideas by which they are said to be known are the only ultimate realities and produce the so-called things.

This kind of view about the reality of ideas, now usually called "idealism," was known as "realism" in the middle ages. (Later on "realism" meant, and still usually means, the view that material things are also real, which extreme idealism denied.) In course of time the problem of the reality of universals became a burning question among the Scholastics. It was usually raised in connection with Porphyry's discussion of Aristotle's predicables, but that was a matter of chance; it would probably have arisen in any case in connection with the study of the differences between Platonism and Aristotelianism. Until late in the 11th century, under the predominant influence of Platonism or Neo-Platonism, "realism" was the usual view Roscelinus (?1050–1121) was the first "nominalist," that is to say, he denied the independent reality of universals, and regarded general terms as mere names. For a long period, however, he had no following. Anselm of Canterbury (1033–1109) was a pronounced realist. He also formulated the characteristic view of Scholasticism that faith must precede knowledge—*credo ut intelligam*.

An innovator was Abelard (1079–1142), famous for his association with Heloise. His view of universals was rather like that of Avicenna. He held that universals are embodied in the individual things The "forms" or "ideas," however, are conceived by God from all eternity. The human mind only gets to know them by abstraction from particulars. So universals exist *ante res, in rebus*, and *post res*. Abelard is noteworthy for his defence of doubt. He claimed a certain value for it inasmuch as doubt leads to enquiry, and enquiry leads to truth. In his ethical treatise *Scito te ipsum* ("Know thyself"—the first separate ethical treatise in the middle ages) Abelard shows himself comparatively tolerant towards pagans, Jews and philosophers or freethinkers.

The Crusades (1097–1290) brought Christendom into contact with Eastern learning and so helped to promote a fuller knowledge of Platonism and Aristotelianism, especially the latter, as expounded by Arabian and Jewish philosophers This tendency made a good beginning when in 1085 Toledo fell into the hands of the Christians who thus came into possession of numerous philosophical manuscripts. And the movement reached its climax when in the course of the 13th century Aristotelian manuscripts in the original Greek found their way gradually from Constantinople to the new centres of European learning. Aristotelianism, rejected by the Church in the early part of the 13th century, grew rapidly in favour, especially in the Dominican order, which produced the two greatest Aristotelian Scholastics, namely, Albertus Magnus (1193–1280) and Thomas Aquinas (1225–1274), Albertus wrote voluminous expositions of Aristotelianism with the help of Arabian and Jewish commentators, especially Avicenna and Maimonides. In the realm of natural knowledge he respected the authority of Aristotle as much as he trusted Augustine in the sphere of Christian faith In fact, it was he who first distinguished sharply between *natural* and *theological* knowledge—a distinction of no little importance in the history of Scholasticism, and even later.

Aristotelian Scholasticism culminated in Thomas Aquinas. He also emphasized the distinction between natural and theological knowledge, between the light of reason (*lumen naturale*) and the light of revelation, and even admitted, in principle, the autonomy of the former. In practice, however, he subordinated natural to theological knowledge in the sense of making the former aid to the latter. Philosophy is thus treated as the handmaid of theology, and nature as the mere forerunner of grace, though grace is alleged to crown nature, not to reject it. The distinction, though difficult or impossible to maintain, turned out to be helpful inasmuch as it rendered possible a certain amount of independent thinking in the realm of nature, so long as no reference was made to the concepts of historical Christianity (which constituted the realm of grace). Like Aristotle Aquinas laid great stress on the distinction between matter and form, though he is rather liberal in his conception of the numerous "forms" capable of existing apart from matter. The human soul, though associated with a body, is also capable of separate existence. It is the lowest of the "separate forms," of which there is a scale ascending through all kinds and degrees of angels and spirits (including those which guide the stars and their courses) and culminating in the "absolute form," namely, God. By assuming that God had conferred a measure of autonomy upon nature, Aquinas further facilitated to some extent the possibility of an autonomous philosophy or science. His conception of the character of human knowledge also tended in the same direction Instead of regarding it (as Augustine had done) as a direct divine illumination, Aquinas conceived it to be produced by images which external objects deposit, so to say, in the soul. Empirical studies thus received some recognition. On the question of universals the view of Aquinas was that one "form" is embodied in all the material objects of the same class, and that their matter is responsible for their particularity and multiplicity In the case of Angels, etc., that is, immaterial forms, there is no such multiplicity of replicas, so to say—each form is unique Our knowledge of material objects *qua* particulars comes through our senses, but their "form" is apprehended by the intellect.

The Aristotelianism of the Dominicans was opposed by the rival Franciscan order, the principal representative of which was Duns Scotus (1217–1293). He strongly opposed the intellectualism of Aquinas and repudiated the endeavour to harmonize faith with knowledge, theology with philosophy, and rather emphasized their antagonism. What is true in philosophy may be quite false in theology, which leaves no room for philosophical dialectics. Whereas Aquinas regarded knowledge as primary, and will as dependent on knowledge, Duns Scotus claims primacy for the will, which he treats as the fundamental faculty of the soul. Imagination and conception are entirely subordinate to the will, with which the decision always rests, and which is free from all possibility of coercion. The good is above the true And the good is good because God has declared it such (Aquinas maintained that God ordained certain things because they are good) Things are what they are because God has arbitrarily made them so. And the duty of man is to will to obey God's commands On the question of universals Duns Scotus upheld the same kind of realism as did Anselm, Avicenna and Aquinas The doctrine of the primacy of the will was adopted later by Descartes.

The teaching of Duns Scotus concerning the irreconcilable antagonism between philosophy and theology, and concerning the arbitrary character of divine creations and decrees was carried even to greater extremes by William of Occam (d 1347). He maintained that philosophy is utterly incapable of proving the existence of God, or demonstrating His attributes. From this bankruptcy of the natural light of reason he infers the necessity of revelation. He carries his conception of the good, as the arbitrary decree of God, so far as to maintain that a so-called evil deed is not evil if it is done in the service of God In opposition to the moderate "realism" of the Dominicans, Occam revived the nominalism of Roscelinus and maintained that universals are merely subjective conceptions, all real things being individual or particular. To posit real universals in addition to the corresponding particular objects is an uncalled for duplication It was in this connection that he formulated the familiar principle, commonly known as "Occam's Razor," *entia praeter necessitatem non sunt multiplicanda*—the number of entities should not be increased unnecessarily. After Occam, Scholasticism rapidly declined in influence. In one form or another it continued, of course, and continues to this day. It has even enjoyed various revivals. But its power was broken by the onward march of that great combination of forces called the Renaissance or Revival of Learning. (*See* SCHOLASTICISM; KNOWLEDGE, THEORY OF.)

MODERN PHILOSOPHY

Transition.—Subordination to authority was the chief characteristic of mediaeval thought. It took many generations and diverse influences to break the power of ecclesiastical authority, and to secure autonomy for philosophy. No doubt authority was a guide as well as a task-master, a support as well as a rod, during the adolescence of mediaeval thought. Greek thought did not allow itself to be shackled by tradition or by authority. On the other hand, a great deal of the thought of Christendom, even in the "modern" period, can hardly claim to be free from the marked influence of Christian tradition and authority. So it would be a mistake, on the whole, to think of ecclesiastical authority in the middle ages as a tyranny imposed entirely from outside. But thought had to come of age sooner or later And many influences helped it towards maturity. When Constantinople was threatened by the Turks, the Greek scholars there fled to Italy carrying their classical treasures with them One of them, *Pletho* (?1355–1450) persuaded Cosimo de Medici to found a Platonic Academy in Florence. With the co-operation of *Marsilius Ficinus* (1433–1499), *Pico de Mirandola* (1463–1494) and others, Platonic and Neo-Platonic philosophy made headway against Aristotelianism on which Scholasticism was based Writers like *Lorenzo Valla* (1408–1457) attacked Scholasticism for its sins against literary form, and its interest in words instead of things. *Nicolaus Cusanus* (1401–1464) showed pantheistic and scientific leanings, and believed not only in the spherical form of the earth, but also in its rotation about its axis.

Paracelsus (1493–1541) and *von Helmont* (1577–1644) denounced "authority" and mere book learning in the study of natural phenomena; although their own methods had little to commend them. *Telesio* (1508–1588) founded an academy at Naples to promote the study of nature on scientific lines He embraced the ethics of the Stoics, and introduced the conception of a self-preserving impulse somewhat like that formulated subsequently by Spinoza Very important in many ways, during this period of transition, was *Giordano Bruno* (1548–1600), whose martyrdom marked the first open breach with the Church. He was at once pantheist and atomist, and gave currency to the conception of "monads" of varying grades with God as "the monad of monads." Some of his ideas reappeared later in Spinoza, Leibniz and Schelling *Montaigne* (1533–1592) and *Sanchez* (1562–1632) attacked dogmatism with the weapons of scepticism, and pleaded the cause of toleration But most important of all was the progress of science and the growth of the scientific spirit through the achievements of *Copernicus* (1473–1543), *Kepler* (1571–1630), *Galileo* (1564–1642) and *Newton* (1642–1727); *Vesalius* (1514–1564), *Fabricius* (1537–1619), and *Harvey* (1578–1667); *Gilbert* (1540–1603), *Boyle* (1627–1691) and *Huygens* (1629–1695).

Modern philosophy owes little or nothing to the Reformation. The Reformers (Luther, Calvin and Zwingli) were as intolerant as possible. Luther denounced reason as the mistress of the devil, and Calvin committed Servetus to the flames, in 1553, with as much Christian charity as the Inquisition showed to Bruno in 1600. All that can be said is that the dissensions between the Churches indirectly stimulated a certain amount of independent thought among thoughtful people, and so reinforced a similar tendency encouraged by the mystical movement which, though it only produced few geniuses like Eckhard (1260–1327) and Böhme (1575–1624), had never entirely ceased in Christendom. Francis Bacon (1561–1626) must also be mentioned here. He described himself as the herald of modern thought, and perhaps rightly so. He showed rather less originality than his namesake Roger Bacon, who preceded him by three centuries But he summed up very effectively all the grievances against Scholasticism The place of honour as father of the new philosophy is usually given to Descartes. Many of his contemporaries certainly regarded Descartes as the founder of a new philosophy. So one may as well date modern philosophy from Descartes.

FROM DESCARTES TO LEIBNIZ

Descartes (1596–1650), like Bacon and others before him, was dissatisfied with the state of knowledge in his time. Mathematics was the only study that seemed to be well founded. And he thought that the difference was due to a difference in method. Other studies then followed the scholastic method of citing authorities for and against certain views. With mathematics it was different. It did not depend on authorities, but set out from certain clear ideas (axioms, postulates, definitions) and then proceeded deductively from them to results which were not challenged and contradicted constantly as were the results reached by different thinkers in other fields of study. Descartes resolved, accordingly, to introduce something essentially like the mathematical method into philosophy. The first requisite was a sure starting point, an Archimedean fulcrum, as Descartes called it. In order to discover it he adopted from Augustine the instrument of "methodical doubt" rejecting everything that was open to doubt until he could discover something indubitable. Like Augustine he found that though everything else could be doubted, the reality of the doubt itself could not "It is easy to suppose that there is no God, no heaven, no bodies, and that we have no hands, no feet, no body; but we can not in the same way conceive that we who doubt these things are not; for there is a contradiction in thinking that that which thinks does not exist when it thinks. Hence the conclusion I think, *therefore I am* is the first and most certain of all that occurs to one who philosophizes in an orderly way" (*Principles of Philosophy, I*, vii). This conclusion, however, is only accepted because it is "clear and distinct" Hence the general rule that "whatever I apprehend very clearly and distinctly is true" (*Meditation* III.).

Among such very clear and distinct ideas he includes that of God, the axioms of geometry and such already familiar "eternal truths" as *ex nihilo nihil fit*, etc , which he also calls innate ideas, in the sense that they are not derived from experience, but are evolved, in due course, by the immanent power of thought itself. Still, Descartes finds it necessary to prove the existence of God, and his main arguments are borrowed from Anselm and Campanella. Next, relying on the veracity of God, he accepts the reality of the things of the world of experience, with the reservation that error arises when we believe what is not very clear and distinct Such error is possible because belief or judgment is an act of will according to Descartes, who with Duns Scotus believed in the primacy of the will As to the nature of real things, God is the only self-existent being (or substance in the strict sense) on whom all other things depend for their creation and continuance Of created things there are two main types, namely, "extended things," or bodies, and "thinking things" or minds These are created substances, or substances in a secondary sense Like Augustine Descartes regarded the material and the mental as so utterly different and opposite that there can be no interaction between them. The union of body and soul in man is simply a miracle, whereby the soul (with the help of God—*concursus Dei*) can *direct* the motion of the body, but not add to it in any way. When discussing problems which do not directly concern God or man, Descartes shows a much more scientific spirit, though his scientific contributions were of little value except in relation to geometry, to which he rendered services of first-rate importance.

Like Galileo, his senior contemporary, Descartes attempted to explain all natural phenomena mechanically and consequently denied the objective reality of secondary qualities The lower animals he treated as mere automata or machines; and by attributing an imaginary function to the pineal gland and resorting to the antiquated "animal spirits" of Galen, he tried to introduce at least something mechanical into the relation between the body and the soul. This was not consistent with his conception of the opposed natures of bodies and minds. His followers, accordingly, tried another explanation, known as "occasionalism." According to this view, body and soul do not influence each other at all, but any change in either is an occasion for divine intervention in the other, so as to produce a corresponding change. This, of course, is supernaturalism pure and simple; and that is what Cartesian philosophy is essentially The striking difference between Descartes' leaning toward mechanism in science and super-

naturalism in philosophy is readily intelligible as an instance of that distinction between the two spheres of knowledge, the natural and the supernatural, which was a familiar Catholic tradition traceable to Albertus Magnus and Thomas Aquinas. (*See* DESCARTES; CARTESIANS; KNOWLEDGE, THEORY OF; PSYCHOLOGY, HISTORY OF.)

Hobbes (1588–1679) shared Descartes' respect for mathematics and for deduction, as against the empiricism of Bacon. But, unlike Descartes, he was opposed to supernaturalism, and whereas Descartes confined mechanical explanations within the limits of material nature, Hobbes applied it everywhere, to the mental as well as to the material. The result was a materialistic philosophy. Matter and motion are the only ultimate realities, and explain everything, even knowledge. For all knowledge is derived from sense. "There is no conception in a man's mind, which hath not at first, totally or by parts, been begotten upon the organs of sense." And the sense experiences are produced by the several motions of the matter pressing on the sense organs. "Neither in us that are pressed are they anything else but divers motions; for motion produceth nothing but motion" (*Leviathan*, I., i.). For Hobbes mind is matter, and thought, like every process or change, is motion—"all mutation consists in motion." And the same fundamental tendency characterizes all beings, whether human or not, namely, the tendency to persist in their present condition, whether of motion or of rest. Hobbes does not deny the existence of God. The search for the cause of an effect, and for the cause of that cause, and so on, leads to the thought of an ultimate eternal cause or God; but we "cannot have any idea of him." The chief work of Hobbes belongs mainly to the history of ethics and of political philosophy. (*See* HOBBES; MATERIALISM; ETHICS, HISTORY OF.)

Spinoza (1632–1677) marks the culmination of the various tendencies of the Renaissance. He vindicated the autonomy of reason against every kind of authority, subordinating even the Scriptures to it. Rationalism expresses itself most characteristically in the attempt to connect things in continuous series or systems of events which suffer no arbitrary incursions from outside in the form of supernatural interventions. The great achievements of that classic age of science were essentially expressions of the rationalism of the 17th century. Yet the rationalism of all the great scientists of the time was fragmentary, one-sided; it was a week-day rationalism handicapped with a Sunday irrationalism. Spinoza was the complete rationalist, the prince of rationalists. He attempted to interconnect the *whole* of reality in *one* organic cosmos, which suffered no cleavage into a natural and a supernatural realm, or into a work-day and a Sabbath vista. For Spinoza, the world is a real universe. It is also a real cosmos, orderly through and through, subject to no arbitrariness, not even the arbitrariness of God. The rejection of the supernatural and the arbitrary constitutes the naturalism of Spinoza. But his conception of the universe avoided sacrificing any one part of it to any other, of the material to the mental, or vice versa. While repudiating any reality outside the cosmos (or Nature) he was careful to include within it whatever could claim reality—not only the material and the mental, but also the divine. They all have their place in the cosmic system. In fact God is the cosmic system. For God is conceived as the Perfect Self-existent; and that is just what the cosmos or Nature is—hence *Deus sive Natura*. The All is God, and God is All. This constitutes the pantheism of Spinoza.

The way in which Spinoza arrived at his main conceptions is rather obscured by the geometric method of exposition pursued in his *Ethics*. Briefly it was this. To understand any finite object or event it is necessary to follow up innumerable conditions on which it depends. These ramify in all directions, yet we can never halt, for the conditions invoked are themselves dependent on innumerable others. But a world consisting *entirely* of dependent objects and events would be unintelligible, inconceivable. There must be some unconditioned, self-dependent, absolute reality, or Substance, to account for the reality of all that is conditioned and dependent. This is usually admitted. But the traditional solution, accepted by Descartes and the greatest scientists of the 17th century, was that God, a supernatural omnipoten Being, is this self-existent, absolute Being or Substance, who ha created all things and maintains them. But the idea of an extern Creator did not satisfy Spinoza. His rationalism revolted agains the arbitrariness implied in the creation having taken place at on time rather than another; nor could it find in the notion c creation out of nothing anything more intelligible than the prob lems it was intended to solve. If it is necessary to posit a absolute ground of reality, why not accept the system of realit itself as this self-dependent substance?

This view avoided the unnecessary multiplication of entitie and the difficulties of creation out of nothing. It was also mor satisfactory to the religious side of Spinoza's character, for brought man into more intimate relation with God. Such a vie was, of course, only possible in consequence of the friendlie attitude towards Nature which the Renaissance cultivated, a against the hostile association of "the world, the flesh and th devil" characteristic of mediaeval Christianity. With regard t the structure of the cosmic system, the leading ideas of Spinoz may be summarized as follows. God (or Nature or Substance) not static but dynamic, and exercises all the kinds of energy th there are. It alone is absolutely infinite or absolutely perfec Each kind of energy that is ultimate, that is, irreducible to an other kind, Spinoza calls an attribute of substance. Spinoza refe to an infinity of such attributes. But by "infinite" he mean "complete" (not innumerable) and by "finite" incomplete c fragmentary. Man only knows two such attributes, namely e tension and thought, that is, physical energy and mind energ There may be others; there probably are. Moreover, each attr bute is *infinite of its kind*, that is, exhausts everything of its ow kind, so that there is no physical energy outside extension, nc mind energy outside thought.

All finite bodies and physical events are "modes," that is, mod fications or states, of extension, and all minds and mental e periences are modes of thought. Similarly with the other attr butes, if any. All cosmic activities or processes are immanen not transcendent. And all apparent interactions between the mod of different attributes, say that between the body and soul c man, result from the fact that they are concomitant expressior of the attributes of the one substance. "The order and connectic of thoughts is the same as the order and connection of things. Physical effects should be traced to physical causes, and ment experiences to mental causes. The various finite modes com into being and pass away; but not into nothingness—for the Or remains in which the many change. God as conceived by Spinoz is not a "personal" God, not however because He is less, bu because He is infinitely more than any personality known to ma (*See* SPINOZA; PANTHEISM; ETHICS, HISTORY OF; KNOWLEDG THEORY OF.)

Leibniz (1646–1716) was influenced mainly by his faith i the permanent reality of individual souls. His philosophy, accor ingly, is so constructed as to secure the ultimate reality of i dividuals, and to assure their permanence. To this end two thin were felt to be necessary. He had to dissociate souls fro physical atoms, and to treat each individual soul as a kind c "substance," or self-contained thing. The Cartesian identificatio of matter with extension (which was widely accepted then prompted Leibniz to deny the reality of matter altogether. F matter is then infinitely divisible, and no real "atom," nothir ultimate and really indivisible, can be conceived for the co struction of the composite bodies of ordinary observation. Fro this he concluded that all space or all material bodies are me subjective appearances, not objective realities. Reality, accor ing to Leibniz, consists entirely of souls or spirits of all degre of development. These are the real "atoms" or "individuals real unities not made up of parts. Some of them have only a ve low degree of consciousness or sub-consciousness, they are in state of chronic somnolence, so to say; some are in something li a dream state; others are more awake, have clear thoughts, are even self-conscious; and God, the "monad of monads" supremely conscious and active. There is an infinity of monad their gradation is continuous, without a break; and no two a

exactly alike.

To avoid the tendency to pantheism, Leibniz regarded the monads as not interconnected in any way, as incapable of influencing one another—"they have no windows by which anything can come in or go out." But there is one important exception to this, for God has created all other monads, which are "emanations" from the monad of monads. This, of course, makes the supreme monad different in *kind,* not merely different in *degree* from the other monads. However, having conceived the monads as "without windows" Leibniz has now to explain the appearance of interaction between them—the apparent interaction, *e.g.,* between the assembly of less developed monads which look like a body and that higher monad which is the soul. The problem is very like the problem which confronted the Cartesians, and the solution offered by Leibniz is rather like occasionalism. The ordinary monads do not really interact; each is self-contained, and develops from within, its present being pregnant with its future. But God has so made them all that they act in harmony. It is as if He had wound up so many clocks to keep time together. There is thus a "pre-established harmony" in consequence of which also each monad may be regarded as mirroring the entire universe, or every other monad, from its own point of view.

Like Descartes, Leibniz also follows strictly mechanical methods in dealing with physical problems, but he conceives mechanism to be in the service of teleology, and his general outlook, of course, was essentially teleological. His conception of the relation between the supreme monad and the other monads is obviously supernatural. In his philosophy, as in his public activities, Leibniz tried to bring together too many different elements to succeed in unifying them in one system. Leibniz is also famous for his optimism, that is, for holding the view that the actual world is "the best of all possible worlds." What he meant was that the "pre-established harmony" actually established by God was chosen by Him as the best possible, out of an endless variety of possibilities, in view of the purpose which He had in view. This does not imply that each thing regarded by itself is the best of its kind, or even good. It means only that in order to make any one thing better, the entire scheme of things would have to be different, and, as a whole, rather worse. (*See* LEIBNIZ; IDEALISM; KNOWLEDGE, THEORY OF; OPTIMISM.)

FROM LOCKE TO HUME

Locke (1632–1704) has the distinction of having given a decidedly epistemological turn to modern philosophy. He relates that five or six friends used to discuss philosophical or theological problems with him, but fruitlessly. So it occurred to him "that before we set ourselves upon inquiries of that nature, it was necessary to examine our own abilities, and see what objects our understandings were or were not fitted to deal with." By "extending their inquiries beyond their capacities" people only "raise questions and multiply disputes, which, never coming to any clear resolution, are proper only to continue and increase their doubts, and confirm them at last in perfect scepticism." Locke attempted to carry out the task which he set himself by means of a descriptive account of human "ideas" or experiences, of which he drew up a detailed inventory in his *Essay concerning Human Understanding* (1690). Locke uses the term "idea" for any "object of the understanding," any object as experienced; and, directly or indirectly, he traces all ideas to experience. This constitutes his empiricism. He rejects innate ideas, maintaining that prior to experience the mind is like a blank paper; but he credits the mind with certain powers. Ideas are of two kinds in respect of their origin. Some are induced by sensible objects—they are "ideas of sensation." Others result from reflection upon such ideas of sensation—they are "ideas of reflection." And the mind not only reflects, but also combines the given simple ideas into complex ones.

Locke believes that there are external things. But the mind does not apprehend them directly; ideas of sensation are at best only "appearances" of things, only copies of them, mediating between them and the apprehending mind. And this is true only of ideas relating to primary qualities (extension, figure, number, motion, solidity); the ideas of sensation relating to secondary qualities (colour, smell, etc.) are simply secondary or subjective effects produced in us by the primary qualities, and are not copies of anything objective. By combining the simple ideas of sensation and reflection there result complex ideas of substances, modes (*i.e.,* states of substances), and relations. The idea of a substance, or substratum, supporting qualities, etc., corresponding to simple ideas, Locke regards as an invention—he cannot trace it to a simple idea of experience, and he admits that it is vague. Yet he accepts the reality of substances, both physical and mental substances.

Of his own existence, each man is absolutely sure, by intuition; he cannot even doubt it without presupposing it. Of God's existence we are also certain, by demonstration; for our own existence cannot be explained without reference to Him as its cause. But, all the same, the "real essence" of substances is unknowable, and Locke is "apt to doubt a science of physical bodies as out of our reach" beyond merely empirical limits. (*See* LOCKE; EMPIRICISM; KNOWLEDGE, THEORY OF; PSYCHOLOGY, HISTORY OF.)

Berkeley (1685–1753) set himself the task of opposing the mechanistic methods of explanation generally accepted in his time in consequence of the fashion set by the great pioneers of modern science. He feared that that way lay materialism and atheism. But it was Locke's *Essay* that served him chiefly as the text of his criticism, especially in his *Principles of Human Knowledge* (1710) and the *Three Dialogues* (1713). Locke had maintained that our ideas of primary qualities resemble their external objects, whereas those of secondary qualities have no corresponding objects. Berkeley objected that both kinds of ideas are equally dependent on the mind and there is no more need or justification to assume the objective existence of primary than of secondary qualities. Moreover it is absurd to suppose that an idea can resemble anything that is not an idea. And if it is superfluous to assume the objective existence of primary qualities corresponding to certain ideas of sensation, it is even more unnecessary to assume, with Locke, the independent existence of material substance, of which, strictly speaking, we have no idea at all.

Locke had treated ideas of sensation as things which mediate between the knowing mind and corresponding material objects which they resemble where there is real knowledge; but Berkeley denounces this distinction between ideas and external objects as "the very root of scepticism"—"for how can it be known that the things which are perceived are conformable to those which are not perceived?" (*Principles,* 86). For Berkeley the ideas are the objects of knowledge, and there is nothing beyond them. "All the choir of heaven and furniture of earth, in a word all those bodies which compose the mighty frame of the world, have not any substance without the mind; . . . their *being* is to be perceived or known . . . consequently so long as they are not actually perceived by me, or do not exist in my mind, or that of any other created spirit, they must either have no existence at all, or else subsist in the mind of some Eternal Spirit" (*Ibid.* § 6). With the substantiality of matter its causality is also rejected. One idea of sensation cannot *cause* another; it can only *suggest* it. "The fire which I see is not the cause of the pain I suffer upon my approaching it, but the mark that forewarns me of it" (*Ibid.* § 65). And if one asks how it comes about that there appear to be such regular connections between divers ideas, the answer is "that this is done in virtue of an arbitrary connection instituted by the Author of Nature" (*Theory of Visual Language,* § 43). For spirits or minds are active agents, in fact the only ones.

Mechanistic explanations are therefore illusory. And if one objects (as Hume did soon afterwards) that there seems to be no more reason for assuming a mental substance than a material substance, ideas being the only things known, then Berkeley's reply is as follows: "I *myself* am not ideas, but . . . a thinking, active principle that . . . operates about ideas. I know that I . . . perceive both colours and sounds: that a colour cannot perceive a sound, nor a sound a colour: that I am therefore one individual principle, distinct from colour and sound, and . . . all other sensible things or inert ideas" (*Third Dialogue*). He admits, however, that he has no "idea" of minds or spirits, only a

"notion." Anyway the net result of Berkeley's speculations is an idealist philosophy according to which the only realities are God, other spirits or minds which He has created, and the innumerable ideas which He has produced and arranged for us to apprehend in certain sequences arbitrarily decreed by Him. (*See* BERKELEY; IDEALISM; KNOWLEDGE, THEORY OF.)

Hume (1711–1776) pursued the problems and methods of Locke to their extreme conclusion, in the sense that he showed that the kind of empiricism which Locke had advocated leads to positivism in science and scepticism in philosophy. It is one of the ironies of history that the book which Berkeley wrote in order to prevent or to cure scepticism actually infected Hume with it. "He professes [so writes Hume of Berkeley] in his title-page . . . to have composed his book against the sceptics as well as the atheists and freethinkers. But that all his arguments, tho' otherwise intended, are in reality merely sceptical, appears from this, that they admit of no answer and produce no conviction. Their only effect is to cause that momentary amazement and irresolution and confusion, which is the result of scepticism" (*Enquiry Concerning Human Understanding,* section 12, part i.n.). Berkeley had contended that there is not sufficient evidence for assuming material substances or material causality, as we have no ideas of either; but he defended both the substantial nature and causal power of minds or spirits. Hume argued that the same reasons which led Berkeley to reject material substances and material causes are also valid against the assumption of mental substances and mental causes.

Berkeley had tried to save mental substances and mental agency by pleading that we have "notions" of them apprehended by reason, though not "ideas" of experience. But Hume rejected this view of a radical distinction between "reason" and "experience," and submitted everything, even rational judgments, to the test of experience, and insisted on accounting for everything in terms of experience. He accordingly denied the certainty even of so-called mathematical knowledge, and reduced all alleged knowledge or certainty to mere probability. Causality itself he explained away as habitual association of sequent impressions or ideas; and substances as due to the mistaking of similar, recurring impressions for continuous impressions of the same thing. (*See* HUME; KNOWLEDGE, THEORY OF; SCEPTICISM.)

FROM KANT TO HEGEL

Kant (1724–1804) is the founder of the "critical" philosophy or of "transcendentalism." The stress which Descartes had laid on thought, or subjective experience, in basing his whole system on the *cogito ergo sum,* quite naturally resulted in a divorce between ideas, on the one hand, and the external world on the other. This is clear alike in the idealism of Leibniz and Berkeley, in the empiricism of Locke, and in the scepticism of Hume. The only philosophers of importance who avoided this predicament were Spinoza, on the one hand, and Thomas Reid (1710–96) and the Scottish school, on the other. But the alleged atheism of Spinoza robbed him of real influence; and the "common-sense philosophy" of the Scottish school was not sufficiently subtle to impress speculative minds. Kant attempted a new way of bringing thought and reality into touch once more. Kant himself liked to stress the "critical" character of his philosophy as the new element which he contributed; and consequently called his three great works *critiques.* He described all his predecessors as "dogmatic" philosophers, because they did not begin their philosophy with a critical examination of human capacity for knowledge.

The way in which Kant attempted to reunite knowledge with reality was briefly as follows. Known objects, according to Kant, are a multiplicity of sense-materials supplied to the apprehending mind which synthesizes them in accordance with certain forms of intuition (space and time) and certain categories of thought (substance and attribute, cause and effect, etc.). What the multiplicity of sense-materials may be before the mind has synthesized them, we do not and cannot know. But they are not produced by the mind, they are only apprehended and moulded by it—they are or pertain to "things-in-themselves." On the other hand, the forms of intuition and the categories of thought are ways in which the mind in virtue of its own nature moulds or systematizes the multiplicity of disconnected sense-materials so as to adapt them to its own unity. These forms are *a priori* or "transcendental" in the sense that they are not derived from experience, inasmuch as experience itself would be impossible without them; on the other hand, the multiplicity of sense-material is *a posteriori,* only given in experience and known through it (though not known "in itself").

These various *a priori* forms of apprehension are not peculiarities of the unity of individual minds as such, but rather express the unity of "consciousness in general" in which individual minds participate, but which is "super-individual." That is how it comes about that there is universal agreement in the use of the *a priori* forms and categories, instead of individual variations. Anyway, human knowledge does not extend to the intrinsic nature of ultimate reality or "things-in-themselves" but only to their appearances as moulded by the forms of intuition and categories of thought. In Kant's language, human knowledge is of "phenomena" not of "noumena" or "things-in-themselves." And any attempt to apply the *a priori* or "transcendental" forms to what does not fall within the realm of possible human experience, Kant condemned as "transcendent." The existence of God, and the immortality of the soul, *e.g.,* are beyond the realm of possible human experience, and therefore of knowledge though what cannot be *known* may yet be *believed* as a matter of *faith.*

And it is on such "practical reasons" that Kant based the beliefs in the existence of God, in the freedom of the will, and in the immortality of the soul. These things, according to Kant, are postulates of morality. The "categorical imperative," the unconditional character of the sense of duty, can only be understood and justified on the assumption or faith that we are free to do, or "can" do, what we "ought" to do, that there is a God who can duly correlate virtue with happiness, and that there is a hereafter in which the injustices of the present life may be adjusted. Kant's moral philosophy brings out with special clearness a striking feature of his whole method of philosophizing. He does not doubt the validity of the sense of duty or the "categorical imperative"; he acknowledged it, and only draws out its implications or conditions. Similarly, Kant did not question the reality of the external world as conceived by contemporary (Newtonian) science; he accepted it (as Hume the sceptic would not), and tried to elicit the conditions of the validity of that science. (*See* KANT; ETHICS, HISTORY OF; KNOWLEDGE, THEORY OF; TRANSCENDENTALISM; RATIONALISM.)

Fichte (1775–1854) agreed with Kant in ascribing to mind or "consciousness in general" (or "absolute self" as he preferred to call it) the forms of intuition and categories of thought which characterize objects of knowledge. But he held that Kant had not gone far enough. Kant had recognized "things-in-themselves" or "noumena" independent of consciousness, and furnishing the sense-materials for experience. These "noumena" could only be vaguely thought about, not perceived, except as moulded in the forms of knowledge, supplied by consciousness. Fichte, however, held that even the "thing-in-itself" is also the product of consciousness. The "absolute self" (in which individual minds participate) is the source of the whole of experience, not of its forms only. It divides itself in experience into a knowing self and a known object, because the development of the moral life needs objects as obstacles to be overcome by moral effort prompted by a sense of duty. Moreover, there must be many minds or selves, if there are to be mutual duties. But they are all the expressions of one moral order, which is the "absolute self" or God. (*See* FICHTE; IDEALISM.) A philosophy essentially like that of Fichte was taught subsequently by R. Eucken (1846–1926).

Schelling (1775–1854) reverted more or less to the fundamental conception of Spinoza, and tried to vindicate the reality of the material against the efforts of so many modern philosophers to reduce it to mere appearances or ideas. He contended that the beauty of the material world (or Nature, in the narrower sense of the term) gave it a sufficient claim to have a reality of its

own. So he conceived of Nature as an expression or manifestation of the Absolute in the same way as consciousness or mind is. Nature and mind are thus conceived to be related to the Absolute in the same kind of way as the two attributes, extension and thought, were conceived by Spinoza to be related to substance. The Absolute, however, came to be conceived as being in itself neither material nor mental, but something common to both or identical in both. Hence the name "identity philosophy" by which Schelling's system is commonly known. (*See* SCHELLING; IDEALISM.)

Hegel (1770–1831) is the founder of logical Idealism or Panlogism. He rejected the unknown "thing-in-itself" of Kant and the equally unknown "identity" or Absolute which, according to Schelling, manifests itself in Nature and mind He denied the opaqueness of ultimate reality and insisted that the entire universe "can be penetrated by thought." Mind and Nature are not merely manifestations or expressions of an otherwise unknown Absolute; they are the Absolute itself. Moreover, mind and Nature, according to Hegel, are not two distinct or parallel realities but integral components of one process of self-revelation. Mind needs for its own development an objective world, or Nature, on which to exercise itself; but this objective world is itself mental, something that is at once appearance and reality—"the real is rational, and the rational is real" The development of this rational reality is a kind of dialectic proceeding by the method of thesis, antithesis, and synthesis, or position, negation and reconciliation Some thought occurs: it is opposed by another thought, which also turns out to be inadequate; but what is true in each, the thesis and the antithesis, is harmonized and made mutually supplementary in another thought which synthesizes them; *e g.*, "becoming" is such a synthesis of "being" and "not-being"

The whole world, according to Hegel, is made up of such opposites which are reconciled The general scheme of the cosmic dialectic is this First comes "mind in itself," or the system of categories, which are conceived by Hegel, not as mere forms of thought by which unknown things-in-themselves are apprehended, but as ultimate realities; next comes "mind for itself," that is Nature as the self-externalization of "mind in itself"; lastly, comes "mind in and for itself," that is, mind or consciousness coming or returning to itself This last phase, the mind's coming to itself, has a number of grades or stages These are: individual mind or subjective consciousness; objective mind or social consciousness as expressed in law, morality, the State; and absolute mind or consciousness active intuitively in art, imaginatively in religion and intellectually in philosophy. Hegel's conception of the cosmic process as a rational dialectic stimulated new views of history and, consequently, a new interest in it. (*See* HEGEL; KNOWLEDGE, THEORY OF; IDEALISM.)

GERMAN PHILOSOPHY SINCE HEGEL

Materialism.—Various influences combined to occasion a tendency towards materialism about the middle of the 19th century Idealism had on the whole sided definitely with conservatism in religion and politics. Hegel's dictum, "the real is rational," was readily exploited in a reactionary sense beyond anything that Hegel intended, conservative as he himself had been. The generation inspired by the revolutionary tendencies of 1848 resented this kind of idealism. Stimulated by the microscopic biology of Schwann (who showed the cell to be the unit of plant and animal organisms), by the chemical researches of Liebig, by Schleiden's rejection of vitalism, and by the physical experiments of Mayer, Joule, Colding and Helmholtz, which resulted in the discovery of the principle of conservation of energy, the scientific spirit of the age revolted against the idealists' indulgence in romantic speculation. Industrial progress, advance in the technical arts, and the consequent improvement in economic and material conditions, also helped to stimulate special interest in things material. And the doctrines of the French materialists of the 18th century, La Mettrie (1709–51), Holbach (1723–89) and Cabanis (1757–1808), were ready at hand to be taken up and developed. J. Moleschott (1822–93) described the whole cycle of life in terms of matter and energy. Matter conditions life, life conditions thought, and thought conditions the will to improve life. Physical conditions are the main determinants of human destiny.

K. Vogt (1817–95) supplemented Moleschott's dictum, "no sulphur, no thought," with the statement that "thought is related to the brain in the same way as bile is to the liver." The same thing had been said already by Cabanis. Vogt did not pretend to know how exactly the brain does produce thought L. Büchner (1824–99) was the most influential of this group, and his *Force and Matter* (1855) served for a considerable time as the source-book of materialism. He identified force of every kind with movement, and regarded everything as the product of matter and motion which are distinguishable but not separable. He rejected vitalism, held that life is spontaneously generated out of matter under certain conditions, and that mental process is only "a radiation through the cells of the grey substance of the brain of a motion set up by external stimuli" H Czolbe (1819–73) rejected everything supersensuous and all "transcendental nonsense." But he maintained that the world cannot be derived from any one principle, such as Buchner's "force and matter," but only from a plurality of irreducible principles, including material atoms, organic forces, mental elements, etc, which between them constitute an harmonious and purposive natural system. Like the other materialists in this group, he was inspired by an enthusiasm for humanity and the amelioration of human conditions. (*See* MATERIALISM)

Schopenhauer (1788–1860) is the philosopher of "voluntarism" and "pessimism" Just as Hegel, his senior contemporary, had identified ultimate reality with reason, so Schopenhauer, on the contrary, identified it with will, and irrational will to boot. He too, claimed to be developing the philosophy of Kant For Kant, like Descartes and others before him, had maintained the primacy of the will, on which the whole moral philosophy (including the moral postulates) was based Will, then, according to Schopenhauer, is the sole reality Moreover, it is universal, or "will in general" (analogous to the "consciousness in general" of Kant and the German Idealists) There are really no individual things or wills For individuality is bound up with differences of time and place, which had been shown by Kant to be not real constituents of things-in-themselves, but merely forms of their appearance Individuality is thus mere illusion Again, Schopenhauer, like Kant, agreed with the Christian view that the will is essentially evil It is a will to live at any cost, and knowledge or reason is merely an instrument which it has invented to serve its own evil ends. But there is no satisfying the will to live. All the pains taken to satisfy any desire do not really avail. For the satisfaction of any one desire is only the beginning of another, and the quest is infinite So life is a welter of painful strivings and unsatisfied cravings which vastly exceed its moments of satisfaction or happiness The remedy is a kind of Buddhist self-renunciation By realizing the illusoriness of the individual self and the vanity of its quest for self-satisfaction, man may see through the vanity of life with all its values and pursuits. (*See* SCHOPENHAUER; PESSIMISM)

Fechner (1801–87) developed the philosophy known as Panpsychism, that is, the view that the universe is a system or society of souls, of which God is the highest and all-comprehensive soul. According to Fechner material bodies are souls as they appear to other souls, whereas each soul as experienced from within is psychical In this way he tried to save the reality of matter as well as of mind in psychophysical entities of which they are the outer and the inner side respectively But he regarded the two sides as parallel without any interaction; and it was largely due to his influence that many psychologists adopted psychophysical parallelism as the working hypothesis in psychology. Fechner tried to combine pantheism with something sufficiently like the monadology of Leibniz to safeguard the interests of finite souls. He identified God with the soul of the universe, and regarded it as embracing all other souls just as larger bodies contain smaller bodies, and nature contains them all. (*See* FECHNER; PSYCHOLOGY, HISTORY OF)

Lotze (1817–81) elaborated a philosophy which may be

described as idealistic pantheism. In other words ultimate reality, according to him, is like Spinoza's substance, with thought (or consciousness) for its sole attribute. He agreed with Kant that all known things are merely sensible phenomena; but he rejected Kant's unknown "things in themselves." He agreed with Leibniz in regarding spiritual monads as the causes of material phenomena; but he rejected the view that the monads are substances. The monads, according to Lotze, are only modes or modifications of the one and infinite Substance, God. The interaction of the monads he reduced to the immanent causality of God, who is the sole real cause or agent. The mechanistic character of phenomena Lotze explained by saying that God carries out His immanent activities in accordance with uniform laws. These laws, however, are subordinate to divine ends, the system being teleological as well as mechanistic in part. Human souls, like other monads, are not substances, but modes or activities of the one Substance. Lotze repudiated the method of Hegelian idealism as unscientific. But he tried to save all such idealistic elements as he considered to be in harmony with science and human experience. (*See* LOTZE; LOGIC, HISTORY OF.) A philosophy essentially like that of Lotze was taught by James Ward (1843–1925) who had studied under him.

Hartmann (1842–1906) adopted and developed Schopenhauer's voluntarism and pessimism. For Schopenhauer reality is essentially will which produces knowledge or representation as an instrument for its satisfaction. For Hartmann, however, representation is on a level with, not subordinate to, will. Together they constitute the "unconscious," which is the "absolute" in his system. With the development of the unconscious its two components differentiate gradually, and the unconscious becomes conscious, even self-conscious, and realizes the tragedy of the will to live. The remedy is so to set the two components of the unconscious, will and representation, into mutual antagonism as to secure eventually their mutual annihilation and eternal peace from the restless and unsatisfying pursuits of life. (*See* HARTMANN.)

Nietzsche (1844–1900) was influenced chiefly by Kant, Schopenhauer and Darwin. He agreed with Schopenhauer's main theses but drew a different moral from them. Nietzsche, even more than Schopenhauer, so interpreted Kant's theory of knowledge as to deny the very possibility of knowledge, and to reduce all so-called knowledge to mere fiction or artistry. The human mind, in the very act of apprehending reality, transforms it. "Truth (says Nietzsche) is not something which is already there to be found or discovered; it is something which has to be created"—it is "man-made," as the Pragmatists said after him. This does not mean that he lumps all human beliefs together indiscriminately. Only in place of the usual distinction between "true" beliefs and "false" ones, Nietzsche would substitute the distinction between those which are "useful" and those which are not, but without in any way holding that the useful is true, even as a matter of probability.

The epistemological side of Nietzsche's philosophy was developed in the "fictionism" of Vaihinger's *Philosophy of "As If"* (1911, Eng. trans. 1926). Ontologically Nietzsche agrees with Schopenhauer in identifying all reality with will. "It is will that struggles for existence in animate and inanimate nature." For Nietzsche, however, this will is not merely a will to live, but a "will to power." "This universe is a monster of energy, without beginning or end." Nietzsche accepted "will to power" as ultimate reality because his experience convinced him of the reality of desires and impulses as of nothing else; and he considered these a sufficient guide to philosophical construction. Like Schopenhauer, he frequently paints the world in sombre colours. But the shortcomings of the world stimulate him instead of depressing him. And far from accepting Schopenhauer's ideal of a Buddhist saint, he regarded the world as a kind of Greek tragedy affording ample opportunity for heroes to show their mettle. Hence his gospel of energetic life, and his ideal of a "superman" who shall surpass the present type of man as much as man surpasses the ape. (*See* NIETZSCHE.)

Wundt (1832–1921) begins by insisting that human experience consists of ideas in which subjective and objective factors are inseparably combined. These factors may be distinguished by abstraction. And in physical science the objective factors, or objects, are so habitually abstracted that they come to be regarded as independent things. But this is an error, for "the whole world exists for us only in our ideas," and all that reason posits behind or beyond phenomena must be regarded as transcendent "ideals." Again, the basic reality in experience, "the most proper being of the individual subject," is will, though it is never entirely divorced from feeling and ideas. There are two grades of will, namely, impulsive will and voluntary will. Even impulsive will needs feeling directed to an end, and therefore an idea, but not conscious adoption of a motive, which pertains to voluntary will. He attributes impulsive will to all organisms, and consequently maintains that in organic evolution teleology precedes mechanism, final causes precede and originate mechanical or efficient causes. Wundt describes not only attention but also thinking as will. For it is activity, and all activity is will. (The conception of this "will to believe" was elaborated by William James.) Wundt, in fact, regards the soul as "activity," not substance—it is the entire mental activity associated with a system of bodily activities. The body itself is only an object distinguished by abstraction from the complete experience, of which soul is the subjective factor. There is consequently no psychophysical opposition or interaction, only a psychophysical parallelism. Human knowledge is limited to experience, or phenomena, or ideas. Reason does indeed transcend experience. But it can only posit "ideals," which are matters not of knowledge but, at most, matters of faith. One such "ideal" is God, conceived as the world-will. (*See* WUNDT; PSYCHOLOGY, HISTORY OF.)

Neo-Kantianism.—The attempt to correct at once the materialism of the time and the absolute idealism which had partly provoked it led to a revival of interest in the philosophy of Kant and a concentration on the problems of knowledge. The movement was initiated by O. Liebmann (1840–1912). In his book *Kant und die Epigonen* (1865) every chapter ends with the refrain, "we must therefore return to Kant." F. A. Lange (1828–75) advanced the movement by means of his *History of Materialism* (1866) in which he attempted to refute materialism by means of arguments based on Kant's theory of knowledge and its repudiation of all knowledge of the ultimate nature of reality, or things as they are in themselves. He insisted that the "matter," "atoms," "forces," etc., by means of which materialists try to account for all things, are not ultimate realities but only auxiliary conceptions of science. In 1871 H. Cohen (1842–1918) published his book on *Kant's Theory of Experience*, and soon became the leader of the whole movement. He was joined by P. Natorp (1854–1924), his colleague in the University of Marburg, where Lange too had been professor, and the movement consequently came to be known as "the Marburg School" of philosophy. The chief representative of Neo-Kantianism at present is E. Cassirer (1874–). It cannot be said that the Neo-Kantians are agreed on all points. Far from it. What is common to them is the recognition of the importance of understanding Kant and developing his transcendental method. Cohen in particular attempted to do without Kant's aesthetic, to dispense with the assumption of a given sense material, and to begin at once with the transcendental logic. There is no object then to be known; what becomes known only becomes an object in becoming known. Nothing is independent of thought. For thought and being are identical, and the judgment is the unit of both. (*See* NEO-KANTIANISM.)

POSITIVISM AND EVOLUTIONISM

Comte (1798–1857) was the founder of "Positivism," that is, the view that knowledge is limited to the objects of direct observation or experience. This view is very like the empiricism of Locke and his successors. Comte's positivism, however, was the outcome rather of the influence of Kant's philosophy, according to which human knowledge (as distinguished from faith) is limited to phenomena, and cannot penetrate to noumena or things-in-themselves. What is beyond experience, Comte insisted, is unknowable. It is consequently best to concentrate on tasks

that are within human competence. Such are the pursuits of the sciences and the work of social amelioration. Philosophers, instead of their search for an unknown and unknowable Absolute, should devote themselves to the task of co-ordinating and systematizing the methods and results of the positive sciences. Religion, instead of being the worship of an unknown God and a source of division, sectarian conflict and hatred, should be identified with the service of the cause of mankind—a religion of Humanity. And humanity should be so improved by collective endeavour that it shall become worthy of being viewed as "the great Being," the object of religious service. What Comte had in mind was a grandiose Catholicism without religion, as religion is commonly conceived. Positivism, Comte realized, is a position not readily taken up. First in the history of intellectual growth, comes the theological point of view, and everything is explained by reference to one or more gods who are created in the likeness of men. Next comes the metaphysical stage in which the anthropomorphic Gods are more or less dehumanized and replaced by abstract entities or principles. Then only comes the positivist stage. But even Comte was not a strict positivist. For he severely criticized the actual state of mankind, and pleaded for various reforms according to standards derived, not from observation, but from ideals. (*See* COMTE; POSITIVISM.)

Mill (1806–73) also may be called a positivist. But in his case the connection with British empiricists is more marked than in the case of Comte. His logic, his utilitarian ethics, and his political economy are all worked out on empirical or positivist lines. (*See* MILL; LOGIC, HISTORY OF.)

Spencer (1820–1903) admitted an ultimate reality as the ground of the phenomenal world, but regarded it as otherwise "unknown." Inasmuch as he confined knowledge to phenomena, he was a positivist. But his fame rests mainly on his comprehensive attempt at an evolutionary philosophy which brought or forced "all the choir of heaven and furniture of earth" into the evolutionary scheme. The conception of evolution was not new to philosophy. Hegel's philosophy was evolutionary in a sense; but not quite in Spencer's or Darwin's or generally in a scientific sense. According to Spencer the universe commenced as an homogeneous something, which may be called force, or matter and motion, but the inner nature of which is unknown to us. Then by increasing differentiation and specialization there evolved the heavenly bodies (more or less in accordance with the nebular hypothesis of Laplace); the inorganic evolved into the organic (more or less on the lines of Lamarckian and Darwinian biology); differentiation of structure and function in living bodies, and division of labour in industry, etc., followed in due course. And always the amount of energy remains the same in accordance with the principle of Conservation of Energy; it is only redistributed in various ways. The evolutionary process as conceived by Spencer and others was mechanistic in character. This conception subsequently met with increasing opposition. In contemporary philosophy Bergson's theory of "creative evolution" and Lloyd Morgan's theory of "emergence" or "emergent evolution" are intended as a corrective of mechanistic determinism in favour of spontaneity and originality in cosmic processes of many kinds. (*See* SPENCER; ETHICS, HISTORY OF; EMERGENCE; EVOLUTION AND MIND.)

RECENT AND CONTEMPORARY PHILOSOPHY

Neo-Hegelianism.—Until comparatively recently, British philosophy pursued its own course in almost entire independence of Continental philosophy. Its most characteristic feature was its initial empiricism, though it ended variously in agnosticism, scepticism or even in idealism. When the widespread influence of Kant's critical philosophy asserted itself, it was still used mainly to supplement the agnostic tendencies of native empiricism. In view of Kant's own indebtedness to Hume, this was not unnatural. Anyway, Kant's denial of the possibility of knowledge of things as they are in themselves, and its limitation to phenomena could readily be identified with Locke's and Hume's denial of our knowledge of "substances" and its restriction to "ideas."

The philosophical agnosticism of Hamilton (1788–1856), Mansel (1820–71), Spencer and Huxley (1825–95) may thus be regarded as betraying Continental influence only to a slight extent. The influence of German voluntarism was no greater, probably rather less. Martineau (1805–1900) was probably the only one in his generation to identify God, or the ultimate cause of the universe, with Will. The influence of German Absolute Idealism, however, was much more marked, especially in the logical form in which it was developed by Hegel. It cannot be asserted that Hegelianism had actual followers in England or in America. But Hegelianism harmonized well with the growing revolt against empiricism, and so some of the acutest thinkers in both countries were influenced by it sufficiently to be commonly described as Neo-Hegelians. The most important representatives of the group were Green (1836–82), Bradley (1846–1924), Bosanquet (1848–1923), Haldane (1856–1928) and McTaggart (1866–1925) in England, and Royce (1855–1916) in America—to say nothing of the many well-known representatives who are happily still living. Considering the logical or rational character of Hegel's idealism, it is natural to find that at least two of the Neo-Hegelians have made most important contributions to logic, which they treated in a highly epistemological manner (Bradley's *Principles of Logic,* and Bosanquet's *Logic*). Neo-Hegelianism is essentially a metaphysic of logical coherence, involving a doctrine of varying grades or degrees of reality. Reality, according to Bradley, is in the last resort a system of experience. The finite as such is not illusory, yet not absolutely real, only relatively so: it is entirely dependent upon, and rests within, the Absolute, or entire system of experience. In the broad sense in which the term Neo-Hegelian is here used it may also be applied to the two Italian philosophers, Croce (1866–   ) and Gentile (1875–   ), the Dutch philosopher Bolland (1854–   ), and the German Volkelt (1848–   ). (*See* NEO-HEGELIANISM.)

Pragmatism as a method of evaluating ideas by their practical consequences was formulated by C. S. Peirce (1839–1914) in 1878, and developed more fully by W. James (1842–1910), J. Dewey (1859–   ) and F. C. S. Schiller (1864–   ). The movement is based partly on psychological considerations, and partly on a dissatisfaction with the intellectualism and deterministic monism of absolute idealism. "Thinking," according to James, "is first and last and always for the sake of doing," and "the conception with which we handle a bit of sensible experience is really nothing but a teleological instrument." The agnostic or relativist side of Kant's teaching, as developed by Nietzsche and Vaihinger in some ways encouraged the substitution of the practically useful for the theoretically true as the standard of value for beliefs. And German voluntarism tended in the same direction. "The 'true,'" according to James, "is only the expedient in the way of thinking, just as the 'right' is only the expedient in the way of behaving." In the circumstances, it was natural that the effort at self-preservation characteristic of finite individuals should express itself in favour of a belief in the ultimate reality and worth of a plurality of finite beings, as against their merely relative being and worth in a monistic "block-universe." Hence the combination of pragmatism with pluralism. (*See* PRAGMATISM; PLURALISM; TRUTH.)

The New Realism.—In Germany it was idealism that provoked materialism, and materialism occasioned that revival of epistemological interest which produced Neo-Kantianism. With British and American philosophy the case is rather different. It was the materialistic tendencies of empiricism, agnosticism and evolutionism that provoked the idealism of the Neo-Hegelians, and the new realistic tendencies in epistemology have come as a revolt against idealism generally, and subjective idealism more particularly. The present movement was started mainly by G. E. Moore and B. Russell, and has been taken up eagerly by many others in Britain and in America. These thinkers differ in their views in some respects, but they agree in their endeavour to vindicate the independent reality of the objects of human knowledge, and especially of the objects apprehended in perception. (*See* KNOWLEDGE, THEORY OF.)

Bergson (1859–) is the founder of what is variously known as the philosophy of change, of creative evolution, or of duration. Like so many idealist philosophers, his main aim is to vindicate the spiritual principle in nature and freedom in human nature against the mechanistic tendencies of modern science. Somewhat like Fichte he conceives of ultimate reality as something less determinate than consciousness or matter, but from which both consciousness and matter are derived. This ultimate reality is an incessant flux, a creative evolution, or real duration. It is not an inaccessible absolute; it can be apprehended by man. "In the absolute we live and move and have our being. The knowledge we possess of it is incomplete, no doubt, but not external or relative. It is reality itself, in the profoundest meaning of the word, that we reach by the combined and progressive development of science and philosophy." Materiality and spirituality are resultants of processes in opposite directions. Spirituality is the process of concentrated activity in which the past interpenetrates the present; materiality corresponds to a relaxation of this activity.

The evolution of life has taken three divergent directions, the vegetative, the instinctive, and the intelligent or rational. These are not successive stages, but divergent lines of evolution. Instinct is a faculty of using organic instruments; intelligence is a faculty of making and using inorganic tools. Instinct is a kind of unconscious practical knowledge of things; intelligence is conscious thought about relations. Owing to its original function of making tools out of inert matter, intelligence when it develops its theoretical side tends to regard the whole of reality as though it were a dead mechanism. This can be corrected by means of intuition, which is instinct become self-conscious and capable of reflecting upon its objects. It is the function of philosophy to seize, expand and unite such fleeting intuitions which reveal the spiritual life. But intuition must not be divorced from intellection, nor science from philosophy. They must be brought into close relationship if we are to avoid chill mechanism, on the one hand, and illusory mysticism, on the other. For Bergson, not perception but memory is typical of the spiritual or conscious. Perception is simply incipient or nascent action, not consciousness. Memory is real duration, in which the past "gnaws into the future." (*See* Bergson.)

B. Croce (1866–) sets out from the Cartesian, or rather Augustinian, contention that thought is what we are most sure of, and then proceeds, like the German idealists, to maintain that it is the only reality that need be assumed. By thought, however, he does not mean merely the thought of finite individuals. Like most idealists he posits a universal mind which is more than any finite individual thoughts can be but which is immanent in them. And whereas Hegel conceived of the dialectic of universal thought as essentially logical in character, though he could not avoid conveying the impression that he also regarded it as a process in time, Croce definitely conceives the cosmic thought process as a process in time, and identifies reality or philosophy (for the two are essentially the same in such an idealistic scheme) with history. Like Bergson and James, Croce rejects the conception of a static, unchanging Absolute, a "block universe" complete once for all. Ultimate reality, as he conceives it, is incessantly changing, ever active, always creative. This cosmic activity has no beginning and no end, but proceeds in cycles. The objects to which thought is always directed are themselves the creations of thought. In fact, the process of thinking, the object of thought, and the distinction between the act and the object of thought, are all of them parts of the same total experience, and it is only by a kind of abstraction that a world of objects is set up as an independent world over and against the world of thought.

In reality the whole universe is just Mind or Spirit, and all differences and distinctions are within it. Of the activities of mind there are two main types, namely, theoretical and practical activities. Theoretical activity is of two principal varieties, namely, intuition and conception. Intuition is the act of creating the materials of thought, and is exemplified most clearly in the creative imagination of the artist. There is no sense material supplied to the mind from outside, according to Croce; the mind just has intuitions which constitute the material on which conceptual thought operates. Conception or conceptual thinking is the activity which creates and traces relations between intuitions. But the two, intuition and conception, are only distinguishable, not separable. Intuition without conception would be blind; conception without intuition would be empty. The practical activities are all of them volitional processes or functions, for there can really be no "physical" activities in a purely spiritual universe. And like the theoretical functions they also have two aspects or components, namely, a particular or individual aspect and a universal aspect, which are distinguishable but not separable. (*See* Croce; Idealism; Neo-Hegelianism.)

Alexander (1859–) is the first British philosopher to attempt a system of philosophy; and that after the prophets had confidently asserted that there would be no more system building in philosophy. His *Space, Time and Deity* (2nd ed., 1928) develops a philosophy which incorporates the new conceptions of space-time, and of emergent evolution, and leads up to a kind of pantheism not altogether unlike that of Spinoza. Ultimate reality is Space-Time, of which space alone and time alone are mere abstractions. Space-Time is a kind of ocean whose whirlpools constitute particular objects. Things, in other words, are differentiated complexes of motion within the one comprehensive system of motion. Space-Time has certain pervasive or "categorical" properties (existence, universality, relation, order, substance, quantity, number, motion, etc.) which characterize everything. Besides these there are various empirical qualities which distinguish different classes of objects, and which emerge only under special conditions. They form a hierarchy. What happens is this. Space-Time spontaneously differentiates into finite collocations of point-instants. The simples of these consist of motions of different velocities and extents of motion. When these objects form certain patterns there emerges the quality of materiality; when certain other conditions are added, there emerges colour; and so on.

When certain physico-chemical complexes arise, life emerges; out of certain configurations of living complexes consciousness emerges. In this hierarchy of objects, those that have the higher qualities also have the lower qualities. But they experience them differently—they "enjoy" their highest quality immediately and inwardly, but only "contemplate" the lower qualities more or less externally. By reasonable extrapolation we may assume that there are higher qualities than consciousness. And the highest of such conceivable qualities is "deity." As consciousness is the highest quality of man so "deity" is the highest quality of God, whose "body" is the whole universe. God is the whole universe as evolving the quality "deity." As time is never complete, higher qualities continue to emerge, and so God is never complete. The world with its nisus towards deity stirs in us a longing for God with Whom we are in communion. And practical religion consists in doing our duty so as to advance the progress of the world towards deity. The triumph of good over evil in human affairs is one of the conditions of the emergence of deity, and deity is on the side of goodness. The right attitude towards life is that of intellectual acquiescence coupled with practical efforts towards its amelioration, even though the springs of pain may never be sealed. As to the relation of the finite many to the infinite One, "the One is the system of the many in which they are conserved, not the vortex in which they are engulfed." (*See* Qualities, Primary, Secondary and Tertiary.)

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PHILOSOPHY AND PHILOSOPHICAL STUDIES.

Philosophy is a general term whose meaning and scope have varied very considerably according to the usage of different authors in different ages. It can best be explained by a survey of the steps by which philosophy differentiated itself, in the history of Greek thought, from the idea of knowledge and culture in general. These steps may be traced in the gradual specification of the term. The earliest uses of the word (the verb φιλοσοφεῖν occurs in Herodotus and Thucydides) imply the idea of the *pursuit* of knowledge; but the distinction between the σοφός, or wise man, and the φιλόσοφος, or lover of wisdom, appears first in the Platonic writings, and lends itself naturally to the so-called Socratic irony. The same thought is to be found in Xenophon, and is doubtless to be attributed to the historical Socrates. But the word soon lost this special implication. What is of real interest to us is to trace the progress from the idea of the philosopher as occupied with any and every department of knowledge to that which assigns him a special kind of knowledge as his province.

A specific sense of the word first meets us in Plato, who defines the philosopher as one who apprehends the essence or reality of things in opposition to the man who dwells in appearances and the shows of sense. The philosophers, he says, "are those who are able to grasp the eternal and immutable"; they are "those who set their affections on that which in each case really exists" (*Rep.* 480). In Plato, however, this distinction is applied chiefly in an ethical and religious direction; and, while it defines philosophy, so far correctly, as the endeavour to express what things are in their ultimate constitution, it is not yet accompanied by a sufficient differentiation of the subsidiary inquiries by which this ultimate question may be approached. Logic, ethics and physics, psychology, theory of knowledge and ontology are all fused together by Plato in a semi-religious synthesis. It is not till we come to Aristotle that we find a demarcation of the different philosophic disciplines corresponding, in the main, to that still current. The earliest philosophers, or "physiologers," had occupied themselves chiefly with what we may call cosmology; the one question which covers everything for them is that of the underlying substance of the world around them, and they essay to answer this question, so to speak, by simple inspection. In Socrates and Plato, on the other hand, the start is made from a consideration of man's moral and intellectual activity; but knowledge and action are confused with one another, as in the Socratic doctrine that virtue is knowledge. To this correspond the Platonic confusion of logic and ethics and the attempt to substitute a theory of concepts for a metaphysic of reality. Aristotle's methodic intellect led him to separate the different aspects of reality here confounded. He became the founder of logic, psychology, ethics and aesthetics as separate sciences; while he prefixed to all such (comparatively) special inquiries the investigation of the ultimate nature of existence as such, or of those first principles which are common to, and presupposed in, every narrower field of knowledge. For this investigation Aristotle's most usual name is "first philosophy" or, as a modern might say, "first principles"; but there has since been appropriated to it, apparently by accident, the title "metaphysics." "Philosophy," as a term of general application, was not, indeed restricted by Aristotle or his successors to the disciplines just enumerated. Aristotle himself includes under the title, besides mathematics, all his physical inquiries. And "philosophy" was used in this wide sense (but often divided into "natural" and "moral" or "mental" philosophy) until comparatively recent times, although some of the special sciences had attained to independent cultivation already in the Alexandrian period. However, as the mass of knowledge accumulated, it naturally came about that the name "philosophy" ceased to be applied to inquiries concerned with the particulars as such. The details of physics, for example, were abandoned to the scientific specialist, and philosophy restricted itself in this department to the question of the relation of the physical universe to the ultimate ground or author of things. This inquiry which was long called "rational cosmology," may be said to form part of the general subject of metaphysics, or at all events a pendant to it. By the gradual sifting out of the special sciences philosophy thus came to embrace primarily the inquiries grouped as "metaphysics" or "first philosophy." These would embrace, according to the Wolffian scheme long current in philosophical textbooks, ontology proper, or the science of being as such, with its three-branch sciences of (rational) psychology, cosmology and (rational or natural) theology, dealing with the three chief forms of being—the soul, the world and God. Subsidiary to metaphysics, as the central inquiry, stand the sciences of logic and ethics, to which may be added aesthetics, constituting three normative sciences—sciences, that is, which do not, primarily, describe facts, but rather prescribe ends or set forth ideals.

In sum, then, we may say that "philosophy" has come to be understood at least in modern times as a general term covering the various disciplines just enumerated. We shall first of all attempt to differentiate philosophy from the special sciences, and afterwards proceed to take up one by one what have been called the philosophical sciences, with the view of showing how far the usual subject-matter of each is really philosophical in its bearing. The order in which it will be most convenient to consider these disciplines will be psychology, epistemology or theory of knowledge, and ontology, then logic, aesthetics and ethics. Finally, the connection of the last-mentioned with politics (or, to speak more modernly, with jurisprudence and sociology), with the philosophy of history and the philosophy of religion, will call for a few words on the relation of these sciences to general philosophy.

Philosophy and Natural Science.—In distinguishing philosophy from the sciences it may not be amiss at the outset to guard against the possible misunderstanding that philosophy is concerned with a subject-matter different from, and in some obscure way transcending, the subject-matter of the sciences. Now that psychology, or the observational and experimental study of mind, may be said to have been definitively included among the positive sciences, there is not even the apparent ground which once existed for such an idea. Philosophy has no other subject-matter than the nature of the real world, as that world lies around us in everyday life, and lies open to observers on every side. But if this is so, it may be asked what function can remain for philosophy when every portion of the field is already lotted out and enclosed by specialists? Philosophy claims to be the science of the whole; but, if we get the knowledge of the part from the different sciences, what is there left for philosophy to tell us? To this it is sufficient to answer generally that the synthesis of the parts is something more than that detailed knowledge of the parts in separation which is gained by the man of science. It is with the ultimate synthesis that philosophy concerns itself; it has to show that the subject-matter which we are all dealing with in detail really *is* a whole, consisting of articulated members. Evidently, therefore, the relation existing between philosophy and the sciences will be, to some extent, one of reciprocal influence. The sciences may be said to furnish philosophy with its matter, but philosophical criticism reacts upon the matter thus furnished, and transforms it. Such transformation is inevitable, for the parts only exist and can only be fully, *i.e.*, truly, known in their relation to the whole. A pure specialist, if such a being were possible, would be merely an instrument whose results had to be co-ordinated and used by others. Now, though a pure specialist may be an abstraction of the mind, the tendency of specialists in any department naturally is to lose sight of the whole in attention to the particular categories or modes of nature's working which happen to be exemplified, and fruitfully applied, in their own sphere of investigation; and in proportion as this is the case it becomes necessary for their theories to be co-ordinated with the results of other inquirers, and set, as it were, in the light of the whole. This task of co-ordination, in the broadest sense, is undertaken by philosophy; for the philosopher is essentially what Plato, in a happy moment, styled him, συνοπτικός, the man who takes a "synoptic" or comprehensive view of the universe as a whole. The aim of philosophy (whether fully attainable or not) is to exhibit the

universe as a rational system in the harmony of all its parts; and accordingly the philosopher refuses to consider the parts out of their relation to the whole whose parts they are. Philosophy supplements in this way the abstractions which are inevitably made by the scientific specialist.

For it is evident from what has been said that the way in which we commonly speak of "facts" is calculated to convey a false impression. The world is not a collection of individual facts existing side by side and capable of being known separately. A fact is nothing except in its relations to other facts; and as these relations are multiplied in the progress of knowledge the nature of the so-called fact is indefinitely modified. Moreover, every statement of fact involves certain general notions and theories, so that the "facts" of the separate sciences cannot be stated except in terms of the conceptions or hypotheses which are assumed by the particular science. Thus mathematics assumes space as an existent infinite, without investigating in what sense the existence or the infinity of this *Unding*, as Kant called it, can be asserted. In the same way, physics may be said to assume the notion of material atoms and forces. These and similar assumptions are ultimate presuppositions or working hypotheses for the sciences themselves. But it is the office of philosophy, as a theory of knowledge, to submit such conceptions to a critical analysis, with a view to discover how far they can be *thought out,* or how far, when this is done, they refute themselves, and call for a different form of statement, if they are to be taken as a statement of the ultimate nature of the real. The first statement may frequently turn out to have been merely provisionally or relatively true; it is then superseded by, or rather inevitably merges itself in, a less abstract account. In this the same "facts" appear differently, because no longer separated from other aspects that belong to the full reality of the known world. There is no such thing, we have said, as an individual fact; and the nature of any fact is not fully known unless we know it in all its relations to the system of the universe, or, in Spinoza's phrase, *sub specie aeternitatis.* In strictness, there is but one *res completa* or concrete fact, and it is the business of philosophy, as science of the whole, to expound the chief relations that constitute its complex nature.

The last abstraction which it becomes the duty of philosophy to remove is the abstraction from the knowing subject which is made by all the sciences, including as we shall see, the science of psychology. The sciences, one and all, deal with a world of objects, but the ultimate fact as we know it is the existence of an object for a subject. Subject-object, knowledge, or, more widely, self-consciousness with its implicates—this unity in duality is the ultimate aspect which reality presents. It has generally been considered, therefore, as constituting in a special sense the problem of philosophy. Philosophy may be said to be the explication of what is involved in this relation, or, in Kantian phraseology, a theory of its possibility. Any would-be theory of the universe which makes its central fact impossible stands self-condemned. On the other hand, a sufficient analysis here may be expected to yield us a statement of the reality of things *in its last terms,* and thus to shed a light backward upon the true nature of our subordinate conceptions.

Psychology, Epistemology and Ontology.—This leads to the consideration of the main divisions of philosophy—psychology (*q.v.*), epistemology (theory of knowledge) and ontology. A special relation has always existed between psychology and systematic philosophy, but the closeness of the connection has been characteristic of modern and more particularly of English thought. The connection is not difficult to explain, seeing that in psychology, or the science of mind, we study the fact of intelligence (and moral action), and have, so far, in our hands the fact to which all other facts are relative. From this point of view we may even see a truth in Jacobi's dictum as quoted by Sir W. Hamilton: "Nature conceals God; man reveals God." Nature by itself, that is to say, is insufficient. The ultimate explanation of things cannot be given by any theory which excludes from its survey the intelligence in which nature, as it were, gathers herself up. But knowledge, or the mind's knowing, willing, etc., may be looked at in two different ways. It may be regarded simply as a fact; in which case the evolution of mind may be traced and reduced to laws in the same way as the phenomena treated by the other sciences. This study gives us the science of empirical psychology, or, as it is now termed, psychology *sans phrase.* In order to give an adequate account of its subject-matter, psychology may require higher or more complex categories than are employed in the other sciences, just as biology, for example, cannot work with mechanical categories alone, but introduces the conception of development or growth. But the affinities of such a study are manifestly with the sciences as such rather than with philosophy; and the definitive establishment of psychology as an independent science has already been alluded to. Since it has been taken up by specialists, psychology is being established on a broader basis of induction, and with the advantage, in some departments, of the employment of experimental methods of measurement. But it is not of mind in this aspect that such assertions can be made as those quoted above. Mind, as studied by the psychologist—mind as a mere fact or phenomenon—grounds no inference to anything beyond itself. The distinction between mind viewed as a succession of "states of consciousness" and the further aspect of mind which philosophy considers was very clearly put by Croom Robertson, who also made a happy suggestion of two terms to designate the double point of view:

"We may view knowledge as mere subjective function, but it has its full meaning only as it is taken to represent what we may call objective fact, or is such as is named (in different circumstances) real, valid, true. As mere subjective function, which it is to the psychologist, it is best spoken of by an unambiguous name, and for this there seems none better than Intellection. We may then say that psychology is occupied with the natural function of *Intellection,* seeking to discover its laws and distinguishing its various modes (perception, representative imagination, conception, etc.) according to the various circumstances in which the laws are found at work. Philosophy, on the other hand, is theory of *Knowledge* (as that which is known)."—"Psychology and Philosophy," *Mind* (1883), pp. 15, 16.

The confusion of these two points of view has led, and still leads, to serious philosophical misconception. It is hardly an exaggeration to say that, in the English school since Hume, psychology superseded properly philosophical inquiry. And we find even a thinker with a wider horizon like Sir W. Hamilton encouraging the confusion by speaking of "psychology *or* metaphysics," while his lectures on metaphysics are mainly taken up with what belongs in the strictest sense to psychology proper, with an occasional excursus (as in the theory of perception) into epistemology. The distinction between psychology and theory of knowledge was first clearly made by Kant, who repeatedly insisted that the *Critique of Pure Reason* was not to be taken as a psychological inquiry. He defined his problem as the *quid juris* or the question of the validity of knowledge, not its *quid facti* or the laws of the empirical genesis and evolution of intellection (to use Croom Robertson's phraseology). Since Kant, philosophy has chiefly taken the form of theory of knowledge or of a criticism of experience. Not, indeed, a preliminary criticism of our faculties or conceptions such as Kant himself proposed to institute, in order to determine the limits of their application; such a criticism *ab extra* of the nature of our experience is essentially a thing impossible. The only criticism which can be applied in such a case is the immanent criticism which the conceptions or categories exercise upon one another. The organized criticism of these conceptions is really nothing more than the full explication of what they mean and of what experience in its full nature or notion is. This constitutes the theory of knowledge in the only tenable sense of the term, and it lays down, in Kantian language, the conditions of the possibility of experience. These conditions are the conditions of knowledge as such, or, as it may be put, of objective consciousness—of a self-consciousness of a world of objects and through them conscious of itself. The inquiry is, therefore, transcendental in its nature, and does not entangle us in any decision as to the conditions of the genesis of such consciousness in the individual. When we inquire into subjective conditions we are

thinking of facts causing other facts. But the transcendental conditions are not causes or even factors of knowledge; they are the statement of its idea. Hence the dispute between evolutionist and transcendentalist rests, in general, on an *ignoratio elenchi;* for the history of the genesis of an idea does not contain an answer to—though it may throw light on—the philosophical question of its truth or validity. Speaking of this transcendental consciousness, Kant goes so far as to say that it is not of the slightest consequence "whether the idea of it be clear or obscure (in empirical consciousness), no, not even whether it really exists or not. But the possibility of the logical form of all knowledge rests on its relation to this apperception as a faculty or potentiality" (*Werke*, ed. Hartenstein, iii. 578 note).

Kant's problem is not, in its wording, very different from that which Locke set before him when he resolved to "inquire into the original, certainty and extent of human knowledge together with the grounds and degrees of belief, opinion and assent." Locke's *Essay* is undoubtedly, in its intention, a contribution to the theory of knowledge. But, because time had not yet made the matter clear, Locke suffered himself to digress in his second book into the psychological question of the origin of our ideas; and his theory of knowledge is ruined by the failure to distinguish between the epistemological sense of "idea" as significant content and the psychological sense in which it is applied to a fact or process in the individual mind. The same confusion runs through Berkeley's arguments and vitiates his conclusions as well as those of Hume. But appearing with these thinkers as the problem of perception, epistemology widens its scope and becomes, in Kant's hands, the question of the possibility of experience in general. With Hegel it passes into a completely articulated "logic," which apparently claims to be at the same time an ontology or an ultimate expression of the nature of the real.

This introduces us to the second part of the question we are seeking to determine, namely the relation of epistemology to ontology. It is evident that philosophy as theory of knowledge must have for its complement philosophy as ontology or theory of being. The question of the truth of our knowledge, and the question of the ultimate nature of what we know, are in reality two sides of the same inquiry; and therefore our epistemological results have to be ontologically expressed. But it is not every thinker that can see his way with Hegel to assert in set terms the identity of thought and being. Hence the theory of knowledge becomes with some a theory of human ignorance. This is the case with Herbert Spencer's doctrine of the Unknowable, which he advances as the result of epistemological considerations in the philosophical prolegomena to his system. Very similar positions were maintained by Kant and Comte; and, under the name of "agnosticism" (*q.v.*), the theory has popularized itself in the outer courts of philosophy, and on the shifting borderland of philosophy and literature. The truth is that the habit of thinking exclusively from the standpoint of the theory of knowledge tends to beget an undue subjectivity of temper. And the fact that it has become usual for men to think from this standpoint is very plainly seen in the almost universal description of philosophy as an analysis of "experience," instead of its more old-fashioned designation as an inquiry into "the nature of things." As it is matter of universal agreement that the problem of being must be attacked indirectly through the problem of knowledge, this substitution may be regarded as an advance, more especially as it implies that the fact of experience, or of self-conscious existence, is the chief fact to be dealt with. But if so, then self-consciousness must be treated as itself real, and as organically related to the rest of existence. If self-consciousness be treated in this objective fashion, then we pass naturally from epistemology to ontology. (For, although the term "ontology" has been as good as disused, it still remains true that the aim of philosophy must be to furnish us with an ontology or a coherent and adequate theory of the nature of reality.) But if, on the other hand, knowledge and reality be *ab initio* opposed to one another—if consciousness be set on one side as over against reality, and merely holding up a mirror to it—then it follows with equal naturalness that the truly real must be something which lurks unrevealed behind the subject's representation of it. Hence come the different varieties of a so-called phenomenalism. The upholders of such a theory would, in general, deride the term "ontology"; but it is evident, none the less, that their position itself implies a certain theory of the universe and of our own place in it, and the establishment of this theory constitutes their ontology.

Without prejudice, then, to the claim of epistemology to constitute the central philosophic discipline, we may simply note its liability to be pressed too far. The exclusive preoccupation of men's minds with the question of knowledge during the neo-Kantian revival in the 'seventies of the last century drew from Lotze the caustic criticism that "the continual sharpening of the knife becomes tiresome, if after all, we have nothing to cut with it." Stillingfleet's complaint against Locke was that he was "one of the gentlemen of this new way of reasoning that have almost discarded substance out of the reasonable part of the world." The same may be said with greater truth of the devotees of the theory of knowledge; they seem to have no need of so old-fashioned a commodity as reality. Yet, after all, Fichte's dictum holds good that knowledge *as* knowledge—*i.e.*, so long as it is looked at as knowledge—is, *ipso facto, not* reality. The result of the foregoing, however, is to show that, as soon as epistemology draws its conclusion, it becomes ontology; the theory of knowledge passes into a theory of being. The ontological conclusion, moreover, is not to be regarded as something added by an external process; it is an immediate implication. The ontology is the epistemology from another point of view—regarded as completing itself, and explaining in the course of its exposition that relative or practical separation of the individual knower from the knowable world, which it is a sheer assumption to take as absolute. This, not the so-called assumption of the implicit unity of being and thought, is the really unwarrantable postulate; for it is an assumption which we are obliged to retract bit by bit, while the other offers the whole doctrine of knowledge as its voucher.

Logic, Aesthetics and Ethics.—If the theory of knowledge thus passes insensibly into ontology it becomes somewhat difficult to assign a distinct sphere to logic (*q.v.*). Ueberweg's definition of it as "the science of the regulative laws of thought" (or "the normative science of thought") comes near enough to the traditional sense to enable us to compare profitably the usual subject-matter of the science with the definition and end of philosophy. The introduction of the term "regulative" or "normative" is intended to differentiate the science from psychology as the science of mental processes or events. In this reference logic does not tell us how our intellections connect themselves as mental phenomena, but how we ought to connect our thoughts if they are to realize truth (either as consistency with what we thought before or as agreement with observed facts). Logic, therefore, agrees with epistemology (and differs from psychology) in treating thought not as mental fact but as knowledge, as idea, as having meaning in relation to an objective world. To this extent it must lead on to the theory of knowledge. But, if we desire to keep by older landmarks and maintain a distinction between the two disciplines, a ground for doing so may be found in the fact that all the main definitions of logic point to the investigation of the laws of thought in a subjective reference—with a view, that is, by an analysis of the operation, to ensure its more correct performance.

Aesthetics (*q.v.*) may be treated as a department of psychology or physiology, and in England this is the mode of treatment that has been most general. To what peculiar excitation of our bodily or mental organism, it is asked, are the emotions due which make us declare an object beautiful or sublime? And, the question being put in this form, the attempt has been made in some cases to explain any peculiarity in the emotions by analysing them into simpler elements, such as primitive organic pleasures and prolonged associations of usefulness or fitness. But, just as psychology in general cannot do duty for a theory of knowledge, so it holds true of this particular application of psychology that a mere reference of these emotions to the mechanism and interactive play of our faculties cannot be regarded as an account of the nature of the beautiful. Perhaps by talking of "emotions" we tend to give

an unduly subjective colour to the investigation; it would be better to speak of the *perception* of the beautiful. Pleasure in itself is unqualified, and affords no differentia. In the case of a beautiful object the resultant pleasure borrows its specific quality from the presence of determinations essentially objective in their nature, though not reducible to the categories of science. Unless, indeed, we conceive our faculties to be constructed on some arbitrary plan which puts them out of relation to the facts with which they have to deal, we have a *prima facie* right to treat beauty as an objective determination of things. The question of aesthetics would then be formulated—What is it in things that makes them beautiful, and what is the relation of this aspect of the universe to its ultimate nature, as that is expounded in metaphysics? The answer constitutes the substance of aesthetics, considered as a branch of philosophy. But it is not given simply in abstract terms: the philosophical treatment of aesthetics includes also an exposition of the concrete phases of art, as these have appeared in the history of the world, relating themselves to different phases of human culture.

Of ethics (*q.v.*) it may also be said that many of the topics commonly embraced under that title are not strictly philosophical in their nature. They are subjects for a scientific psychology employing the evolutionary method with the conceptions of heredity and development, and calling to its aid, as such a psychology will do, the investigations of all the sociological sciences. To such a psychology must be relegated all questions as to the origin and development of moral ideas. Similarly, the question debated at such length by English moralists as to the nature of the moral faculty (moral sense, conscience, etc.) and the controversy concerning the freedom of the will belong mainly to psychology. If we exclude such questions in the interest of systematic correctness, and seek to determine for ethics a definite subject-matter, the science may be said to fall into two departments The first of these deals with the notion of duty, and endeavours to define the good or the ultimate end of action; the second lays out the scheme of concrete duties which are deducible from, or which, at least, are covered by, this abstractly stated principle The second of these departments is really the proper subject-matter of ethics considered as a separate science; but it is often conspicuous by its absence from ethical treatises However moralists may differ on first principles, there seems to be remarkably little practical divergence when they come to lay down the particular laws of morality. It may be added that, where a systematic account of duties is actually given, the connection of the particular duties with the universal formula is in general more formal than real. It is only under the head of casuistry (*q.v.*) that ethics has been much cultivated as a separate science. The first department of ethics, on the other hand, is the branch of the subject in virtue of which ethics forms part of philosophy As described above, it ought rather to be called, in Kant's phrase, the metaphysic of ethics. A theory of obligation is ultimately found to be inseparable from a metaphysic of personality. The connection of ethics with metaphysics will be patent as a matter of fact, if it be remembered how Plato's philosophy is summed up in the idea of the good, and how Aristotle also employs the essentially ethical notion of end as the ultimate category by which the universe may be explained or reduced to unity. But the necessity of the connection is also apparent, unless we are to suppose that, as regards the course of universal nature, man is altogether an *imperium in imperio,* or rather (to adopt the forcible phrase of Marcus Aurelius) an abscess or excrescence on the nature of things. If, on the contrary, we must hold that man is essentially related to what the same writer calls "a common nature," then it is a legitimate corollary that in man as intelligence we ought to find the key of the whole fabric.

Philosophy of the State, History and Religion.—In Plato and Aristotle ethics and politics are indissolubly connected. In other words, seeing that the highest human good is realizable only in a community, the theory of the state as the organ of morality, and itself in its structure and institutions the expression of ethical ideas or qualities, becomes an integral part of philosophy. The difficulty already hinted at, which individualistic systems of ethics experience in connecting particular duties with the abstract principle of duty is a proof of the failure of their method. For the content of morality we are necessarily referred, in great part, to the experience crystallized in laws and institutions and to the unwritten law of custom, honour and good breeding, which has become organic in the society of which we are members. Plato's *Republic* and Hegel's *Philosophie des Rechts* are the most typical examples of a fully developed philosophy of the state, but in the earlier modern period the prolonged discussion of natural rights and the social contract must be regarded as a contribution to such a theory. Moreover, if philosophy is to complete its constructive work, it must bring the course of human history within its survey, and exhibit the sequence of events as an evolution in which the purposive action of reason is traceable. This is the task of the philosophy of history, a peculiarly modern study, due to the growth of a humanistic and historical point of view. Lessing's conception of history as an "education of the human race" is a typical example of this interpretation of the facts, and was indeed the precursor which stimulated many more elaborate German theories. The philosophy of history differs, it will be observed, from the purely scientific or descriptive studies covered by the general title of sociology. Sociology conceives itself as a natural science elucidating a factual sequence. The philosophy of history is essentially teleological; that is to say, it seeks to interpret the process as the realization of an immanent end. It may be said, therefore, to involve a complete metaphysical theory. Social institutions and customs and the different forms of state-organization are judged according to the degree in which they promote the realization of the human ideal History is thus represented by Hegel, for example, as the realization of the idea of freedom, or rather as the reconciliation of individual freedom and the play of cultured interests with the stable objectivity of law and an abiding consciousness of the greater whole in which we move. So far as the course of universal history can be truly represented as an approximation to this reconciliation by a widening and deepening of both the elements, we may claim to possess a philosophy of history But although the possibility of such a philosophy seems implied in the postulated rationality of the universe many would hold that it remains as yet an unachieved ideal.

There only remains to be briefly noticed the relation of philosophy to theology and the nature of what is called Philosophy of Religion By theology is commonly understood the systematic presentation of the teaching of some positive or historical religion as to the existence and attributes of a Supreme Being, including his relation to the world and especially to man But these topics have also been treated by philosophers and religious thinkers, without dependence on any historical data or special divine revelation, under the title of Natural Theology. Natural Theology is specially associated with the Stoic theories of providence in ancient times and with elaborations of the argument from design in the 18th century. But there is no warrant for restricting the term to any special mode of approaching the problems indicated; and as these form the central subject of metaphysical inquiry, no valid distinction can be drawn between natural theology and general metaphysics The philosophy of religion, on the other hand, investigates the nature of the religious consciousness and the value of its pronouncements on human life and man's relation to the ground of things. Unity, reconciliation, peace, joy, "the victory that overcometh the world"—such, in slightly varying phrases, is the content of religious faith. Does this consciousness represent an authentic insight into ultimate fact, or is it a pitiful illusion of the nerves, born of man's hopes and fears and of his fundamental ignorance? The philosophy of religion assumes the first alternative. The function of philosophy in general is the reflective analysis of experience, and the religious experience of mankind is *prima facie* entitled to the same consideration as any other form of conscious activity. The certainties of religious faith are matters of feeling or immediate assurance, and are expressed in the pictorial language of imagination. It becomes the function of philosophy, dealing with these utterances, to relate them to the results of other spheres of experience, and to determine their real meaning in the more exact terms of thought.

The philosophy of religion also traces in the different historical forms of religious belief and practice the gradual evolution of what it takes to be the truth of the matter. Such an account may be distinguished from what is usually called the science of religion by the teleological or metaphysical presuppositions it involves. The science of religion gives a purely historical and comparative account of the various manifestations of the religious instinct without pronouncing on their relative truth or value and without, therefore, professing to apply the idea of evolution in the philosophical sense. That idea is fundamental in the philosophy of religion, which therefore can be written only from the standpoint of a constructive metaphysical theory.

It is, indeed, only from the standpoint of such a theory that the definitions and divisions of the different philosophical disciplines adopted in this article can be said to hold good. But those who, like the positivist, agnostics and sceptics, deny the possibility of ontology as a theory of the ultimate nature of things, are still obliged to retain philosophy as a theory of knowledge, in order to justify the asserted limitation or impotence of human reason.

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PHILOSTRATUS, "THE ATHENIAN" (*c.* 170–245), the author of the *Life of Apollonius of Tyana*, which he dedicated to Julia Domna, wife of Alexander Severus and mother of Caracalla (*see* Apollonius of Tyana). He wrote also Βίοι Σοφιστῶν (*Lives of the Sophists*), *Gymnasticus* and *Epistolae* (mainly of an erotic character). Very little is known of his career. It is probable that he was born in Lemnos, studied and taught at Athens, and then settled in Rome. He is said by Suidas to have been living in the reign of Philip (224–249). The common authorship of *Apollonius* and of the *Lives of the Sophists* is confirmed by internal evidence.

The *Lives* are not in the true sense biographical, but rather picturesque impressions of leading representatives. The *Gymnasticus* contains interesting matter concerning the Olympic games and contests. The *Letters* breathe the spirit of the New Comedy and the Alexandrine poets; portions of *Letter 33* are almost literally translated in Ben Jonson's *Song to Celia*, "Drink to me only with thine eyes." The Ἡρωικός, formerly attributed to Philostratus the Athenian, but probably by another Philostratus ("of Lemnos"), is a popular disquisition on the heroes of the Trojan War. His other work is the Εἰκόνες (*Imagines*), ostensibly a critical description of 64 pictures in a Neapolitan gallery.

See K. Münscher in *Philologus* (1907) suppl. X., pp. 469–557. Of works bearing the name Philostratus there is a collected edition by C. F. Kayser (Zurich, 1844; Leipzig, 1870–71), and another by Westermann (Paris, 1849), with Latin translation; these supersede those by F. Morel (Paris, 1608) and Olearius (Leipzig, 1709). There are separate editions of the *Eikones* by Schenkl and Reisch (Leipzig, 1902); of the *Gymnasticus* by Mynas (1858), Daremberg (1858), Volckmar (Zurich, 1862), and especially Julius Jüthner (1909), with introd., comments and Ger. trans.; of 73 epistles by Boissonade (1842). The *Life of Apollonius* was first published by Aldus (1502); a French translation by Blaise de Vigenère appeared in 1596; an Eng. trans. of bks. i. and ii. was published (1680) by C. Blount, with notes by Lord Herbert of Cherbury (prohibited in England in 1693, it was reprinted on the Continent); a full translation appeared in 1903. Critical works on the *Eikones* are numerous: K. Friederichs, *Die Philostratischen Bilder* (1860); Goethe, "Philostrats Gemälde" in *Complete Works* (ed. Stuttgart, 1879); Brunn, *Die Philostratischen Bilder* (1860); A. Bougot, *Une Galérie antique* (1881); E. Bertrand, *Un Critique d'art dans l'antiquité: Philostrate et son école* (1882); Bergk, "Die Philostrate" in *Fünf Abhandlungen zur Geschichte der griechischen Philosophie und Astronomie* (1883); Schmid, *Atticismus* iv. 7, on the attribution of the works, and Überweg, *Grundriss der Gesch. der Philosophie*, Bd. I. (1926).

PHILOXENUS, of Cythera (435–380 B.C.), Greek dithyrambic poet. On the conquest of the island by the Athenians he was taken as a prisoner of war to Athens, where he was purchased by the dithyrambic poet Melanippides, who educated him and set him free. Philoxenus afterwards resided in Sicily, at the court of Dionysius, tyrant of Syracuse, whose bad verses he declined to praise, and was in consequence sent to work in the quarries. After leaving Sicily he travelled in Greece, Italy and Asia, reciting his poems, and died at Ephesus. According to Suidas, Philoxenus composed twenty-four dithyrambs and a lyric poem on the genealogy of the Aeacidae. In his hands the dithyramb seems to have been a sort of comic opera, and the music, composed by himself, of a debased character. His masterpiece was the *Cyclops*, a pastoral burlesque on the love of the Cyclops for the fair Galatea, written to avenge himself upon Dionysius, who was wholly or partially blind of one eye. It was parodied by Aristophanes in the *Plutus* (290). The popularity of Philoxenus is attested by a complimentary resolution passed by the Athenian senate in 393.

Fragments, with life, by G. Bippart (1843); T. Bergk, *Poetae lyrici graeci*.

PHILOXENUS (Syriac, Aksēnāyā) (*fl. c.* 500) of Mabbōg, one of the best of Syriac prose writers, and a vehement champion of Monophysite doctrine. He was by birth a Persian, born at Taḥal, in the district of Bēth Garmai east of the Tigris. He was educated at Edessa. Philoxenus soon attracted notice by his strenuous advocacy of Monophysite doctrine, and on the expulsion of Calandio (the orthodox patriarch of Antioch) in 485 was ordained bishop of Mabbōg (Hierapolis) by his Monophysite successor Peter the Fuller (Barhebraeus, *Chron. eccl.* i. 183). It was probably during the earlier years of his episcopate that Philoxenus composed his thirteen homilies on the Christian life. Later he revised the Syriac version of the Bible, and with the help of his chorepiscopus Polycarp produced in 508 the so-called Philoxenian version, used by the Monophysites during the 6th century. He bitterly opposed Flavian II., who had accepted the decrees of the Council of Chalcedon and was patriarch of Antioch from 498 to 512. In 512 the Monophysites finally ousted and replaced him by their partisan Severus. But Justin I., who succeeded Anastasius in 518, was less favourable to Severus and Philoxenus, and in 519 they were sentenced to banishment. Philoxenus was sent to Philippopolis in Thrace, and afterwards to Gangra in Paphlagonia, where he met his death by foul play in 523.

Of the chief monument of his scholarship—the Philoxenian version of the Bible—only the Gospels and certain portions of Isaiah are known to survive (*see* Wright, *Syr. Lit.* 14). His thirteen homilies on the Christian life and character have been edited and translated by Budge (London, 1894). Many of his letters survive.

PHIPS or **PHIPPS, SIR WILLIAM** (1651–1695), colonial governor of Massachusetts, was born on Feb. 2, 1651, at Woolwich, Me., near the mouth of the Kennebec river. He was a shepherd until he was 18 and then a ship carpenter's apprentice for four years; worked at his trade in Boston for a year, at this time learning to read and write. In 1687, with a commission from the British Crown, he found, after a search of many years, a wrecked Spanish treasure ship of which he had heard on a voyage to the Bahamas. From it he recovered £300,000, of which he received £16,000 as his share, was knighted by James II., and was appointed sheriff of New England. Poorly educated and ignorant of law, Phips could accomplish little, and returned to England. In 1689 he returned to Massachusetts, and at once entered into the life of the colony. He was soon appointed commander of an expedition against the French in Canada, which sailed in April, 1690, and easily captured Port Royal. A much larger expedition led by Phips in July against Quebec and Montreal ended disastrously. In the winter of 1690 he returned to England, and urged, with Increase Mather, the colonial agent, a restoration of the colony's charter, annulled during the reign of Charles II. The Crown, at the suggestion of Mather, appointed him the first royal governor under the new charter. On reaching Boston in May, 1692, Phips found the colony in a very disordered condition, and though honest and persevering, he was unfitted for the difficult position. In defending the frontier he displayed great energy, but his policy of building forts was expensive and therefore unpopular. Numerous complaints to the home government resulted in his being summoned to England to answer charges. While in London awaiting trial, he died on Feb. 18, 1695.

See Cotton Mather's *Life of His Excellency Sir William Phips*

(1697; republished in his *Magnalia* in 1702); Francis Bowen's "Life of Sir William Phips," in Jared Sparks's *American Biography*, 1st series, vol. vii. (1856); William Goold's "Sir William Phips," in *Collections of the Maine Historical Society*, series 1, vol. ix. (Portland, 1887); Ernest Myrand's *Sir William Phipps devant Quebec* (Quebec, 1893); Thomas Hutchinson's *History of Massachusetts* (Boston; 3rd ed. 1795); and J. G. Palfrey's *History of New England* (1858–90).

PHLEBITIS, a medical term for inflammation affecting veins. Usually the venous condition results from inflammation in tissue surrounding the vessel and extending to its walls. The vein becomes thickened and can be recognized as a definite, perhaps reddened, and very painful cord if it be superficial, *e.g.*, saphenous vein. When the inflammation extends to the inner coat of the vessel and nutrition of the lining endothelium is impaired, local clotting of blood occurs, the clot being adherent to the vessel wall where it is first formed and extending upwards and downwards within the lumen (*see* THROMBOSIS AND EMBOLISM). From the primary focus clotting extends also into the tributaries of the vein thus inducing widespread obstruction to the return of blood from the part and consequent oedema. The condition calls for complete rest owing to the danger of dislocating the clot and causing embolism; this danger is greatest when the condition is septic. In most cases, under rest, the inflammation subsides and the primarily affected vein becomes permanently occluded by newly formed fibrous tissue, but circulation in the part formerly drained by the vein is restored by the opening up of collateral channels. In some regions phlebitis is particularly dangerous, *e.g.*, the lateral sinus to which inflammation from middle ear disease may extend with subsequent cerebral abscess or purulent meningitis or general pyaemia. In such cases surgery is the sole hope for the patient.

PHLEGON, of Tralles in Asia Minor, Greek writer and freedman of the emperor Hadrian, flourished in the 2nd century A.D. His chief work was the *Olympiads*, an historical compendium in sixteen books, from the 1st down to the 229th Olympiad (776 B.C. to A.D. 137), of which several chapters are preserved in Photius and Syncellus. Two small works by him are extant: *On Marvels* and *On Long-lived Persons,* a list of Italians who had passed the age of 100, taken from the Roman censuses.

Fragments in C. Müller, *Frag. hist. graec.* iii.; of the *Marvels* and *Long-lived* in O. Keller, *Rerum naturalium scriptores*, i. (1877); *see* also H. Diels, "Phlegons Androgynenorakel" in *Sibyllinische Blätter* (1890).

PHLOGOPITE, a mineral belonging to the group of micas (*q.v.*). It is a magnesium mica, differing from biotite in containing only a little iron; $[H,K,(MgF)]_3Mg_3Al(SiO_4)_3$, is the chemical formula and it is named from Gr. φλογωπός (fiery-looking), the mineral being sometimes brownish-red and coppery in appearance. Sometimes it is quite colourless and transparent, but usually of a characteristic yellowish-brown colour, and often with a silvery lustre on the cleavage surfaces, hence the trade names "amber mica" and "silver mica" for some varieties. Phlogopite occurs chiefly as scales and plates embedded in crystalline limestones of the Archaean formation, and the cleavage flakes are not quite so elastic as those of muscovite. The mica mined in Canada and Ceylon is mainly phlogopite, and is largely used as an insulator for electrical purposes. In Canada it occurs with apatite in pyroxene rocks associated with Laurentian gneisses and crystalline limestones, the principal mining district being in Hull county, Quebec and near Burgess in Lanark county, Ontario. In Ceylon the mineral forms irregular veins, rarely exceeding one or two feet in width, traversing granulite, especially near the contact of this rock with crystalline limestone.

PHLOX (family Polemoniaceae), a genus of about 60 species, mostly perennial hardy plants of great beauty, natives of North America (one occurs in Siberia), with entire, usually opposite, leaves and showy flowers generally in terminal clusters. Each flower has a tubular calyx with five lobes, and a salver shaped corolla with a long slender tube and a flat limb. The five stamens are given off from the tube of the corolla at different heights and do not protrude beyond it. The ovary is three-celled with one to two ovules in each cell; it ripens into a three-valved capsule. Many species and varieties are tall herbs yielding a wealth of bloom throughout the summer and early autumn. They require a deep, rich and rather heavy loam, and a cool, moist position.

The dwarf perennial species and varieties, the "moss pinks" of gardens, are suitable plants for the rockery, and as edging to beds and borders. They are trailing and tufted in habit, the branches rooting at the nodes. They succeed in poorer soil, and drier situations than the tall kinds. Seed is seldom produced. Propagation is effected by cuttings in July and early August, placed in a cold frame, and by division of the plants, which should be lifted carefully, and cut into rooted portions as required. The tufted kinds decay in patches in winter if the situation is moist.

Phlox Drummondii and its numerous varieties are half-hardy annuals in Great Britain. It is a small-growing hairy plant, flowering profusely during the summer months. For early flowering it should be sown in heat in March and April and transferred out of doors in June. It succeeds if sown out of doors in April, but the flowering season is later and shorter.

The tall-growing border phloxes are divided into early and late flowering kinds respectively, the former derived mainly from *P. glaberrima* and *P. suffruticosa*, and the latter from *P. maculata* and *P. paniculata*. Owing to the frequent introduction of new kinds, no account of varieties can be given.

As practically all the species are native to the United States, with handsome representatives in every section of the country, admirers of this beautiful genus of plants have urged its adoption as the floral emblem or national flower of America.

PHOCAEA (mod. *Fokia* or *Fokha*), an ancient city on the western coast of Asia Minor, famous as the mother city of Marseilles. It was the most northern of the Ionian cities, and was situated on the coast of the peninsula which separates the gulf of Cyme, occupied by Aeolian settlers, from the Hermaean Gulf, on which stood Smyrna and Clazomenae. Its position between two good harbours, Naustathmus and Lampter (Livy xxxvii. 31), led the inhabitants to devote themselves to maritime pursuits. According to Herodotus the Phocaeans were the first of all the Greeks to undertake distant voyages, and made known the coasts of the Adriatic, Tyrrhenia and Spain. Arganthonius, king of Tartessus in Spain, invited them to emigrate in a body to his dominions, and, on their declining, presented them with a large sum of money. This they employed in constructing a strong wall around their city, a defence which stood them in good stead when Ionia was attacked by Cyrus in 546. Eventually they determined to seek a new home in the west, where they already had flourishing colonies, *e.g.*, Alalia in Corsica and Massilia (mod. *Marseilles*). A large part of the emigrants proceeded only as far as Chios, returned to Phocaea, and submitted to the Persian yoke.

Phocaea continued to exist under the Persian government, but greatly reduced in population and commerce. Though it joined in the Ionian revolt against Persia in 500 it was able to send only three ships to the combined fleet which fought at Lade. But a Phocaean took the supreme command. It never again played a prominent part in Ionian history. The modern town in the immediate neighbourhood, still known as Fokia, was founded by the Genoese in 1421 on account of the rich alum mines in the neighbourhood. It has a fair natural harbour.

PHOCAS, East Roman emperor (602–610), was a Cappadocian of humble origin. He was still but a centurion when chosen by the army of the Danube to lead it against Constantinople. A revolt within the city soon afterwards resulted in the abdication of the reigning emperor Maurice, and in the elevation of Phocas to the throne. Phocas proved entirely incapable of governing the empire. He consented to pay an increased tribute to the Avars and allowed the Persians to overrun the Asiatic provinces and to penetrate to the Bosporus. When the African governor Heraclius declared against him, Phocas was deposed with scarcely a struggle (610). He died in the same year on the scaffold.

See J. B. Bury, *The Later Roman Empire* (1923), vol. ii.; Gibbon, *Decline and Fall* (ed. Bury, 1911), vol. 5, p. 65–7050; J. Kulakowsky in "Byzant. Vremmenik" vol. xxi.

PHOCION, Athenian statesman and general, was born about 402 B.C., the son of a small manufacturer. He became a pupil of Plato and in later life was a close friend of Xenocrates. Under

Chabrias he distinguished himself in the great sea-fight of Naxos (376), and subsequently won the confidence of the allies by his justice and integrity. In 351–349 he entered the Persian service and helped to subdue a rebellion in Cyprus. Henceforward he always held a prominent position in Athens, and although he never canvassed he was elected general forty-five times in all. In politics he is known chiefly as the consistent opponent of the anti-Macedonian party. He countered the eloquence of Demosthenes and his supporters by the plain facts of Athens' situation. He helped to defend Aeschines in 343, and secured lenient terms from Philip after the disaster of Chaeroneia (338). He also rendered good service in the field: in 348 he saved the force operating against the philo-Macedonian tyrants in Euboea by the brilliant victory of Tamynae. Under the Macedonian predominance his reputation increased. Though by no means inclined to truckle to the Macedonians, as is shown by his protection of the refugee Harpalus and his spirited campaign in defence of Attica in 322, he won the confidence of the conquerors, and in the restricted democracy which Antipater enforced he became the virtual ruler of Athens. On the restoration of the democracy in 318, Phocion was deposed. He fled to Polyperchon, but was sent back to be tried at Athens. The assembly shouted Phocion down and condemned him to death unheard. Not long after, the Athenians decreed a public burial and a statue in his honour.

See Plutarch, *Life of Phocion;* Holm. *Gk. Hist.* vol. iii. (Eng. trans., London, 1896).

PHOCIS, an ancient district of central Greece (now a department, pop. *c.* 65,000, area, 625 sq.m.), bounded on the W. by Ozolian Locris and Doris, on the N. by Opuntian Locris, on the E. by Boeotia, and on the S. by the Corinthian Gulf. The massive ridge of Parnassus (8,068 ft.), traverses the heart of the country. Between this and the northern frontier range of Cnemis (3,000 ft.) is the narrow fertile valley of the Cephissus, along which lie most of the Phocian townships. South of Parnassus the two small plains of Crisa and Anticyra are separated by Mt. Cirphis. Phocis was mainly pastoral.

Its early history is obscure. Its population was reckoned Aeolic, but the dialects are of the West-Greek group, more akin to Doric. There was a tradition that the Phocians once owned land round Daphnus opposite Euboea, and had their frontier at Thermopylae. Later restriction of territory was due to the hostility of Boeotia and Thessaly. The latter in the 6th century even raided the Cephissus valley. In early days Phocians controlled the sanctuary of Delphi. But Delphi constantly strove for independence and about 590 B.C. induced a coalition of Greek states to proclaim a "Sacred War" and free the oracle from Phocian supervision. Thus Phocian influence at Delphi was restricted to the possession of two votes in the Amphictyonic Council.

During the Persian invasion of 480 the Phocians at first joined in the national defence, but their irresolute conduct lost Thermopylae for the Greeks; and at Plataea they were on the Persian side. In 457 an attempt to control the head waters of the Cephissus in the territory of Doris brought a Spartan army into Phocis in defence of the "metropolis of the Dorians." A similar attack on Delphi in 448 was again frustrated by Sparta, but not long afterwards the Phocians recaptured the sanctuary with the help of the Athenians, with whom they became allied in 454. When Athenian land-power declined, Phocian friendship waned, and in the Peloponnesian War Phocis was nominally an ally of Sparta, and had lost control of Delphi.

In the 4th century Phocis was constantly endangered by Boeotian oppression. After helping Sparta to invade Boeotia during the Corinthian War (395–394), the Phocians received assistance from Sparta in 380, but afterwards submitted to the growing power of Thebes. Phocians took part in Epameinondas' earlier inroads into the Peloponnesus, but abstained from the campaign of Mantineia (370–362). In return for this negligence the Thebans secured a penal decree against them for religious offences from the Amphictyonic synod (356). The Phocians, led by two capable generals, Philomelus and Onomarchus, replied by seizing Delphi and using its riches to hire mercenaries with whose help they invaded Boeotia and Thessaly, and though driven out of Thessaly by Philip of Macedon, maintained themselves for ten years, until the exhaustion of the temple treasures and the treachery of their leaders placed them at Philip's mercy. In 339 the Phocians began to rebuild their cities; in 338 they fought against Philip at Chaeroneia; in 323 they took part in the Lamian War against Antipater, and in 279 helped to defend Thermopylae against the Gauls.

During the 3rd century Phocis passed into the power of Macedonia and of the Aetolian League, to which in 196 it was annexed. Under Roman rule its league was dissolved, but was revived by Augustus, who also restored to Phocis the votes in the Delphic Amphictyony which it had lost in 346 and enrolled it in the new Achaean synod. The Phocian League is last heard of under Trajan.

See Strabo, pp. 401, 418, 424–425; Pausanias x. 1–4; E. Freeman, *History of Federal Government* (ed. 1893), pp. 113–114; G. Kazarow, *De foederis Phocensium institutis* (Leipzig, 1899); B. Head, *Historia numorum* (1887), pp. 287–288. Pauly-Wissowa *s.v.*

PHOCYLIDES, Greek gnomic poet of Miletus, contemporary of Theognis, was born about 560 B.C. A few fragments of his "maxims" have been preserved (chiefly in the *Florilegium* of Stobaeus). A complete didactic poem called Ποίημα νουθετικόν or γνῶμαι, and which bears the name of Phocylides, is now considered to be the work of an Alexandrian Christian of Jewish origin who lived between 170 B.C. and A.D. 50.

See fragments and the spurious poem in T. Bergk, *Poetae lyrici graeci,* ii. (4th ed., 1882); J. Bernays *Über das Phokylideische Gedicht* (1858); *Phocylides, Poem of Admonition,* with introduction and commentaries by J. B. Fenling, and translation by H. D. Goodwin (Andover, Mass., 1879). There is an English verse translation by W. Hewett (Watford, 1840), *The Perceptive Poem of Phocylides.*

PHOEBE (*Sayornis phoebe*), the name given to a familiar American bird belonging to the family *Tyrannidae* (the "American flycatchers"). Distinguished by its dark crown-cap, olive-grey plumage, and the white outer vane to the outer tail feather, the phoebe breeds in eastern North America from the south-west Mackenzie southwards, wintering in southern U.S.A. and Mexico. The bulky nest of moss and mud, lined with grass, hair and feathers, is placed on a beam or under a bridge or bank, often close to or on a building. Say's phoebe (*S. sayi*) is a more westerly species, abundant west of Kansas and Nebraska. The black phoebe (*S. nigricans*) has a more southern range.

PHOEBUS, a common epithet of Apollo (*q.v.*).

PHOENICIA, in ancient geography, the name given to that part of the seaboard of Syria which extends from the Eleutherus (Nahr el-Kebir) in the north to Mt. Carmel in the south, a distance of rather more than two degrees of latitude. These limits, however, were exceeded at various times; thus, north of the Eleutherus lay Aradus and Marathus, and south of Carmel the border sometimes included Dor and even Joppa. The harbours which played so important a part in antiquity are nearly all silted up, and, with the exception of Beirut, afford no safe anchorage for the large vessels of modern times. Sidon, Tyre and Aradus, though now connected with the mainland, were built originally upon islands; the Phoenicians preferred such sites, because they were convenient for shipping and easily defended against attack.

The chief towns of ancient Phoenicia, as we know of them from the Amarna tablets (15th century B.C.) and from Egyptian, Assyrian and the Old Testament documents, were the following: Acco (now Acre or 'Akkā, Judg. i. 31), Achzib (now ez-Zīb, *ibid.*), Ahlab (in Assyrian Mahalliba, *ibid.*)—three towns on the coast south of Tyre, Kānāh (Josh. xix. 28), Tyre (Phoen. Sōr, now Sūr), Zarephath or Sarepta (1 Kings xvii. 9 [now Sarafand]), Sidon (now Ṣaidā), Berytus (Biruta in Egyptian, Biruna in the Amarna tablets, now Beirūt), Byblus (in Phoen. and Hebr. Gebal, now Jebeil), Arka, 80m. north of Sidon (Gen. x. 17, now 'Arḳā), Sin (Assyr. Siannu, *ibid.*) Simyra (Gen. x. 18, now Ṣumrā), Marathus (now Amrīt) not important till the Macedonian period, Arvad or Aradus (in Phoen. Arwād, now Ruād, Gen. x. 18; Ezek. xxvii. 8, 11), the most northerly of the great Phoenician towns.

Race and Language.—The Phoenicians were an early offshoot from the Semitic stock, and belonged to the Canaanite branch of it. The Phoenicians themselves believed that they had migrated from an eastern shore, probably meaning Babylonia.

By settling along the Syrian coast they developed a strangely un-Semitic love for the sea, and advanced on different lines from the other Canaanites who occupied the interior. They called themselves Canaanites and their land Canaan; such is their name in the Amarna tablets, *Kinahhi* and *Kinahni;* and with this agrees the statement assigned to Hecataeus (*Fr. hist. gr.*, i. 17) that Phoenicia was formerly called Χνᾶ (*Chnâ*) a name which Philo of Byblus adopts into his mythology by making "Chna who was afterwards called Phoinix" the eponym of the Phoenicians (*Fr. hist. gr.*, iii. 569). In the reign of Antiochus IV. and his successors the coins of Laodicea of Libanus bear the legend "Of Laodicea which is in Canaan" (Cooke, *North-Semitic Inscriptions,* quoted as *NSI.*, No. 149 B 8); the Old Testament also sometimes denotes Phoenicia and Phoenicians by "Canaan" and "Canaanites" (Isa. xxiii. 11; Obad. 20; Zeph. i. 11), though the latter names generally have a more extended sense. But "Sidonians" is the usual designation both in the Old Testament and in the Assyrian monuments (Sidunnu); and even at the time of Tyre's greatest ascendancy we read of Sidonians and not Tyrians in the Old Testament and in Homer; thus Ethbaal, king of Tyre (Jos., *Ant.*, viii. 13, 2) is called king of the Sidonians in 1 Kings xvi. 31. In the Homeric poems we meet with *Sidonioi, Sidoniē* (Od., iv. 618; *Il.*, vi. 290; *Od.*, xiii. 285; *Il.*, vi. 291) and *Phoinikes, Phoinikē* (*Od.*, xiii. 272, xiv. 288 *seq.*, etc.), and both terms together (*Od.*, iv. 83 *seq.*, *Il.*, xxiii. 743 *seq.*). And the Phoenicians themselves used Sidonians as a general name; thus in one of the oldest Phoenician inscriptions (*CIS.*, i. 5=*NSI.*, No. 11), Hiram II., king of Tyre in the 8th century, is styled "king of the Sidonians." But among the Greeks "Phoenicians" was the name most in use, *Phoinikes* (plur. of *Phoinix*) for the people and *Phoinikē* for the land (*cf.* PHOENIX). The former was probably the older word and may be traced to *phoinos*="blood-red"; the Canaanite sailors were spoken of as the "red men" on account of their sunburnt skin.

Language.—Inscriptions, coins, topographical names preserved by Greek and Latin writers, names of persons and the Punic passages in the *Poenulus* of Plautus, all show conclusively that the Phoenician language belonged to the North-Semitic group, and to that sub-division of it which is called the Canaanite and includes Hebrew and the dialect of Moab. A comparison between Phoenician and Hebrew reveals close resemblances both in grammatical forms and in vocabulary; in some respects older features have been preserved in Phoenician, others are later, others again are peculiar to the dialect; many words poetic or rare or late in Hebrew are common in Phoenician. Hence we may conclude that the two languages developed independently from a common ancestor, which can be no other than the ancient Canaanite, of which a few words have survived in the Canaanite glosses to the Amarna tablets (written in Babylonian). But in forming an estimate of the Phoenician language it must be remembered that our material is scanty and limited in range; the Phoenicians were in no sense a literary people; moreover, except the inscriptions found at Gebal, now Jebeil, (10th century) and *NSI.* No. 11, most of the inscriptions are subsequent to the 6th century B.C.; the majority belong to the 4th century and later, by which time the language must have undergone a certain amount of decay. Indirectly, however, the Phoenicians rendered one great service to literature; they took a large share in the development and diffusion of the alphabet which forms the foundation of Greek (Herod., v. 58) and of all European writing. The Phoenician letters in their earlier types are practically identical with those used by the Hebrews, the Moabites, and the Aramaeans of north Syria (*NSI.*, Plates xii., xiii). They passed through various modifications in the course of time; after leaving the mother country the script acquires a more cursive flowing style on the stones from Cyprus and Attica; the tendency becomes more strongly marked at the Punic stage; until in the neo-Punic, from the destruction of Carthage (146 B.C.) to the 1st century A.D., both the writing and the language reached their most degenerate form. As a rustic dialect the language lasted in north Africa till the 5th century A.D. In his sermons St. Augustine frequently quotes Punic words. The oldest specimens of Phoenician writing at present known have been found at Gebal. In 1922 Montet unearthed the sarcophagus of Aḥîram, incised with a Phoenician inscription in an archaic form of lettering, which bears a close resemblance to the inscription of Abi-baal, discovered some years ago on the same site.

History.—The Phoenicians, in imitation of the Egyptians, claimed that their oldest cities had been founded in remote antiquity; but no certainty can be attached to the traditional chronologies; *e.g.*, Herod., ii. 44; Justin, xviii. 3; Menander in Jos., *Ant.*, viii. 3, 1 and *c. Ap.*, i. 18.

Phoenicia comes into history proper *c.* 1600 B.C., when the Egyptian empire began to extend in the direction of Asia under Aḥmosi (Amasis) I.; who carried his arms into Syria, and conquered at least Palestine and Phoenicia, the latter being the country called *Da-hi* on the Egyptian monuments (Müller, *As. u. Eur.*, p. 181). Thothmes III. (1503–1449) repeated and consolidated the earlier conquest, and established Egyptian suzerainty over all the petty states of Syria and Phoenicia (*see* EGYPT: *History.* I.). For the geography and civilization of Canaan about 1400 B.C. we have valuable evidence in the Egyptian papyrus Anastasi I., which mentions Kepuna (Gubna, Gebal-Byblus) the holy city, and continues: "Come then to Berytus, to Sidon, to Sarepta. Where is the ford of Nat-'ana (? Nahr el-Ḳāsimīyeh, or a town)? Where is 'Eutu (?Ushu, Palaetyrus)? Another city on the sea is called a haven, D'ar (Tyre) is its name, water is carried to it in boats; it is richer in fish than in sands." But the fullest information about the state of Phoenicia in the 15th and 14th centuries B.C. comes from the Amarna tablets, among which are many letters from the subject princes and the Egyptian governors of Phoenicia to the Pharaoh. It was a time of much political disturbance. The Hittites (*q.v.*) were invading Syria; nomads from the desert supported the invasion; and many of the local chiefs were ready to seize the opportunity to throw off the yoke of Egypt. The towns of Phoenicia were divided; Aradus, Simyra, Sidon supported the rebellion; Rib-addi, the regent of Byblus, and Abi-melech, king of Tyre, held out for Egypt; but while all the towns made professions of fidelity, they were scheming for their own interests, and in the end Egypt lost them all except Byblus. The tablets which reveal this state of affairs are written in the language and script of Babylonia, and thus show indirectly the extent to which Babylonian culture had penetrated Palestine and Phoenicia; at the same time they illustrate the closeness of the relations between the Canaanite towns and the dominant power of Egypt. After the reign of Amenophis IV. (1376–66) that power collapsed altogether; but his successors attempted to recover it, and Ramses (Rameses) II. reconquered Phoenicia as far as Beirut, and carved three tablets on the rock beside the Nahr el-Kelb (Gressmann, *Texte u. Bilder*^{2} ii. Pl. lxv.). In the reign of Ramses III. (*c.* 1200) many great changes began to occur owing to the invasion of Syria by peoples from Asia Minor and Europe, which ended in the establishment of the Philistines on the coast near Ashkelon. The successors of Ramses III. lost their hold over Canaan; the 21st dynasty no longer intervened in the affairs of Syria; but Sheshonk (Shishak), the founder of the 22nd dynasty, about 928 B.C. endeavoured to assert the ancient supremacy of Egypt (*cf.* 1 Kings xiv. 25 *sqq.*), but his successes were not lasting, and, as we learn from the Old Testament, the power of Egypt became henceforward ineffective.

Independence of Phoenicia.—Between the withdrawal of the Egyptian rule in Syria and the western advance of Assyria there comes an interval during which the city-states of Phoenicia owned no suzerain. Gebal had kings of its own, Aḥîram, Ithobaal, Abi-baal, in the 10th century, as recent excavations have shown. The history of this period is mainly a history of Tyre, which not only rose to a sort of hegemony among the Phoenician states, but founded colonies beyond the seas (p. 769). From 970 to 772 B.C. the bare outline of events is supplied by extracts from two Hellenistic historians, Menander of Ephesus and Dius (largely dependent upon Menander), which have been preserved by Josephus, *Ant.*, viii. 5, 3 and *c. Ap.*, i. 17, 18. From the data given in these passages we learn that Hiram I., son of Abi-baal, reigned in Tyre from 970 to 936 B.C. The Tyrian annals, more-

over, alluded to the connection between Hiram and Solomon. Before this time, indeed, the Phoenicians had no doubt lived on friendly terms with the Israelites (*cf.* Judges v. 17; Gen. xlix. 13); but the two nations seem to have drawn closer in the time of Solomon. 2 Sam. v. 11, which brings David and Hiram together, probably antedates what happened in the following reign. For Solomon's palace and temple Hiram contributed cedar and fir trees as well as workmen, receiving in exchange large annual payments of oil and wine, supplies which Phoenicia must have drawn regularly from Israelite districts (1 Kings v. 9, 11; *cf.* Ezek., xxvii. 17; Ezr. iii. 7; Acts xii. 20; Jos., *Ant.* xiv. 10, 6); finally, in return for the gold which he furnished for the temple, Hiram received the grant of a territory in Galilee (Cabul, 1 Kings ix. 10–14). This alliance between the two monarchs led to a joint expedition from Eziongeber on the Gulf of Akaba to Ophir (?on the east coast of Arabia, *see* Ophir) for purposes of trade. The list of Hiram's successors given by Josephus indicates frequent changes of dynasty until the time of Ithobal I., priest of Astarte, whose reign (887–855) marks a return to more settled rule. In contrast to Hiram I., king of Tyre, Ithobal or Ethbaal is styled in 1 Kings xvi. 31 "king of the Sidonians," *i.e.*, of the Phoenicians, showing that in the interval the kings of Tyre had extended their rule over the other Phoenician cities. Under Ethbaal further expansion is recorded; Botrys north of Byblus and Aoza in north Africa are said to have been founded by him (Jos., *Ant.*, viii. 13, 2); the more famous Carthage owed its origin to the civil discords which followed the death of Metten I. (*c.* 851), his next successor but one. According to tradition, Metten's son Pygmalion (*c.*860–814) slew the husband of his sister Elissa or Dido; whereupon she fled and founded Carthage (*q.v.*) in Libya (Justin, xviii. 4–6). At this point Josephus's extracts from Menander end, *see* Schrader, *KAT.*, 3rd ed. 12G ff.).

Assyrian Rule, 876–605 B.C.—From the time of Ethbaal onwards the independence of Phoenicia was threatened by the advance of Assyria. In 868 B.C. Assur-nasir-pal III. "washed his weapons in the great sea," and exacted tribute from the kings of Tyre, Sidon, Byblus and other cities, including Arvad (*Keilinschr. Bibliothek*, i. 109). The inscriptions of his son Shalmaneser II. mention the taking of tribute from the Tyrians and Sidonians in 842 and again in 839; the Byblians are included at the latter date, and among the kings defeated at Karkar in 854 or 853 was Metten-baal, king of the Arvadites (*ibid.*, pp. 141, 143, 173). Thus Shalmaneser established a supremacy which lasted for over a hundred years and was acknowledged by occasional payments of tribute. In 741 Tiglath-pileser III. mentions on his tribute-lists "Ḥirûm of Tyre"; and here a piece of native evidence becomes available. An early Phoenician inscription (*CIS.* i. 5= *NSI.* No. 11), engraved upon the fragments of a bronze bowl, mentions a certain governor of Qarth-ḥadasht (or Karti-Hadasti, "New City," *i.e.*, Citium), "servant of Hiram king of the Sidonians to Baal of Lebanon," showing that this Hiram II. was not only king of Tyre, as the Assyrian inscription calls him, but of Sidon too; and further, that by this time Tyre has established a colony in Cyprus (*q.v.*). In Tiglath-pileser's Philistine campaign of 734 Byblus and Aradus paid tribute, and a king of Tyre, Metten, was forced to do the same (*KB.* ii. 23). For the period which follows a certain amount of information is furnished by Menander (in Jos., *Ant.*, ix. 14, 2). Elulaeus IX., in Assyrian Lulī, who ruled under the name of Pylas, was king of Tyre, Sidon, and other cities at this time (*c.* 725–690), and at the beginning of his reign suffered from an invasion by Shalmaneser IV.; this was probably the expedition against Hoshea of Samaria in 725; "the king of Assyria . . . overran all Phoenicia, but soon made peace with them all and returned back." In the reign of Sargon Phoenicia itself seems to have been left alone, though Cyprus submitted to him in 709; but in the reign of Sennacherib Elulaeus joined the league of Philistia and Judah, in alliance with Egypt and Ethiopia, which aimed at throwing off the oppressive tyranny of Assyria. In the great campaign of 701 Sennacherib came down upon the revolting provinces; he forced Lulī, king of Sidon, to fly for refuge to Cyprus, took his chief cities, and set up Tuba'lu (Ethbaal) as king, imposing a yearly tribute (*KB.* ii. 91). The blockade of Tyre by sea, significantly passed over in Sennacherib's inscription, is described by Menander; the Assyrian king, however, so far accomplished his object as to break up the combination of Tyre and Sidon, which had grown into a powerful state. At Sidon the successor of Ethbaal was Abd-milkath; in alliance with a Cilician chief he rebelled against Esarhaddon about the year 678, with disastrous consequences. Sidon was annihilated; Abd-milkath fell into the hands of Esarhaddon, who founded a new Sidon on the mainland, peopled it with foreigners, and called it after his own name. The old name, however, survived in popular usage; but the character of the city was changed, and till the time of Cyrus the kingdom of Sidon ceased to exist (*KB.* ii. 125 *seq.*, 145; *KAT*³., 88). Tyre also came in for its share of hardship. Elulaeus was followed by Baal, who in 672 consented to join Tirhaka, the Ethiopian king of Egypt, in a rebellion against Assyria. Esarhaddon, on his way to Egypt for the second time, blockaded Tyre, but he did not capture the city itself. His monument found at Zenjirli represents the great king holding Baal of Tyre and Tirhaka of Egypt by cords fastened in their lips; there is no evidence, however, that he actually took either of them prisoner (Gressmann, *Texte u. Bilder*², ii. Pl. lxiii.). Early in the reign of Assur-bani-pal Tyre was besieged again (668), but Assur-bani-pal succeeded no better than his predecessors. Nevertheless Baal submitted in the end, along with the princes of Gebal and Arvad, Manasseh of Judah, and the other Canaanite chiefs; in the island of Cyprus the Assyrians carried all before them (*KB.* ii. 149 *seq.*, 169, 173). On his return from the Arabian campaign Assur-bani-pal severely punished the rebellious inhabitants of Ushu (Palaetyrus) and Akko (*ibid.*, 229). In Phoenicia, as elsewhere, Assyrian rule created nothing and left nothing behind it but a record of barbarous conquest.

The Neo-Babylonian Period, 605–538 B.C.—In the last crisis of the dying power of Assyria the Egyptians for a short time laid hands on Phoenicia; but after their defeat at the battle of Carchemish (605), the Chaldaeans became the masters of western Asia. Jeremiah's allusion (xxv. 22) in 604 to the approaching downfall of the kings of Tyre and Sidon and the coastland beyond the sea, *i.e.*, the Phoenician settlements on the Mediterranean, seems to imply that the Phoenician states recovered some measure of independence; if they did it cannot have lasted long. In 588 Apries (Pharaoh Hophra) made an attempt to displace the Chaldaean supremacy; he defeated Tyre and Sidon, and terrorized the other cities into submission (Herod., ii. 161; Diod. Sic., i. 68). Some of the Phoenician chiefs, among them Ithobal II., the new king of Tyre, while forced to yield to a change of masters, were bold enough to declare their hostility to the Babylonians. This state of affairs did not escape the vigilance of Nebuchadrezzar. After the fall of Jerusalem he marched upon Phoenicia; Apries withdrew his army, and the siege of Tyre began. For 13 years the great merchant city held out (585–573; Jos., *c. Ap.*, i. 21: *cf.* Ezek. xxvi. 1 *seq.*). Ezekiel says that Nebuchadrezzar and his host had no reward for their heavy service against Tyre, and the presumption is that the city capitulated on favourable terms; for Ithobal's reign ends with the close of the siege, and the royal family is subsequently found in Babylon. The king appointed by Nebuchadrezzar was Baal II. (574–564), after whose death a republic was formed under a single suffete or "judge" (*shōfēt*). Josephus (*loc. cit.*) is again our authority for the changes of government which followed until the monarchy was revived. At length under Hiram III. Phoenicia passed from the Chaldaeans to the Persians (538), and at the same time Amasis II. of Egypt occupied Cyprus (Herod., ii. 182). There seems to have been no struggle; the great siege and the subsequent civil disorders had exhausted Tyre, and Sidon took its place as the leading state. About this time, too, Carthage made an effort for independence under Hanno the Great (538–521), the real founder of its fortunes; the old dependence upon Tyre was changed for a mere relation of piety observed by the annual sending of delegates (θεωροί) to the festival of Melkarth (Arrian, ii. 24; Polyb., xxxi. 20, 12). The disasters which befell Tyre during this and the foregoing period might suggest that its prosperity had been seriously damaged. But Tyre always counted for

more in commerce than in politics; and in the year 586, just before the great siege, Ezekiel draws a vivid picture (ch. xxvii.) of the extent and splendour of its commercial relations.

Constitution.—At this point it is convenient to mention what little is known about the constitution of the Phoenician states. All Canaanite analogy speaks for kingship as the oldest form of Phoenician government. In the native inscriptions the chief of the city in Phoenicia itself and in Cyprus is always called king. The royal houses claimed divine descent, and the king could not be chosen outside their members. His power, however, was limited by the wealthy merchant families, who possessed great influence in public affairs. The priest of Melkarth at Tyre was the second man in the kingdom. Associated with the prince was a council of elders; such was the case at Gebal (Byblus) from the earliest times to the latest (Ezek. xxvii. 9); at Sidon this council consisted of 100 members (Diod., xvi. 45), perhaps also at Tyre (*NSI.* p. 129). Inscriptions of the 3rd and 2nd centuries B.C. mention a *Rab* (chief) in Sidon, Cyprus and Gaulus (Gozo); what his position was it is difficult to say; in the colonies he may have been a district governor. During Nebuchadrezzar's time, as we have seen, a republic took the place of the monarchy at Tyre, and the government was administered by a succession of suffetes (judges); they held office for short terms, and in one instance two ruled together for six years. Much later, in the 3rd century B.C. an inscription from Tyre mentions a suffete (*NSI.* No. 8) without adding more to our knowledge. Carthage, of course, was governed by two suffetes, and these officers are frequently named in connection with the Carthaginian colonies (*NSI.* p. 115 *seq.*); but we must be careful not to draw the inference that Phoenicia itself had any such magistrates. Under the Persians a federal bond was formed comprising Sidon, Tyre and Aradus, whose duty it was to contribute 300 triremes to the Persian fleet (Herod., vii. 89), the lesser towns being under the command of the great cities. But federation on a larger scale was never possible in Phoenicia, for the reason that no sense of political unity existed to bind the different states together. Commercial interests dominated everything else, and while these stimulated a municipal life not without vigour, civil discipline and loyalty were but feebly felt. On occasion the towns could defend their independence with strenuous courage; the higher qualities which make for a progressive national life the Phoenicians did not possess.

The Persian Period, 538–333 B.C.—Phoenicia now became part of the fifth satrapy of the Persian empire, and entered upon a spell of comparative peace and growing prosperity. At this period Sidon occupied the position of leading state; in the fleet her king ranked next to Xerxes and before the king of Tyre (Herod., viii. 67); her situation afforded advantages for expansion which Tyre on its small and densely populated island could not rival. In the first half of the 4th century Straton I. (in Phoen. *'Abd-'ashtart* or *Bod-'ashtart*) was king, *c.* 374–362. He cultivated friendly relations with Athens, indicated in a decree of *proxenia* (Michel, *Rec. d'inscr. gr.* No. 93=*CIG.* No. 87); and the extent to which phil-Hellenic tendencies prevailed at this time in Sidon is shown by the royal sarcophagi, noble specimens of Greek art, which have been excavated in the necropolis of the city. It was in the reign of Straton that Tyre fell into the hands of Evagoras, king of Salamis, who had already supplanted Phoenician with Greek civilization in Cyprus (Isocr., *Evag.*, 62, *Paneg.*, 161; Diod. xv. 2). Straton made friends with Nicocles, son of Evagoras, and with him came to an untimely end through their implication in the great revolt of the satraps, 362 B.C. A new revolt of Sidon against the Persians took place under King Tennes; with the aid of Nectanebus of Egypt, the Sidonians carried the rest of Phoenicia with them and drove the satraps of Syria and Cilicia out of the country. Tennes, however, betrayed his people and opened the city to Artaxerxes III.; then he was executed after he had served the ends of the great king (346 B.C.; Diod., xvi. 41–45). The last king of Sidon was Straton II. ('Abd-'ashtart, 346–332) before the Persian empire came to an end.

Towards the close of the 5th century the Phoenician coins begin to supplement our historical sources. From the time of Darius the Persian monarchs allowed their satraps and vassal states to coin silver and copper money at discretion. Hence Aradus, Byblus, Sidon and Tyre issued a coinage of their own, of which many specimens exist; the coins are stamped as a rule with the emblem or name of the city, sometimes with the ruler's name. Thus from the coins of Byblus we learn the names of four kings, 'El-pa'al, 'Az-ba'al (between 360 and 340 B.C.), Adar-melek, 'Ain-el; from the coins of the other cities it is difficult to obtain much information. The native inscriptions, however, now become available, though most of them belong to the period which follows, and only a few have been discovered in Phoenicia itself. One of the earliest of these is the inscription of Byblus (*CIS.* i. 1=*NSI.* No. 3), dating from the Persian period; it records a dedication made by Yeḥaw-milk, king of Gebal, and mentions the name of the king's grandfather, Urimilk, but the exact dates of their reign are not given.

The Macedonian Period, 333–369 B.C.—When Alexander the Great entered Phoenicia after the battle of Issus (333 B.C.), the kings were absent with the Persian fleet in the Aegean; but the cities of Aradus, Byblus and Sidon welcomed him readily, the last-named showing special zeal against Persia. The Tyrians also offered submission, but refused to allow the conqueror to enter the city and sacrifice to the Tyrian Heracles. Alexander was determined to make an example of the first who should offer opposition, and at once began the siege. It lasted seven months. With enormous toil the king drove out a mole from the mainland to the island and thus brought up his engines; ships from the other Phoenician towns and from Cyprus lent him their aid, and the town at length was forced in July 332; 8,000 Tyrians were slain, 30,000 sold as slaves, and only a few notables, the king Azemilkos, and the festal envoys from Carthage who had taken refuge in the sanctuary of Melkarth, were spared (Diod., xvii. 40–46). It is not unlikely that Zech. ix. 2–4 refers to this famous siege. For the time Tyre lost its political existence, while the foundation of Alexandria presently changed the lines of trade, and dealt a blow even more fatal to the Phoenician cities.

During the wars of Alexander's successors Phoenicia changed hands several times between the Egyptian and the Syrian kings. From the year 275 "the people of Tyre" reckoned their era (*CIS.* i. 7=*NSI.* No. 9, *cf.* 10). The Tyrian coins of the period, stamped with native, Greek and Egyptian symbols, illustrate the traditional relations of the city and the range of her ambitions. A special interest attaches to these silver tetradrachms and didrachms because they were used by the Jews for the payment of the temple tax as "shekels of the sanctuary" (*NSI.* pp. 351, 44).

Among the Phoenician states we know most about Sidon during this period. The kingship was continued for a long time. The story goes that Alexander raised to the throne a member of the royal family, Abdalonymus, who was living in obscure poverty and working as a gardener (Justin, xi. 10; Curt., iv. 1; Diod., xvii. 47 wrongly connecting the story with Tyre). In 312 Ptolemy, then master of Phoenicia, appointed his general Philocles king of the Sidonians, and a decree in honour of this king has been found at Athens (Michel, No. 387, *cf.* 1,261); but he cannot have reigned long. For at the end of the 4th and the beginning of the 3rd century we have evidence of a native dynasty in the important inscriptions of Tabnith, Eshmun'azar and Bod-'ashtart, and in the series of inscriptions (repeating the same text) discovered at Bostan esh-Shēkh near Sidon (*NSI.* Nos. 4, 5, 6 and App. i.). With Bod-'ashtart, so far as we know, the dynasty came to an end, say about 250 B.C.

After the death of Antiochus IV. Epiphanes in 164 B.C., the kingdom of the Seleucids began to collapse. Berytus was destroyed by the usurper Trypho in 140 B.C. Tyre in 120 and Sidon in 111 received complete independence, and inaugurated new eras from these dates. Byblus and Tripolis fell into the hands of "tyrants" (Strabo, xvi. 2, 18; Jos., *Ant.*, xiv. 3, 2); from 83–69 B.C. the entire kingdom was held by the Armenian Tigranes.

Roman Rule.—At last in 64 B.C. Pompey arrived upon the scene and established order out of chaos. Phoenicia was incorporated into the Roman province of Syria; Aradus, Sidon, Tyre and Tripolis were confirmed in their rights of self-government and in

the possession of their territories. Under the beneficent government of Rome the chief towns prospered and extended their trade; but the whole character of the country underwent a change. During the Macedonian period Greek influences had been steadily gaining ground in Phoenicia; relations with the Greek world grew closer; the native language fell into disuse, and from the beginning of the Roman occupation Greek appears regularly in inscriptions and on coins, though on the latter Phoenician legends do not entirely vanish till the 2nd century A.D.; while the extent to which Hellenic ideas penetrated the native traditions and mythologies is seen in the writings of Philo of Byblus. For the purposes of everyday life, however, the people spoke not Greek, but Aramaic. As elsewhere, the Roman rule tended to obliterate characteristic features of national life, and under it the native language and institutions of Phoenicia became extinct.

Navigation, Trade, Colonies.—The Phoenicians were essentially a seafaring nation. Fearless and patient navigators, they ventured into regions where no one else dared to go, and, always with an eye to their monopoly, they carefully guarded the secrets of their trade routes and discoveries, and their knowledge of winds and currents. At the beginning of the 7th century B.C. a Phoenician fleet is said to have circumnavigated Africa (Herod., iv. 42). To the great powers Phoenician ships and sailors were indispensable; Sennacherib, Psammetichus and Necho, Xerxes, Alexander, all in turn employed them for their transports and sea-fights. Even when Athens had developed a rival navy Greek observers noted with admiration the discipline kept on board the Phoenician ships and the skill with which they were handled (Xen., *Oec.*, viii.); all the Phoenician vessels from the round merchant-boat (γαῦλος—after which the island of Gaulus, now Gozo, near Malta, was called) to the great Tarshish-ships, the "East-Indiamen" of the ancient world, excelled those of the Greeks in speed and equipment. As E. Meyer points out, the war between the Greeks and the Persians was mainly a contest between the sea-powers of Greece and Phoenicia. At what period did Phoenicia first rise to be a power in the Mediterranean? We are gradually approaching a solution of this obscure problem. Recent discoveries in Crete (*q.v.*) have brought to light the existence of a Cretan or "Minoan" sea-power of remote antiquity, and it is clear that a great deal of what used to be described as Phoenician must receive quite a different designation. The Minoan sea-power was at last broken up by invaders from the north, and a Carian rule became dominant in the Aegean (Herod., i. 171; Thucyd., i. 4, 8). It was a time of disorder and conflict due to the immigration of new races into the ancient seats of civilization, and it synchronized with the weakening of the power of Egypt in the countries which bordered on the eastern Mediterranean. This was in the 12th century B.C. The Tyrian trader saw that his opportunity was come, and the Aegean lay open to his merchant vessels. Where much is still obscure, all that seems certain is that the antiquity of Phoenicia as a sea- and trading-power has been greatly exaggerated both in ancient and in modern times; the Minoan power of Cnossus preceded it by many centuries; the influence of Phoenicia in the Aegean cannot be carried back much earlier than the 12th century B.C.

A vivid description of the Phoenicians' trade at the time of Tyre's prosperity is given by Ezekiel (xxvii. 12–25), and it shows how extensive were their commercial relations not only by sea, but by land as well. It was they who distributed to the rest of the world the wares of Egypt and Babylonia (Herod., i. 1). From the lands of the Euphrates and Tigris regular trade-routes led to the Mediterranean with trading-stations on the way, several of which are mentioned by Ezekiel (xxvii. 23). In Egypt the Phoenician merchants soon gained a foothold; they alone were able to maintain a profitable trade in the anarchic times of the 22nd and 23rd dynasties (825–650 B.C.), when all other foreign merchants were frightened away. Though there were never any regular colonies of Phoenicians in Egypt, the Tyrians had a quarter of their own in Memphis (Herod., ii. 112). The Arabian caravan-trade in perfume, spices and incense passed through Phoenician hands on its way to Greece and the west (Herod., iii. 107). Between Israel and Phoenicia the relations naturally were close; the former provided certain necessaries of life, and received in exchange articles of luxury and splendour (Ezek. xxvii. 16–18). Israelite housewives sold their homespun to Phoenician pedlars (Prov. xxxi. 24 R.V.M.); in Jerusalem Phoenician merchants and money lenders had their quarter (Zeph. i. 11), and after the Return we hear of Tyrians selling fish and all manner of ware in the city (Neh. xiii. 16), and introducing other less desirable imports, such as foreign cults (Isa. lxv. 11). The Phoenician words which made their way into Greek at an early period indicate the kind of goods in which the Phoenicians traded with the west, or made familiar through their commerce; the following are some of them—χρυσός, χιτών, βύσσος, ὀθόνη, μύῤῥα, νάβλα, κύπρος, φῦκος, μνᾶ, παλλακίς, βαίτυλος. Another article of commerce which the Phoenicians brought into the market was amber.

The Phoenician colonies were all supposed to have been founded from Tyre: with regard to the colonies in Cyprus and north Africa this was undoubtedly true. Cyprus possessed resources of timber and copper which could not fail to tempt the keen-eyed traders across the water, who made Citium (from Kittim, the name of the original non-Semitic inhabitants) their chief settlement, and thence established themselves in Idalium, Tamassus, Lapethus, Larnaka, Qarth-ḥadasht (Karti-hadasti) and other towns. In the inscriptions of the 4th to 3rd centuries, the Phoenician potentates in the island call themselves "kings of Kition and Idalion" (*N.S.I.* pp. 55–89).

Homer represents the Phoenicians as present in Greek waters for purposes of traffic, but not as settlers (*Il.*, xxiii. 744). They occupied trading-stations on some of the Aegean islands and on the Isthmus of Corinth. One of their objects was the collection of murex, of which an enormous supply was needed for the dyeing industry; specially famous was the purple of the Laconian waters, the isles of Elishah of Ezek. xxvii. 7. But a great deal of what was formerly assigned to Phoenician influence in the Aegean at an early period—pottery, ornaments and local myths—must be accounted for by the vigorous civilization of ancient Crete. In the Greek world the Phoenicians made themselves heartily detested by their passion for gain (Plato, *Rep.* iv. 436 A.).

Farther west in the Mediterranean Phoenician settlements were planted first in Sicily, at Heraclea or Ras Melqarth; the islands between Sicily and Africa, Melita (Malta) on account of its valuable harbour, Gaulus and Cossura were also occupied (Diod., v. 12); and a beginning was made with the colonization of Sardinia and Corsica; but farther west still more permanent colonies were established. It was the trade with Tarshish; *i.e.*, the region of Tartessus in south-west Spain, which contributed most to the Phoenicians' wealth; it was said that even the anchors of ships returning from Spain were made of silver (Diod., v. 35). From Gadeira (Punic *Gādēr*, Lat. *Gades*, now Cadiz), the Sidonian ships ventured farther on the ocean and drew tin from the mines of north-west Spain or from the richer deposits in the Cassiterides; *i.e.*, the Tin Islands. These were discovered to be, not a part of Britain as was imagined at first, but a separate group by themselves, now known as the Scillies; hence it is improbable that the Phoenicians ever worked the tin-mines in Cornwall.

The rich trade with Spain led to the colonization of the West. Strabo dates the settlements beyond the Pillars of Hercules soon after the Trojan War (i. 3, 2), in the period of Tyre's first expansion. Lixus in Mauretania, Gades and Utica, are said to have been founded, one after the other, as far back as the 12th century B.C. Most of the African colonies were no doubt younger; we have traditional dates for Aoza (887–855) and Carthage (813). A large part of north-west Africa was colonized from Phoenicia; owing to these first settlers, and after them to the Carthaginians, the Phoenician language became the prevailing one, and the country assumed quite a Phoenician character.

In the days of Tyre's greatness her power rested directly on the colonies, which, unlike those of Greece, remained subject to the mother-city, and paid tithes of their revenues to its chief god, Melqarth, and sent envoys annually to his feast. Then at the beginning of the 8th century B.C. the colonial power of Tyre began to decline; on the mainland and in Cyprus the Assyrians

gained the upper hand; in the Greek islands the Phoenicians had already been displaced to a great extent by the advancing tide of Dorian colonization. But as Tyre decayed in power the colonies turned more and more to Carthage as their natural parent and protector. For effective control over a colonial empire Carthage had the advantage of situation over far-away Tyre; the traditional bonds grew lax and the ancient dues ceased to be paid, though as late as the middle of the 6th century Carthage rendered tithes to the Tyrian Melqarth. And the mother-country cherished its claims long after they had lost reality; in the 2nd century B.C., for example, Sidon stamped her coins with the legend, "Mother of Kambē (*i.e.*, Carthage), Hippo, Kition, Tyre" (*NSI*. p. 352).

Manufactures, Inventions, Art.—From an early date the towns of the Phoenician coast were occupied, not only with distributing the merchandise of other countries but with working at industries of their own; especially purple-dyeing and textile fabrics (*Il.*, vi. 289 *sqq.*), metal work in silver, gold and electrum (*Il.*, xxiii. 741 *sqq.; Od.*, iv. 615 *sqq.* xv. 458 *sqq.*), and glass-work, which had its seat at Sidon. The iron and copper mines of Cyprus (not Sidon, as Homer implies, *Od.*, xv. 424) furnished the ore which was manufactured into articles of commerce. Egyptian monuments frequently mention the vessels of gold and silver, iron and copper, made by the Dahi, *i.e.*, the Phoenicians (W. M. Müller, *As. u. Eur.*, 306); and in Cyprus and at Nimrud bronze and silver paterae have been found, engraved with Egyptian designs, the work of Phoenician artists (*see* table-cases C and D in the Nimrud gallery of the Brit. Mus.). The invention of these various arts and industries was popularly ascribed to the Phoenicians, no doubt merely because Phoenician traders brought the products into the market. But dyeing and embroidery probably came from Babylon in the first instance; glass-making seems to have been borrowed from Egypt; the invention of arithmetic and of weights and measures must be laid to the credit of the Babylonians. The ancients believed that the Phoenicians invented the use of the alphabet (*e.g.*, Pliny, *N.H.*, v. 13, *cf.* vii. 57; Lucan, *Bell. Civ.*, iii. 220 *seq.*); but it is unlikely that any genuine tradition on the subject existed, and though the Phoenician theory has found favour in modern times it is open to much question.

The art of Phoenicia is characterized generally by its dependence upon the art of the neighbouring races. It struck out no original line of its own, and borrowed freely from foreign, especially Egyptian, models. Remains of sculpture, engraved bronzes and gems, show clearly the source to which the Phoenician artists went for inspiration; for example, the uraeus-frieze and the winged disc, the *ankh* or symbol of life, are Egyptian designs frequently imitated. It was in the times of the Persian monarchy that Phoenician art reached its highest development, and to this period belong the oldest sculptures and coins that have come down to us. A characteristic specimen of the former is the stele of Yeḥaw-milk, king of Gebal (*CIS*. i. 1), in which the king is represented in Persian dress, and the goddess to whom he is offering a bowl looks exactly like an Egyptian Isis-Hathor; (Gressmann, *Texte u. Bilder*², ii. Pl. ccviii.). The whole artistic movement in Phoenicia may be divided into two great periods: in the first, from the earliest times to the 4th century B.C., Egyptian influence and then Babylonian or Asiatic influence is predominant, but the national element is strongly marked; while in the second, Greek influence has obtained the mastery, and the native element, though making itself felt, is much less obtrusive. Throughout these periods works of art, such as statues of the gods and sarcophagi, were imported direct at first from Egypt and afterwards mainly from Rhodes. The finest sarcophagi that have been found in the necropolis of Sidon (now in the Imperial Museum, Constantinople) are not Phoenician at all, but exquisite specimens of Greek art. The Phoenicians spent much care on their burial-places, which have furnished the most important monuments left to us. Thus, on the site of Gebal, now Jebeil, the French excavators, under the leadership of Montet, 1921–23, have unearthed the fine sarcophagus of Aḥîram, Egyptian in style, and engraved with the earliest Phoenician inscripition so far known; *see* Gressmann; *Texte u. Bilder*², i. 440; ii. 189–192 and Pl. ccliv. (1927). Besides busts and figurines, which belong as a rule to the Greek period, the smaller objects usually found are earthen pitchers and lamps, glass-wares, tesserae and gems. Of buildings which can be called architectural few specimens now exist on Phoenician soil, for the reason that for ages the inhabitants have used the ruins as convenient quarries. Not a vestige remains of the great sanctuary of Melqarth at Tyre; a few traces of the temple of Adonis near Byblus were discovered by Renan, and a peculiar mausoleum, Burj al-Bezzāq, is still to be seen near Amrit; excavations at Bostan esh-Shēkh near Sidon revealed parts of the enclosure or foundations of the temple of Eshmun (*NSI*. p. 401); the conduits of Ras el- 'Ain, south of Tyre, are considered to be of ancient date.

Religion.—Like the Canaanites of whom they formed a branch, the Phoenicians connected their religion with the great powers and processes of nature. The gods whom they worshipped belonged essentially to the earth; the fertile field, trees and mountains, headlands and rivers and springs, were believed to be inhabited by different divinities, who were therefore primarily local, many in number, with no one in particular supreme over the rest. It seems, however, that as time went on some of them acquired a more extended character; thus Ba'al and Astarte assumed celestial attributes in addition to their earthly ones, and the Tyrian Melqarth combined a celestial with a marine aspect. The gods in general were called *'elōnīm, 'elīm;* Plautus uses *alonium valonuth* for "gods and goddesses" (*Poen.*, v. I, 1). These plurals go back to the singular form 'El, the common Semitic name for God; but neither the singular nor the plural is at all common in the inscriptions (*NSI*. pp. 24, 41, 51); 'El by itself has been found only once; the fem. 'Elath is also rare (*ibid.*, pp. 135, 158). The god or goddess was generally called the Ba'al or Ba'alath of such and such a place, a title which was used not only by the Canaanites, but by the Aramaeans (Be'el) and Babylonians (Bel) as well. There was no one particular god called Ba'al; the word is not a proper name but an appellative, a description of the deity as *owner* or *mistress;* and the same is the case with Milk or Melek, 'Adon, 'Amma, which mean *king, lord, mother*. The god himself was unnamed or had no name. Occasionally we know what the name was; the Ba'al of Tyre was Melqarth which again means merely "king of the city"; similarly among the Aramaeans the Ba'al of Harran was the moon-god Sin. As each city or district had its own Ba'al, the "husband" of the land which he fertilized, so there were many Ba'als, and the Old Testament writers could allude to the Ba'ālim of the neighbouring Canaanites. Sometimes the god received a distinguishing attribute which indicates an association not with any particular place, but with some special characteristic; the most common forms are Ba'al-ḥammān, the chief deity of Punic north Africa perhaps "the glowing Ba'al," the god of fertilizing warmth, and Ba'al-shamēm, "Ba'al of the heavens" (*cf.* Dan. xii. 11, xi. 31, etc.). The latter deity was widely venerated throughout the north Semitic world; his name, which does not appear in the Phoenician inscriptions before the 3rd century B.C., goes back at least to 800 B.C. (Aramaic inscription of Zakir, from Hamath.) The worship of the female along with the male principle was a strongly marked feature of Phoenician religion.

To judge from earliest evidence on the subject, the Ba'alath of Gebal or Byblus, referred to again and again in the Amarna letters (*Bêlit ša Gubla*, Nos. 68–125), must have been the most popular of the Phoenician deities, as her sanctuary was the oldest and most renowned. The *mistress of Gebal* was no doubt 'Ashtart (Astartē in Greek, 'Ashtōreth in the Old Testament, pronounced with the vowels of *bōsheth*, "shame"), a name which is obviously connected with the Babylonian Ishtar, and, as used in Phoenician, is practically the equivalent of "goddess." She represented the principle of fertility and generation; the common epithets Κύπρις and Κυθέρεια (of Kuthera in Cyprus), Cypria and Paphia, show that she was identified with Aphrodite and Venus. Though not primarily a moon-goddess, she sometimes appears in this character (Lucian, *Dea syr*, § 4; Herodian v. 6, 10), and Herodotus describes her temple at Ashkelon as that of the heavenly

Aphrodite (i. 105). We find her associated with Ba'al and called "the name of Ba'al"; *i.e.*, perhaps his manifestation. Another goddess, specially honoured at Carthage, is Tanith (pronunciation uncertain); nothing is known of her characteristics; she is regularly connected with Ba'al on the Carthaginian votive tablets, and called "the face of Ba'al"; *i.e.*, his representative or revelation, though again some question this rendering as too metaphysical, and take "face of Ba'al" to be the name of a place, like Peni'el ("face of 'El"). Two or three other deities may be mentioned here: Eshmun, the god of vital force and healing, worshipped at Sidon especially, but also at Carthage and in the colonies, identified by the Greeks with Asclepius; Melqarth, the patron deity of Tyre, identified with Heracles; Reshef or Reshūf, the "flame" or "lightning" god, especially popular in Cyprus and derived originally from Syria, whom the Greeks called Apollo. A tendency to form a distinct deity by combining the attributes of two produced such curious fusions as Milk-'ashtart, Milk-ba'al, Milk-'osir, Eshmun-melqarth, Melqarth-reṣef, etc. As in the case of art and industries so in religion the Phoenicians readily assimilated foreign ideas. The influence of Egypt was specially strong (*NSI.* pp. 62, 69, 148, 154). The Phoenician settlers at the Peiraeus worshipped the Assyrian Nergal, and their proper names are compounded with the names of Babylonian and Arabian deities (*NSI.* p. 101). Closer intimacy with the Greek world naturally brought about modifications in the character of the native gods, which became apparent when Ba'al of Sidon or Ba'al-shamēm was identified with Zeus, Tanith with Demeter or Artemis, 'Anath with Athena, etc.; the notion of a supreme Ba'al, which finds expression in the Greek *βῆλος* and *βααλτίς* or *βήλθης* (the goddess of Byblus), was no doubt encouraged by foreign influences. On the other hand, the Phoenicians produced a considerable effect upon Greek and Roman religion, especially from the religious centres in Cyprus and Sicily. A great number of divinities are known only as elements in proper names, *e.g.*, *Sakun*-yathon (Sanchuniathon), 'Abd-*sasom*, *Ṣed*-yathon, and fresh ones are continually being discovered. It was the custom among the Phoenicians, as among other Semitic nations, to use the names of the gods in forming proper names and thus to express devotion or invoke favour; thus Ḥanni-ba'al, 'Abd-melqarth, Hanni-'ashtart, Eshmun-'azar. The proper names further illustrate the way in which the relation of man to God was regarded; the commonest forms are *servant* ('abd, *e.g.*, 'Abd-'ashtart), *member* or *limb* (bod, *e.g.*, Bodmelqarth), client or *guest* (ger, *e.g.*, Ger-eshmun); the religious idea of the *guest* of a deity had its origin in the social custom of extending hospitality to a stranger and in the old Semitic right of sanctuary.

Sacred Objects and Worship.—Probably like other Canaanites the Phoenicians offered worship "on every high hill and under every green tree"; but to judge from the allusions to sanctuaries in the inscriptions and elsewhere, the Ba'al or 'Ashtart of a place was usually worshipped at a temple, which consisted of a court or enclosure and a roofed shrine with a portico or pillared hall at the entrance. In the court sometimes stood a conical stone, probably the symbol of Astarte, as on the Roman coins of Byblus (*see* Ohnefalsch-Richter, *Cyprus*, pl. lvi., the temenos at Idalion). Stone or bronze images of the gods were set up in the sanctuaries (*NSI.* Nos. 13 *seq.*, 23–27, 30, etc.); and besides these the *baetylia* (meteoric stones) which were regarded as symbols of the gods. Pillars, again, had a prominent place in the court or before the shrine (*naṣab, ibid.* pp. 102 *seq.* and W. R. Smith, *Rel. of Sem*³., pp. 203 ff., 456 ff.); but it is not known whether the sacred pole (*'asherah*), an invariable feature of a Canaanite sanctuary, was usual in a Phoenician temple. The inscriptions mention altars of stone and bronze, and from the sacrificial tariffs which have survived we learn that the chief types of sacrifice among the Phoenicians were analogous to those which we find in the Old Testament (*NSI.* p. 117). The ghastly practice of sacrificing human victims was resorted to in times of great distress (*e.g.*, at Carthage, Diod., xx. 14), or to avert national disaster (Porphyry, *de Abstin*, ii. 56); it was regarded as a patriotic act when Hamilcar threw himself upon the pyre after the disastrous battle of Himera (Herod., vii. 167). The god who demanded these victims, and especially the burning of children, seems to have been Milk, the Molech or Moloch of the Old Testament. In this connection may be mentioned the custom of burning the chief god of the city in effigy, or in the person of a human representative, at Tyre and in the Tyrian colonies, such as Carthage and Gades; the custom lasted down to a late time (*see* Frazer, *Adonis, Attis, Osiris*, ch. v.). Another horrible sacrifice was regularly demanded by Phoenician religion: women sacrificed their virginity at the shrines of Astarte in the belief that they thus propitiated the goddess and won her favour (*Rel. of Sem*³., 329, 611 ff.); licentious rites were the natural accompaniment of the worship of the reproductive powers of nature. These temple prostitutes are called *qedēshīm qedēshōth, i.e.*, sacred men, women, in the Old Testament (Deut. xxiii. 18; I Kings xiv. 24, etc.). Other persons attached to a temple were priests, augurs, sacrificers, barbers, officials in charge of the curtains, masons, etc. (*NSI.* No. 20); we hear also of religious gilds and corporations, perhaps administrative councils, associated with the sanctuaries (*ibid.*, pp. 94, 121, 130, 144 *seq.*).

Mythology and Religious Ideas.—No doubt the Phoenicians had their legends and myths to account for the origin of man and the universe; to some extent these would have resembled the ideas embodied in the book of Genesis. Two cosmogonies have come down to us which, though they differ in details are fundamentally in agreement. The one, of Sidonian origin, is preserved by Damascius (*de prim. principiis*, 125) and received at his hands a Neoplatonic interpretation; the other and more elaborate work was composed by Philo of Byblus (temp. Hadrian); he professed that he had used as his authority the writings of Sanchuniathon (*q.v.*), an ancient Phoenician sage, who again derived his information from the mysterious inscribed stones (*ἀμμουνεῖς* = חמנים, i.e., images or pillars of Ba'al-ḥammān) in the Phoenician temples. Philo's cosmogony has been preserved, at least in fragments, by Eusebius in *Praep. evang.*, vol. i. (*Fr. hist. gr.*, iii. 563 *sqq.*). It cannot, however, be taken seriously as an account of genuine Phoenician beliefs. At the same time Philo did not invent all the nonsense which he has handed down; he drew upon various sources, Greek and Egyptian, some of them ultimately of Babylonian origin, and incidentally, he mentions matters of interest which, when tested by other evidence, are fairly well supported. He shows at any rate that some sort of a theology existed in his day; particularly interesting is his description of the symbolic figure of Cronus with eyes before and behind and six wings open and folded (*Fr. hist. gr.*, iii. 569), a figure which is represented on the coins of Gebal-Byblus (2nd century B.C.) as the mythical founder of the city. It is evident that the gods were regarded as being intimately concerned with the lives and fortunes of their worshippers. The vast number of small votive tablets found at Carthage prove this; they were all inscribed by grateful devotees "to the lady Tanith, Face of Ba'al, and the lord Ba'al-ḥammān, because he heard their voice." The care which the Phoenicians bestowed upon the burial of the dead has been alluded to above; pillars (*maṣṣēbōth*) were set up to commemorate the dead among the living (e.g., *NSI.* Nos. 18, 19, 21, 32); if there were no children to fulfil the pious duty, a monument would be set up by a man during his lifetime (*ibid.*, No. 16; *cf.* 2 Sam. xviii. 18). Any violation of the tomb was regarded with the greatest horror (*ibid.*, Nos. 4, 5). The grave was called a resting-place (*ibid.*, Nos. 4, 5, 16, 21), and the departed lay at rest in the underworld with the *Refāim*, the weak ones (the same word and idea in the Old Testament, Isa. xiv. 9, xxvi. 14, 19; Job xxvi. 5; Ps. lxxxviii. 10 etc.). The curious notion prevailed, as it did also among the Greeks and Romans, that it was possible to communicate with the gods of the underworld by dropping into a grave a small roll of lead (*tabella devotionis, NSI.* No. 50), inscribed with the message, generally a curse, which it was desired to convey to them.

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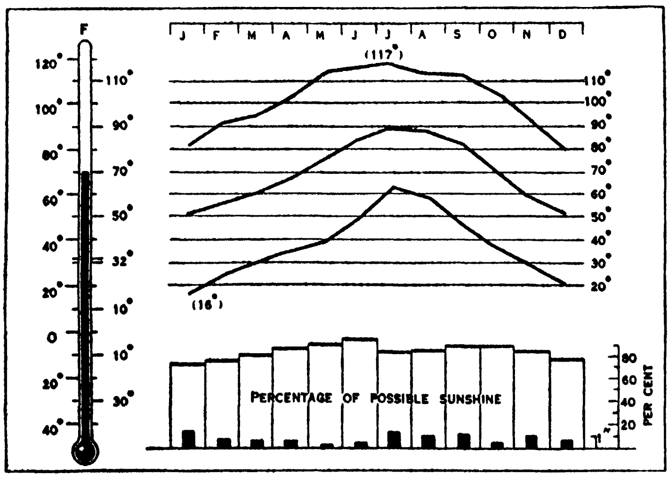
PHOENIX, the capital and largest city of Arizona, U.S.A., and the county-seat of Maricopa county; on the Salt river, at an altitude of 1,100 ft., midway between El Paso and Los Angeles.



WEATHER GRAPH OF PHOENIX, ARIZONA. THE MERCURY INDICATES THE NORMAL ANNUAL MEAN TEMPERATURE, AND THE CURVES SHOW THE MONTHLY MAXIMUM, AVERAGE AND MINIMUM MEAN TEMPERATURES. THE BLOCK SHOWS THE POSSIBLE SUNSHINE PERCENTAGE, AND THE SHADED SPOTS INDICATE THE NORMAL MONTHLY PRECIPITATION

It is on Federal highways 80 and 89; has a municipal airport; and is served by the Santa Fe and the Southern Pacific railways. The population was 29,053 in 1920 (81% native white) and was estimated locally at 65,000 in 1928. The climate of the Salt River valley is mild, dry, and clear, and Phoenix is an important health and pleasure resort. The average monthly mean temperature ranges from 51·2° F in December to 89·8° in July; the average annual precipitation is 7·87 inches; the amount of "possible sunshine" averages 84%. It is estimated that tourists spend $3,000,000 in the city in a year. The city occupies 5·75 sq.m. in a vast saucer-like valley, encircled by mountains, which is irrigated from the Roosevelt dam, 70 m. N.E., and other projects. Cotton (largely a long-staple variety), alfalfa, lettuce, cantaloupes, grapes, citrus fruits, olives, apricots, and other fruits and vegetables are leading crops. Date palms, pepper and eucalyptus trees, and the magnificent saguaro cactus, are features of the landscape. The state capitol, of native tufa, is set in a 10-acre park where all the trees and shrubs indigenous to the region are represented. The Papago Saguaro National Monument (1,940 acres) lies 3 m. E.; 6 m. S. is the city's mountain park of 14,000 acres; at Tempe, 8 m. E., is a State Teachers' college; and the State experimental farm is near Mesa, 15 m. S.E. Phoenix has an assessed valuation of $57,625,882 (1928); bank deposits on June 30, 1928, aggregated $36,677,801; and post-office receipts for 1927 were $428,637. Since 1914 it has had a commission-manager form of government. Phoenix was founded in 1871, incorporated in 1881, and became the capital of Arizona in 1889. In 1890 the population was 3,152; in 1900, 5,544; in 1910, 11,134. Between 1910 and 1920 it increased 161%.

PHOENIX, a fabulous bird, sacred to the sun (Gr. Φοῖνιξ, apparently "bright-coloured"; φοῖνιξ also means "a palm-tree"). From statements in a large number of classical and post-classical authors, ranging from the 5th century B.C. (Herodotus, perhaps Hecataeus) to the Middle Ages (Isaac Tzetzes) the following account is obtained: The phoenix was a large bird of very gorgeous plumage, having, according to one or two authorities, a sweet voice. It was always male, the only one of its kind, and lived a long time (various authors give periods ranging from 500 years, the commonest account, up to 12,954; Tacitus, *Annales* vi. 28, 4, gives 1,461 years, which is an Egyptian Sothis period). At the expiration of that time it made itself a nest of twigs of spice-trees, on which it died, by setting the nest on fire and burning itself alive. From its body, or its ashes, or the nest, which it had fertilized, came forth another phoenix, either perfect or at first in the shape of a white grub. This young bird, as soon as it was strong enough, took up the body of its father, covered in spices, or the ashes, nest, and all, and flew to Heliopolis in Egypt, where it deposited them on the altar of the Sun. There are numerous variants in detail; sometimes the phoenix goes to Egypt to die, having produced its offspring before dying.

It was not doubted by the majority that the phoenix really was seen now and then in Egypt; Tacitus, *loc. cit.*, and Pliny, *nat. hist.*, x. 2, mention recorded appearances, genuine and otherwise. Attention is therefore drawn by A. Wiedemann to the facts that a bird of the stork kind, the *bennu* or *bannu,* was sacred at Heliopolis and connected with the local sun-worship, moreover, that its name also means a palm-tree. This certainly gives a plausible origin for some parts of the Greek story and accounts for Herodotus's statement (ii. 73, 1) that he saw a picture of it in Egypt; for the *bennu* is to be found on surviving monuments. But it fails to account for the persistent statement that the phoenix is not a native of Egypt, but lives in Arabia, Assyria, Ethiopia or India, nor does the real or pictured *bennu* at all resemble the phoenix as described. Hence it is likely that the ultimate origin of the story, however it may have reached Greece, is to be sought in the mythology of one or another of these countries.

Many commentators still understand the word חול, *chol,* in Job xxix. 18 (in King James's Version, "sand") to apply to the phoenix. This interpretation is perhaps as old as the (original) Septuagint, and is current with the later Jews. Among the Arabs the story of the phoenix was confused with that of the salamander; and the samand or samandal (Damiri, ii. 36 *et seq.*) is represented sometimes as a quadruped, sometimes as a bird. It was firmly believed in; for the incombustible cloths woven of flexible asbestos were popularly thought to be made of its hair or plumage, and were in fact, called by the same name (*cf.* Yaqut i. 529, and Dozy, *s.v.*). The *'anka* (Pers. *simurgh*), a stupendous bird like the roc (rukh) of Marco Polo and the *Arabian Nights,* also borrows some features of the phoenix. According to Kazwini (i. 420) it lives 1,700 years, and when a young bird is hatched the parent of opposite sex burns itself alive.

Ancient and modern authorities are collected and analysed by Türk, in Roscher's *Lexikon*, iii. col. 3,450 *et seq.*

PHOENIX ISLANDS: *see* PACIFIC ISLANDS.

PHOENIXVILLE, a borough of Chester county, Pennsylvania, U.S.A., on the Schuylkill river, at the mouth of French creek, 28 m. N.W. of Philadelphia; served by the Pennsylvania and the Reading railways. Pop. (1920) 10,484 (80% native white); 1928 local census 12,282. It has extensive iron and steel works, making steel bridges, architectural steel, boilers and many other products; also underwear, silk and silk hosiery mills. The aggregate manufactured output in 1925 was valued at $13,583,696. Phoenixville was settled in 1732 and incorporated in 1849.

PHOLIDOTA, an order of mammals, comprising only the scaly ant-eaters (Manidae) of Asia and Africa. The order was formerly united with the Xenarthra and Tubilidentata (*q.v.*) as the order Edentata (*q.v.*). (*See* also PANGOLIN.)

PHONETICS is the science of the pronunciation of languages. It is concerned with the mechanism by which speech-sounds are formed, the manner of combining sounds so as to make syllables, words and sentences, the treatment of speech-sounds in different languages as regards their "attributes" (length, stress and voice-pitch), the *timbre* (acoustic quality) of speech-sounds and groups of speech-sounds, the methods of representing speech-sounds by means of writing (including transcripts for language learners, spelling reform and the writing of languages hitherto unwritten).

Phonetics has two main practical objects: (1) to help learners of foreign languages to hear accurately and to pronounce accurately, and (2) to enable those who are concerned with the spelling or writing down of languages to devise the simplest and most practical system for each language.

Phonetic Analysis.—In order to effect either of these prac-

tical objects it is necessary that a "phonetic analysis" should be made of the language under consideration. The nature and mode of formation of every speech-sound of the language must be ascertained with the greatest possible accuracy; long passages of the language must then be transcribed phonetically by means of a minutely accurate system, with the object of finding out how the sounds may be grouped into "phonemes" (*see* p. 774). The usage of the particular language as regards the length of sounds, the stress (force-accent) of syllables and the intonation (pitch, musical accent) of words and sentences must be examined in detail. To obtain the best results, the investigations must be made by the "acoustic" method; the results may be corroborated by "experimental" methods.

Analysis by the "acoustic" method can only be carried out by an observer who is a trained phonetician, *i.e.*, a person whose ear has been trained to distinguish and recognize minute shades of sound and who has arrived at a high degree of precision in the control over the movements of his tongue and other parts of the speech-organs—who can in fact already pronounce a large number of difficult foreign sounds and sound-combinations. He must have as a collaborator a native speaker of the language to be analysed—if possible, one with natural linguistic ability. The process of investigation is as follows. The observer gets the native to repeat words and phrases of his language a very large number of times. He may find these words and phrases to be composed of sounds already known to him. If so (and if the language does not present special difficulties in the matter of length, stress or intonation), he will at once be able to repeat them to the native's satisfaction. If the native is not satisfied, it means that the word or phrase contains one or more unfamiliar sounds, or that the language contains some unusual features of length, stress or intonation. To acquire the correct pronunciation, the observer uses his power of making fine adjustments in the positions and movements of his own speech organs. He tries one variation, and then another, until he succeeds in pronouncing the word or phrase to the native's satisfaction. He then knows by his own muscular and tactile sensations what is the exact manner of formation of the unfamiliar sounds of the language. The investigator must make his native collaborator understand that nothing short of pronunciation indistinguishable from that of a native is to be accepted. When necessary, he must test his native collaborator's ear by making intentional mispronunciations. The best results are of course obtained when the observer can train the native himself in methods of phonetic research.

Experimental Methods.—Analysis of pronunciation by the acoustic method may be checked by "experimental" methods, *i.e.*, investigation by apparatus. The most important pieces of apparatus are the gramophone, the phonograph, the phonetic kymograph and the lioretgraph (an instrument for enlarging the curves formed by the grooves of gramophone and phonograph records). They are particularly useful in the analysis of length and intonation. The ascertaining of the positions of the tongue and velum and of the shapes assumed by the pharyngeal cavity is facilitated by X-ray photography. Indications of tongue-positions may also be found by the use of a special kind of artificial palate.

Phonetics Applied to the Learning of Foreign Languages.—The following is a brief account of the method of using phonetics in learning a foreign language with the aid of a teacher. The task of the teacher is to make his pupil pronounce the foreign language correctly. Consequently his first aim must be to teach him to make the sounds of that language. This is done by imitation coupled with phonetic theory. Thus if the sound to be taught is the French sound of *u* in *lune,* and, as is usually the case, the English pupil is unable to make it correctly by imitation, the teacher tells the pupil to perform the following exercise, which is based on the theory of tongue and lip positions: Purse up the lips as for the English *oo*-sound, and while holding them in that position, try to pronounce the English *ee*-sound. With a very little practice the French sound of *u* will result. Again, if the pupil is to learn to make the sound ɬ (Zulu *hl,* Welsh *ll*), the teacher, knowing that the sound is a "voiceless l," tells him to keep his tongue as if he were going to say an ordinary l and then simply blow a strong stream of air through his mouth; this will give a good approximation to the sound, and it can be perfected by a knowledge of the details of the formation of l-sounds. If the pupil is to learn to make the German sound of *ch* in *recht,* the teacher, knowing that its tongue-position is almost identical with that of the English *ee*-sound, tells him to keep his tongue as if he were going to say the English *ee*-sound and then merely to blow out a stream of air. If he is to learn to make the Polish sound of *ć* or Pekingese sound written *hs,* the teacher tells him to try to make this German sound and *s* simultaneously, knowing that the attempt to do this will give the right tongue-position. The methods used in the above cases are very simple; in more difficult cases it is often necessary to try several methods before one is found which will enable the pupil to produce the correct sound.

Ear-training.—One of the most important parts of any course of instruction in phonetics consists of "ear-training" or more accurately "cultivation of the auditory memory." The pupil must learn (1) to *discriminate* between one foreign sound and another which on a first hearing may seem to resemble it; (2) to *discriminate* between foreign sounds and sounds of the mother tongue which resemble them; (3) to *remember* the acoustic qualities of foreign sounds; (4) to *recognize* foreign sounds with ease and certainty. There is only one method of training the auditory memory, namely "nonsense dictation." The teacher dictates meaningless words made up of sounds of the language to be learnt. The pupil writes what he thinks he hears by means of a phonetic system; then the teacher can see from the transcript whether the pupil has recognized the foreign sounds correctly. When the pupil makes a mistake, the teacher repeats the meaningless word firstly as he originally said it and then in the way written by the pupil; he repeats the two pronunciations a number of times so that the pupil may hear clearly the nature of his mistake. The pupil's course of study should include a large amount of this type of exercise carefully graduated. Thus if the pupil is learning the pronunciation of French, the earlier ear-training exercises would contain easy words such as the following: petozɛ, vɔʃɛnut, fɑkøna, sogɛ̃ʒib. The exercises become progressively more difficult until words are given such as: pfestriɔʒnwɛbm, uidznezmœrlɔ, bɑ̃ɔzvələlaʃkeɛ. (The system of transcription used here and elsewhere in this article is that of the *International Phonetic Association.*) Later on, the exercises are made still more difficult by the introduction of sounds of the pupil's mother tongue.

Phonetic Transcription.—Besides being able to hear the foreign sounds correctly and to make them correctly the pupil must know which are the appropriate sounds to use in words and sentences. This information is best conveyed to him by means of a phonetic notation, *i.e.*, by spelling the words and sentences with an alphabet which provides one letter for each phoneme (*see* p. 774) of the language. (In certain cases, in order to avoid introducing additional symbols, it is convenient to represent a sound by means of a digraph, *i.e.*, a sequence of two letters; thus the sounds of German *z* and English *ch* are commonly transcribed ts, tʃ.) The pupil's course of study should therefore include reading from phonetic texts and writing passages of the language phonetically as exercises to be corrected by the teacher. The pupil must also be instructed in the use made of length, stress and intonation in the foreign language. These features of the language should be marked as far as practicable in the phonetic transcriptions.

When the learner is unable to find a phonetically trained teacher of the language, he should make himself familiar with the principles of general phonetics, and thus learn to analyse his instructor's speech and reproduce it accurately. If there exists a good book on the phonetics of the language, he should be able to pronounce intelligibly with its aid. Good gramophone records may also be of considerable assistance.

Phonetics Applied to the Teaching of the Mother Tongue.—The "received" form of a language is a kind of foreign language to those who speak dialects or speak with special "accents." The

methods of teaching "received" pronunciation are therefore similar to those followed in teaching a foreign language. Some of the sounds of "received" pronunciation will be new to the pupil, and must be taught by means of exercises which his phonetically trained teacher invents to suit his particular needs. His natural pronunciation may also differ from "received" pronunciation in other respects, and particularly by the use of a different distribution of known sounds, as when a Londoner makes the last syllable of *opposite* rhyme with *might,* or when a native of Lancashire gives to the *u* in *butcher* the same value as it has in *cut.* Here phonetic transcriptions are useful for showing the difference of sound.

Phonemes.—When the sounds existing in a given language have been analysed, it is always found that some of them may be regarded as variants of others, which they replace in certain well-defined conditions. A family consisting of one distinctive sound of the language together with the variants which represent it in particular sound-combinations is called a "phoneme." The nature of a phoneme is best shown by examples. The three k's in *keep, cool, cot* are different sounds, but for practical purposes they may be treated as a single entity; they are said to belong to the same phoneme. The precise k-sound used in any particular case is determined by the nature of the neighbouring sounds, and the different varieties are not used for the purpose of distinguishing English words. Similarly the three t-sounds in *eight, eighth, train* belong to one phoneme, because the variants in *eighth* (phonetically eɪtθ), *train,* are dependent upon the neighbouring sounds θ, r. The French sounds l and l̥ (voiceless l) are members of the same phoneme. l̥ is used in French only in final position when a consonant precedes, as when the word *boucle* occurs at the end of a sentence; ordinary voiced l does not occur in this position, and consequently a Frenchman naturally regards the two very dissimilar sounds l and l̥ as a single entity.

It often happens that sounds which belong to one phoneme in one language constitute separate phonemes in another language; they are consequently used for the purpose of distinguishing words in the second language though not in the first. Thus l and l̥ are separate phonemes in Welsh, Burmese and Zulu, though they constitute only one phoneme in French (l̥ is transcribed ɬ when it is a separate phoneme). Again h and ç (the German *ich*-sound) are separate phonemes in German, but ç is a member of the h-phoneme in Japanese (the sound used when i follows). The French sounds of *è* and *é* are separate phonemes in French and are used for distinguishing words in that language; but similar sounds occur in Russian and in Zulu as members of one phoneme, their use being determined in Russian by the nature of the adjacent consonants and in Zulu by a principle of vowel-harmony.

Phonemes are families of sounds occurring in a language as pronounced by a single individual. They must be distinguished from diaphones (*see* below) which contain sounds used by two or more different speakers of a language.

The simplest system of phonetic transcription of a language is that which provides one symbol for each phoneme of that language. Such a system is known as "broad" transcription. It is unambiguous to the native and to anyone who knows the rules governing the use of the subsidiary members of the phonemes. More detailed transcriptions, providing symbols for subsidiary members of phonemes, are called "narrow" transcriptions. They are useful in comparative work, dialectology, etc.

Diaphones.—Speakers of the same language often do not all use exactly the same sounds. Thus the vowel element of the word *day* is pronounced in several different ways according to the locality and to the social position of the speaker (phonetically deː, deɪ, dɛɪ, dɛe, dæɪ, etc.). In such cases it is convenient to have a term to denote the family of sounds consisting of a sound of a language as pronounced by an "average" speaker together with other sounds which are used in place of it by other speakers. Thus the various vowel sounds used in the word *day* by different speakers of English are said to constitute one diaphone in the English language.

Phonetic Symbols.—In nearly every language the number of phonemes is greater than the number of letters in the Roman alphabet. It is therefore impossible to represent most languages unambiguously by means of the ordinary Roman letters only. So any romanic phonetic system, whether designed as a current orthography or as a transcription for the use of language learners, must contain new letters to supplement those of the present Roman alphabet. It can be shown that, on psychological, typographical and pedagogical grounds, specially designed letters are better than ordinary Roman letters with diacritical marks attached. In the designing of new letters several factors have to be taken into consideration, the chief of which is that the printed forms of the letters should harmonize as well as possible with the ordinary Roman characters, so that the general appearance of the printed page may be satisfactory. It must also be possible to write the new letters with ease. It is further desirable that the letters should have italic forms which do not differ from the Roman forms in any essential part of their outline. To ensure legibility it is necessary that each letter should be as different as possible from every other letter. For typographical reasons the letters should, as far as possible, be designed so as to avoid the necessity of kerned types. Kerns at the top or bottom of the type are entirely inadmissible. Kerns at the side are undesirable and must be resorted to as sparingly as possible; but it does not seem possible in a comprehensive alphabet to avoid them altogether. Lastly, it is a great advantage that the phonetic alphabet as a whole should be international, that is to say that each letter should always be used with the same or approximately the same value.

Of the phonetic alphabets hitherto invented only one, that of the International Phonetic Association, complies satisfactorily with the above-mentioned requirements. The next best is the Swedish dialect alphabet (which, in spite of its name, is really international).

Manner of Using a Phonetic Alphabet.—In constructing phonetic orthographies, or in making phonetic transcripts for

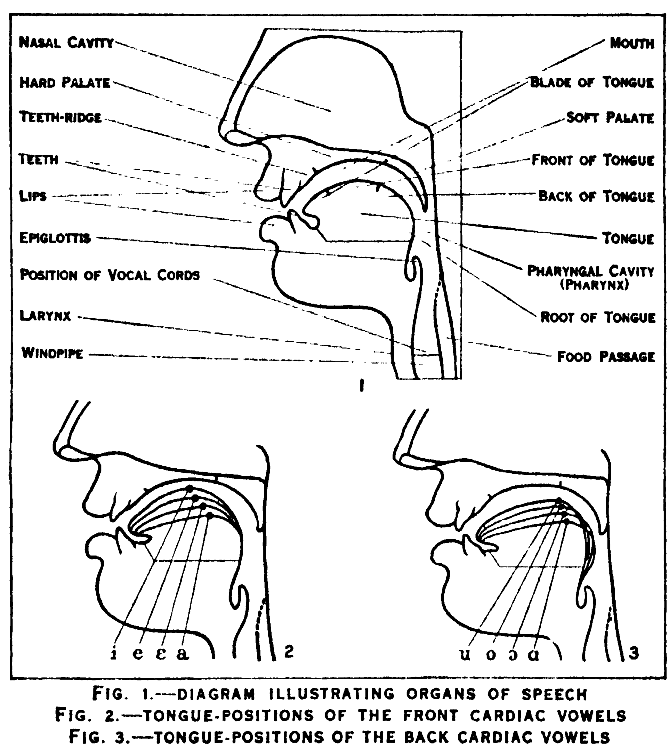


FIG. 1.—DIAGRAM ILLUSTRATING ORGANS OF SPEECH
FIG. 2.—TONGUE-POSITIONS OF THE FRONT CARDIAC VOWELS
FIG. 3.—TONGUE-POSITIONS OF THE BACK CARDIAC VOWELS

language students, attention must be given not only to the design of any special letters that may be required, but also to the manner of using the alphabet. This will depend (1) on the precise purpose for which the alphabet is required, and (2) on the structure of the particular language or languages dealt with. Thus if the writer's purpose is to make a comparative study of related languages he may be obliged to mark distinctions which it would be unnecessary to mark in a transcript of one language for the use of those who wish to learn to speak it.

THE INTERNATIONAL PHONETIC ALPHABET.

CONSONANTS	Bi-labial	Labio-dental	Dental and Alveolar	Retroflex	Palato-alveolar	Alveolo-palatal	Palatal	Velar	Uvular	Pharyngal	Glottal
Plosive	p b		t d	ʈ ɖ			c ɟ	k g	q ɢ		ʔ
Nasal	m	ɱ	n	ɳ			ɲ	ŋ	ɴ		
Lateral Fricative			ɬ ɮ								
Lateral Non-fricative			l	ɭ			ʎ				
Rolled			r						ʀ		
Flapped			ɾ	ɽ					ʀ		
Fricative	ɸ β	f v	θ ð s z ɹ	ʂ ʐ	ʃ ʒ	ɕ ʑ	ç j	x ɣ	χ ʁ	ħ ʕ	h ɦ
Frictionless Continuants and Semi-vowels	w ɥ	ʋ	ɹ				j (ɥ)	(w)	ʁ		

VOWELS	Bi-labial	Front	Central	Back
Close	(y ʉ u)	i y	ɨ ʉ	ɯ u
	(ʏ ʊ)	ɪ ʏ		ʊ
Half-close	(ø o)	e ø		ɤ o
			ɵ	
Half-open	(œ ɔ)	ɛ œ	ɜ	ʌ ɔ
			æ ɐ	
Open	(ɒ)		a	ɑ ɒ

(Secondary articulations are shown by symbols in brackets.)

OTHER SOUNDS.—Palatalized consonants: ƫ, ȡ, etc. Velarized or pharyngalized consonants: ɫ, ᵭ, ᵴ, etc. Ejective consonants (plosives with simultaneous glottal stop): p', t', etc. Implosive voiced consonants: ɓ, ɗ, etc. ɼ fricative trill. σ, ϱ (labialized θ, ð, or s, z). ʅ, ʓ (labialized ʃ, ʒ). ʇ, ʗ, ʖ (clicks, Zulu *c*, *q*, *x*). ɺ (a sound between r and l). ʍ (voiceless w). ɵ (a vowel between ø and o).

Affricates are normally represented by groups of two consonants (ts, tʃ, dʒ, etc.), but, when necessary, ligatures are used (ʦ, ʧ, ʤ, etc.), or the marks ⁀ or ‿ (t͡s or t‿s, etc.). c, ɟ may occasionally be used in place of tʃ, dʒ. Aspirated plosives: ph, th, etc.

LENGTH, STRESS, PITCH.— ː (full length). ˑ (half length). ˈ (stress, placed at beginning of the stressed syllable). ˌ (secondary stress). ¯ (high level pitch); ˍ (low level); ˊ (high rising); ˏ (low rising); ˋ (high falling); ˎ (low falling); ˆ (rise-fall); ˇ (fall-rise). See *Ecriture Phonétique Internationale*, p. 9.

MODIFIERS.— ˜ nasality. ̥ breath (l̥ = breathed l). ̬ voice (s̬ = z). ʻ slight aspiration following p, t, etc. ̣ specially close vowel (ẹ = a very close e). ̨ specially open vowel (ę = a rather open e). ̫ labialization (n̫ = labialized n). ̪ dental articulation (t̪ = dental t). ˙ palatalization (ż = ʒ). ˔ tongue slightly raised. ˕ tongue slightly lowered. ˒ lips more rounded. ˓ lips more spread. ̩ (e.g. n̩) syllabic consonant. ̆ consonantal vowel. ʃˢ variety of ʃ resembling s, etc.

Classification of Speech-sounds.—The above table of the International Phonetic symbols taken in conjunction with the chart of the organs of speech (fig. 1) shows the chief principles of sound classification. The meanings of most of the technical terms describing the various classes of sounds are self-evident. Attention may, however, be called to the following, which require some explanation. The "back" of the tongue is the part which lies normally opposite the soft palate (velum); the "front" is the part which lies normally opposite the "hard" palate; the "blade" is the part which lies normally opposite the teeth-ridge (upper gum, alveolars). "Palatal" consonants are those formed by the "front" of the tongue against the hard palate, such as the English sound of *y* or the German *ch* in *ich*. "Retroflex" consonants are those made by the tip of the tongue against the hard palate such as the Hindi sounds of ट ड.

Classification of Vowels.—Vowels are classified (1) according to the position of the tongue, and (2) according to the position of the lips. In forming a vowel the opening between the lips and the distance of the tongue from the palate must be sufficient to ensure that there is no audible friction when voice is emitted. The lips may be spread (as for the English *ee*-sound) or they may have "close" rounding (as in the sound of *u* in *rule*) or "open" rounding (as in the vowel in *long*). The classification of vowels according to tongue positions and the terminology employed in describing vowels is shown in figs. 2, 3 and 4. The relative tongue-positions of vowels may be indicated by dots placed on the vowel figure (fig. 4).

Cardinal Vowels.—In order to give an intelligible description of the vowels of any language, it has been found necessary to

marked by the large black dots in fig. 4. The eight primary cardinal vowels are represented by the letters i, e, ɛ, a, ɑ, ɔ, o, u; these are numbered 1 to 8 respectively. Eight secondary cardinal vowels are represented by y, ø, œ, –, ɒ, ʌ, ɤ, ɯ (numbered 9 to 16 respectively). (No letter has been adopted for secondary cardinal vowel No. 12, as it has not been found to exist as a separate phoneme in any language.) They have the same tongue-positions as the primary cardinal vowels, but different lip-positions. Nos. 9 to 13 have lip-rounding, and Nos. 14, 15, 16 have lip-spreading. The tongue-positions of any vowel may be represented by a dot at the appropriate place on the cardinal vowel chart. This marking, together with a description of the lip-position, shows the language learner exactly how the vowel is formed, and gives him a good idea of what it sounds like. Thus a foreign learner who has never heard English can learn to make the vowel of *cat* when he knows that it is half way between cardinal vowels 3 and 4 (ɛ and a). An Englishman learning Italian without a teacher can get a good idea of what the Italian vowels sound like from a diagram (fig. 5) which shows the relationship of the Italian vowels to the cardinal vowels.

In transcribing particular languages, the cardinal vowel letters are used to represent sounds in the vicinity of the cardinal vowel sounds. The letters, in fact, serve to represent vowels lying within certain areas on the vowel figure as shown in fig. 2. In the comparatively unusual cases when two vowel-sounds within the same cardinal area are used for the purpose of distinguishing words additional vowel-letters have to be introduced. Such are ɪ (used for the English vowel in *sit*), ʊ (used for the English vowel in *put*), ʏ (used for the German vowel in *Glück*). æ is

corner of the a-area, though there is no objection to using a for it except in comparative work. Symbols are also required for "central" vowels. The most important is ə which represents the "neutral" or "intermediate" sound of *a* in *along*. Others are ɨ, ʉ, which represent unrounded and rounded vowels with tongue-positions intermediate between those of i and u; ɨ is the Russian ы and ʉ is heard in the Norwegian *hus* and in a frequent Scottish pronunciation of *book*. The vowel in the London pronunciation of *bird* is represented by ɜ or by ə with a length mark (əː).

Intonation.—An important branch of phonetics is that which deals with intonation or the rise and fall in the musical pitch of the voice. In the languages called "tone languages" (*e.g.*, Chinese and most Sudanic and Bantu languages) intonation is used to distinguish one word from another. Thus in Cantonese the syllable *fan* said with a high falling tone means "divide"; said with five other tones it means "powder," "sleep," "burn," "courageous" and "duty" respectively. In the Sechuana language of South Africa *metse* said with a mid level tone on each syllable means "villages," but with a mid-level tone on the first syllable and a high level tone on the second it means "water."

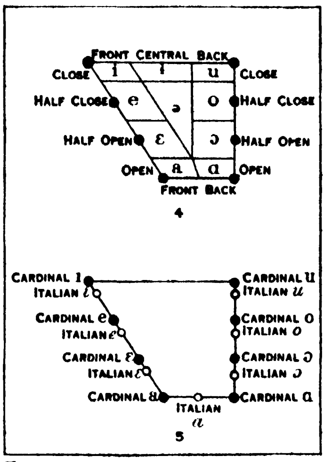


FIG. 4.—THE VOWEL AREAS SERVED BY THE MOST IMPORTANT VOWEL-LETTERS

FIG. 5.—THE ITALIAN VOWELS COMPARED WITH THE CARDINAL VOWELS

Such tones are best indicated in phonetic transcription by accent marks which by their shapes and positions give a certain graphic representation of the musical values of the tones, thus:—high level tone ā, low level tone a̠ high falling tone à, low falling tone a̖, high rising tone á, low rising tone a̗, fall-rise a̭, rise-fall â, etc. It is sometimes convenient to place the tone-marks before the syllable.

In languages which are not "tone languages" intonation affects the meaning of whole sentences, but it is not an integral part of any word. Intonation then gives "expression" to sentences; it conveys shades of meaning which cannot conveniently be expressed by other means. Thus in English the two meanings of *I beg your pardon* ("I am sorry" and "What did you say?") are distinguished by intonation. It is not practicable to mark this kind of intonation in orthography, though slight indications of it may be given by punctuation marks, the use of italics, etc.

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PHONOGRAPH, an instrument for reproducing sound by transmitting to the air the mechanical vibrations of a stylus in contact with a sinuous groove in a moving record. Less specifically the term designates any instrument for recording and reproducing speech. The first audible reproduction of recorded sound was accomplished by Thomas A. Edison in 1877.

The history of most of the technical arts shows that their development takes place irregularly. The introduction of fundamentally new ideas introduces periods of very rapid advance. These periods are followed by intervals during which the development appears much slower and is concerned mainly with the refinement of methods and the adaptation of the new results to commercial processes. The phonographic art is no exception.

Since the last big advance which became commercially prominent in 1925, the improvements have been largely an adaptation of the tools provided, to the production of artistic and commercially valuable results. The tools which were made available by this last advance are completely described under the heading GRAMOPHONE. The major portion of the improvement introduced has dealt with the co-ordination of the results obtainable with the new equipment and the production of a proper artistic effect. As might be expected, this has dealt mainly with the study of the proper acoustic conditions in the space in which the sound is produced.

The early recording by the new process was done largely in small rooms in which the acoustics were well controlled. It was soon found that the acoustic properties of small rooms were totally unsuited to the proper artistic effect when dealing with those types of music which are usually produced in large auditoriums or theatres. A large amount of experimenting was, therefore, done, which showed definitely that the best way to record symphony orchestras, choruses, opera selections, etc., was to place the artists in a small theatre or auditorium, and to arrange them in much the way that they would be arranged were an audience present.

The early experiments indicated two major difficulties with this type of arrangement. First, there appeared to be excessive reverberation; and, secondly, it was difficult to find a situation for the microphone or pick-up device at which interference was

not present in certain frequency regions. (That is, at certain parts of the musical scale.)

It was found by experiment that the time of reverberation, as in small studios, should be approximately ·7 to ·8 of that required for audience listening. Also, it was found that the portion of the space in which the sound is produced should have surfaces of more reflecting ability than the average indicated for the auditorium, while the space in which the microphone or pick-up device is situated should be as dead or well damped as possible.

In the field of phonograph reproduction, there have been no major developments within the last few years. The trend of the improvements introduced has been towards the use of electric methods rather than mechanical. The wide range of both frequency and loudness, which can be obtained by the use of electric methods and the simplicity with which the loudness can be controlled, is probably mainly responsible for this trend. While for small, low-priced instruments, it is still possible to obtain more faithful reproduction with the mechanical machines, the improvements in the electric methods of reproduction have caused this method to take precedence in the higher priced field.

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PHONOLITE, in petrology, a group of alkaline lavas containing much nepheline and sanidine felspar (Gr. *φωνή*, sound, and *λίθος*, stone). The term "clinkstone" was formerly given by geologists to many fine-grained compact lavas, which split into thin tough plates, and gave out a ringing sound when struck with the hammer. Some of these were phonolites in the modern sense, but as the name clinkstone was used for a large variety of rocks, many of which have no close affinities with one another, it has been discarded and "phonolite" substituted. The group includes rocks which are rich in alkalis with only a moderate percentage of silica; hence they contain no free quartz but much alkali-felspar (sanidine and anorthoclase) and nepheline. Large plates of sanidine are often visible in the rocks; the nepheline is usually not obvious to the unaided eye. Most phonolites show fluxion structure, both in the orientation of their phenocrysts and in the smaller crystals which make up the ground-mass; and this determines to a large extent the platy jointing. Although vitreous and pumiceous forms are known they are rare, and in the great majority of cases these rocks are finely crystalline with a dull or shimmering lustre in the ground-mass.

Dominant Minerals.—These are sanidine, nepheline, pyroxene, amphibole, various felspathoids and iron oxides. The sanidine is usually in two generations, the first consisting of large crystals of flattened and tabular shape, while the second is represented by small rectangular prisms arranged in parallel streams in the ground-mass; these felspars are nearly always simply twinned on the Carlsbad plan. They contain often as much soda as potash. The nepheline takes the form of hexagonal prisms with flat ends, and may be completely replaced by fibrous zeolites, so that it can only be recognized by the outlines of its pseudomorphs. In some phonolites it is exceedingly abundant in the ground-mass, and these rocks form transitions to the nephelinites (nephelinitoid phonolites); in others it is scarce and the rocks resemble trachytes containing a little nepheline (trachytoid phonolites). The felspathoid minerals, sodalite, haüyne and nosean, which crystallize in isometric dodecahedra, are very frequent components of the phonolites; their crystals are often corroded. Small rounded enclosures of glass are often numerous in them. The pyroxenes may be pale green diopside, dark green aegirine-augite, or blackish green aegirine (soda iron pyroxene), and in many cases are complex, the outer portions being aegirine while the centre is diopside. Fine needles of aegirine are often found in the ground-mass.

The chemical analyses of phonolites given herewith show that they are very rich in alkalis and alumina with only a moderate amount of silica, while lime, magnesia and iron oxides are present only in small quantity. They have a close resemblance in these respects to the nepheline-syenites of which they provide the effusive types. Most of these rocks are of Tertiary or Recent age, but in Scotland Carboniferous phonolites occur in several localities, *e.g.*, Traprain in Haddingtonshire, in the Eildon Hills and in Renfrewshire; in Brazil phonolites belonging to the same epoch are also known and there are several districts in Europe where Tertiary or Recent phonolites occur in considerable numbers, as in Auvergne (Mont Dore), the Eifel and Bohemia. The Wolf Rock, off the S. of Cornwall and the site of a well-known lighthouse, is the only mass of phonolite in England; it is supposed to be the remains of a Tertiary lava or intrusion. In the United States phonolites occur in Colorado (at Cripple Creek) and in the Black Hills of South Dakota.

Leucite occurs in place of nepheline in a small group of phonolites (the leucite-phonolites), known principally from Rocca Monfina and other places near Naples. When sanidine, nepheline and leucite all occur together in a volcanic rock it is classed among the leucitophyres (*see* Petrology).

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O
I. Phonolite, Wolf Rock, Cornwall	56·46	22·29	2·70	0·97	tr	1·47	11·13	2·81	2·05
II. Phonolite, Teplitzer Schlossberg, Bohemia	58·16	21·57	2·77		1·26	2·01	5·97	6·57	2·03
III. Leucite-phonolite, Rocca Monfina, Italy	58·48	19·56	.	4·99	0·53	2·60	3·14	10·47	0·24

PHORMION, Athenian admiral in the 5th century B.C., was the son of Asopius, of the deme Paeania. He first appears in 440 B.C. when he was sent with reinforcements to the Athenian troops before Samos. In 432 he took out reinforcements to the force blockading Potidaea, took over the command from Callias, and completed the circumvallation of the city. He seems to have stayed in the north-east, as in 431 he was co-operating with Perdiccas against the Chalcidians. In 430 he was sent with 30 ships to help the Acarnanians against the Ambraciots. That winter there followed the operations on which his fame is based. He was given 20 ships and stationed at Naupactus, to effect a blockade of Corinth from that side. In the summer of 429 a superior Peloponnesian fleet arrived, and was decisively beaten by Phormion. In a second engagement he was forced to retreat, but turned and again routed his pursuers. He was probably dead by 428.

Thuc. I. and II., *passim;* Diod. XII., 37, 47, 48; *Schol.* ad Arist. *Pac.* 348. And *see* art. Peloponnesian War.

PHORMIUM or **NEW ZEALAND FLAX** (also called "New Zealand hemp"), a fibre obtained from the leaves of *Phormium tenax* (family Liliaceae), a native of New Zealand, the Chatham islands and Norfolk island. This plant was discovered by Sir Joseph Banks and Dr. Solander, who accompanied Captain Cook on his first voyage of discovery. It grows luxuriantly in the south of Ireland, where it was introduced in 1798, and also flourishes on the west coast of Scotland, and is generally cultivated as an ornamental garden plant in the warmer parts of Europe and North America. It has been introduced for economic purposes into the Azores and California. The name *Phormium* is from Gr. *φορμός*, a basket, in allusion to one of the uses made of its leaves by the New Zealanders. It has a fleshy rootstock, creeping beneath the surface of the soil and sending up luxuriant tufts of narrow, sword-shaped leaves, from 4 to 8 ft. long and from 2 to 4 in. in diameter The leaves are vertical, and arranged in two rows as in the garden flag; they are very thick, stiff and leathery, dark green above, paler below, with the margin and nerve reddish-orange. From the centre of the tuft ultimately arises a tall flower-bearing stem, 5 to 15 ft. high, bearing on its numerous branches a very large number of lurid red or yellow, somewhat tubular

flowers, recalling those of an aloe, and from 1 to 2 in. long. After flowering the plant dies down, but increases by new lateral growths from the rootstock. The plant will grow in almost any soil, but best on light rich soil, by the side of rivers and brooks, where sheltered from the wind.

Phormium is a cream-coloured fibre with a fine silky gloss, capable of being spun and woven into many of the heavier textures for which flax is used, either alone or in combination with flax. It is, however, principally, a cordage fibre, and in tensile strength it is second only to manila hemp; but it does not bear so well the alternations of wet and dry to which ship-ropes are subject.

PHORONIS. *Phoronis* is one of those limbless creatures popularly termed "worms." It is, however, so peculiar in its structure that it is given a class to itself, Phoronidea There are a good many species found all over the world, but they are so alike that they are placed in a single genus *Phoronis,* although they vary from ½ in. to 6 in. in length. *Phoronis* is marine and lives in a leathery tube from which the fore-part of the body can be protruded The front part carries a peculiar platform or "lophophore," crowned with beautiful upright tentacles covered with cilia which are in perpetual motion. In *P. hippocrepia* the lophophore is shaped like a horse-shoe and the tentacles are arranged along its edge, those on the concavity of the shoe being somewhat the shorter. All species have lophophores more or less of this shape but the tips of the shoe are in some much more prolonged than in others and even inrolled. The cilia produce a current which sweeps small organisms into the mouth, situated between the outer and inner row of tentacles It is elongated and slit-like and provided with a covering lip, the epistome, which projects from the concave side of the lophophore Below the lophophore, on the side of the concavity of the horseshoe, the anus projects as a little papilla. At the sides of the anus two smaller papillae carry the openings of a pair of ciliated tubes which connect the body-cavity with the exterior. These tubes (*coelomiducts*) serve to get rid of the excreta in the body-cavity fluid and to let out the germ-cells when these are ripe

Since the mouth and anus are close together and the animal has a long worm-like body, it is obvious that the alimentary tube will be U-shaped. The long gullet leads into a globular stomach lying at the lower end of the body, from which the long, slender, ascending intestine leads to the anus. The first part of the intestine where it leaves the stomach is swollen, lined by ciliated epithelium and devoid of glands. The alimentary tube is enswathed by a true secondary body-cavity or coelom, which is lined by an epithelium the outer layer of which is pressed against the body-wall whilst the inner layer lies against the gut cells This cavity is divided into two by a horizontal platform just behind the mouth. The front portion communicates with the cavities of the tentacles and of the epistome. This is the lophophoral coelom: the hinder portion, in which the gullet and intestine lie, and into which the coelomiducts open, is the trunk-coelom and is traversed by a median septum or mesentery which ties the outer side of the oesophagus to the body wall: in addition, the oesophagus is anchored by two lateral mesenteries. These mesenteries, however, cease before the stomach is reached. The genital cells appear as thickenings of the inner wall of the coelom and both male and female are produced by the same individual in separate swellings, projecting from the wall of the stomach. The trunk coelom is thus divided into three chambers, a right and left lateral on the convex side of the lophophore and a large rectal chamber on the concave side. In this latter lies the intestine, which is tied to the body wall by its own independent mesentery and is also fused by its side to one of the lateral mesenteries

Each "coelomiduct" opens into the body-cavity by two funnel-shaped openings lined by cilia, a short one communicating with the lateral chamber and a long slit-like one opening into the rectal chamber.

The nervous system is simple, consisting merely of an interlacing mass of extremely fine fibrils and small nerve-cells which thickens to form a horizontal band passing around the lophophore and giving off a special branch to each tentacle. There is also a thickening in the skin of the epistome.

The life of *Phoronis* consists merely in expanding the front of the body, erecting the tentacles and working the cilia vigorously; the mouth being opened wide to catch whatever fortune brings. On the approach of danger the whole body is withdrawn within the tube This is effected by bands of longitudinal muscles in the body-wall—the expansion being brought about by circular muscles, which by compressing the body force fluid into the lophophore and engorge it

The interest of *Phoronis* lies in its strong resemblance to certain *Polyzoa* (*q.v.*). Lankester went so far as to call Phoronis the only solitary polyzoon. But *Phoronis* possesses, distinct altogether from the body-cavity, a well-developed blood-system, containing a colourless serum in which float red blood corpuscles. No such organ is found in any polyzoon. This blood-system consists of an "artery" running on the anal side of the gullet to the level of the lophophore where it gives off right and left a vessel to each arm of the lophophore. From these a single vessel goes to each tentacle This vessel at the base of the tentacle sends a fork to an outer or recipient vessel, which runs along the convex side of the lophophore on each side. The right and left recipient vessels pass downwards, pierce the lophophoral platform and unite on the convex side of the oesophagus to form a single "vein" which below the stomach opens into the artery

The reproduction raises other questions. The eggs, after being shed, stick to the tentacles and are there fertilized by sperms from another individual. They complete the first stages of their development within the egg-membrane, from which they hatch out as peculiar free-swimming larvae known as *Actinotrocha* This larva is provided with a ciliated forehead in which a large ganglion is embedded There is an oblique wreath of ciliated tentacles behind the mouth by which it swims. There is a belt of cilia round the hind end of the body in front of the anus This larva after feeding for a time and growing greatly in size, develops an intucking of skin on its under-surface, to which a fold of the intestine becomes attached Suddenly (inside a quarter of an hour) this intucked area is everted, forming a finger-shaped process containing a loop of the intestine which gives rise to the body of the "worm" The ciliated forehead is cast off, as are also the ciliated tentacles, but new tentacles which give rise to the lophophore of the adult are regenerated from their stumps This larva with its extraordinary life-history has given rise to much speculation. We owe the clearing up of its real affinities to E S Goodrich and Shearer, who have shown that *Actinotrocha* is merely a modified trochophore, such as occurs in the life-history of the Gephyrea amongst the Annelida (*q v*). The typical trochophore has a broad preoral belt of *cilia,* the *prototroch,* and a slender postoral one, the *metatroch,* whilst a belt of cilia, the *telotroch,* encircles just in front of the anus.

(E. W. MacB.)

PHORORHACOS, a gigantic extinct Patagonian bird, allied to the Cranes and in some respects recalling the South American *Cariama* bird. About six species of the type genus have been discovered, the most complete being *P. inflatus,* with skull, mandible, pelvis, limbs and some of the vertebrae The skull of *P. longissimus* is about 2ft. long and 10in high; that of *P. inflatus* is 13in. long, and this creature is supposed to have stood only 3ft high at the middle of the back. The under jaw is slightly curved upwards. The strongly hooked upper beak is high, and laterally compressed. The vomer is inconspicuous. The quadrate has a double knob for articulation with the skull, and basipterygoid processes are absent. What little is known of the shoulder-girdle points to a flightless bird, and so do the short wing bones, although these are stout. The pelvis has an ischiadic foramen. The hind limbs are distinctly slender, the tibia of *P. inflatus* being between 15 and 16in. in length.

BY COURTESY OF THE BRITISH MUSEUM
THE SKULL OF PHORORHACOS LONGISSIMUS, AN EXTINCT BIRD OF PREY

PHOSGENE or **CARBONYL CHLORIDE,** an extremely poisonous, heavy gas, came into prominence during the

World War (1914–18), being used either alone or in mixtures both for cloud-gas and shell-gas attacks. It has a nauseating, choking smell, and, even in very small doses has very bad after-effects on the heart and lungs. Phosgene owes its name to the fact that it can be formed by exposing carbon monoxide and chlorine to sunlight ($CO+Cl_2=COCl_2$), but it is now manufactured by passing the two gases over specially prepared charcoal catalyst (*see* CATALYSIS). Phosgene can be condensed to a liquid which boils at 8° C under ordinary pressure; it is stored either in steel cylinders under slight pressure or as a solution in toluene. It is very reactive chemically and is used in the dyestuff industry for the manufacture of intermediates. It also reacts rapidly with water to give carbon dioxide and hydrogen chloride (hydrochloric acid): $COCl_2+H_2O_2=CO_2+HCl$. (*See* also CARBON.)

PHOSGENITE, a rare mineral consisting of lead chlorocarbonate $(PbCl)_2CO_3$. The tetragonal crystals are prismatic or tabular in habit, and are bounded by smooth, bright faces; they are usually colourless and transparent, and have a brilliant adamantine lustre. Sometimes the crystals have a curious helical twist about the tetrad or principal axis. The hardness is 3 and the specific gravity 6·3. The mineral is rather sectile, and consequently was early known as "corneous lead." The fanciful name phosgenite is from phosgene, the old name of carbon oxychloride, because the mineral contains the elements carbon, oxygen and chlorine. At Cromford in Derbyshire it was long ago found in an old lead mine, being associated with anglesite and matlockite (Pb_2OCl_2) in cavities in decomposed galena; hence its synonym cromfordite.

PHOSPHATES, salts of phosphoric acid. Phosphoric oxide, P_2O_5 or P_4O_{10} (Tilden and Barnett, *v. inf.*), combines with water in three proportions to form $H_2O{\cdot}P_2O_5$ or HPO_3, metaphosphoric acid; $2H_2O{\cdot}P_2O_5$ or $H_4P_2O_7$, pyrophosphoric acid; and $3H_2O{\cdot}P_2O_5$ or H_3PO_4, orthophosphoric or ordinary phosphoric acid. These acids each give origin to several series of salts, those of ordinary phosphoric acid being the most important.

Orthophosphoric acid, H_3PO_4, a tribasic acid, is obtained by boiling a solution of the pentoxide in water; by oxidizing red phosphorus with nitric acid, or white phosphorus under the surface of water by bromine or iodine; and also by decomposing a mineral phosphate with sulphuric acid. It usually forms a thin syrup which on concentration in a vacuum over sulphuric acid deposits hard, transparent, rhombic prisms which melt at 41·7° C. After long heating the syrup is partially converted into pyrophosphoric and metaphosphoric acids, but on addition of water and boiling the ortho-acid is re-formed. It gives origin to three classes of salts: $M'H_2PO_4$ or $M''(H_2PO_4)_2$; M'_2HPO_4 or $M''HPO_4$; and M'_3PO_4, $M''_3(PO_4)_2$ or $M'''PO_4$, wherein M', M'', M''' denote a uni-, bi-, and tri-valent metal. These correspond to H_3PO_4 in which one, two or three atoms of hydrogen, respectively, have been replaced by a metal. The three principal groups differ remarkably in their behaviour towards indicators. Those of the first type are strongly acid, the second are neutral or faintly alkaline, whilst the third are strongly alkaline and are decomposed by carbon dioxide: $Na_3PO_4+CO_2+H_2O=NaHCO_3+Na_2HPO_4$. The salts of the types NaH_2PO_4 and $CaH_4P_2O_8$ may be obtained in crystal form, but those of the heavy metals are only stable when in solution. All soluble orthophosphates give with silver nitrate a characteristic yellow precipitate of silver phosphate, Ag_3PO_4, soluble in ammonia and in nitric acid. Since the reaction with the acid salts is attended by liberation of nitric acid: $NaH_2PO_4+3AgNO_3=Ag_3PO_4+NaNO_3+2HNO_3$, $Na_2HPO_4+3AgNO_3=Ag_3PO_4+2NaNO_3+HNO_3$, it is necessary to neutralize the nitric acid if the complete precipitation of the phosphoric acid be desired. The three series also differ when heated: the trimetallic salts containing fixed bases are unaltered, whilst the mono- and di-metallic salts yield meta- and pyro-phosphates respectively. Other common precipitants of phosphoric acid or its salts in solution are: ammonium molybdate in nitric acid, which gives on heating a canary-yellow precipitate of ammonium phosphomolybdate, $12[MoO_3]\ (NH_4)_3PO_4$, insoluble in acids but readily soluble in ammonia; magnesium chloride, ammonium chloride and ammonia, which give on standing in a warm place a white crystalline precipitate of magnesium ammonium phosphate, $Mg(NH_4)PO_4{\cdot}6H_2O$, which is soluble in acids but highly insoluble in ammonia solutions, and on heating to redness gives magnesium pyrophosphate, $Mg_2P_2O_7$.

Of the organic phosphates, triphenyl phosphate $(C_6H_5)_3PO_4$, is important, acting as a filler or "dope," and as a substitute for camphor. It is a colourless solid of m.p. 53° C and b.p. 245° C.

Pyrophosphoric acid, $H_4P_2O_7$, is a tetrabasic acid which may be regarded as derived by eliminating a molecule of water between two molecules of ordinary phosphoric acid; its constitution may therefore be written $(HO)_2OP{\cdot}O{\cdot}PO(OH)_2$. It may be obtained as a glassy mass, indistinguishable from metaphosphoric acid, by heating phosphoric acid to 215°. When boiled with water it forms the ortho-acid, and when heated to redness the meta-acid. After neutralization, it gives a white precipitate with silver nitrate. Being a tetrabasic acid it can form four classes of salts; for example, the four sodium salts $Na_4P_2O_7$, $Na_3HP_2O_7$, $Na_2H_2P_2O_7$, $NaH_3P_2O_7$ are known. The most important is the normal salt, $Na_4P_2O_7$, which is readily obtained by heating disodium orthophosphate, Na_2HPO_4. It forms monoclinic prisms (with $10H_2O$) which are permanent in air. All soluble pyrophosphates when boiled with water are converted into orthophosphates.

Metaphosphoric acid, HPO_3, or more correctly $H_2P_2O_6$ as determined by vapour density (Tilden and Barnett), is a monobasic acid which may be regarded as derived from orthophosphoric acid by the abstraction of one molecule of water, thus $H_3PO_4-H_2O=HPO_3$; its constitution is therefore $(HO)PO_2$. The acid is formed by dissolving phosphorus pentoxide in cold water, or by strongly heating orthophosphoric acid. It forms a colourless vitreous mass, hence its name "glacial phosphoric acid." It is readily soluble in water, the solution being gradually transformed into the ortho-acid, a reaction which proceeds much more rapidly on boiling. Although the acid is monobasic, salts of polymeric forms exist of the types $(MPO_3)_n$, where n may be 1, 2, 3, 4 or 6. They may be obtained by heating a monometallic orthophosphate of a fixed base, or a dimetallic orthophosphate of one fixed and one volatile base, *e.g.*, microcosmic salt: $MH_2PO_4=MPO_3+H_2O$; $(NH_4)NaHPO_4=NaPO_3+NH_3+H_2O$. The salts are usually non-crystalline and fusible. Their solutions on boiling yield orthophosphates, whilst those of heavy metals give a trimetallic orthophosphate and orthophosphoric acid: $3AgPO_3+3H_2O=Ag_3PO_4+2H_3PO_4$. Metaphosphoric acid can be distinguished from the other two acids by its power of coagulating albumen, and by not being precipitated by magnesium and ammonium chlorides in the presence of ammonia. For perphosphoric acids, *see* PHOSPHORUS.

PHOSPHORESCENCE. Physicists apply the word phosphorescence to the emission of light at low temperatures by certain substances (chiefly sulphides), after previous exposure to light or radiation of other kinds. However, common usage has made it applicable to the glow of phosphorus, or of the sea, or of dead fish or meat, or of wood, the "fox-fire" of forests. Phosphorescence of the sea or of flesh, wood, etc., is due to living organisms of various kinds and should more properly be called bioluminescence. Such light is the result of a slow oxidation of material manufactured by the organism.

At least 40 different orders of animals contain luminous species, and also two groups of plants, the bacteria, responsible for the luminescence of flesh, and the fungi, responsible for the luminescence of wood. Either the fine strands of fungus mycelium, which penetrate the wood, or the fruiting body, the mushroom, or both, may be luminous.

The luminous bacteria are so small that individuals cannot be seen by their own light, whereas natural colonies are easily visible. They may be cultured on artificial media and form excellent material for the experimental study of bioluminescence. They are not pathogenic to man but are known to infect living animals, giving rise to a natural luminescent disease of sand-fleas, shrimps and possibly midges, which is eventually fatal. Luminous bacteria may also live symbiotically in definite organs of fish, notably *Photoblepharon* and *Anomalops* of the Banda islands. Some believe that the luminescence of all luminous animals, even the firefly, is due to symbiotic luminous bacteria, but this is far from

proven. The characteristic of the light of bacteria and fungi, which distinguishes them from all other luminous organisms, is its uniformity, shining night and day, independently of stimulation. Other animals light only when disturbed or stimulated.

Phosphorescence of the sea is largely due to Protozoa, of which the Radiolaria, Dinoflagellata and Cystoflagellata (including *Noctiluca*) are luminous. The latter two groups may develop in such enormous numbers that the sea is a pink or red by day and a vivid sheet of flame by night. Larger patches of light in the ocean are mainly due to coelenterates, jelly-fish, Siphonophora or Ctenophora (comb-jellies). The latter are often very abundant and show the interesting phenomenon of loss of luminescence in sunlight or on bright illumination by electric light. The luminescence again appears on stimulation after about one-half hour in the dark. The coelenterates contain more luminous species than any other group, the sea pens or pennatulids showing especially brilliant luminescence, which travels along nerves over the colony of polyps in the form of a wave.

Among the Crustacea, Copepoda and Ostracoda (Cypridina) contain many luminous forms while the schizopod and decapod shrimps possess members with true luminous organs or photophores, often consisting of lens, reflector and pigment screens, veritable lanterns on a microscopic scale, earlier mistaken for eyes.

Among the worms, many marine forms and some earthworms are luminous. Among the echinoderms, only the brittle-stars (Ophiuroids) possess luminous members.

Luminous molluscs are represented only by *Pholas dactylus* (a bivalve) and *Phyllirrhoë bucephala* (a nudibranch), together with the cephalopods, of which many members produce light. The cephalopods and deep-sea fish possess the most complex lantern-like luminous organs.

Some centipedes are luminous, as well as the spring-tails, larvae of the fly, *Bolitophila,* which live in New Zealand caves, and beetles (fire-fly, glow-worm and *Pyrophorus* of the West Indies). All stages, including the egg, of some fire-flies are luminous.

Balanoglossus and *Pyrosoma,* primitive chordates, are also luminous. The latter forms large colonies, floating near the surface of the sea, each individual possessing two luminous spots.

Finally, mention should be made of the fish, both elasmobranchs and teleosts, containing luminous members. The deep-sea forms are often bizarre in appearance and sometimes contain the luminous organ on the end of a long process dangled before the animal as a lure for prey.

The sponges, Alcyonaria, Bryozoa, mayflies, termites, spiders and Salpae contain reported luminous forms, whose light-production is, however, doubtful. The light of many phosphorescent animals is not produced by the animals themselves but by symbiotic micro-organisms.

In general, luminous organs or regions are glandular and the luminous material may be ejected (extracellular luminescence) as a slime or a secretion, which in the squid, *Heteroteuthis dispar,* surrounds the animal in the sea water as does the black ink of other squids. Or the luminous material may be consumed within the photogenic cells (intracellular luminescence) as in the fire-fly and organisms possessing photophores. There is always a mechanism for supplying the organ with abundant oxygen, a fact which indicates that the light-production is an oxidation.

Chemical Nature of Bioluminescence.—Knowledge of the chemical nature of bioluminescence has proceeded in four steps. (1) R. Boyle (1667) showed that fungi and bacteria required air (oxygen) for luminescence, becoming dark under an air pump and luminescing again when air was readmitted.

(2) Reamur (1733) and Spallanzani (1794) showed that water was necessary, that luminous cells could be dried and preserved, in some cases indefinitely, producing light whenever moistened. This fact proves also that bioluminescence is not a process involving definite structural peculiarities of the cell, as is the contraction of a muscle or the conduction of a nerve impulse, which will not occur after drying and moistening.

(3) Dubois, in 1887, found that the photogenic material could be separated into two constituents, luciferin and luciferase, due to marked difference in chemical behaviour. The latter is destroyed on boiling and behaves like an enzyme or catalyst; the former is heat-resisting and the oxidizable body. These substances can be treated like any other chemical compound, precipitated by certain reagents and redissolved in appropriate solvents. They have been partially purified but their chemical composition is still unknown. Their isolation and synthesis is a matter of time and material.

(4) Harvey (1918) showed that luciferin, after oxidation to oxyluciferin, could be reduced again, that the luminescent process was reversible and of the nature of an oxidative dehydrogenation. It seems most probable that many organisms reduce the oxyluciferin formed during luminescence and thus re-utilize the material again and again, a principle that may in time be adopted in industry as the basis of an efficient method of illumination.

Bioluminescence is often spoken of as "cold light." This does not mean that no heat is produced, but only that very little appears as compared with the ordinary methods of illumination, which depend on the incandescence of carbon particle in flames or of wires through which a current is passing. The rise of temperature in some luminous animals is less than 0·001° C. The light is no different, physically, from any other kind of light—it will affect a photographic plate, can induce chemical reactions, and can be polarized. There are no infra-red or ultra-violet radiations and no penetrating radiations are produced. Hence the luminous efficiency, *i.e.,* the percentage of the radiant energy which is visible, is very high, nearly 100%. This does not tell, however, what the radiant efficiency is, *i.e.,* the percentage of the energy (chemical) of the oxidation process which appears as radiant energy; nor does it tell the overall efficiency, *i.e.,* the energy (chemical) in the food of the animal which appears as visible radiant energy. This is the efficiency in which an illuminating engineer is interested, and studies on luminous bacteria have shown that the overall efficiency of these forms is at least slightly and probably considerably greater than that of a nitrogen-filled incandescent lamp, when calculated from the energy of the coal necessary to run the dynamo that supplies current to the lamp.

The Uses of Luminescence.—Regarding the use of luminescence to the animal, little can be said with certainty. In deep-sea forms, living in perpetual darkness, it would seem that the organs must be lanterns for seeing or recognition, or for attracting prey. Many luminous forms live in light places, and it has been suggested that the luminescence may be a warning to scare away predacious animals which might molest the luminous forms, or a lure to attract creatures upon which the luminous animal feeds. These suggestions remain to be proven, but we do know that in the fire-fly the light acts as a signal or attraction to bring the sexes together. On the other hand, who can suggest the use of light to a luminous bacterium, an organism $\frac{1}{25,000}$ in. in diameter with no nervous reactions of a higher form, or the use to a protozoan, living at the surface of the sea, blown hither and thither by the wind? One is forced to the conclusion that in their case the light is merely fortuitous, a chance phenomenon, accompanying some of the chemical changes in the organism.

It is well known that many substances produce light on slow oxidation (chemiluminescence) and the whole process of light-production by luminous organisms can be so perfectly imitated by such reactions in the laboratory that we may no longer consider it a mysterious or unusual phenomenon.

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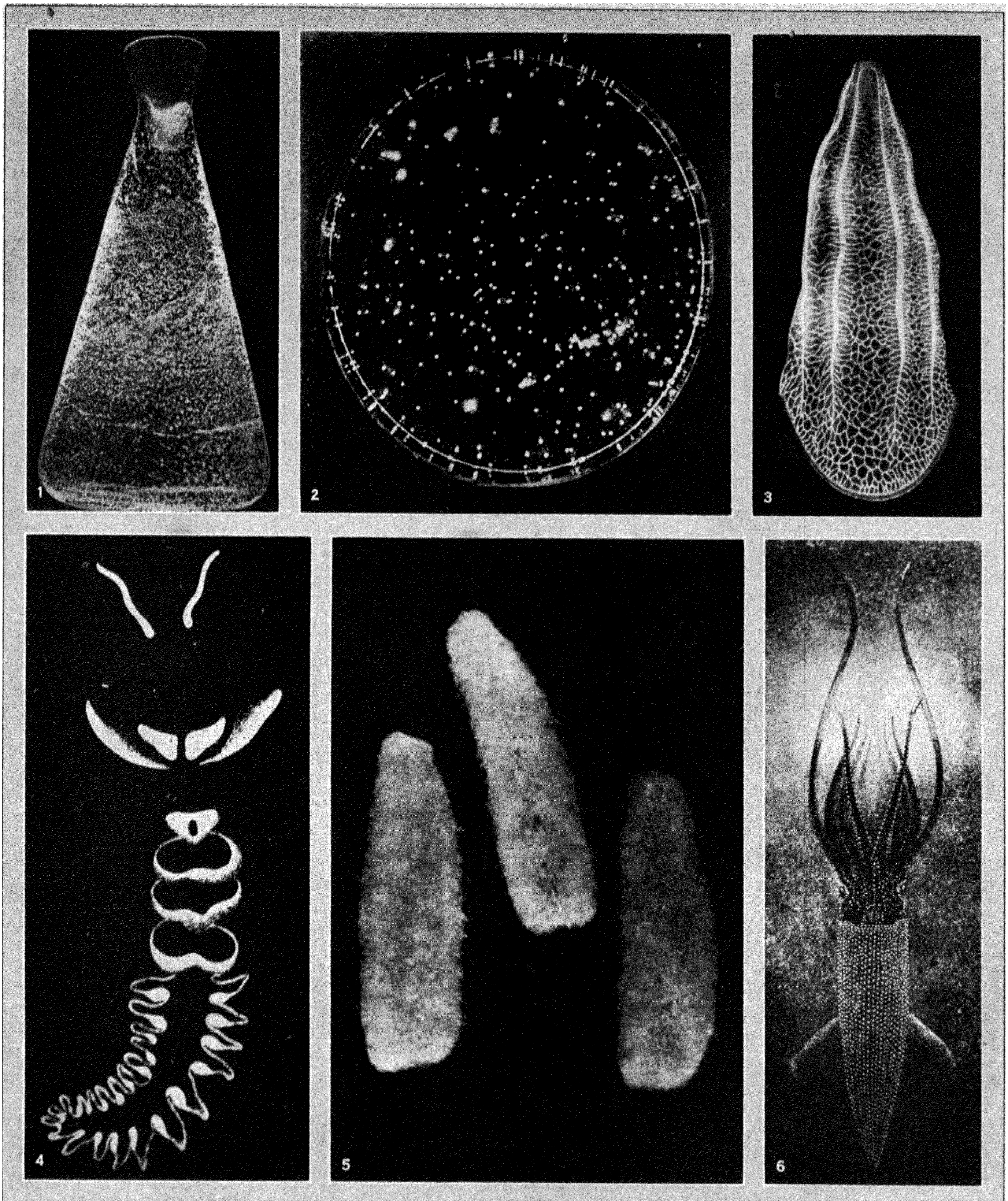
PHOSPHORIC ACID (IN RELATION TO MUSCULAR CONTRACTION): *see* MUSCLE.

PHOSPHORITE, in mineralogy, the name given to impure massive apatite (*q.v.; see* also PHOSPHATES).

PHOSPHORUS, a non-metallic element, first known as *Phosphorus mirabilis* or *igneus.* (Symbol P, atomic number 15,



LUMINOUS ORGANISMS

1, 2. Colonies of luminous bacteria growing on culture media
3. "Comb" jellyfish or Ctenophore
4. A marine worm (*Chaetopterus*)
5. A sea-squirt (*Pyrosoma*)
6. A luminous squid (*Watasenia*)

atomic weight 30·98.) It is never found free, but is widely and abundantly distributed in combination as phosphates (*q.v.*). It is essential to animal and vegetable life, occurring in urine, blood and tissues, and, as calcium phosphate, forming 58% of bones. The element was first obtained in 1669 by Brand of Hamburg, who kept his process secret. In England, however, Kunckel (1678) and Boyle (1680) attempted its preparation and happened to use Brand's method—urine was evaporated to dryness and the residue distilled with sand. In 1775 Scheele prepared it from bones, and these still form one of the chief commercial sources of phosphorus. Degreased bones or mineral phosphates are treated with sufficient sulphuric acid to combine with all the calcium, this sulphate is filtered off, and the filtrate is mixed with charcoal, coke or sawdust, dried in a furnace, and then distilled from Stourbridge-clay retorts at a white heat. The vapours are led through malleable iron pipes into troughs containing water, where they condense. The reactions are:

$$Ca_3(PO_4)_2+3H_2SO_4=3CaSO_4+2H_3PO_4;\quad H_3PO_4=HPO_3+H_2O;$$
$$2HPO_3+6C=H_2+6CO+2P.$$

Modern Processes.—In more modern electrothermal processes, calcium phosphate is mixed with sand and carbon, and fed into a furnace heated by an alternating current. At the high temperature the silica of the sand displaces phosphoric oxide and forms calcium silicate, and the oxide is reduced by the carbon so that the phosphorus vapour and carbon monoxide pass over into a condenser. The silicate remains as a liquid slag and is run off periodically. Other processes seek to produce calcium carbide simultaneously with phosphorus by using only calcium phosphate and carbon, thus obtaining a more valuable by-product. In all cases the phosphorus is cast into sticks either under water or in water-cooled pipes.

Properties.—Perfectly pure phosphorus is a white, transparent waxy solid, its usual yellowish appearance being due to traces of the allotropic "red phosphorus," which is formed by exposure to light. At 25° to 30° C it is soft and flexible, but when cooled it becomes brittle and shows a crystalline fracture. Crystallization from carbon disulphide or sublimation yields large crystals of regular dodecahedra or octahedra, but these fire spontaneously unless protected from the air. It is also soluble in sulphur chloride, benzene, oil of turpentine, and liquefied ammonia or sulphur dioxide. It is a non-conductor of electricity, has density 1·836 at 0° C, melts at 44·3°, and boils at 287° giving a colourless vapour, the density of which corresponds to tetratomic molecules, P_4; above 1,500° C the vapour density indicates dissociation to P_2. The elevation of boiling point of solutions of phosphorus in carbon disulphide, and the depression of freezing point of solutions in benzene, both indicate P_4.

The element is highly inflammable, taking fire in air at 34°, burning with a bright white flame and forming dense white clouds of phosphoric oxide; H. B. Baker has shown, however, that in perfectly dry air or oxygen it can be distilled unchanged. (*See* DRYNESS, CHEMICAL.) When exposed to air which has not been excessively dried, a stick of phosphorus undergoes slow combustion, as shown by the phosphorescence visible in the dark. In pure oxygen, however, this phosphorescence is not exhibited unless the gas pressure is reduced or the temperature raised; similarly, in compressed air the phosphorescence ceases when a certain pressure is reached. Moreover, the presence of certain substances (*e.g.*, Cl, Br, I, NH_3, N_2O, NO_2, H_2S, SO_2, CH_4, C_2H_4) entirely inhibits the phosphorescence. During the process, oxygen is slightly ionized and traces of ozone are formed. Some of the phenomena accompanying phosphorescence have been ascribed to the oxidation of the trioxide. A very complete bibliography of investigations is given by W. E. Downey (*J. Chem. Soc.*, 1924, 125, p. 349), and H. J. Emeléus (*ibid.*, 1926, p. 1336; 1927, p. 788; 1928, p. 628) gives a further discussion of the inhibition and of the ultra-violet spectrum of the glow. Phosphorus combines directly with the halogens, sulphur and selenium, and most metals burn in its vapour forming phosphides. When very finely divided it decomposes water, giving hydrogen phosphide, and when boiled with water it gives hypophosphorous acid in addition; slow oxidation of wet phosphorus yields hypophosphoric acid.

PHYSICAL PROPERTIES

Allotropic Forms.—Many allotropic varieties of phosphorus have been described but it seems probable that the white and violet forms are the only definite allotropes (*see* ALLOTROPY), the others being "solid solutions" (*see* CHEMISTRY, PHYSICAL) of these two. The ordinary yellowish phosphorus is really white when pure, and probably owes its slight colour to a trace of the violet form. The so-called *red phosphorus* (used for matches) is produced by heating white phosphorus to about 230° C for 24 hours in an inert atmosphere, or to 300° C for a few minutes in closed vessels; a trace of iodine expedites the change. Commercially, the process is carried out in iron pots with air-tight lids which, however, have a long narrow tube open to the air; at first a little phosphorus burns, but this uses up all the oxygen, and the process thereafter continues in an inert atmosphere with no risk of explosion. The product is ground under water, freed from unchanged white phosphorus by boiling with caustic soda, washed and dried. The same form is also produced by submitting ordinary phosphorus to the silent electric discharge, to sunlight or to ultra-violet light. Red and white phosphorus differ greatly: the red does not inflame until heated above 350° C (hence its use in the match industry), is insoluble in all the solvents which dissolve the white, has a higher density (2·2), is stable to air and light, is much less chemically reactive (since its formation from white phosphorus is accompanied by liberation of much heat—3,700 cal. per 31 g.), and is non-poisonous.

Hittorf's "metallic" or *violet phosphorus* is formed by heating phosphorus with lead to redness in a sealed tube, and removing the lead by boiling with nitric acid or by electrolytic means. It is also obtained by heating white or red phosphorus for long periods at high temperatures, the proportion of violet phosphorus increasing with time and temperature. This fact, together with the circumstance that the density of red phosphorus continually increases with the duration and intensity of its heating, suggests that the red form is only an intermediate stage in the production of the violet. (*See* above.) This variety forms lustrous, heavy, nearly black, minute rhombohedra. A scarlet form was obtained by R. Schenk in 1905, and in 1921, P. W. Bridgman described a black graphitic variety which was obtained by heating ordinary phosphorus at 200° C under a pressure of 12,000 atmos., and which was incombustible, very dense, and conducted electricity. Bridgman obtained also another modification of white phosphorus, with a transition point at −76·9° C under atmospheric pressure. The relationships of these forms to white and violet phosphorus are indefinite. The various forms are probably polymerides, for the red phosphorus is at least as complex as P_8, whereas the white is P_4. Smits postulates two forms P_α and P_β as the basis of all varieties, and, as many of the conversions are very slow, the equilibria involved are probably complex.

Phosphine (phosphoretted hydrogen), PH_3, a gas formed in the putrefaction of organic matter containing phosphorus, was first obtained (Gengembre, 1789) by the action of potash on phosphorus; this was spontaneously inflammable, whereas Davy obtained a hydride which was not spontaneously inflammable by heating phosphorous acid. In 1835 Le Verrier showed that the two gases were essentially identical, and that the inflammability was due to traces of another hydride, P_2H_4. When caustic alkalis are boiled with phosphorus, the impure gas is obtained, and it also results from the action of water on calcium phosphide (unless this is very pure), but the pure PH_3 may be obtained by heating phosphonium iodide with caustic potash. It is a colourless, very poisonous gas, with an offensive odour like that of rotting fish; it can be liquefied at −86° C and solidified at −133°. It is only slightly soluble in water, burns with a luminous flame, fires spontaneously in air at about 100°, and combines violently with oxygen and the halogens. When passed over heated metals, it liberates hydrogen and forms the phosphide. It forms double compounds such as $PH_3.2BF_3$ and $2PH_3.SiCl_4$, gives phosphonium salts, PH_4X, with the halogen acids, and decomposes to its elements when heated out of contact with air. The hydride P_2H_4 can be condensed as a liquid if the impure gas (above) is passed through U-tubes in a freezing mixture. It boils at 57°–58° C, and above

this temperature it breaks down to P_4H_2, which also results when it is exposed to light or left in contact with hydrochloric acid. The hydride P_4H_2 is a solid obtained by the action of phosphorus trichloride on PH_3, or of water on phosphorus di-iodide.

PHOSPHONIC SALTS AND OXIDES

Phosphonium Salts.—The *chloride,* PH_4Cl, large transparent cubes can be obtained by direct combination of phosphine and hydrogen chloride at $-30°$ C but decomposes on rise of temperature. The *bromide* may be prepared similarly or by heating phosphorus with hydrobromic acid at 110° in sealed tubes; it is unstable in air and is decomposed by water. The *iodide* is readily obtained by mixing phosphorus and iodine in carbon disulphide in a retort, distilling off the solvent, adding the requisite quantity of water and subliming the iodide:

$$5I+9P+16H_2O=5PH_4I+4H_3PO_4.$$

Caustic alkali or more water decomposes it to phosphine and iodide or hydriodic acid.

Just as amines (*q.v.*) are derivatives of ammonia, so phosphine gives rise to primary, secondary and tertiary phosphines, and organic phosphonium bases correspond to phosphonium salts. The primary and secondary phosphines, RPH_2 and R_2PH, are formed when alkyl iodides are heated with phosphonium iodide and zinc oxide to 150° C, the reaction mixture is treated with water, whereby the primary phosphine is obtained, and the secondary phosphine is liberated from its hydriodide by caustic soda. The tertiary phosphines and quaternary phosphonium salts are formed by the same reaction at higher temperatures (180° C) and without the use of zinc oxide. The primary and secondary phosphines are colourless liquids (except methylphosphine which boils at $-14°$ C) of unpleasant odour; they react neutral but form salts with acids, and are often spontaneously inflammable; nitric acid oxidizes them to mono- and di-alkylphosphinic acids, respectively, $RPO(OH)_2$ and $R_2PO(OH)$. The tertiary phosphines tend to give derivatives of quinquevalent phosphorus, and therefore readily form addition compounds and are oxidized to phosphine oxides, R_3PO. The quaternary phosphonium salts resemble the corresponding nitrogen compounds, being stable towards aqueous alkalis but converted by digestion with moist silver oxide to the very strongly alkaline phosphonium hydroxide; on heating, they decompose to the phosphine oxide and a hydrocarbon:

$$R_4P{\cdot}OH=R_3PO+R{\cdot}H.$$

The alkylphosphinic acids are colourless crystalline compounds, readily soluble in water or alcohol, and dibasic, whereas the dialkylphosphinic acids are monobasic.

Oxides.—Three oxides are well defined, viz , P_4O_6, P_2O_4, P_4O_{10}; others (*e.g.,* P_4O and P_2O) have been described and also disputed. *Phosphorus oxide,* P_4O_6, is a product of the limited combustion of phosphorus in air; if the element is burned in a hard glass tube and a rapid current of air is passed over it, the oxide may be condensed in a metal condenser and removed later by warming it. It sublimes in feathery crystals and melts at 22° to a colourless mobile liquid of sp.gr. 1·936 and boiling point 173°. Vapour-density determinations indicate the formula P_4O_6; above about 300° in a sealed tube it decomposes to phosphorus and the tetroxide. It is slowly oxidized by air and rapidly by oxygen (with inflammation at 70°) to phosphoric oxide; with cold water it slowly gives phosphorus acid, but with hot water it reacts violently, forming phosphorus, phosphine, phosphoric acid, and other products; hot alkalis decompose it similarly, but cold dilute alkalis form phosphites. Chlorine or bromine converts it chiefly to $POCl_3$ or $POBr_3$, whereas iodine forms the di-iodide, P_2I_4, and P_4O_{10}; hydrogen chloride and phosphorus pentachloride react with it as follows:

$$P_4O_6+6HCl=2PCl_3+2H_3PO_3;\quad P_4O_6+6PCl_5=4PCl_3+6POCl_3.$$

It combines violently with sulphur to give $P_4O_6S_4$ which sublimes as highly lustrous plates (m.p. 102°; b.p. 295°) and which is readily decomposed by water to sulphuretted hydrogen and phosphoric acid. Ammonia reacts to give the diamide $P(OH)(NH_2)_2$ and its ammonium salt. Phosphorus oxide has a peculiar garlic-like odour and is very poisonous; the odour and toxicity of phosphorus vapour are probably due to this oxide. *Phosphorus tetroxide,* P_2O_4 or better $(PO_2)_n$ since its molecular complexity is not certain, is obtained (*see* col. 1) as lustrous, deliquescent crystals; it is not the anhydride of hypophosphoric acid (*see* below), for water decomposes it to phosphorus and phosphoric acids. *Phosphoric oxide,* phosphoric anhydride (loosely termed "pentoxide"), is P_4O_{10} even at very high temperatures; it is obtained by the burning of phosphorus in excess of air or oxygen, as a soft flocculent powder which sublimes to transparent monoclinic crystals. It reacts violently with water and can be reduced to the element by heating with carbon.

Acids.—Hypophosphorous and hypophosphoric acids, H_3PO_2 and $H_4P_2O_6$ (or H_2PO_3), have no known anhydrides; phosphorous acid, H_3PO_3, is derived from P_4O_6; meta-, pyro- and orthophosphoric acids are derived from P_4O_{10} and are described under PHOSPHATES; perphosphoric acids, H_3PO_5 and $H_4P_2O_8$ are also known. *Hypophosphorous acid,* $H_2PO(OH)$, is prepared as its barium salt by boiling phosphorus with baryta water, removing excess of baryta by passing in carbon dioxide, and crystallizing the filtrate; if this salt is decomposed by the calculated amount of dilute sulphuric acid, the pure acid can be obtained, by careful evaporation of the filtrate under reduced pressure, as white crystals melting at 26·5° C. It is a monobasic acid and is slowly oxidized in air; on heating it gives phosphine and phosphoric acid. It is usually sold as a solution of sp.gr. 1·137 (about 32%) which is fairly stable. When warmed with copper sulphate solution it produces a red precipitate of the hydride, Cu_2H_2, thus demonstrating its exceptionally strong reducing properties; its salts are also effective reducing agents. *Phosphorous acid,* $H{\cdot}PO(OH)_2$, is formed from its anhydride, P_4O_6, or by passing chlorine into melted phosphorus covered with water, the phosphorus trichloride being decomposed *in situ.* The crystals melt at 70°, are very deliquescent, and oxidize in the air; on heating they give phosphine and phosphoric acid. It is an energetic reducing agent and, although normally dibasic, it gives rise to organic esters of the type R_3PO_3.

Hypophosphoric acid, $H_4P_2O_6$ or H_2PO_3, occurs among the products of oxidation of phosphorus in moist air or in water; the solution is neutralized by sodium carbonate, and the sparingly soluble lead salt is made, and then decomposed by hydrogen sulphide; sticks of phosphorus immersed in copper nitrate solution are also oxidized to this acid by means of nitric acid. The aqueous solution of the free acid is stable, but it decomposes on concentration unless this be done in a vacuum, in which case the hydrate ($H_4P_2O_6$, $2H_2O$) separates and can be dried below 50° to give the acid; this melts at 70° and decomposes. The solution does not readily act as a reducing agent. Owing to uncertainty as to the constitution, formulae such as $PO(OH)_2{\cdot}O{\cdot}PHO(OH)$ and $PO(OH)_2$ have been proposed; an ester $(CH_3)_2PO_3$ is known (Rosenheim, 1910), so the salts are probably best regarded as derived from the polymerized acid. Permono- and perdi-phosphoric acids are obtained from phosphoric anhydride or meta- or pyro-phosphoric acids and hydrogen peroxide at 0° C, large excess of peroxide favouring the production of the di-acid. The salts are also obtained by electrolysis of dipotassium hydrogen phosphate, a high anode current density increasing the proportion of the permono-salt; $K_4P_2O_8$ forms good crystals. The two acids differ in their action on iodides, the permono-acid liberating iodine at once, and the other slowly (compare persulphates; *see* SULPHUR).

Halogen Compounds.—*Phosphorus trifluoride,* PF_3, obtained by direct union of its elements, is a colourless, non-fuming gas, which liquefies at $-10°$ under 20 atmos., solidifies at $-160°$, and boils at $-95°$. It is comparatively stable, is only slowly decomposed by water, and does not attack glass when cold. *Phosphorus pentafluoride,* PF_5, results from combustion of the element or trifluoride in excess of fluorine, or from the interaction of arsenic trifluoride and phosphorus pentachloride. It is a colourless fuming gas of b.p. $-75°$ and m.p. $-83°$, and is dissociated by large induction sparks but not by heat (compare PCl_5 and PBr_5); it is readily decomposed by water

$$(PF_5+4H_2O=5HF+H_3PO_4)$$

and combines with ammonia to give $2PF_5,5NH_3$. *Phosphoryl fluoride,* POF_3, is best obtained by heating powdered cryolite with 1½ times its weight of phosphoric anhydride; it is a colourless, fuming gas of m.p. −68° and b.p. −40°.

Phosphorus trichloride, PCl_3, obtained by passing a slow stream of chlorine over heated red phosphorus or through a solution of yellow phosphorus in carbon disulphide and fractionally distilling the product, is a colourless, mobile liquid of sp.gr. 1·613 (at 0° C) and b.p. 76°, and freezes at −112°. As prepared above, it may be contaminated with PCl_5, from which it is freed by distillation from excess of phosphorus. Cold water gives hydrochloric and phosphorous acids, and hot water gives red phosphorus and other products. When diluted with hydrogen and led into liquid ammonia, PCl_3 yields $NH{:}P{\cdot}NH_2$, which gives $P_2(NH)_3$ on heating; a similarly diluted mixture, when submitted to the electric discharge, forms the dichloride, P_2Cl_4, an unstable fuming liquid, boiling and decomposing at 180°. *Phosphorus pentachloride,* PCl_5, obtained by the action of excess of chlorine on the element or its trichloride, is a pale straw-coloured solid, which sublimes and dissociates on heating, but may be melted at 148° under pressure; the dissociation is repressed by excess of chlorine: $PCl_5 \rightleftarrows PCl_3+Cl_2$. Water effects decomposition rapidly in two stages:

$$PCl_5+H_2O=2HCl+POCl_3;\quad POCl_3+3H_2O=3HCl+H_3PO_4.$$

The pentachloride is extensively used in organic chemistry, *e.g.*, for replacing hydroxyl groups by chlorine:

$$R{\cdot}OH+PCl_5=RCl+POCl_3+MCl.$$

Phosphoryl chloride, or phosphorus oxychloride, $POCl_3$, may be produced as shown above, or by the interaction of phosphoric oxide on the pentachloride or on hydrogen chloride:

$$3PCl_5+P_2O_5=5POCl_3;\quad 2P_2O_5+3HCl=POCl_3+3HPO_3.$$

It is a colourless liquid of b.p. 107° and m.p. 1°; with water it gives hydrochloric and phosphoric acids, with dilute alcohol ethylphosphoric acid, $C_2H_5{\cdot}H_2PO_4$, and with absolute alcohol triethyl phosphate, $PO(OC_2H_5)_3$. *Pyrophosphoryl chloride,* $P_2O_3Cl_4$, is also known. *Thiophosphoryl chloride,* $PSCl_3$, is formed by direct combustion of sulphur and PCl_3, by the action of sulphuretted hydrogen, antimony trisulphide or phosphorus pentasulphide upon P_4O_{10}, or by dissolving phosphorus in sulphur chloride and distilling: $2P+3S_2Cl_2=4S+2PSCl_3$. It is a colourless liquid (b.p. 125°), is decomposed by water to acids corresponding to each of the three elements, and gives thiophosphates with alkalis, *e.g.*, $PS(OK)_3$.

Phosphorus tribromide, PBr_3, prepared by passing bromine vapour (diluted with carbon dioxide) over phosphorus, or by mixing solutions of the two in carbon disulphide and distilling, is a liquid boiling at 173° and resembling the trichloride chemically. The *pentabromide,* PBr_5, resulting if an excess of bromine is used in the above preparations, is a yellow solid closely resembling the pentachloride. *Phosphoryl bromide,* $POBr_3$ (m.p. 45°; b.p. 195°), and *thiophosphoryl bromide,* $PSBr_3$ (m.p. 38°), both resemble the corresponding chloro-compounds. The action of iodine and phosphorus when dissolved in carbon disulphide (free from sulphur) gives rise to a *di-iodide,* PI_2 or P_2I_4 (m.p. 124°), a *tri-iodide,* PI_3 (m.p. 61°), and possibly a *sub-iodide,* P_4I.

SULPHUR AND NITROGEN COMPOUND

Sulphur Compounds.—Phosphorus and sulphur combine energetically to form a series of sulphides, three of which are well defined, viz., P_4S_3, P_4S_7 and P_2S_5 (*see* A. Stock, *Berichte,* 1908 *et seq.*); the first is sometimes used as a substitute for phosphorus in matches, and the last finds application in organic chemistry for replacing oxygen by sulphur. There is also evidence for the existence of PS_6, P_2S_3, and possibly P_2S. Thiophosphates (*e.g.*, Na_3PSO_3 and $Na_3PS_2O_2$) result from the dissolution of P_2S_5 in alkalis, whereas by melting it with the sulphides or chlorides of heavy metals, salts analogous to Na_3PS_4 are obtained, which are somewhat unstable in water and still more so towards acids.

Nitrogen Compounds.—Phosphorus pentachloride reacts readily with ammonia to give PCl_5, $5NH_3$ and thence $PCl_3(NH_2)_2$, chlorophosphamide, which is decomposed by water to $PO(NH)(NH_2)$ or by heat to "phospham," $NH{:}P{\vdots}N$, a white infusible, stable solid; when $PO(NH)(NH_2)$ is heated it gives "phosphoryl nitride," $O{:}P{\vdots}N$. When ammonia and phosphorus pentasulphide react at a red heat they give a *nitride,* P_3N_5, whereas if the pentoxide is used (in the presence of a trace of water) a series of amides of phosphoric acid result: $PO(NH_2)_2(OH)$, $PO(NH_2)(OH)_2$ and $PO(OH)(NH)$. The interaction of phosphorus pentachloride and ammonium chloride in a sealed tube produces a series of chloronitrides, $(PNCl_2)_n$, where *n* may be 3, 4, 5, 6 or 7. These give rise to a great variety of complex polymerized compounds by reaction with water.

Therapeutics and Toxicology.—Various preparations of phosphorus are used in the British Pharmacopoeia. The element is essential for the growth of bones in young animals, and hence its compounds are used in rickets. It is also efficient as a nerve tonic in paralysis agitans, locomotor ataxia, impotence and nervous exhaustion. In some skin diseases, such as psoriasis, chronic eczema and acute indurata, phosphorus is useful. The hypophosphites are recommended in pulmonary affections and are used in tonics, and the glycero-phosphates stimulate metabolism. Dilute phosphoric acid is used as a gastric stimulant.

Phosphorus is readily accessible in poisonous forms, *e.g.*, in vermin pastes and some matches, and is often taken either intentionally or accidentally. Symptoms of acute poisoning are usually shown after some delay, with nausea, vomiting, and burning sensations in the oesophagus, stomach and abdomen. Emetics and purgatives should be given at once to prevent absorption of the poison. Doses of 3–5 grains of copper sulphate in water at intervals of a few minutes form the harmless copper phosphide. The stomach should be washed out with warm water and then with a 2% solution of potassium permanganate, and this solution should also be given as an enema. Oils, which are effectual in other cases of irritant poisoning, *should not be given,* for they tend to dissolve phosphorus and retain it in the system; the old French oil of turpentine, however, acts as an antidote in allaying the toxic effects. When yellow phosphorus was used in matches, those engaged in the manufacture used to suffer from a form of necrosis, called "phossy jaw" in England; the red form now employed is, however, non-poisonous. (A. D. M.)

PHOTIUS (*c.* 820–891), patriarch of Constantinople (858–867 and 878–886). The way to public life was probably opened for him by the marriage of his brother Sergius to the princess Irene, sister of Theodora, who, upon the death of her husband Theophilus in 842, had assumed the regency of the empire. Photius became captain of the guard and subsequently first imperial secretary. The dissensions between the patriarch Ignatius and Bardas, the uncle of the youthful Emperor Michael III., brought promotion to Photius. Ignatius was arrested and imprisoned (Nov. 858), and upon refusing to resign his office was illegally deposed, while Photius, although a layman, received all the necessary sacerdotal orders within six days, and was installed as patriarch in his place. Ignatius, continuing to refuse the abdication which could alone have given Photius's elevation a semblance of legality, was treated with extreme severity. His cause was subsequently espoused by Pope Nicholas in a manner highly offensive to the independent feeling of the Eastern Church. Photius felt himself the champion of Eastern Christianity against Latin pretensions; and when in 863 Nicholas finally anathematized and deposed him, he replied by a counter-excommunication. Meanwhile, the situation was suddenly changed by the murder of Photius's patron, Bardas, by order of the emperor Michael, who was himself assassinated by his colleague Basil in the following year (867). The fall of Photius immediately ensued; he was removed from his office and banished about the end of September 867, a few days after the accession of Basil, and Ignatius was reinstated on Nov. 23.

About 876 Photius was suddenly recalled to Constantinople and entrusted with the education of Basil's children. On the death of Ignatius, probably in October 878, Photius again became patriarch. In 879 the legates of Pope John VIII. attended a synod convened at Constantinople, prepared to acknowledge Photius as legitimate patriarch, a concession for which John was

much censured by Latin opinion. But John stood firm on outstanding points of difference; disowned his legates, and again excommunicated Photius. Photius ignored John's action, but a palace revolution caused his banishment (886) to Bordi in Armenia. He is said to have died there on Feb. 6, 891.

Photius shows to no little advantage as an ecclesiastical statesman. His firmness was heroic, his sagacity profound and farseeing; he supported good and evil fortune with equal dignity; and his fall was on both occasions due to revolutions beyond his control. In erudition, literary power, and force and versatility of intellect he far surpassed every contemporary.

The most important of the works of Photius is his renowned *Bibliotheca* or *Myriobiblon* (ed. I. Bekker, 1824–1825), a collection of extracts from and abridgments of 280 volumes of classical authors (usually cited as *Codices*), the originals of which are now to a great extent lost. To Photius we are indebted for almost all we possess of Ctesias, Memnon, Conon, the lost books of Diodorus Siculus, and the lost writings of Arrian.

The *Lexicon* (Λέξεων Συναγωγή), was probably in the main the work of some of his pupils. The only ms. of the *Lexicon* is the Codex Galeanus, at Trinity College, Cambridge (ed. S. A. Naber, 1864, with introduction on the authorities, critical commentary and valuable indexes). The *Amphilochia* is a collection of some 300 questions and answers on difficult points in Scripture, addressed to Amphilochius, archbishop of Cyzicus (ed. Sophocles Oeconomus, Athens, 1858). Other similar works are his treatise in four books against the Manichaeans and Paulicians, and his controversy with the Latins on the Procession of the Holy Spirit. His *Epistles* were edited by J. Valettas, London (1864). A large number of his speeches and homilies have been edited by S. Aristarches (1900). The only complete edition is Bishop Malou's in Migne's *Patrologia graeca*, ci.–cv. R. Reifzenstein (*Der Anfang des Lexikons des Photius*, 1907) has published a hitherto unedited ms. containing numerous fragments from various verse and prose authors.

See Cardinal Hergenröther, *Photius, Patriarch von Constantinopel* (1867–69).

PHOTOCHEMISTRY is that division of physical chemistry which deals with the chemical action of radiant energy on matter, and with the direct production of radiation by chemical reactions. The field of photochemistry might be regarded as being equally as extensive as the range of electromagnetic vibrations; from the tiny ultra-X-rays to the huge waves of "wireless." Actually, limitations exist and photochemical reactions are considered primarily as the transformations of matter associated with radiations between and including the trans-ultraviolet and infra-red radiations. This range includes the visible radiations, and a band on either side of approximately the same width as that covered by the visible radiations. The wave-lengths included are those between 10$\mu\mu$ and 1,000$\mu\mu$. The micron, μ, a measure of length, is 10^{-4} cm. or 10^{-3} mm., and the millimicron, $\mu\mu$, is 10^{-7} cm. or 10^{-6} mm. The direct production of radiation by chemical reaction is termed *chemiluminescence*. It is differentiated from the radiation produced in such reactions as combustion, by the absence of thermal equilibrium between the matter and the radiation concerned (*see* RADIATION).

Principle of Photochemical Equivalence.—Previous to about 1910, photochemistry had but one accepted generalization, the *absorption law*, according to which only the light energy absorbed by a body is active in promoting chemical change. This is a special case of the principle of conservation of energy, which states that energy may be neither created nor destroyed. Nearly a century after the first expression of this law, a principle of photochemical equivalence was put forward, in 1922, by A. Einstein. It is founded on Planck's quantum theory (*see* QUANTUM THEORY) of radiation, according to which all exchange of energy as radiation between atoms and molecules takes place discontinuously by quanta of finite magnitude $\epsilon = h\nu$, where ν is the frequency of vibration, h a universal constant, equal to $6{\cdot}55 \times 10^{-27}$ ergs/sec.; ϵ varies continuously in magnitude with the multiplying frequency ν, but Planck's h is an invariable *quantum* of *action*.

The photochemical equivalence principle of Einstein states that in a primary photochemical process, the decomposition of one molecule requires one quantum of energy $h\nu$, or that one gram-molecule requires $Nh\nu$, where N is Avogadro's number of gas molecules per litre, $6{\cdot}06 \times 10^{23}$. In his original derivation he postulates a reversible reaction of simple unimolecular decomposition

$$AB + h\nu \rightleftharpoons A + B,$$

the bimolecular "dark" reverse reaction giving the chemiluminescent radiation $h\nu$; the reaction was supposed to occur in a gaseous or dilute system. In a later deduction, this primary photochemical event was supposed to be limited to the excitation of an atom or molecule

$$C + h\nu \rightleftharpoons C^*$$

the atom or molecule C being raised to a higher energy level. It may be stated at once that this generalization is not so complete or sufficient that all photochemical phenomena can be interpreted by its sole aid. It has, none the less, completely changed the outlook, beside leading to improvements in the technique.

Experiment and Technique.—Modern investigation of a photochemical reaction essentially involves determining its quantum efficiency, in the sense of Einstein's principle. This requires certain elements of technique:—(a) a light source of sufficient intensity adequately monochromatized; (b) exact measurement of the energy absorbed during a given reaction period; (c) distinction of the primary photochemical reaction, if possible, from secondary dark reactions; (d) determination of the molecular "order" of the reaction involved, and analytical measurement of the product of the photochemical reaction proper.

As to the first, there are not many available reactions occurring in light of the visible spectrum range. As visibility coincides fairly closely with the spectral distribution of energy in sunlight—a matter of natural selection—it is obvious that on the whole only systems stable in such illumination will be readily found. Much more frequent are photochemical reactions in the ultraviolet; and artificial light sources rich in these rays are most used in laboratory research, as well as for certain industrial applications. The ultra-violet radiation from electric glow lamps is relatively feeble and does not extend far to the shorter waves. Recourse has to be made to spark and arc discharges. The latter are generally more convenient. The three chief types used may be described as carbon arcs, magnetite and high-melting metal arcs, as tungsten arcs, and metal vapour arcs; of these, the mercury vapour arc in fused quartz is the most important. The spectrum is discontinuous, and it is not difficult to secure approximately monochromatic light at several different wavelengths by the use of colour screens or ray filters. Unfortunately when the far ultra-violet rays are in question (λ less than 200 $\mu\mu$) there are no very satisfactory filters available, the best requiring the use of chlorine and bromine gases. When a high degree of monochromatic purity is required, the light must be dispersed and quartz monochromators employed, with great reduction of intensity. With regard to the other requirements, the measurement of the energy absorbed in a reaction is determined with a radiometer (*q.v.*, such as a thermopile, radiomicrometer or bolometer) as the difference between the energy incident upon and transmitted through the reaction mixture; the latter is usually contained in a vessel with plane-parallel quartz walls, and maintained at constant temperature. The distinction of the primary photochemical reaction, the determination of the molecular order and of the quantum efficiency are then matters of interpreting the analytical results for different periods of the reaction.

The fundamental researches on photochemical equivalence were those of E. Warburg. They occupy in the modern era of photochemistry somewhat the position of the classical photochemical investigations by Bunsen and Roscoe in preceding years. Warburg introduced a convenient term, the *quantum efficiency*; this is the ratio of the effective photochemical equivalent ϕ to the ideal photochemical equivalent P. Both ϕ and P are expressed in terms of the number of gram-molecules absorbing and decomposed by one gram-calorie of radiation of frequency ν. When Einstein's law holds $\phi/P = 1$. Tabulated results of several reactions show that relatively few reactions confirm the Einstein relation, among which are some for which the efficiency is actually less than unity, but which give this value when extrapolated back to the start of the reaction. This procedure is justifiable when

strongly absorbing product is formed. On the other hand there are many reactions whose efficiency (ϕ/P) is much greater than unity, even to hundreds and thousands of molecules per quantum.

Mechanism of Photochemical Reactions.—Although it is true that certain substances are more obviously photosensitive than others, a useful classification of photochemical reactions is not possible in terms either of chemical structures or of types of chemical reaction. This is particularly evident in the field of organic chemistry. The great variety of substances and types of reaction is illustrated in the following table:

Allotropic change in elements	Sulphur Light Rhomb. ⇄ Amorph.
Intramolecular change and isomerization .	Infra red Fumaric acid: COOH—C—H ∥ H—C—COOH ⇄ Maleic acid: H—C—COOH ∥ H—C—COOH
Polymerization and depolymerization .	$C_{14}H_{10}$ ⇄ $C_{28}H_{20}$ Anthracene ⇄ Dianthracene $3O_2 \rightleftharpoons 2O_3$ Oxygen Ozone
Hydrolysis . .	$(CH_3)_2{\cdot}CO + H_2O = CH_3{\cdot}COOH + CH_4$ Acetone Water Acetic acid Methane
Reduction . .	$2AgCl = Ag_2 + Cl_2$ Silver chloride Silver Chlorine $Fe_2(C_2O_4)_3 = 2Fe(C_2O_4) + 2CO_2$ Ferric oxalate Ferrous oxalate Carbon dioxide
Oxidation . .	$PbS + 2O_2 = PbSO_4$ Lead sulphide Oxygen Lead sulphate
Decomposition .	$2HI = H_2 + I_2$ Hydriodic acid Hydrogen Iodine
Synthesis . .	$CO + Cl_2 = COCl_2$ Carbon monoxide Chlorine Phosgene

To obtain a classification it is therefore necessary to search more deeply into the fundamental mechanisms of photochemical reactions. Every advance in knowledge of these will displace a previous classification or system but will supply a better working hypothesis. Einstein's proof of his principle implied that the *primary photochemical process* is a dissociation of a molecule, *e.g.*, into atoms. Thus in the combination of hydrogen, H_2, and chlorine, Cl_2, in light to form hydrogen chloride, HCl, it was assumed that the primary reaction was $Cl_2 + h\nu = Cl + Cl$. Now the photochemical efficiency of the $H_2.Cl_2$ reaction is very great—it can amount to thousands of molecules of HCl per quantum absorbed. This was explained by the conception of secondary reaction chains (*see* subsequent section). Primary decomposition of molecules also implies a wave-length limit to a given photochemical reaction; because if the quantum, $h\nu$, absorbed be of less energy than the heat of formation of the molecule, it should be impossible to decompose it directly, and therefore, according to Einstein's principle, the relation of photochemical yield ϕ to the wave-length would have the form shown in fig 1.

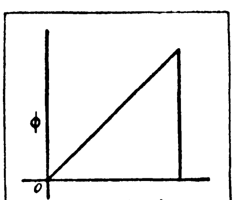


FIG. 1.—DIAGRAM SHOWING HOW PHOTOCHEMICAL YIELD SHOULD INCREASE WITH WAVE-LENGTH

Now cases are certainly known where the wave-lengths active in photochemical change are below the value corresponding to the heat of formation. In fact, the existence of definite photochemical spectrum thresholds has scarcely been demonstrated.

A difficulty of exactly the opposite kind for the primary decomposition of the molecule developed from the investigations of physicists on the energy required to make gas molecules fluoresce. It was shown that at low pressures a molecule of gas can take up many times its heat of formation without decomposing. For example, iodine, I_2, can absorb and re-emit as resonance-radiation an amount of energy five times its heat of formation. On the modern theory of atomic and molecular structure as related to the emission and absorption of light, named, after its principal founder, the Bohr theory (*see* ATOM), these results are explained as follows. The total internal energy of a molecule, however acquired (and understanding by a molecule a multinuclear structure) will consist of:

Energy of rotation + Energy of oscillation + Energy of electron displacements.

The whole energy, and the distribution of this energy, is governed by quantum rules, *i.e.*, it cannot vary continuously, but can only assume a series of finitely differing values, or quantum states. The gain of internal energy of an excited molecule consists primarily in the exaltation of the electron system to higher quantum states, when the oscillation and rotation energies are also altered by the coupling of their periods with those of the electron system. The rotational and oscillation energies are mainly responsible for absorption and emission of infra-red rays. At present there is but slender evidence for direct intervention of these in chemical reactions. A primary chemical decomposition, *i.e.*, one not involving collision with chemically indifferent molecules, might occur by such increase of rotational energy that the centrifugal force exceeded the chemical affinity. Similarly for an excessive increase of oscillation of the parts. Apparently the constitution of molecules is such that this cannot be effected either by direct infra-red absorption or by absorption in the bands corresponding to electronic displacements, but only at frequencies beyond the band spectrum. (A typical molecular band spectrum is illustrated in the article BAND SPECTRA, *q.v.*) The theory of such spectra is not yet entirely adequate to complete prediction of the distribution of energy in all cases. But certain conclusions are definite. The change in rotational energy on excitation is small enough to be negligible, so that it is quantum-coupled increase of oscillation energy that is critical for dissociation.

The Dissociation of the Molecule.—In the gaseous or independent state, molecules may be classed as heteropolar and homopolar or non-polar (*see* ELECTROLYSIS), the former having large electrical moments. In the homopolar molecules no such electrical dissymmetry appears. However, not only are molecules of all sorts of intermediate type known, but the polarity of one and the same molecule depends on its environment. If a heteropolar molecule, such as HBr, absorb energy, the increase of oscillation energy is small. An electron of the positive ion is raised to a higher quantum state, thereby inducing stronger, not weaker binding, and no dissociation, *e.g.*, into positive and negative ions, can be expected from the absorption of light. It is not impossible, however, that an electron should be removed from the anion by radiation, although spectra corresponding to the reaction

$$\underset{\text{Chlorine Atom}}{Cl} + \underset{\text{Electron}}{\odot} \leftrightarrows \underset{\text{Chloride Ion}}{\overline{Cl}}$$

termed *electron affinity spectra* are not yet known. In such case we should have dissociation of the molecule into a positive ion, a neutral atom, and an electron, thus:

$$(HBr) \rightarrow \overset{+}{H} + Br + \odot.$$

In homopolar molecules Franck suggests two types of linkage. In one, electrons are shared in common (covalency), *e.g.*, in H_2 and O_2; "such molecules cannot separate from the normal state adiabatically into two atoms, and the electron jumps associated with the formation and dissociation of these molecules cannot be produced by radiation processes but only through collision." In agreement with this no point of convergence of bands has been observed in the molecular spectrum of hydrogen. A second type of homopolar linkage is, however, of much smaller strength—sometimes termed van der Waal's forces, *i e*, akin to the attraction between gas molecules and the chemist's residual affinity operative in molecular association. Here the molecule may take up so much oscillation energy through absorption that it will separate into a normal and an excited atom. There is evidence that the halogen molecules belong to this class. The absorption

spectrum of iodine, which is approximately represented in fig. 2, indicates that the shorter the wave-length, the smaller the interval between the oscillation-quanta, until a real convergence limit appears at about 5,000 Å.U. with a strong continuous spectrum beyond. The Ångstrom unit, Å.U., $= 10^{-8}$ cm. $= 0 \cdot 1 \mu\mu$. Bromine and chlorine also show continuous spectra, of known wave-length limits, 5,200 Å.U. for Br_2 and 4,800 Å.U. for Cl_2. This con-

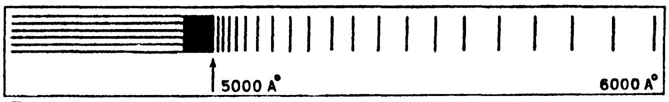


FIG. 2 —DIAGRAMMATIC REPRESENTATION OF A PORTION OF THE ABSORPTION SPECTRUM OF IODINE

vergence limit seems to be critical for dissociation of the molecule; and it may be assumed that *absorption of light of wave-length equal to or shorter than these convergence limits of the band spectra will dissociate the molecule into a normal and an excited atom.* Recent work indicates that the absorption spectrum of oxygen, O_2, is similar to that of iodine but the continuous spectrum lies at a much shorter wave-length. Furthermore, the ultra-violet absorption spectra of HBr and HI during photochemical decomposition were found to be continuous. Hence it is concluded that these molecules also are directly dissociated into atoms by light absorbed in this region.

Types of Photochemical Reaction.—On the basis of comparison of the absorption spectrum with actual photochemical behaviour, we have then a very important division of photochemical reactions into two classes. (This division was clearly suggested by J. Franck, "Elementary Processes of Photochemical Reactions," *Faraday Soc. Symposium*, but more explicitly developed by R. H. Gerke, *J. Amer. Chem. Soc.*, 1927, 49, p. 2671.) In one class, the molecule is merely converted by absorption of radiation into an "excited" molecule,

$$AB + h\nu \rightleftharpoons A^*B.$$

The resultant excited molecule may: (*a*) lose energy by radiation (fluorescence, resonance radiation), or (*b*) lose energy by collision with another molecule, in which case a number of things may happen. The most likely is conversion to heat, as energy of translational motion. The broadening of absorption lines in gases with pressure, and in solutions, the reduction of fluorescence by inert gases, are evidence of energy "damping" of this kind. Another possibility, however, is collision not with an indifferent molecule, but with an acceptor, *i.e.*, a molecule capable of reacting with the excited molecule, or of itself undergoing chemical change. In all cases where the excited molecule itself appears in the photo-product, we have what has been conveniently termed (R. H. Gerke, *loc. cit.*) the *excited reactant* type of photochemical reaction. Some examples are given in the following table:

Reaction	Absorbing molecule	Type of spectrum	Active radiations, Å.U.	Quanta absorbed per mol. of reaction	Heat effect of reaction
$O_2 = 2/3\ O_3$	O_2	Band	1,970–1,756	1·04–3·4	Endothermic
$NH_3 = 1/2\ N_2 + 3/2\ H_2$	NH_3	,,	2,260–1,515	2–10	,,
$O_3 = 3/2\ O_2$	O_3	,,	6,700 and u.-v.	.	Exothermic
$H_2 + 1/2\ O_2 = H_2O$ (dry)	O_2	,,	1,970–1,756	..	,,
$CO + 1/2\ O_2 = CO_2$ (dry)	O_2	,,	1,970–1,756	..	,,
$CH_3 \cdot CHO + 1/2\ O_2 = CH_3 \cdot COOH$	$CH_3 \cdot CHO$	,,	2,800–2,350	..	,,

Where, however, the excited molecule does not itself enter into chemical reaction, but colliding with another different molecule induces chemical change in this, we have an *excited sensitizer* or photocatalysed reaction. The first cases of gas reaction of this type were discovered by F. Weigert (1907), being a number of reactions in which chlorine gas in light produced decompositions or combinations without appearing in the products. A notable example was the sensitized decomposition of ozone by chlorine. Recent experiments on the excitation of mercury vapour in ultra-violet light have widened the field of these reactions and helped to clarify their nature. In experiments on the excitation of gas molecules or atoms by electrons of known velocity (voltage), it was found that for a certain velocity of the electron a bombarded atom became excited and emitted radiation of definite wave-length. The system of the atom plus electron lost kinetic energy just equal to the quantum radiated. But conversely, a slow moving electron colliding with an excited atom might gain kinetic energy, the atom becoming normal without radiating. Such collisions are termed "rayless collisions of the second kind." The same kind of rayless transfer of quantized energy was also found to be possible between atoms and molecules in gases. Cario and Franck showed that mercury atoms, excited by the resonance line λ 2537, could transfer their excess energy to hydrogen molecules, with production of "active" hydrogen, very possibly atomic hydrogen, according to the reactions

$$Hg + h\nu \rightarrow Hg^*$$
$$Hg^* + H_2 \rightarrow Hg + 2H.$$

A considerable number of such mercury sensitized reactions have now been investigated by H. S. Taylor and others. The intermediate "active" hydrogen has been caused to decompose ethylene, C_2H_4, carbon monoxide, CO, forming formaldehyde, solid polymers, and methane. Some of these excited sensitizer reactions are here tabulated:

Reaction	Absorbing sensitizer	Type of spectrum	Active radiation, Å.U.	Quanta of radiation per mol. reactant	Heat effect of reaction
$H_2 = 2H$	Hg	Line	2,536		Endothermic
$O_3 = 3/2\ O_2$	Hg	,,	2,536	.	Exothermic
$H_2 + 1/2\ O_2 = H_2O$	Hg	,,	2,526	..	,,
$N_2O_5 = N_2O_4 + 1/2\ O_2$	NO_2	Band	4,600–4,000	.	Negligible

In both these "excited molecule" reactions, the chemical yield on the photochemical equivalent basis will very probably not agree with the Einstein equivalence principle, because the excited molecule may lose energy either by fluorescence or by ineffective collisions. Yet the primary event, formation of an excited molecule, is itself regulated by the photochemical equivalence. If, however, the absorbed frequency is equal to or greater than the convergence limit of the band spectrum of the substance, absorption takes place with *primary decomposition:*

$$\text{Atom} + h\nu = \text{Ion} + \text{electron}$$
$$\text{Molecule} + h\nu = \underset{\text{(excited)}}{\text{Atom}^*} + \underset{\text{(normal)}}{\text{atom}}$$

and here the yield is in full agreement with Einstein's law. It appears therefore that when absorption takes place of frequencies still low enough for the atom or molecule to resonate, photochemical reaction need only follow indirectly. When, however, the radiation "note" is pitched too high for the system to resonate, the atom or molecule is shattered.

Chain Reactions.—In many exothermic photochemical reactions it is found that the photochemical efficiency may be manifold, up to 10^6 molecules per quantum absorbed. The most fully studied, though still incompletely unriddled, example is the union of chlorine and hydrogen in light:

$$H_2 + Cl_2 = 2HCl.$$

In the completest possible absence of water vapour, this reaction does not proceed in ordinary and ultra-violet light within the band spectrum of chlorine, but does so in ultra-violet light at

3,000 Å.U. In the first case, only an excited Cl_2^* molecule is formed, which is unable to activate hydrogen in absence of water. In the second case, primary decomposition into an excited and normal molecule is believed to occur

$$Cl_2 + h\nu = Cl^* + Cl$$

The chain reaction somewhat as proposed by Nernst probably follows:

$$Cl^* + H_2 = HCl + H$$
$$H + Cl_2 = HCl + Cl$$

In the presence of water vapour, even excited molecules can initiate chains of much greater length. This would signify that "activated molecules" or metastable molecular complexes must be formed of much longer life than the 10^{-8} second usually assigned to excited molecules.

The conception of reaction chains to explain high quantum yields was introduced by M. Bodenstein and developed by W. Nernst. In the type just instanced, implying a primary decomposition reaction, a free atom or group is produced. This reacts with one of the original molecules, forming another free atom or group, and so forth. The process is exhausted by the gradual recombination of the free atoms or groups with each other. In another type, an excited molecule is produced, which activates a molecule of reactant by collision. This activated molecule then forms another activated molecule of the product, and so on. There is therefore a succession of rayless transfers of energy, the chain ceasing again by dissipation of energy in fruitless collisions. It is very possible that in certain cases, particularly where water vapour plays a part, metastable intermediate molecules or groups are formed.

Photochemical Induction, Inhibitors and Water Vapour.—The classical investigations of Bunsen and Roscoe upon the photochemical union of chlorine and hydrogen revealed the existence of a "latent period," during which no combination occurred. They regarded this "induction" as common to all chemical reactions, as required for the overcoming of starting friction. Many explanations were offered of "photochemical induction" until D. L. and M. C. C. Chapman showed it to be due to the presence of specific impurities. These suspend or inhibit the reaction until destroyed by the light or the photochemical change itself. In the hydrogen-chlorine reaction, ammonia is an important inhibitor, as are the oxides of nitrogen. Oxygen again can function as an inhibitor, either by itself accepting hydrogen atoms, or by reacting with excited chlorine atoms. In many reactions, substances may act as negative photocatalysts simply by absorbing exciting radiation.

In certain gas reactions, water vapour may appear as a positive catalyst, as for example in the combination of chlorine and hydrogen in visible light. Explanations range from intermediate hydrates (containing active atoms) to facilitation of an action limited to a polar layer on the walls of the reaction vessel.

Photochemistry and Carbon Compounds.—The number of organic syntheses and decompositions capable of being effected by light has been greatly increased as more efficient sources of ultra-violet light become available. Most of these, however, remain quantitatively unprobed, and so far relatively few have become tools for organic synthesis. The most important investigations in this field at present are those concerned with the quantitative measurement and interpretation of absorption spectra (a notable work is V. Henri's *"Études de Photochimie,"* 1925), from which we may anticipate certain approximate inductions on the photochemical reactivity of specific groups (or specific linkages), such as $>C=O$, $>C=S$, $-C=C-$, $N\equiv C-$, etc., either singly, conjugated in chains or condensed. And this may yield a workable knowledge of relations between photochemical reactivity, unsaturation and the life-periods of free radicals. Among synthetic reactions, the photo-polymerizations of vinyl compounds are perhaps the most interesting, because of the relations of such bodies to organic high-molecular colloids, such as the rubber hydrocarbon $(C_5H_8)_x$, starch $(C_6H_{10}O_5)_m$, and cellulose $(C_6H_{10}O_5)_n$ and eventually proteins, $NH_2(CO{\cdot}NH)_mCOOH$.

There are two organic photolyses of quite dominating importance. These are the retinal process underlying vision, and the green leaf assimilation of carbon dioxide. The photochemical basis of vision consists in the bleaching-out of an organic pigment, "visual purple." This is regenerated in darkness by a secondary chemical process, which appears to be molecular in character. We can represent this process by the symbol

$$S \underset{\text{dark}}{\overset{\text{light}}{\rightleftarrows}} P + A$$

Photosynthesis.—The green leaf synthesis of starch, which is the basis of the great photochemical industry of agriculture, is generally emphatically termed photosynthesis. The riddle expressed in the crude equation

$$6(CO_2 + H_2O) = C_6H_{10}O_5 + 6O_2$$

Carbon dioxide + Water form Starch + Oxygen

is by no means solved. The *formaldehyde hypothesis* of Baeyer explains the production of carbohydrates (starches, sugars, cellulose) by a primary formation of formaldehyde

$$CO_2 + H_2O \rightarrow CH_2O + O_2$$

Carbon dioxide + Water form Formaldehyde + Oxygen

by light in the presence of chlorophyll, which is supposed to be followed by a biochemical or photochemical condensation of the formaldehyde

$$6(CH_2O) = C_6H_{10}O_5 + H_2O.$$

This theory has been strongly supported by B. Moore, D. Berthelot, and recently by E. C. C. Baly, and severely criticized by H. A. Spoehr, whose monograph "Photosynthesis" (*American Chem. Soc. Monographs,* 1925) furnishes a very complete study of the subject. The issue is of capital importance for chemistry, perhaps ultimately for the economy of mankind, since it is concerned with the basic process of food production. Baly and his co-workers claim that the reaction:

$$CO_2 + H_2O = CH_2O + O_2$$

can be effected, (*a*) by ultra-violet rays at 2,060 Å.U., (*b*) by sunlight in the presence of dyes such as Malachite Green. They also assert that the condensation of formaldehyde to reducing sugars can be effected by ultra-violet rays at 2,900 Å.U. More recently Baly has published further evidence supporting the production of alkaloids by direct photochemical synthesis *in vitro.*

Meanwhile the work of other investigators, notably O. Warburg, R. Wurmser and H. A. Spoehr, following the pioneer efforts of A. Brown and H. Escombe, has shown the actual photochemical efficiency of the chlorophyll sensitizer to be fairly high, perhaps up to 80% of an absorbed quantum being converted into stored chemical energy at moderate light intensities. *Chlorophyll,* the chemical constitution of which has been unravelled by the masterly work of R. Willstätter, undoubtedly acts as a photo-chemical sensitizer, like the dyes used in photographic processes (*q.v.*).

Industrial Prospects.—The total amount of solar energy incident upon the earth's surface is very great. Taking a *solar constant* of 1·5 calories per sq.cm. per minute, it can be calculated that onto every square mile of the Sahara Desert about 67 billion British Thermal Units of heat are given by the sun in a 6-hour day; the area of this desert is about 2,300,000 sq. miles. If, therefore, only a minute fraction of this heat could be utilized we should be able to realize the prophetic words of a great chemist (G. Ciamician): "The exhaustion of coal will not halt civilization, destined to advance as long as the sun shines. Then our sooty and neurotic age of coal will yield to a purer and calmer epoch, relying upon solar energy for a fortune and a progress without mischance."

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PHOTOELECTRICITY. The photoelectric effect is the name given to the power shown by light, X-rays and γ-rays of causing a body to emit electrons, or negative electricity. Light, X-rays and γ-rays are all electro-magnetic radiations differing only in their wave-lengths, that of light being the longest; and it is the electric forces in the radiation, acting on the electrons in the atoms of the body, which communicate sufficient energy to the electrons to set them free from the atom, and even to give them very high velocities. The phenomenon is interesting and important from several points of view, of which the chief is that it represents one of the three fundamental methods of interaction between radiation and matter, the other two being resonance-absorption and scattering. The laws governing this phenomenon are simple to express although difficult to understand, and maintain their validity over an enormous range of wave-length. Ordinary light has a wave-length one million times as great as that of the short γ-rays, but yet the relation governing the speed of the ejected electron is the same in both cases.

The study of the photoelectric effect has raised many points of great interest in connection with our views as to the real nature of radiation, since it brings to light a behaviour apparently irreconcilable with the simple continuous wave-theory used to explain interference. While this disagreement still defies explanation, the effect is sufficiently understood to be of the greatest use in elucidating the structure of the atom. The reason for this lies in the fact that the action of the radiation on an atom is selective. While long wave-length light leads to the ejection of electrons from the outer portions of the atom, the much shorter wave-length X-rays and γ-rays interact chiefly with the innermost electrons. From the nature of this interaction it is possible to obtain information successively about the different electrons in the atom.

The photoelectric effect is not only important from the purely scientific standpoint, but also finds a most important practical application in the construction of the photoelectric cell, which is one of the most trustworthy methods existing for measuring the amount of energy in a beam of light. It has rendered possible the construction of accurate photometers for determining the density of photographic plates, and has given methods for measuring the amount of light emitted by extremely faint stars.

The action of the radiation being to cause the ejection of electrons from atoms, it will be seen that the primary questions regarding each individual process are how fast the electron is ejected and in what direction, and to this must then be added the question of how many electrons are set free each second when radiation of given intensity is incident on matter. More or less satisfactory answers can now be given to these questions, and the history of the subject is best described by reference to those researches which showed how the number and velocity of the electrons depended on the intensity and wave length of the radiation.

Historical and General.—The study of photoelectric effects started in 1887, when Hertz found that ultra-violet light falling on a spark-gap enabled a discharge to pass more easily than when the gap was not illuminated. A year later Hallwachs made the important observation that, while ultra-violet falling on a negatively charged body caused a rapid loss of the charge, no loss of electricity occurred when the body was initially positively charged. It was not very long before the cause of this behaviour was discovered, and in 1899 J. J. Thomson and P. Lenard showed independently that the action of the light was to cause the emission of negatively charged corpuscles identical with the cathode rays in a discharge tube.

In the following years a great deal of work was carried out on this peculiar action of light, and attention was first directed to the intensity of the emission and how it depended on the state of the surface of the metal and on the polarization of the light. In 1902 Lenard opened up a new method of investigation by directing attention to the velocity of the ejected electrons. He was able to show that the maximum velocity of the electrons was independent of the intensity of the light but did depend on the wave-length. He appreciated quite clearly the difficulties this raised in the way of any explanation, since the obvious suggestion of the ejection being due to a transference of energy from the light to the atoms of the metal by some resonance action was rendered impossible by its lack of dependence on the intensity. It was this work which formed the basis of Einstein's famous paper of 1905. Einstein suggested that the general phenomenon of the conversion of light could be better understood on the assumption that the energy of light radiation was not distributed continuously in space. As radiation spread out from a source he imagined it to remain localized in small bundles, or energy quanta, which became further and further apart as they receded from the source, whilst individually remaining unchanged. He pointed out that when an atom absorbed radiation the simplest assumption would be that a light quantum gives its whole energy to an electron. It was natural to associate the energy of the light bundles with the definite amounts of energy postulated by Planck in his quantum theory of black body radiation. Hence Einstein suggested that, at every act of absorption, the energy received by the electron was $h\nu$, ν being the frequency of the radiation and h a universal constant which should be identical with that occurring in Planck's formula for the black body radiation.

It follows therefore that the maximum energy of the electrons ejected by radiation of frequency ν is

$$h\nu - P,$$

where P represents any work that has to be done in removing the electron from the place where it absorbs to the place where it is observed. We may subdivide this further and write w for the work to remove the electron just clear of the atom, and P' for the work to remove the electron clear of the body as a whole. These quantities w and P' have different values and importance according to the region of wave-length concerned. P', the work to remove the electron clear of the body, is intimately connected with the work function occurring in Richardson's thermionic equation, and is negligible except in the case of visible light. The quantity w is far more interesting, and depends on the particular position in the atom from which the electron comes. It is a true atomic constant. Up to a certain point we may imagine the electrons in the atom to be arranged in shells, each shell characterized by a certain energy. To remove an electron from a shell and merely to bring it outside the atom with a vanishingly small energy will require the expenditure of a certain characteristic amount of work, w_1, w_2, w_3, etc., according to whether the electron comes from the first, second or third shell. We see, therefore, that on Einstein's hypothesis, light of frequency ν incident on a collection of such atoms would liberate several groups of electrons of different energies:

$$h\nu - w_1, \quad h\nu - w_2, \quad h\nu - w_3;$$

but that the innermost shells would be untouched if the energy of the quantum $h\nu$ were less than the characteristic energies of the shells w_4, w_5, etc.

It only remains now to write down the expression for the energy of the electron in order to obtain Einstein's famous equation. For low velocities this may be written $\frac{1}{2}mv^2$, but for high velocities near that of light the correct relativity expression must be used. This is

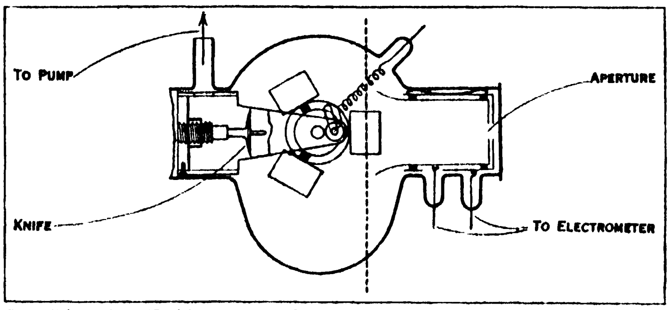
$$mc^2\left(\frac{1}{\sqrt{(1-\beta^2)}} - 1\right),$$

where m is the mass of the electron, c the velocity of light *in vacuo,* and β the velocity of the electron. It is frequently convenient to express this energy by giving the potential fall in volts V an electron β must pass through in order to acquire this energy. Then, if e is the charge on the electron in electrostatic units ($4{\cdot}774\times10^{-10}$), and since 300 volts equal one electrostatic unit of potential, we have finally

$$\frac{V}{300e} = mc^2\left(\frac{1}{\sqrt{(1-\beta^2)}} - 1\right) = h\nu - w.$$

The equation as written here is more explicit than that originally given by Einstein, and considerable research was needed to establish it, but essentially it was all implied in the original paper. The succeeding sections indicate the main steps by which this prediction was shown to be true and how its details were elucidated.

Proof of the Einstein Law for Light.—The law proposed by Einstein connecting the energy of the photoelectron with the



FROM MILLIKAN, "THE ELECTRON" (UNIVERSITY OF CHICAGO PRESS)

FIG. 1.—MILLIKAN'S APPARATUS FOR DETERMINING THE ENERGY OF PHOTO-ELECTRONS LIBERATED BY LIGHT OF KNOWN WAVE-LENGTH

frequency is noteworthy, not only for its simplicity but also because it introduced Planck's constant h into a fresh domain. It was seven years after Einstein had shown his theory agreed in its general lines with Lenard's experiments before it was established definitely by O. W. Richardson, K. T. Compton and also A. L. Hughes that the energy of the emitted electron did increase proportionately with the frequency, and that the constant of proportionality was approximately equal to the value of Planck's constant h obtained by other means. Subsequently Millikan carried out an extensive research which established the relation so accurately that it is now considered to give one of the most trustworthy values for h. This method is typical of the best method of investigation of the photoelectric effect of light and will be described in some detail. The apparatus is shown in fig. 1, and may conveniently be considered in two parts, as divided by the dotted line. Cast cylinders of the alkali metals (sodium, potassium, lithium) were mounted on an axle in a highly evacuated glass vessel. The actual experiment is carried out by the part of the apparatus to the right of the dotted line, light entering through the window, and falling on the metal surface. Previous work had shown that reliable results could be obtained only when the metal had a clean, fresh surface prepared *in vacuo*, and the apparatus on the left of the dotted line consisted of various devices by which the cylinder of alkali metal could be brought opposite the knife, which was then operated by an electro-magnet outside the tube so as to shave off the outer layer of the alkali metal, leaving a fresh uncontaminated surface. Supposing this to be done the cylinder was then rotated to be opposite the window and the actual experiment could begin. A beam of monochromatic light from a spectrometer passed through the window and fell on the prepared surface, leading to the emission of electrons which were collected by the gauze cylinder, on the right side of the apparatus, connected to a quadrant electrometer. If a small positive potential were then applied to the metal block, the electrons would arrive at the gauze with lower energies, owing to the retarding action of the potential. The maximum energy of emission could thus be measured by finding that positive potential V which just sufficed to prevent any electrons arriving at the gauze and communicating their charge to the quadrant electrometer. The maximum energy of the electrons is then Ve, where e is the electronic charge. Millikan showed to an accuracy of one half of 1% that, with each metal, the energy of the emitted electrons varied linearly with the frequency of the light, and that in each case the constant of proportionality was the same, and equal, within the experimental error, to the values obtained for Planck's constant by other methods.

Photoelectric Effect of X-rays or γ-Rays.—The essential distinction between the photoelectric effect of X-rays or γ-rays and that of light lies in the higher frequency of the former radiations and in the correspondingly greater energy of the quantum. The energy given to the atom is now measured in tens of thousands of volts or even hundreds of thousands of volts, and not in tens of volts as in the case of light. It is to be expected that different methods of investigation must be used to meet the changed conditions, but besides this there is a shift of the point of interest. The amount of energy transferred to the electron is so large that the energy lost in getting free of the body as a whole is negligible in comparison, but on the other hand the large energy of the quantum enables electrons to be removed from even the innermost orbits of the atom. Radiation of one frequency can thus give rise to a series of electron groups of different energies, according to whether they are ejected from the outer or inner orbits of the atoms. The electrons from the innermost orbits will have used up the greater portion of their $h\nu$, and will therefore emerge with the lowest velocities, whereas those from the outer levels will have energies close to that of the quantum. It will be realized that there is here an admirable method of investigating the inner structure of the atom. By studying the energies of the different groups of photoelectrons and finding how much less these energies are than that of the original quantum, we can ascertain the orbit from which each electron comes, and the general character of its interaction with light under given conditions.

The general type of apparatus which is used in these investigations is shown in fig. 2. The source of the photoelectrons may be either a thin foil on to which X-rays are fired from outside the box, or a wire coated with radioactive material, which, as will be described later, is a copious emitter of photoelectrons. Above the source is a slit which allows a beam of the electrons to pass. This apparatus is placed in an evacuated box between the poles of a large electromagnet, and on application of the magnetic field the beam of electrons is bent round into circular paths. By this process it will be analysed into its different velocities, since the fastest electrons will describe the largest circles, and the slowest electrons the smallest circles. A record of the velocity spectrum of the photoelectrons is obtained by a strip of photographic plate. This is frequently referred to as the focussing method since, as can be seen from fig. 2, the rays leaving the source within quite a large solid angle are concentrated in one spot on the photographic plate. A reproduction of a photograph was taken recently in this way by Prof. H. H. Robinson.

This type of apparatus does not give lines sharp on both sides but only on the high velocity side, and a series of such lines can be seen on the photograph. These show the various groups of electrons ejected from gold atoms by the characteristic K X-rays of

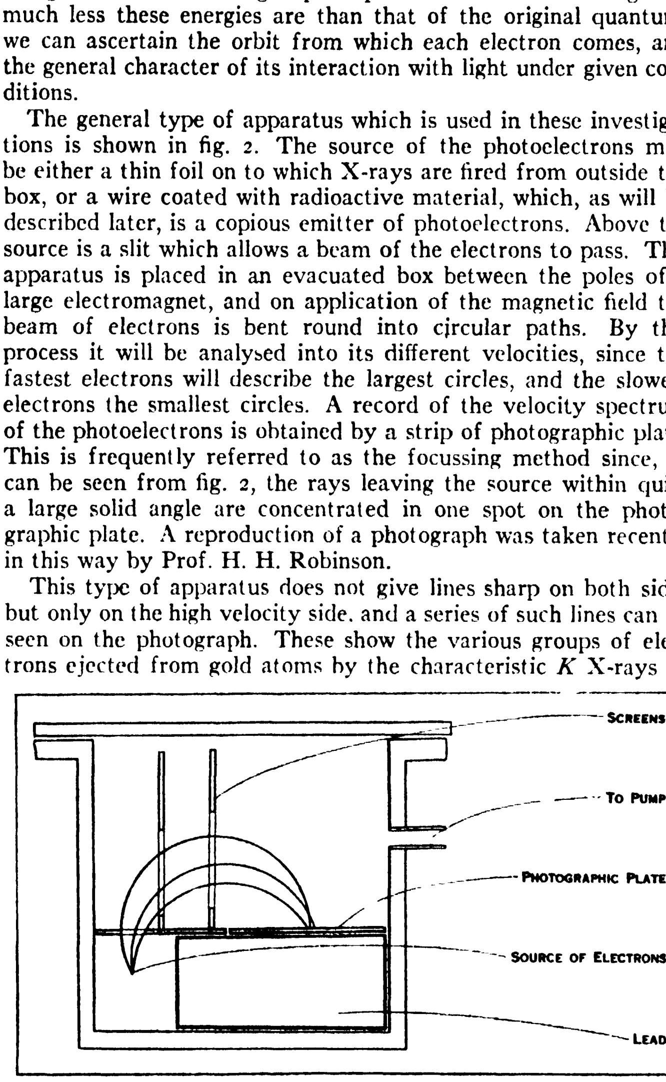


FIG 2.—FOCUSSING METHOD OF ANALYSING COMPLEX BEAM OF ELECTRONS BY REFLECTION IN UNIFORM MAGNETIC FIELD

copper (Cu K_α). On the original photograph it is possible to distinguish no less than 13 groups, some of which are partially superimposed. All of these are due to the absorption of the same frequency radiation, and the difference in the energies of the groups is due to the multiplicity of the electron levels in gold.

This method was first tried by Robinson and Rawlinson in 1913, and owes its development largely to M. de Broglie. Since the frequency of the X-rays used is known from crystal measurements, and the energies of the electron groups can easily be ascertained from the geometry of the apparatus and the value of the

magnetic field, it has been possible to verify Einstein's law with considerable accuracy. The accurate measurements carried out by Robinson have confirmed the truth of this equation to be at least one part in 300. It should, however, be emphasized that the importance of the method is that it provides an admirable means of investigating the electron levels in the atom, and from the intensity of the photographic traces it is possible to estimate the probability of absorption of the radiation by each of the separate levels.

Instead of using X-rays generated in the usual way, it is possible to employ the natural X-rays or γ-rays emitted by radioactive bodies during their disintegration. These are similar to X-rays, only in most cases the frequencies, and therefore the energy of the quantum, are much higher. It was by obtaining photographs by the use of these rays that it was first possible to demonstrate that the γ-rays were sharply monochromatic, and constituted a true characteristic spectrum of the nucleus. This method is particularly interesting in this connection since it forms the only practicable way of measuring the wave-length of γ-rays. The ordinary crystal methods of measuring the wave-length of X-rays are difficult to apply as the wave-length is so short, and before the photoelectric effect was understood only estimates could be made. By investigating the photoelectrons ejected from various metals by the γ-rays, Ellis was able to ascertain the particular portion of the atom from which the electrons were being emitted, and then a simple measurement of their energies, coupled with our X-ray knowledge of the atom, immediately yielded the $h\nu$ of the γ-rays.

An entirely different method of investigation is rendered possible by C. T. R. Wilson's cloud track apparatus in which, by a sudden expansion, moist air enclosed in a suitable chamber is put in a condition of supersaturation. The degree of supersaturation is so chosen that in the absence of any nuclei no condensation occurs. Immediately after the expansion a flash of X-rays is allowed to pass through the chamber, and condensation occurs on the ions that are formed. If suitably illuminated these water drops can be photographed. The X-ray beam was limited to a narrow pencil down the centre of the chamber and five separate photoelectrons were visible. Each of the tracks of these photoelectrons shows the history of a separate absorption of a quantum of energy $h\nu$ by the atom located at the head of the track.

The electrons are ejected with such a high velocity that they can penetrate a considerable distance through the gas. Their path is marked by the ions they form in their passage. In the case of electrons formed by X-rays of lower frequency the speed of ejection is less. This is shown in photographs which reveal the greater tortuosity of the paths and the greater density of the water drops along a track.

The Compound Photoelectric Effect.—This is differentiated from the ordinary photoelectric effect of X-rays by the fact that the absorption of the radiation by an atom leads to the ejection of two electrons, and not one as in the other case. Its existence, although previously suspected, was first clearly demonstrated by P. Auger using the Wilson cloud track chamber method. The gas in the chamber through which the X-rays passed consisted of a small percentage of a heavy gas, such as argon, mixed with hydrogen. The argon is found to be responsible for almost the entire X-ray absorption and the small stopping power of hydrogen allowed the ejected electrons to traverse reasonably large distances and give good tracks.

It might be thought that the double tracks of the photograph only show a normal photoelectric effect by two atoms so close together that the tracks appear to start from the same point, but these double tracks occur far more frequently than would be expected on a probability basis, and it is simplest to consider them to come from one atom by some slight modification of the usual process. It will be seen that the further facts support this hypothesis. If a series of such photographs are taken under exactly the same conditions, with the one exception that the voltage on the X-rays (*i.e.*, the frequency of the X-rays) is increased, it is then found that, while one member of a pair of tracks increases in length as predicted by Einstein's equation, the other shows no change. This must not be taken to show an exception to Einstein's equation but rather that this second track is due to some process in the atom, admittedly excited by the primary radiation, but yet not directly depending on its frequency. The first action of the radiation is to eject an electron from the atom in the normal photoelectric way, and the second track occurs because the atom is left in what is called an "excited state" that is capable of further changes.

In the article Atom it is explained how for numerous purposes we can picture the electrons in the atom arranged in a series of shells or groups, each characterized by a definite energy. The process of radiation is held to be due to the removal of an electron from an inner group and the subsequent filling up of the gap by one of the electrons previously in an outer group. Now in the compound photoelectric effect the primary effect of the X-rays is to remove an electron from one of the groups of an argon atom, and in the majority of cases this will be from the innermost or K group. The argon atom is now said to be excited in the K group, and a subsequent transition of one of the outer electrons into this vacant place will lead to the emission of one quantum of the argon K radiation. Sometimes this radiation escapes from the atom, but it may be internally absorbed and never escape at all. In this case the argon atom will emit a second photoelectron whose energy, and therefore length of track in the gas, is determined by the frequency of the argon K radiation and not by that of the incident X-radiation. It will, therefore, not change when the frequency of the incident X-rays is changed. It is possible to secure a second and even a third repetition of this interesting process thereby giving rise to the emission of three or four photoelectrons from one atom.

This phenomenon has been described as if an excited atom always emitted its surplus energy first in the form of radiation, but that, on occasion, this could be subsequently reabsorbed in the same atom. It is held by many authorities that it is rather artificial to imagine radiation to be emitted, apparently to exist independently of the atom, and then to be reabsorbed all inside the minute volume of the atom. It is maintained that it is simpler to state at once that an excited atom, that is an atom with greater energy than the normal, has at its disposal two distinct methods of getting rid of its extra energy, either by emitting a quantum of radiation, or by emitting an electron. There is no doubt that this is a difficult point, but a somewhat similar phenomenon occurs among the radioactive bodies, when, in the opinion of the writer, the evidence is strongly in favour of a true internal absorption of radiation.

The phenomenon of radioactivity is due to a disintegration of the central positively charged nucleus around which are the electrons forming the rest of the atom. Frequently accompanying the actual disintegration, which involves the emission of a material particle from the nucleus, either the α- or β-particle, there is also an emission from the nucleus of very high frequency radiation called the γ-rays. These are of the same type as X-rays, but of higher frequency. These γ-rays are quite frequently absorbed in the parent atom in their passage out from the nucleus through the electronic system, and give rise to high speed photoelectrons. As some radioactive bodies emit a considerable number of different frequencies, each of which can be converted in either the K, L, M, N, etc. levels, it will be seen that a great number of photoelectric groups are possible. These may be investigated by the magnetic spectrum method, previously described in the case of X-rays, and illustrated by fig. 2. In this case, however, since the radioactive body is at one and the same time both the source of radiation and of the photoelectrons, it is merely necessary to place a wire coated with the radioactive material underneath the slit to obtain results.

The radioactive body used was Radium B, and the radiations have an average frequency corresponding to about 300,000 volts. The great complexity of the spectrum may be seen from this reproduction which only shows a part of the spectrum; to obtain all of it different magnetic fields would have to be used. The sharpness and narrowness of the lines is noteworthy. The reason for this is that, in this γ-ray case, all the photoelectrons are due

to this internal absorption in the parent radioactive atom, and, since the radioactive material only forms the thinnest imaginable layer on the surface of the wire, all the electrons emerge with their full velocity. In the X-ray case, when there is external absorption, photoelectrons are emitted throughout the body of the source, and, while those coming from the surface will have the greatest energy and will form the sharp edge of the line, those liberated inside the material can also get out, but will lose a portion of their energy in the process. They thus hit the photographic plate nearer the source and produce a long tail to the line.

This case of internal absorption is to some extent analogous to the compound photoelectric effect with X-rays, and here there is evidence that we may regard the γ-ray in all cases to be emitted but sometimes to be reabsorbed. On the one hand is the entire lack of any evidence of any other form of interaction between the nucleus and the electronic structures, which makes it doubtful to assume it in this case. On the other hand it has been shown by Ellis and Wooster that this internal absorption appears to obey exactly the same relations as those found for normal external absorption. If this view be substantiated by future work, we have here an extremely interesting example of a photoelectric effect all occurring within the minute volume of an atom.

The Direction of Emission of the Photoelectron.—A matter of great interest is to ascertain how the initial direction of emission of the electron is associated with the direction of the electric force in the radiation. It is well established that radiation is some type of electro-magnetic disturbance propagated through space in which electric and magnetic forces at right-angles are associated, both also being at right-angles to the direction of propagation. (*See* ELECTRICITY.) It is to be anticipated that it is the electric force which acts directly on the electron and wrests it from the atom, so that we should expect the electrons to have at least a large component of this motion in the direction of the electric force. The effect of the magnetic force on the electron, when once it is in motion, will be to throw it slightly forward. However, it is scarcely to be anticipated that all the electrons will come out at exactly the same angle to the electric force, since there are many subsidiary effects which will tend to introduce variations and produce a distribution over a range of angles instead of one unique direction.

This phenomenon is most easily studied in the case of the photoelectrons liberated by X-rays and γ-rays, when the velocities are considerable and the electrons have sufficient energy to penetrate several centimetres of a gas. The most fruitful method of investigation is by the Wilson cloud track method, which has already been referred to. If a thin pencil of unpolarized X-rays is sent through a Wilson chamber and the tracks photographed, we can determine at once what is called the longitudinal distribution. The exact direction of the electric vector is always changing, but of necessity it must be always at right-angles to the direction of propagation. If the cloud tracks are photographed with a stereoscope camera we can count the fraction of electrons which are emitted with their directions initially within say 5° of the direction of propagation, between 5° and 10°, and so on, obtaining in this way a distribution curve. The general results are as would be anticipated. Very few electrons travel near the direction of propagation either forward or backwards, the greater number tending to go off more at right-angles in the direction of the electric vector. The distribution curve therefore shows a marked maximum for directions at right-angles to the direction of propagation.

However this is not all, there is a small subsidiary effect which seems to be of great importance. This maximum of the distribution curve is not exactly at right-angles to the direction of propagation, it is shifted a few degrees forward, so that rather more electrons go forward than go back. This becomes more pronounced as the wave-length gets shorter. While for light and soft X-rays it is not to be detected, it may amount to 10°, 20° or 30° for hard X-rays or γ-rays. The primary cause of this asymmetry is to be found in the magnetic forces in the wave-front, but a simple description can also be given on the light-quantum picture. Imagine a quantum of energy $h\nu$ impinging on an electron, being absorbed, and communicating all its energy to the electron. This quantum is not only characterized by its energy, it will also have momentum of amount $h\nu/c$. If we assume that the other causes responsible for the distribution would only produce a symmetrical spread about the direction of the electric vector, we can say that owing to the momentum of the quantum there should finally be an average forward momentum of amount $h\nu/c$. This does shift the maximum forward by about the right amount; but according to some new measurements by Williams there is not exact agreement—the predicted shift is not large enough. Either some other cause is at work or the electrons in the atom, which are moving forward at the instant the wave passes over them, have a preferential chance of absorbing. This is an interesting point and seems likely to shed fresh light on the details of the interaction of radiation and matter.

Another type of asymmetry has also been investigated. By suitable arrangements a beam of polarized X-rays can be obtained. Suppose this is travelling along the direction of x, and the electric vector in the polarized beam is parallel to the y axis. By taking Wilson cloud photographs close to the direction of the x-axis we can now find how the photoelectrons are distributed in the yz plane. As before a distribution is found, but this time, as would be expected, it is symmetrical. The maximum number occurs parallel to the electric vector and there appear to be very few indeed which come off at right angles to this.

Number of Photoelectrons Ejected.—The discussion so far given has centred round the elementary process of the conversion of a quantum and liberation of a photoelectron, and this process has been shown to be described completely by Einstein's equation. Thus, having treated what happens when a quantum is absorbed, the question now arises how often quanta are absorbed It is the essential peculiarity of the photoelectric effect that these two points can be separated so completely, the energy of the ejected electron depending only on the frequency and being entirely independent of the intensity of the radiation, whereas the number of electrons ejected is directly proportional to the intensity.

In considering the number of photoelectrons set free it is simplest to go at once to the conception of an absorption coefficient. Suppose I ergs per sec. are incident upon each square centimetre of a very thin slab of matter, of thickness δx, then the number δn of photoelectrons set free per second will be

$$\delta n = \mu \frac{I}{h\nu} \cdot \delta x,$$

where μ is called the absorption coefficient and is a characteristic constant of the material and of the frequency of the radiation. If this is applied to a gas it will give exactly the number of tracks that would be observed by a Wilson cloud apparatus In the case of a solid it is usually rather complicated to deduce the actual number of electrons that emerge, since the scattering and absorption of the electrons liberated inside the solid are difficult to follow in detail

It is simplest to consider first the case of the X-rays and γ-rays, and afterwards the absorption effect of one particular set of electrons in the atom, say the K or L electrons. The total absorption of the material is then obtained by adding together the absorption of all the different sets of electrons in the atom. The first point to notice is that absorption, for example by the K electrons of tin, does not start until the frequency is increased to a certain limit. This limit which is characteristic for tin is determined by the condition that the $h\nu$ of the radiation shall be just equal to the work necessary to remove a K electron to the surface of the atom; *i e*, absorption commences with the production of photoelectrons of zero energy From this point onwards, when the absorption is a maximum, it decreases steadily at first about as ν^{-3}, and later, in the γ-ray region, rather less rapidly. The attempt to extend these results towards the region of visible light meets with considerable experimental difficulties, but recently approximate values for the absorption by potassium vapour in the near ultra-violet have been obtained, which may be considered as the extension of the preceding results.

The number of electrons ejected by light engaged the attention

of the early experimenters from rather a different aspect. The experiments were usually carried out with reflecting surfaces of the alkali metals, and an interesting dependence of the number of photoelectrons on the state of polarization of the light was observed. If the light was incident obliquely and was so polarized that the electric vector had a component perpendicular to the surface, the number of electrons ejected was found to be greater

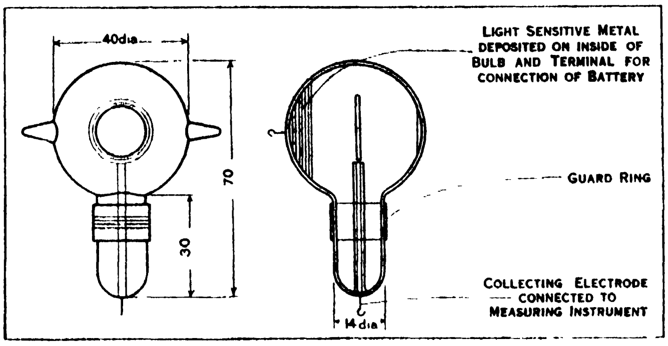


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FIG. 3.—PHOTOELECTRIC CELL

than if the electric vector lay wholly in the surface This phenomenon was investigated in great detail by Pohl and Pringsheim, who found the variation of the emission with change of wave-length of the light when compared on the basis of equal amounts of incident energy. When the electric vector had a component perpendicular to the surface they found a maximum occurred at a certain wave-length, which was not present with the other type of polarization. This led them to effect a division of the whole effect into a normal and a selective effect, the latter showing the maximum.

The important bearing of this subject on the nature of light depends entirely on the surprising fact, expressed by Einstein's equation, that the velocity of the ejected electron is determined only by the frequency of the radiation, and is independent of the intensity of the radiation. This is entirely contrary to what we should expect from a wave motion, yet the phenomena of interference, and in fact the whole of ordinary optics, appear to show indubitably that radiation is a wave motion. This will be apparent if we imagine first a metal plate placed so close to an X-ray tube that the radiation is pouring on to it, and then removed so far away that the radiation is even difficult to detect. On the wave picture one would say that, in the second case, the electric vector in the radiation hitting the plate was very much weaker than in the first, and we would expect that not only would the number of electrons be less but also that the electric vector would be able to transfer much less energy to the electrons, and they would come out with much lower energies

Whilst the number of electrons is certainly less in strict proportionality to the intensity, the energy of the individual electrons will be the same in both cases. Weak or intense radiation, as long as the frequency remains constant, always gives the same energy to the electrons. This result is quite incompatible with our ordinary ideas of a wave motion, and the simplest way of expressing this is to notice how the alternative picture of light quanta explains the dilemma. If, instead of imagining the radiation to spread out from the source in waves, we imagine the energy to be emitted in bundles or quanta of magnitude $h\nu$ then with intense radiation there will admittedly be more quanta traversing a body, but even with weak radiation the few quanta which do arrive are still the same. They will naturally lead to the ejection of fewer electrons, but when a quantum is absorbed it always involves the transference of the same amount of energy, and the photoelectron will have the same energy as if the density of quanta were far greater. Great difficulties are raised by any attempt to explain interference by a light-quantum picture and the problem of reconciling these two different views has at present not been solved. A fuller discussion will be found in the articles QUANTUM THEORY and ATOM, where it is pointed out that probably both views are correct The point is that, if we insist on describing atomic processes in language and concepts used for large-scale phenomena, then inevitably a duality will appear. Radiation must sometimes be pictured as waves, sometimes as particles. How far-reaching is this duality may be seen in the fact that electrons, and other material particles also, behave sometimes in a manner only explicable on a wave basis.

Photoelectric Cells.—The practical application of photoelectricity to measuring light intensities is made by means of the photoelectric cell. In its simplest form this consists of a glass bulb silvered internally, and on this inner coating is deposited a very thin layer of some metal such as potassium. In the centre of the bulb is arranged a collecting electrode supported on a wire sealed directly through the glass, and metallic connection is made to the potassium in the same way. A diagram of such a cell is shown in fig. 3. The cell is sometimes suitably mounted in a light-tight wooden box. The silver is removed from a certain area of the glass so as to allow light to enter into the cell. The collecting electrode is seen at the bottom of fig. 3.

The whole apparatus can truly be described as a photoelectric cell, since, when light enters the bulb, electrons will be ejected from the potassium, which will charge up positively, and will be collected by the central electrode rendering the latter negative. To measure light intensities precautions must be taken to collect the whole of the electron stream liberated, since it is the number of electrons which is directly proportional to the intensity of the light. The method of doing this is to apply a negative potential to the potassium surface as shown in fig. 4, the collecting electrode being practically at the potential of the other end of the battery by connection through the measuring instrument. For considerable intensities of light this may be a sensitive galvanometer, but in most cases some type of electrometer, such as an ordinary quadrant electrometer or the special quick period quadrant designed by Prof. Lindemann, is preferable. The most sensitive arrangement is to measure the rate at which the electrometer charges up, *i e*, the rate at which the needle moves, but when it is possible the constant deflection method is far more convenient It will be noted that while one terminal of the electrometer is connected directly to the collecting electrode, the other is connected to earth, and the constant deflection method consists in connecting a very high resistance, of the order of 10 to 10,000 megohms, across the electrometer. The latter then measures the potential drop across this resistance due to the current through the photoelectric cell. An important precaution is to have a guard ring (*see* fig. 3), consisting of a ring of metal or silvering, in the position shown, and to connect this to earth. This prevents charge creeping over the surface of the glass from the high potential electrode to the measuring instrument. The general working of the cell is rendered far more regular by taking precautions

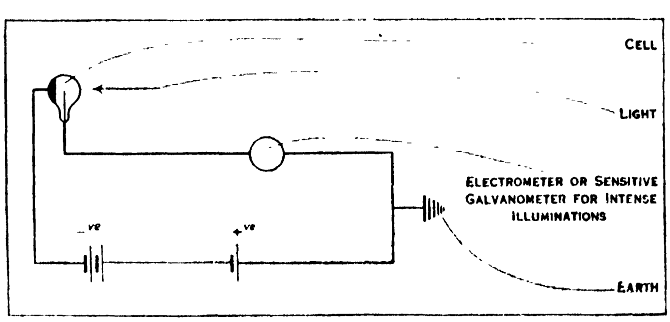

FIG. 4.—METHOD OF USING A PHOTOELECTRIC CELL

to keep it in a dry atmosphere, as a film of moisture on the surface of the glass renders it virtually a conductor.

While a photoelectric cell constructed in this way gives a qualitative measure of the light entering it, it is certainly somewhat insensitive, and great improvements have been effected by attention to two points. The first is the correct preparation of the light-sensitive surface—potassium in the case already described. It appears that the sensitivity can be greatly improved by the following process. The potassium is carefully purified by distillation, and is finally deposited by the same process inside the

cell. A little oxygen is then admitted, and a glow discharge passed for a few moments. The oxygen is then pumped out and the potassium is left in a very sensitive colloidal state. The second improvement is to admit a small amount of helium into the cell instead of leaving it completely evacuated. The electrons leaving the potassium surface and accelerated by the applied potential now cause ionization by collision, and a greatly increased current is obtained. The one objection is that the current now depends on the applied potential, as can be seen from fig. 5. It is usually safe to apply a potential of 200 volts, and at this point a change of 1 volt produces a change of about 1% in the current.

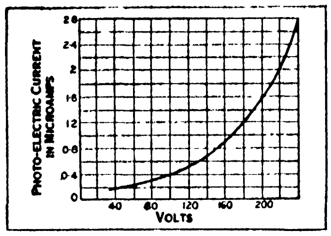

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FIG. 5.—CURVE SHOWING HOW THE CURRENT GIVEN BY A GAS-FILLED PHOTOELECTRIC CELL DEPENDS ON APPLIED VOLTAGE

A matter of great practical importance in the use of photoelectric cells is that they are not equally sensitive to all wave-lengths. This can be seen from fig. 6, which shows in arbitrary units the photoelectric effects in potassium, rubidium and caesium cells for equal amounts of incident energy of different wave-lengths. The vertical scale is arbitrary in each case, and the curves do not show the relative sensitivities of the three types of cell. The ratio of the total sensitivities of potassium, rubidium and caesium cells as here constructed is about as 4:2:1, but the relative sensitivity for any particular colour depends on the wave-length; *e.g.*, for light of 6,000 Å.U., the order would be reversed, the caesium cell being most sensitive. A sodium cell can often be used with advantage for light of a shorter wave-length since its maximum occurs at about 3,400 Å.U. For ultra-violet work the envelope is usually of quartz, as glass begins to absorb strongly. It will be realized from these examples that a photoelectric cell cannot be used for comparing directly the intensities of two beams of light unless they are of the same colour, or, more accurately, of the same spectral distribution.

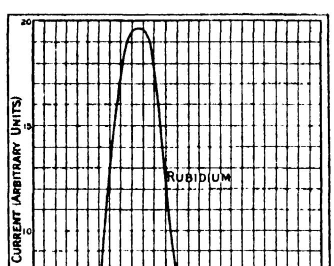

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FIG. 6.—CURVES SHOWING HOW THE PHOTOELECTRIC CURRENT, IN POTASSIUM, RUBIDIUM AND CAESIUM CELLS VARIES WITH THE WAVE-LENGTH OF THE LIGHT (THE 3 CURVES ARE INDEPENDENT)

The uses of photoelectric cells are so manifold that a catalogue of them would be monotonous. Briefly they replace the human eye whenever quantitative measurements are needed; *e.g.*, they are frequently used to measure or compare the light arriving at the earth from stars; also, many photometers (*see* PHOTOMETRY) depend on their use. The density of a photographic plate may be found either by measuring the diminution in intensity of a beam of light passing through it, or alternatively may be put equal to the density of some standard plate when each produce the same weakening of the beam. In either case the essential is to have a quantitative measure of the intensity of a light beam, and for this purpose photoelectric cells are usually used.

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PHOTO-ENGRAVING. A photo-mechanical process of making relief printing blocks in line and half-tone. The term "process engraving" is frequently used in Great Britain and covers the preparation of planographic and intaglio printing surfaces as well as the making of blocks for printing by typographic methods.

It is a strange coincidence that the history of the printing art—the art which secures records of the past and future progress and development of other arts and crafts—cannot record with any degree of accuracy its own inception, which fact also applies to photo-engraving, the most recent addition to the crafts included in the printing industry. The first etched line blocks were made by Gillot, a Parisian lithographer, in 1859, when he took impressions in a special ink from designs drawn on lithographic stones. These he transferred to a zinc plate, and, with an acid resisting ink, rolled up the design, placing the plate in a mordant which etched away the bare metal, leaving the parts protected by the ink standing in relief, and to him is ascribed the development of line blocks. By the same method, transfers from designs engraved or etched into plates (intaglio), wood-cuts, type or drawings made on transfer paper or drawn direct on to a zinc plate, may also be made into printing blocks. At the Paris Exhibition in 1867 Gillot received an award for his work, but it was not until photography was applied to the reproduction of illustrations that the fullest benefits of this speedy method of making printing blocks was reached. By photography an artist's drawing can be reduced or enlarged in proportion, a negative from the original drawing being made to the size required, and photographically printed on to the zinc plate, previously coated with a light sensitive solution. The photographic method was first employed in 1872 by the son of Gillot, and the development of this direct method of reproducing the original drawing soon caused the demise of the wood-cut.

The invention of the half-tone process has given rise to long and heated controversy between present-day authorities as to who first reproduced photographs and paintings by this method. The difference of opinion, however, is largely due to a technical definition of the word, "half-tone," and the particular method whereby the tones of an original picture were "broken up" in order that it may be printed. In early experiments various methods were employed to achieve the end desired. Sometimes a negative was made by photographing through a piece of gauze, or, photographic prints of lines were made on a negative. It is not known who first employed the cross-line screen. The method now used is probably the outcome of experiments conducted by a number of people.

Fox Talbot, of England, in 1852 suggested the "breaking up" of the tones of a photograph by means of a screen of ruled opaque lines, muslin, crêpe or gauze, and from that date experimenters in various parts of the world have been working on these lines, applying their own particular methods. The successful working of the process depends upon the use of a screen by which the tones of the original are represented on the photographic plate by means of "grain" or "dots" of varying sizes. In New York in 1875 W A. Leggo and his brother, Canadian lithographers, ruled lines on a piece of glass through blackened collodion films, sealing two of these (face together) with Canada Balsam; George Meisenbach, of Munich, patented a process in 1882, and to him is generally credited the invention of the half-tone process, he being the first to put the process to practical use; while Frederick Ives, an American, was producing satisfactory work in 1886 by the use of a sealed cross-line screen; and he, probably, is the "father" of the method which is now in common use. The Leggos' method, of making ruled screen, was improved upon by Louis Edward Levy in 1891. In this instance the lines were etched into glass and filled with a thick black pigment. Louis Levy and his brother Max were endeavouring to make cross-line screens in 1883.

The invention and development of this process, however, can probably be summed up by stating that Fox Talbot in England anticipated the half-tone process in 1852, although workers in other countries were working on similar lines, but it was not until the Meisenbach method was used that the process left its experimental stage. The characteristic of the latter method was to reproduce a picture represented by "dots," to achieve this Meisenbach used a single line screen which was turned round during the exposure. His process was introduced into England in 1882, and the printing plates made were commonly known as "Meisenbach Process Blocks."

THE MAKING OF BLOCKS

In making any type of block, if the reproduction of an original rawing is to be successful, attention must be given to every age of the work; the character of the drawing should be nsidered in relation to the special method by which it is to be produced. Originals in line, where light and shade are obtained varying thicknesses of the line, are reproduced by a line block. or this purpose the drawing is made in pen and ink, each line which must be solid and opaque, *i.e.*, the effect must not be tained by grey lines or "washes" but each line must be solidly awn in black ink.

Photographs, wash drawings and paintings are reproduced by alf-tone, *i.e.*, the tones of the original are reproduced by reticulting the subject by means of a screen which may be either grain cross-lined. When photographs, especially of a technical character, are to be reproduced, it is essential that "retouching" of the iginal be resorted to; this is of a highly specialized character, necessitating the emphasising of the parts which are to be specially rought out, throwing back the details which are not of such importance, and, not infrequently, eliminating the surroundings. This done by artists who use pencil, ink, and frequently, aerograph raying in the preparation of an original for reproduction by hoto-engraving.

The Camera.—A specially constructed camera is used, its ain features being its rigidity and long bellows to allow for enrgement or reduction. The front frame of the camera is firmly cured whilst the back frame containing the focussing ground ass moves in slots which keep it parallel with the front. The mera is supported on a frame on one end of which an upright oard is fixed. On this is placed the original to be reproduced; works in grooves so that it can be moved sideways to obin the correct position. On the front frame of the camera is a ction to which the lens is attached; this slides up and down to low for the centring of the copy. It is necessary that the copyoard and the camera move in perfect unison during exposure, nd precautions have to be taken to obviate movements in opposite directions through vibration.

Special lenses, too, are required, and those known as anastigatic are found best for photo-engraving. On the lens is a slot to which stops or diaphragms of peculiar shapes are inserted nd which act in the same way as the iris or circular apertures sed in ordinary photography. The stops used by photo-engravers ave an important function to perfom, since they determine the hape of the "dots" and influence the final results.

For all methods of direct printing the negative has to be reersed, *i.e.*, left to right. This is done by passing the rays of light rough a glass prism or mirror so that the image is first reected on to the prism and from thence through the lens. Another ethod, frequently used in America, is to make the negative withut the use of a prism and, after developing, strip the film and btain a reverse. This method is not possible, however, when aking negatives for colour printing. The reversing is necessary allow for a positive impression of the design to be printed upon ne paper.

When reproducing colour work there is an attachment whereby colour filters" are fixed to the lens. On the back frame of the mera are slots for carrying the dark slide which contains the hotographic plate. When half-tone plates are to be made the reen is placed in the camera in front of the dark slide.

Illumination.—In photo-engraving, great attention has to be iven to lighting to ensure that the copy is evenly and sufficiently luminated. Whilst daylight is most effective, it is not always ossible to use it, therefore artificial lighting has to be resorted ; the usual procedure is to suspend two arc lamps from supports, ne on each side of the copy-board, these being adjustable to eet the special requirements of the work to be reproduced.

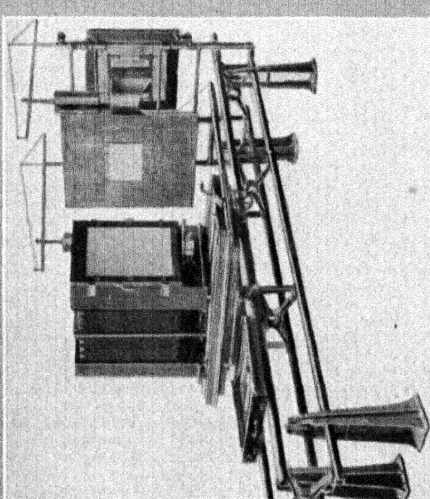
Photographic Plates.—Either wet (collodion) or dry (emulion) plates are used, in certain classes of work the wet plate eing preferred by some photo-engravers.

LINE BLOCKS

When a negative of a line drawing which has to be made into a printing block has been obtained a photographic print from it is placed on to a piece of metal, usually zinc, which is first thoroughly cleaned by polishing with water and powdered pumice, a felt pad being used for the purpose. The plate is treated with a solution of alum and nitric acid and then coated with a solution, sensitive to light, made up of water, albumen, ammonium bichromate and liquid ammonia. The solution is carefully poured over the zinc plate and placed in a whirler which spreads the solution evenly over the surface. This is dried by heat. The negative is then placed film side to the coated zinc plate and put into a printing frame with a plate glass front, a close contact being essential. This is obtained by means of screws or by using a vacuum frame. The negative and coated plate (which are firmly secured in the frame) are then exposed to light (usually electric), the time of exposure varying from two or three minutes to ten minutes according to the quality of the negative and the intensity of the light. The negative and plate are then removed from the frame, and the metal plate, after being slightly warmed, is placed on a flat surface and rolled over with a special ink until it is evenly covered. It is then placed in a tray of clean water and the surface gently rubbed over with cotton wool. The albumen coating, where it has not been hardened by the action of light, is washed away leaving those parts which have become hard and insoluble by exposure to light adhering to the plate. When the clean parts of the zinc are thoroughly cleared, the plate is dried by heat and any defective line retouched, after which the plate is dusted over with a fine powdered resin which sticks to the ink providing a great resistance to the acid with which the plate is to be etched. It is then dusted with a soft hair brush to remove the surplus resin, and subjected to heat which melts the resin, or, as it is commonly called, "dragon's blood," so that it runs slightly down the sides of the lines. When the plate is cool it is ready for etching, *i.e.*, it is placed in a bath made up of two oz. of nitric acid and 60 oz. of water for the first etch; but before doing so the margins and back of the plate have to be coated with a varnish which prevents the acid etching away those parts to be left unetched. Whilst the etching is taking place the mordant is kept in motion. When this is done by hand the baths are rocked so that the solution flows to and fro over the face of the plate, which is brushed during the process to keep the metal clear of oxide; machines, however, are now generally used for this purpose, and the acid is sprayed by means of air on to the surface of the plate. When the plate has been a short time in the bath it is removed, washed and cleaned and lightly wiped over with a sponge containing a weak solution of gum arabic, after which it is rolled up with ink, dried by heat, and another dusting of resin applied in four directions so that each of the four sides of the lines will be protected from the acid which is apt to "underbite" the lines. The plate is again heated, causing the resin in the ink to melt and run down the sides of the etched lines, and the operation has to be repeated several times before the necessary depth is obtained.

The line process is occasionally used for colour work. The colours are generally made up of a number of "solid tints" or "stipple," the usual method being to take "setoffs" from the etched "key plate" and place them on to another piece of zinc, "stopping" out or painting those parts required for the particular colour in which it has to be printed. Where stipple is to be introduced, shading mediums are usually employed. These consist of a sheet of gelatine, with the design of the particular grain, dot, line or stipple, standing in relief. This is rolled over with transfer ink, and placed face downwards on the plate, which has been gummed over on those parts where the "work" is not required, pressure being applied by a roller or squeegee to those parts of the "setoff" from the key plate which have to be printed in the particular ink. Each colour requires a separate plate which is then rolled up, powdered and etched in the usual way.

Half-tone Blocks.—The half-tone engraving is the process by which full-tone subjects in monochrome and colour are reproduced. The negative is made in the usual way, but to provide the necessary reticulated surface the exposure is made through a screen. This may be composed of regular grains (mezzograph),



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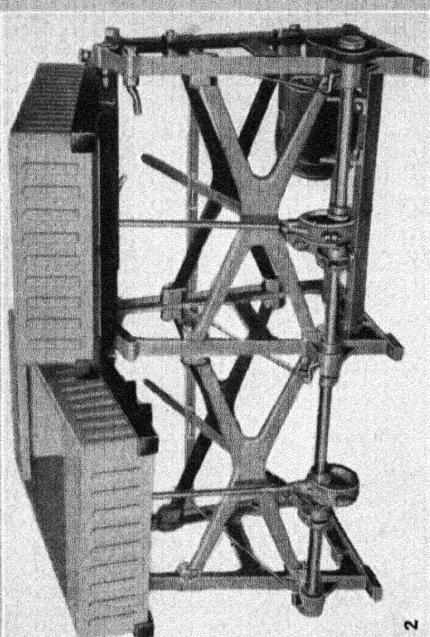

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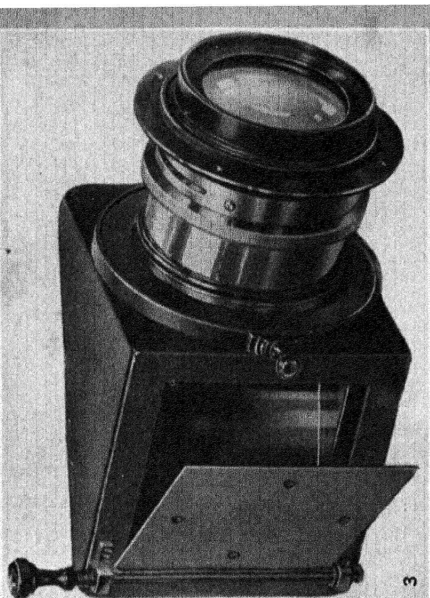

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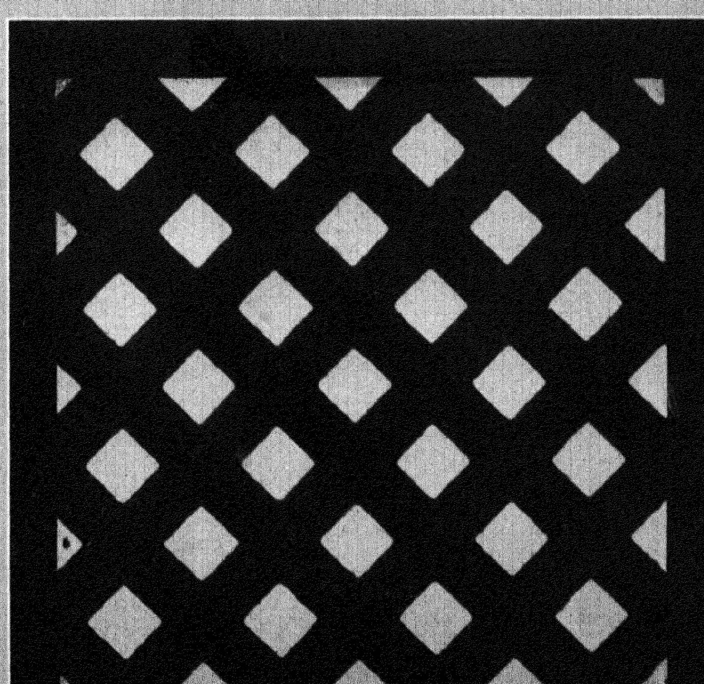

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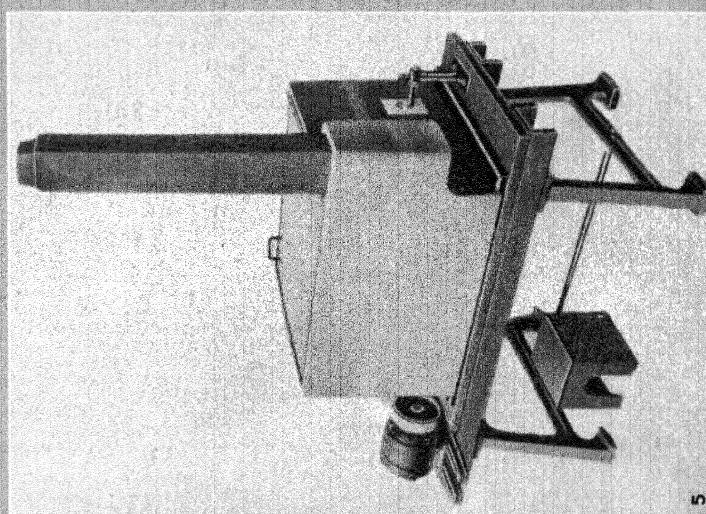

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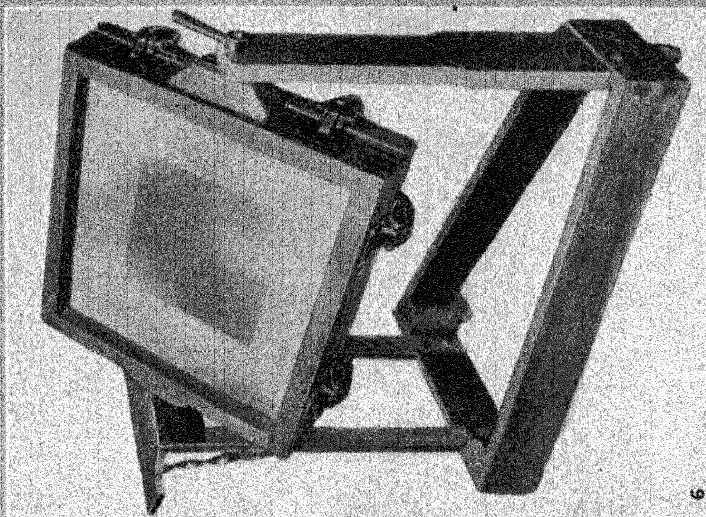
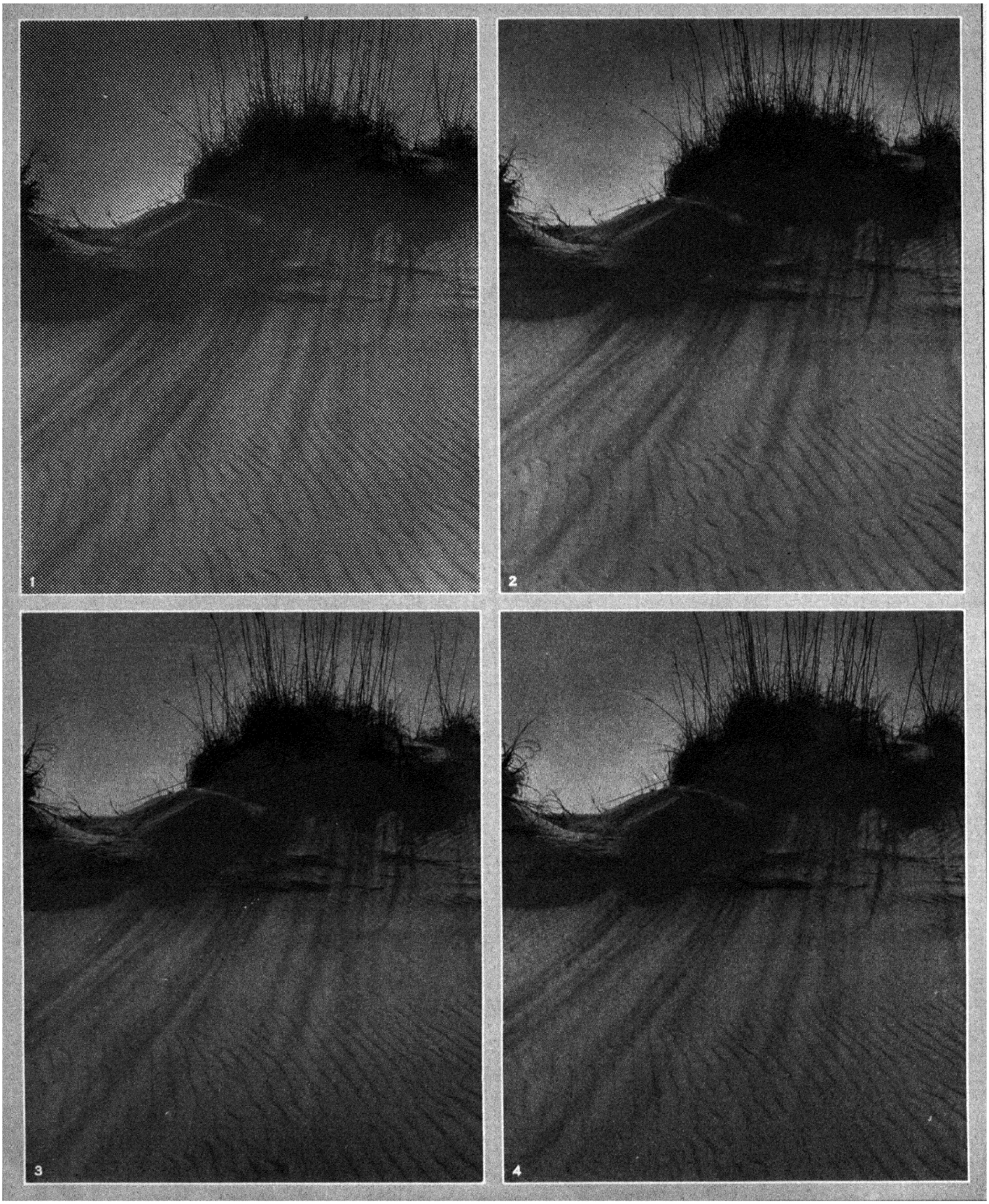


6

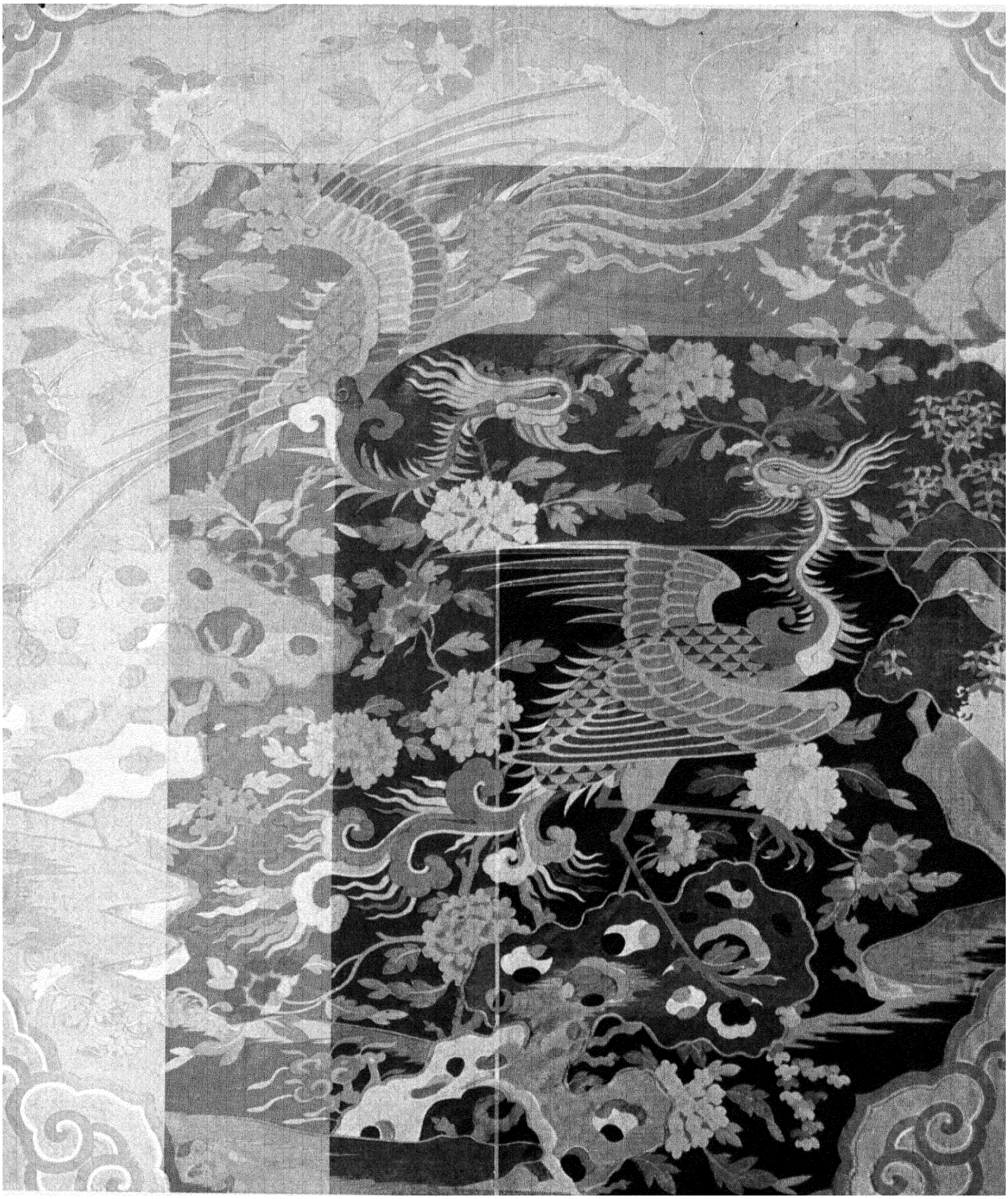
PHOTO-ENGRAVING

1. **Process camera**, showing construction peculiar to this type in which the camera is turned at right angles to frame axis so that image may be turned from left to right by means of prism shown in fig. 3
2. **Etching bath, rocking-tub type**
3. **Lens and prism** used when photographing a subject which has to be printed by **direct method**. The prism reverses the subject so that it appears the "right way" when printed
4. Highly magnified view of **halftone screen**, consisting of two sheets of polished glass on which lines have been ruled diagonally, filled with opaque material and sealed together
5. **Etching machine, splash type**, in which the etching solution is splashed against the plate by means of paddles instead of by rocking as in the tub type
6. **Vacuum printing frame**, so-called because the creation of a vacuum within exerts a uniform pressure on the negative and sensitized metal plate bringing them into close contact before exposure to light



EXAMPLES OF A SUBJECT REPRODUCED BY HALFTONE SCREENS OF DIFFERENT TEXTURES

1. 60 cross-line screen, used when printing on the cheaper grades of paper, such as newspapers and posters
2. 100 cross-line screen, used on machine-finished book paper
3. 133 cross-line screen, used on super-calendared and dull-coated papers
4. 175 cross-line screen, used when reproducing subjects containing fine detail printed on coated paper



THE PROGRESSIVE STEPS IN FOUR-COLOUR PRINTING

The colours used in four-colour printing are: yellow, red, blue and black. The four colours are separated out by photography, by the medium of colour filters, each filter being the complementary to the colour to be separated, viz: Blue violet for yellow printer; green for red printer; orange-red for blue printer and a light yellow for black printer. Photographic prints are made from the four colour negatives on copper plates; after which the copper plates are etched, and when the blocks (one for each colour) are superimposed one upon the other in the printing press the result is a reproduction of the original in all its combination of colour. In the above, from left to right, the large area is an impression from the yellow plate. Next area is the red plate printed upon the yellow. Third is the blue plate printed upon the yellow and red. The smallest area is the black plate printed upon the three colours. Regularly the four plates are all the same size. In the specimen shown here, successively smaller plates were used to illustrate the progressive printings

or, what is most general, a series of lines running across each other at right angles. The cross-line screen consists of two sheets of thin plate glass, ruled with diagonal lines of mechanical exactitude. These are engraved into the glass, each piece of glass being ruled at right angles to the other. The lines are filled with a black pigment, leaving transparent spaces between. The two sheets of glass are placed face to face and sealed, the black lines crossing each other and leaving square transparent openings through which the light passes before it reaches the photographic plate. If a cross-line screen is held up to the light it presents a "lattice work" appearance.

Half-tone screens are made in various "gratings" of rulings. These vary from 60 to 400 lines to the inch, though for half-tone blocks it rarely exceeds 200 lines. The different rulings are used to suit the grade of work to be reproduced and the class of paper on which the illustration is to be printed. When printing on cheap, coarse paper, such as "news," a 60-line screen is usually used. The more open the screen, the more brilliant and great a contrast there is in the reproduction, the easier it is to print. The closer the screen, the greater the detail in reproduction. Blocks made with fine screens require to be printed on a highly finished or coated paper. For ordinary "black and white" commercial work, screens from 120 to 150 are used, and for fine colour reproductions, screens from 150 to 200. The screen is secured in a holder and placed immediately in front of the dark slide holding the photographic plate. The screen distance—an important factor—can be adjusted to suit the particular work in hand. When the exposure is made and the negative developed, it will be found upon examination that the tones in the original are represented by a large number of dots varying in size according to the tones contained in the original.

The next operation is to place photographically a print from the negative on to a metal plate which, for half-tone work, is usually copper. The solution for coating plates for half-tones is different from that used for line work. It is composed of fishglue, ammonium bichromate and liquid ammonia, albumen occasionally being added. The copper plate has to be prepared by removing all grease and foreign matter. It is usual to heat the plate and rub it back and front with caustic potash, finishing off by polishing it with charcoal. The sensitive solution is then poured on the plate and placed in a whirler to distribute the coating evenly. The fishglue solution, or as it is usually termed, "enamel," forms an acid resist. After "printing down," the copper plate is placed in water coloured with an aniline dye, the enamel absorbing the dye. The plate is washed in water, after which the design becomes visible. It is then dried and subjected to heat, or, as it is called, "burnt in," the effect being to increase the resistance of the enamel to the etching fluid. The margins and back of the plate have to be painted with asphalt or shellac varnish to protect those parts from the acid whilst etching. The plate is then ready to be placed in the etching bath, which is made up of a solution of iron perchloride at a strength of about 40° Beaume. The plate is left in the solution for a few minutes and then examined to see if the etching is proceeding evenly over the whole surface.

The etching of the plate is continued until the fine dots in the higher lights are as small as it is possible to etch them, great care being taken that the acid does not underbite the "dots." When the etching of certain parts has reached the stage when it would be dangerous to proceed further, they are "staged," or stopped out with asphalt and varnish and the plate again immersed in the bath. A series of fine etching has then to be undertaken, *i.e.*, stopping out with an acid-resisting varnish those parts which have been etched to their fullest extent, and applying a series of local etchings for the purpose of putting "life" into the plate. This is done by saturating a fine brush with the etch and placing it on the area requiring such treatment. A proof is then pulled from the plate, compared with the original copy, and any necessary alterations made. When passed, the plate is "finished" and mounted on wood ready for the printer.

When a vignetted block is required, the design and close surrounds are protected with varnish and the extreme edges are treated with acid so that the "dots" on the latter are reduced to the smallest point, gradually increasing in size towards the design. In this way, graduated results are obtained until the dots merge into the white paper without showing a sharp edge.

When pencil drawings are to be reproduced, it is usual to make a "high light" negative, *i.e.*, the high lights in the drawing and the paper on which it is made do not show "screen." This is done in the making of the negative, one of two methods being usually followed:—(*a*) *direct*, when an over-exposed negative is made and certain stops used during the exposure which tends to make the "dots" in the high lights overlap and become solid, the other tones being brought back to their correct relation by manipulative development; and (*b*) *the indirect method*, entailing the use of three photographic plates: first, a continuous tone negative is made of the original, which can be retouched; from this a positive is made through a screen; and from the positive a negative is obtained with the "dots" eliminated from the highest lights, which include the paper on which the drawing has been made.

Combined line and half-tone blocks are frequently made for commercial purposes. This can be done either by making two blocks, one in line and the other in half-tone, cutting out the spaces in the line block and inserting half-tone plates which must be made to fit the space; or by making two negatives, one in line and the other in half-tone, stripping the films from the photographic plates and placing them in their respective positions on a piece of glass which constitutes the negative used for printing down on to metal. In this way the combined design is etched on one plate and at one operation.

Colour Work.—When reproducing colour subjects by the half-tone process the blocks are made in the same way as half-tones but the photographic plates must be colour-sensitive (panchromatic); and when making the exposure the light not only passes through the prism, lens and screen but also goes through what are known as "colour filters." These are optically flat coloured pieces of glass held in a frame attached to the lens and as the light passes through the particular filter, only certain rays of light reach the photographic plate. A special colour filter is used for each colour negative. Thus, a negative only records the colour and its component tints of one of the fundamental colours of the spectrum.

To make a negative for the yellow printing plate, a blue filter is used; for the red printing plate, a green filter, and for the blue printing plate, a red filter. The light, passing through the respective filters prevents the colours and tints not complementary to the inks in which the printing blocks are printed being recorded on the special photographic plate.

As in the production of the half-tone plate, the ruled screen is placed in front of the photographic plate, but for colour work, a circular screen, which can be set to different angles, is used for each of the colour negatives. The angles of the screen must be different for each colour to prevent a "pattern" or "moire" effect taking place when the three colours are superimposed in printing. One of the colours has the screen angle at 45° from the vertical, and the others 75° and 15° respectively. The negatives are developed, printed down on to metal and etched in the same way as when making a monochrome half-tone plate, but much fine etching, demanding great skill, has to be done in the production of colour subjects. The "fine etcher" must possess a good knowledge of colour and its analysis so that the final results approximate to the original painting. He has to endeavour to rectify the shortcomings of the means taken to dissect the colours of the original and the inability to obtain photographically a true rendering of the colour values on the negative. This he does by a series of fine etchings, stopping out certain parts and continuing the etching by local application. This operation may have to be repeated a number of times, and many proofs from the plates pulled before the desired results are obtained.

It is now usual to include a fourth colour when reproducing coloured subjects. This is usually printed in a grey or black; the "colour," however, is not dissected in the ordinary sense of the term, although an amber filter is used. The fourth plate represents the whole of the tones in the original in their proper relation

to each other, and becomes the key plate. The fourth printing allows for cleaner and more rapid working on the printing machine and at the same time provides a depth of colour and "quality" which, owing to the scientific shortcomings of the process, it is not always possible to obtain. The plates are finished off in the usual way, mounted on wood and sent to the printer along with a series of colour sheets which show the shades of colour used in the proving.

Half-tone colour negatives are made either by the *direct* or the *indirect* method. In the first instance, each colour negative is made in the same way as an ordinary half-tone negative but the exposure is made through a colour filter in addition to the screen, thus recording on the panchromatic plate one of the fundamental colours and its tints and constituting, when developed, one of the half-tone negatives from which a block will be made to print in a certain coloured ink. The *indirect* method entails the use of three photographic plates for each colour. The first exposure provides a continuous tone colour separation negative. This is obtained by making the exposure through the colour filter. This full tone negative can be retouched to assist in rectifying colour values. From this a positive is made through the screen and the printing down negative made by contact with the positive.

The half-tone process is applied to the preparation of printing surfaces for various methods of reproduction, including plates and cylinders for machine printed photogravure and photo-lithography. The preparation of the negative for the latter is similar to that followed when making half-tone blocks, with the exception that a negative which is to be used for printing by "offset" is not reversed. This is achieved by removing the prism from the lens. Extreme care has to be taken, when making a negative for intaglio and planographic printing, to see that the full range of tones are contained in the negative. It is not possible in these processes to re-etch the plates in the same way as the photo-engraver does when making relief printing blocks. The chief advantage of these methods of printing is that a rough surface paper may be used, and attempts are being made to produce relief printing blocks which will answer the same purpose.

The printing of these special plates may be briefly described as follows: A filler of chromium is electrolytically deposited on a sheet of copper. The chromium-coated plate is floated with a solution of albumen sensitized with ammonium bichromate. A high-light negative (the form of negative usually employed) is placed in contact with the sensitized plate in a pneumatic printing frame and exposed to light. After rolling up with litho ink, the plate is developed by washing in water and then dusted with finely ground bitumen, the ink and the bitumen combining during the subsequent process of burning-in to form an acid resist. The plate is then placed in a dissolving bath, the mordant being hydrochloric acid and glycerine kept at a temperature of 75° F. The action of the bath removes the chromium coating from between the "dots" or lines representing the design, and is continued until the bare copper plate appears, when it is transferred to a saturated solution of potassium cyanide. After a further washing in water, it is placed in a bath wherein silver is electrolytically deposited on the copper portions between the "dots." A sponge saturated with benzol is then used to apply a powder composed of mercury and chalk to the plate; this latter amalgamating with the silver produces ink-rejecting areas, whilst the benzol removes the bitumen resist.

The printing plate therefore consists of a chromium-covered surface which accepts the ink, whilst the spaces between the "dots" or lines comprising the amalgam of silver and mercury repel the ink as the inking rollers pass over the plate. The ink and rollers used for this process contain a small percentage of mercury. It is claimed that Pantone makes possible the printing of half-tone illustrations on any grade or finish of paper, the plates themselves being practically indestructible.

Another method of producing colour work from relief printing blocks to print on a rough surface paper is known as the "Blackmore Tintex Process." The plates for this process are "deep etched" in a special way.

It is probably along these lines that half-tone blocks for typographic printers will be developed. Since most people have a decided objection to a glossy paper, which reflects the light and strains the eyes, this will provide letterpress printers with a means of competing with rotogravure and offset printers in producing prints on a dull and uncoated paper in place of the highly finished coated paper which must be used if the best results are to be obtained from a half-tone block.

(*See* COLOUR; COLOUR PRINTING; COLLOTYPE; PHOTOGRAPHY; PHOTOGRAVURE; PRINTING.)

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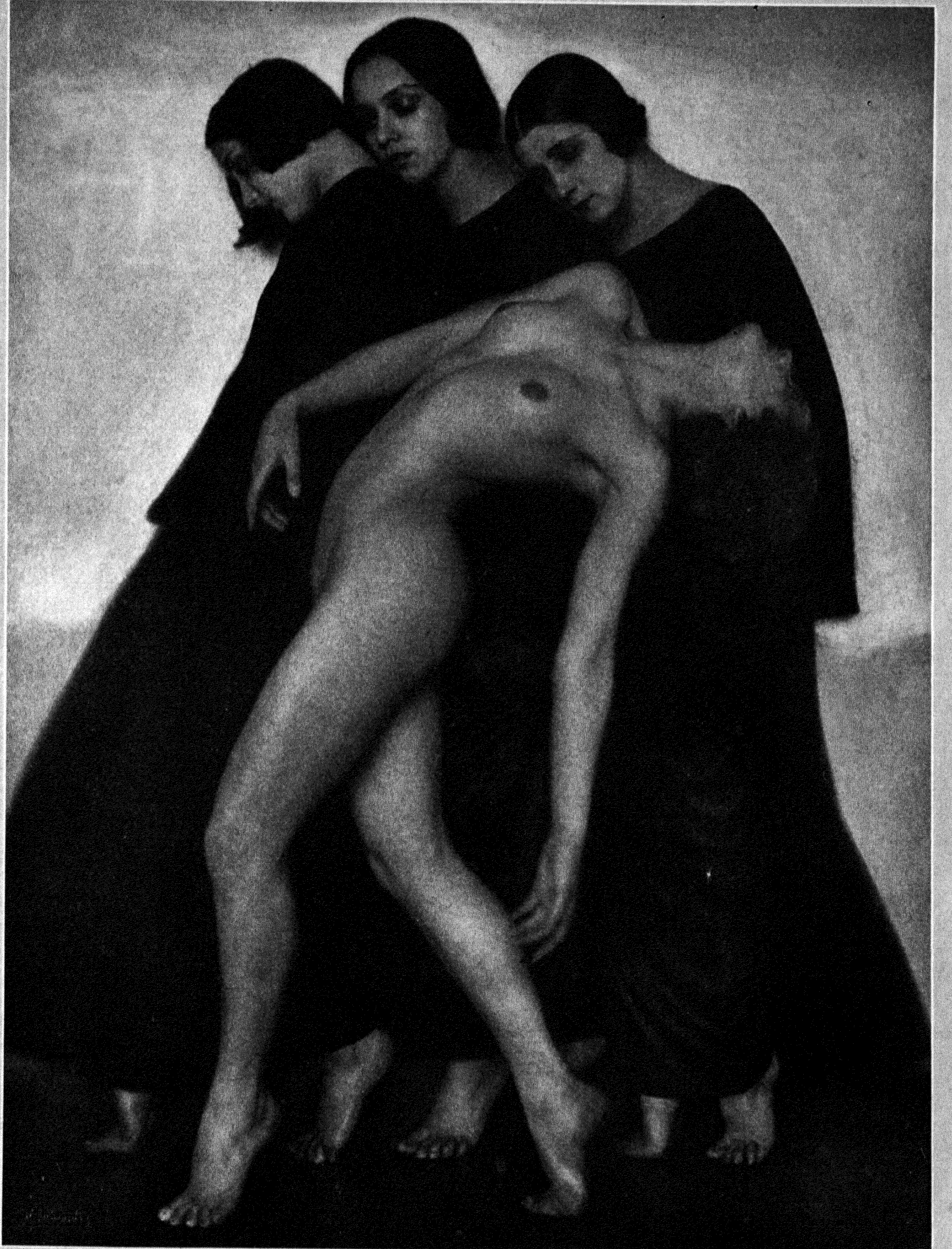
PHOTOGRAPHIC ART. The modern tendency in photography in the hands of both amateur and professional exponents is to employ the camera as a means of artistic expression. No consideration is being taken here of the widespread applications of photography in scientific and technical directions. (*See* PHOTOGRAPHY.) It is more in reference to its position in the realms of art that this article is written. The appeal to the eye is greater than the appeal to the emotions through any other sense, and in this respect photography occupies a unique position to-day as a maker of pictures. Many thousands of individuals in all parts of the world are producing photographs, with the ulterior object of their appeal to the eye as pictorial representations of incidents of interest. Unfortunately, a very large majority of those who use the camera are not artists; in this way the prestige of photography as an art is apt to suffer.

Photography can be regarded as an art in precisely the same way that any other graphic process can be regarded as an art when it is dealt with and conducted by an artist. The process is really a medium of expression, and the camera, lens and sensitive material merely the tools employed. The true artist who seeks to express himself can, within the limitations of his tools and material, do so in any medium that appeals to him for the purpose, and the measure of success that attends the result of a work of art is entirely the measure of the ability and inspiration of the artist. It is recognised that photography has limitations that are imposed by the apparatus employed. When these are recognised, the camera becomes a most facile instrument as a means of expression, and the main idea of picture making in photography is precisely the same as that which is put forward by the artist with any other medium. It is, in brief, that the individual with something to say is never inarticulate. He may find paint, or music, or the pen most responsive for his expression. Photography, with its remarkable ease of production, has solved the difficulty for many.

In 1840–1853, Daguerreotype and Calotype were very popular, and a Scottish artist, D. O. Hill, made a series of portraits in Calotype in 1844–1845, which are still regarded as remarkable examples of pictorial portraiture. (*See* PHOTOGRAPHY: *History*.) From that time onwards, a great variety of investigations and experiments were conducted in photography, and the work steadily progressed towards the simplification of methods. An outstanding development was the introduction of the gelatine process; dry plates were regularly used and the foundations of modern photography were laid. From this time onward the progress in both commercial and amateur photography became very rapid, as both the materials and the apparatus were being steadily improved year by year. Printing processes increased and cameras were simplified.

Colour Photography in Art.—The photography of coloured objects received attention in the early stages of the history of photography, when it was observed that the tones rendered in



BY COURTESY OF THE CAMERA CLUB

A PHOTOGRAPHIC STUDY IN MOVEMENT

A study by Dr. Rudolph Koppitz of Vienna; an important print, one copy of which has been acquired by the Tyng Foundation Trustees, for the permanent collection of the Royal Photographic Society. It is remarkably beautiful because of the strong massing of the figures, and for the rhythm expressed in the curved composition of the four heads, the sweep of curve of the body, and the pattern of the feet

A BRIDGE IN MONTENEGRO

A landscape photographic study by Alexander Keighley, Hon. F.R.P.S. Printing medium, bromoil. The well-chosen angle from which the old bridge is taken gives great depth of perspective to the subject. The background is well blended in, the reflections break up what would otherwise be a rather flat foreground. As a result of the low viewpoint, the stonework looms high enough to make th

monochrome on the photographic plate were not true comparative renderings of the originals, the blue end of the spectrum being rendered practically as white, and the red end of the spectrum practically as black. This irregular sensitiveness to different colours continued until Dr. H. W. Vogel found that the addition of certain dyes to the silver salt in the sensitive emulsion for plates made them more sensitive to yellow and red. This was the foundation of orthochromatic and panchromatic plates and films as they exist to-day. However, colour photography, that is, photography in natural colours, has proceeded on other lines, and may still be regarded as being in the experimental stage. (*See* PHOTOGRAPHY: *Colour Photography.*)

Processes in which coloured results have been achieved have also been arrived at in cinematography, as well as in printing processes, in which the colours have been entirely under the control of the producer of the print and can hardly be regarded as colour photography at all.

Printing Processes.—In recent times, printing processes have also been perfected and others have appeared in which personal control has placed great power in the hands of the worker for pictorial effects. In regard to the direct printing processes, one of the earliest silver methods in which the silver salts were incorporated with albumen, is no longer employed. Gelatine has taken the place of albumen and printing-out-papers have been of the variety known as gelatine-chloride. In these, chloride of silver and gelatine have formed the base of the emulsion coating the paper, the image has been printed out beneath the negative and subsequently toned. Still more recently, bromide and gaslight papers have been the most popular printing media, the former being paper coated with an emulsion of bromide of silver, and the latter with chloro-bromide of silver. Both of these are known as development papers, the image being latent after the exposure and has to be chemically developed to produce a visible image. Many varieties of chloro-bromide papers are in use to-day and are proving extremely popular printing media for pictorial workers, both amateur and professional.

On the "control" processes, gum-bichromate was popular for a period and is still used by some pictorial workers. In this process, paper is coated with bichromatised gum and a suitable pigment. After exposure under a negative, the parts that have not been acted on by light and rendered insoluble, are washed away in water. The personal control in the result is entirely in the hands of the worker, according to the desired result. To a certain extent this process is similar to the carbon process, in which pigment and bichromatised gelatine are coated on paper, and after exposure beneath a negative, the tissue is placed in contact with another support and the image developed in hot water by dissolving away the unacted-upon gelatine.

The most recent developments in control processes have been in oil and bromoil, the former being founded on the action of light on bichromatised gelatine, which is coated on to plain paper, exposed under a negative, and then soaked in water. The parts that have not been acted on by light absorb water in proportion to the light action. In this condition, those parts of the print which have been acted upon by light, and represent the shadows of the original subject, can be made receptive to an oily pigment when dabbed on with a suitable brush, and the picture thus built up in pigment. The original drawing of the photograph is retained, but the tone values are entirely under the control of the operator. In the bromoil process, a print on bromide paper is bleached in a solution in which bichromate salt appears, the bleached image taking on the same qualities when soaked in water as the printed bichromate image in the oil process, and pigment is applied in the same way.

The carbro process is a development of the carbon process in which the same principle applies, and both carbro and bromoil processes have become very popular among pictorial workers in photography, not only on account of the control in the final result that is placed in their hands, but from the fact that the prints can be made from enlargements on bromide paper made from small negatives.

In amateur work in particular, small negatives with subsequent enlarging on to bromide paper produce finished results, either in that process or in bromoil, that account for a large proportion of modern exhibition work. All the tendency to-day is towards simplifying and making smaller and more effective the apparatus for the pictorial worker. The portable hand-camera with speeded shutters, large aperture lenses, and high-speed plates and films have rendered the production of negatives of high quality possible for the multitude, while in the hands of the expert, the most perfect tools are available for use.

Controlled Processes.—The real factors that decide the success of a picture by photography are those which occur before the exposure is made and after the negative has been developed. The use of accurate apparatus, intelligently used with a knowledge of its limitations and with the employment of the right type of plate or film, is a matter within the scope of practically anyone. For the production of pictorial work which may rank as art, the mental outlook that precedes the taking of the photograph and the manipulative processes that occur in the making of the final print, will determine the artistic quality of the result. The selection of subject, choice of viewpoint and due consideration of the lighting effect are three elements of picture making, where the trained artist has the advantage, and it is in these respects that the photographer who is an artist can make the most of his subject, using the apparatus thereafter merely as a recording instrument to secure in a fraction of time the picture that has been visualized. The photographer, therefore, who is by instinct an artist, or who has had an art training, is more likely to make photographs that can rank as art than the snapshotter without these qualifications. After the plate has been exposed and the negative developed, it is in the production of the final print that the artist again finds scope for individuality. The same negative mechanically printed, on the one hand, or treated with care and thought by an artist to produce a beautiful picture by a controlled process, on the other hand, can be two widely different things. It does not necessarily mean from this that controlled printing processes employed indiscriminately, and without very definite knowledge of the final result required, will produce a picture; there is much evidence to the contrary. But many of the finest pictorial results by photography that rank high in pictorial art have been produced by one of the various controlled processes when employed by a worker who is an artist.

Bromoil Process.—Of these processes, probably the one most widely employed at the present time is the bromoil process. Bromoil has much in its favour for every worker who desires to express individual feeling and control in a pictorial photograph, and has the great advantage that, unlike many other photographic processes in which considerable control is possible a finished print on a large scale can be made with perfect facility from a small negative taken with a pocket camera. The artist, therefore, who is equipped with a small but reliable camera, and a knowledge of the picture he requires, can produce with its aid exhibition pictures of large dimensions impractical before the introduction of the bromoil process.

In the bromoil process the original negative, which should be of good quality, with the correct range of tonal values, is enlarged to the desired size by one of the ordinary methods of enlarging on to ordinary bromide paper. This enlarged bromide print then forms the basis of the bromoil print. The print, after developing, fixing and washing, is treated with a special bleaching solution which has the quality of converting the black and white silver image in the gelatine of the bromide print into a bleached image with, at the same time, a tanning action on the gelatine. This tanning action is in direct ratio with the tones of the original image. Thus, the darkest part, or shadows, of the picture become the parts that receive the greatest tanning action, the half-tones less in proportion to their strength, and the high-lights very little, or not at all. The subsequent pigmenting of the image with a greasy ink is regulated by the absorption of water in the gelatine. Where the image has been tanned or hardened by the action of the bleacher, there is not much absorption of water; whereas in the high-lights where the tanning action has not occurred, a considerable amount of water is absorbed, and those parts in turn

reject the application of the greasy pigment, whereas the hardened portions, or shadows, will "take" the pigment, and so on through the entire range from darkest shadow to high-light. The pigment is applied with a specially made flat-topped mop-shaped brush with a dabbing action, and the image is built up in pigment in any colour and any strength, according to the desires or ideas of the artist. The original outline of the image is retained, but the tones are entirely under the control of the worker. One may thus lighten shadows or darken high-lights, according to taste, and as it is largely in the matter of tonal values that many photographs suffer in quality, the amount of control that such a process places in the hands of the artist is considerable.

The working details of the above bromoil process are as follows:—The original bromide print, which may be an enlargement or made by contact, should be on any good quality bromide paper that is suitable for the process Most manufacturers of bromide paper now market a special "bromoil" paper, as some papers are "over-coated," or for other reasons are unsuitable. The print, fully developed and thoroughly fixed and washed, should be of good quality, and preferably fixed in a plain (not an acid) fixing bath of hyposulphite of soda. It may be bleached wet as soon as the washing is concluded, or it can be dried before applying the bleaching solution

The following is a good formula for the bleaching solution —

Copper sulphate	1 oz.
Potassium bromide	1 oz.
Potassium bichromate	60 grains
Hydrochloric acid	6 minims.
Water	20 oz.

For use, one part of this solution should be diluted with three parts of water. To bleach the print it should first be placed in water for a minute until limp and the surface evenly wetted, the water poured off and the bleaching solution poured evenly over the print. In from three to four minutes, the black and white image is converted into a faint brownish image. When fully bleached, the print should be thoroughly washed for a quarter of an hour and then fixed for ten minutes in a plain hypo bath, containing 2 oz. of hypo to 20 oz of water This is followed by a final washing of a quarter of an hour The bleached, fixed and washed print should then be dried, and although it is possible to proceed with the pigmenting immediately after washing, better results are obtainable by first drying

To prepare the bleached print for pigmenting it should be soaked in water at a temperature of 65° Fahr. for about half an hour. This will permit the gelatine to absorb water in inverse proportion to the shadows of the original image The print, after soaking, is placed on a pigmenting pad consisting of several thicknesses of wet blotting paper laid evenly on a hard surface such as a sheet of glass. The wet pigmenting pad is necessary to keep the print in the correct moist condition during the application of the greasy ink.

The wet bleached print is now carefully blotted with fluffless blotting paper until surface dry, and the image will be observed in the gelatine in very slight relief. The high-lights which have absorbed most water have a distinct shine, while the shadows are matt in appearance. The pigments employed are specially prepared for the purpose and are similar in character to ordinary artists' oil colours, but are much stiffer. They are obtainable in practically any colour and in different degrees of hardness, but a very hard or stiff ink can be softened by using the medium sold for the purpose or "megilp." The brushes are also specially made for the process and are approximately in the shape of a horse's hoof, with a slightly domed surface, and are usually made of fitch (pole-cat hair) It is possible to use brushes made of other hair and even of hog hair, but these are generally too coarse for fine work. One or two large brushes and some small ones are necessary for different parts of the work To apply the pigment a little of the colour should be taken from the tube and spread on a piece of glass or similar hard surfaced palette. A medium sized brush, which should be held lightly in an almost vertical position, is dabbed on the pigment and the dabbing continued on the palette until an even film of colour has been spread. The brush is then dabbed on to the surface of the prepared print, where it will be found that the pigment will adhere to those parts which formed the original image, whilst the high-lights reject the ink. From now onwards, the process is a matter of application of the pigment to the surface of the print, building up the image tone by tone until the complete picture is made visible in pigment. A certain amount of practice is necessary and desirable before the correct action for applying the pigment is acquired; but when it has been acquired, the pigmenting of a comparatively large print becomes a simple matter that is entirely under the control of the worker, who is thus able to reconstruct the subject with stronger tones where required, or high-lights filled in where necessary. A slow pressing action of the brush will tend to add more colour, while a quick hopping action will remove it. The colour should always be applied freely, and by continuing to work on the surface the texture will become finer until the right depth of tone is reached. Stronger shadows are produced by using a harder ink, which will tend to produce contrast, whilst softer inks should be used to tone down high-lights, and to make a more even tone over the entire picture. The pigmented print should be allowed to dry naturally in a warm atmosphere, and the surface should not be touched until the pigment is hard, when final spotting and cleaning up can be undertaken

Bromoil Transfer Process.—A further development of the bromoil process, producing final prints of great beauty in pigment on plain paper, is bromoil transfer. This, as its name implies, consists of transferring the pigmented image to another base of selected paper In this case the pigmented print, while still wet, is placed in contact with the new base, and between suitable supports (thin metal plates), is passed through a roller press under considerable pressure, similar to an etching press If the paper is in proper condition the pigmented image is transferred from the bleached bromide print to the new base. If the transferred image is not sufficiently strong, the original print can be repigmented and a supplementary pull made for strengthening the transfer, care being taken to secure correct registration Pictures produced in the bromoil transfer process are thus in permanent pigment on a permanent base, and comparable in the method of production with pictures in other graphic media in which an inked-up plate is pulled in a press.

Process and Expression.—Apart from the progress in processes, apparatus and materials, the individual side of photography has grown even more rapidly, but it must be admitted that, as in all other realms of art, the individual with strong personal proclivities in regard to the rendering of any particular subject matter, is always independent of the process The peculiar advantages of photography for recording incidents, textures and subjects, beautiful *per se*, should have more than a passing claim on the attention of all who may regard it solely as a means of expressing artistic thought There is, nevertheless, a tendency nowadays to confuse the process with the expression To the artist, the latter is the first consideration; the photographer who is not an artist is concerned chiefly with the process, and it is with this clear division of interest that one has an opportunity of comparing results. To know the man is frequently to know his work, but on the other hand, the product does not always betray the man The imitative faculty which the fatal facility of the camera has so readily engendered, renders the simulation of an accepted convention a matter of ease for the unoriginal. The same facility has, however, the saving grace that it enables the beginner with something original to say, to express himself nearly as well as the expert with but a few stock phrases.

The great increase in the number of photographers, both those who are attracted merely by the ease with which a picture is made, or the artists who have pictorial intentions, has been productive of vast numbers of photographic pictures; yet the original workers in the art who have produced the best pictures at various times remain pre-eminent. The multiplication and simplification of photographic processes have done much to smooth the path for the modern worker, and if a photographic exhibition of fifty years ago, or even a quarter of a century ago, could be reconstituted and

A SEA BANQUET

A seascape by F. J. Mortimer, F.R.P.S., a leading English photographer. Printing medium, bromide. There is a fine blending and graduation of the perturbed sea and the stormy sky. The flock of birds is caught at such a point that it forms a sweeping curve guiding the eye to the crest of the highest wave, the picture's intended centre of attention. The movement of the wings of gulls is beautifully expressed in the clattering of those in the foreground and the easy sweep of the gliding birds in the background

a material holder to carry sensitive plates or film, and a connecting shield to protect the sensitive material from light other than that which comes through the lens. This is generally extensible and then takes the form of a *bellows*. (*See* fig. 2.)

The cameras used for various purposes are discussed under the section *Apparatus*.

Positive materials may be used for transparencies, in which case they are *lantern slides* on glass or *positive films* (especially for motion picture photography [*q.v.*]). These materials are prepared in exactly the same way as negative materials, the emulsion being modified to give the results desired. Usually, however, negatives are printed upon sensitized *paper*. Printing papers at the present time are generally coated with a sensitive emulsion prepared either with silver bromide, *bromide papers,* or with silver chloride, *gaslight* or *developing-out* papers.

Until recently, the most usual types of sensitive paper were prepared with an emulsion containing free soluble silver compounds and were printed under the negative in strong light until the image was complete, *printing-out papers*. No development was required with these papers, which are, however, almost obsolete now except for the preparation of *proofs* submitted by professional photographers to customers.

Many other varieties of printing processes are known and some are still being used to a limited extent.

HISTORY

Photography was discovered by no one man. It was the outcome of the early observations of the alchemists and chemists on the action of light, a subject that belongs strictly to the domain of photochemistry (*q.v.*). Although the blackening of silver salts was known in 1565, it was not until 1727, when J. H. Schulze, of Germany, used a mixture of silver nitrate and chalk under stenciled letters, that it was definitely recognized that this darkening action was due to light and not to heat. These experiments were important in that, in conjunction with those of K. W. Scheele, 1777, they led to the experiments of T. Wedgwood with silver nitrate on paper and leather in 1802, which were reported to the Royal Institution of London with the suggestion that silver chloride was more sensitive. These were practically failures because of the very long exposures required, and no means were then known of removing the unaffected material and thus stabilizing the image against light.

Camera.—Leaving for the time being the question of the sensitive salts, we may turn to the evolution of the camera. This was the outcome of the old camera obscura, the invention of which is usually ascribed to Baptista Porta, 1553, though its principle had been indefinitely described by Alhazen, 1100; Roger Bacon, 1267; and others. Leonardo da Vinci, who died in 1519, described and pictured a camera obscura in an unpublished manuscript. In 1550 J. Cardan suggested the use of a speculum or concave mirror in front of the instrument, and D. Barbaro, 1568, proposed convex lenses and the use of a diaphragm to secure greater sharpness of the images. E. Danti, 1573, corrected the reversed image by means of a mirror behind the lens, a device still in use. F. Risner, who died in 1580, described in his works published in 1606 the methods of enlarging and reducing, and a portable box in lieu of the cumbrous fixed hut in use until then. Porta in his second edition, 1589, of which an English translation was published in 1658, was the first to introduce the use of the convex lens in the camera. Kepler, the famous astronomer, in his work on optical astronomy, 1604–1611, described the use of a concave lens behind the convex to obtain larger images, and thus anticipated the telephoto lenses of the present day. In J. Zahn's book, 1665, there was described a portable camera obscura with two or three lenses, to secure greater brilliancy of the image, and side wings to shield it from extraneous light; thus with the reversing mirror he antedated a type of modern camera. At the beginning of the eighteenth century the portable camera obscura had become a regular article of commerce and was used to obtain sketches from nature.

The Beginnings of Photography.—A. Senefelder discovered lithography in 1796, but, though it was introduced in Paris in 1802, it was not until 1813 that it became a success and a fashionable hobby. From this date until 1817 J. Nicéphore Niepce was engaged in an examination of the French natural stones to find one suitable for the process. Since he was unable to draw, his son, Isidore, undertook this work, and when the latter was called for military service, Niepce was impelled to produce the images automatically. In conjunction with his brother Claude, Niepce first essayed photography with silver chloride on paper. The light-sensitiveness of iron, manganese, acids, and other compounds was tested, stone, metal, and paper being used as supports. Finally, guaiacum resin was tried and then asphaltum, or bitumen of Judea, which had been in common use as an etching ground since the days of Rembrandt. This, becoming insoluble in its usual solvents by the action of light, gave not only a resist for the etching of metal plates but also transparent images on glass. A successful result was obtained in 1822, and thus it may be said that the first permanent photograph was made in that year by Niepce.

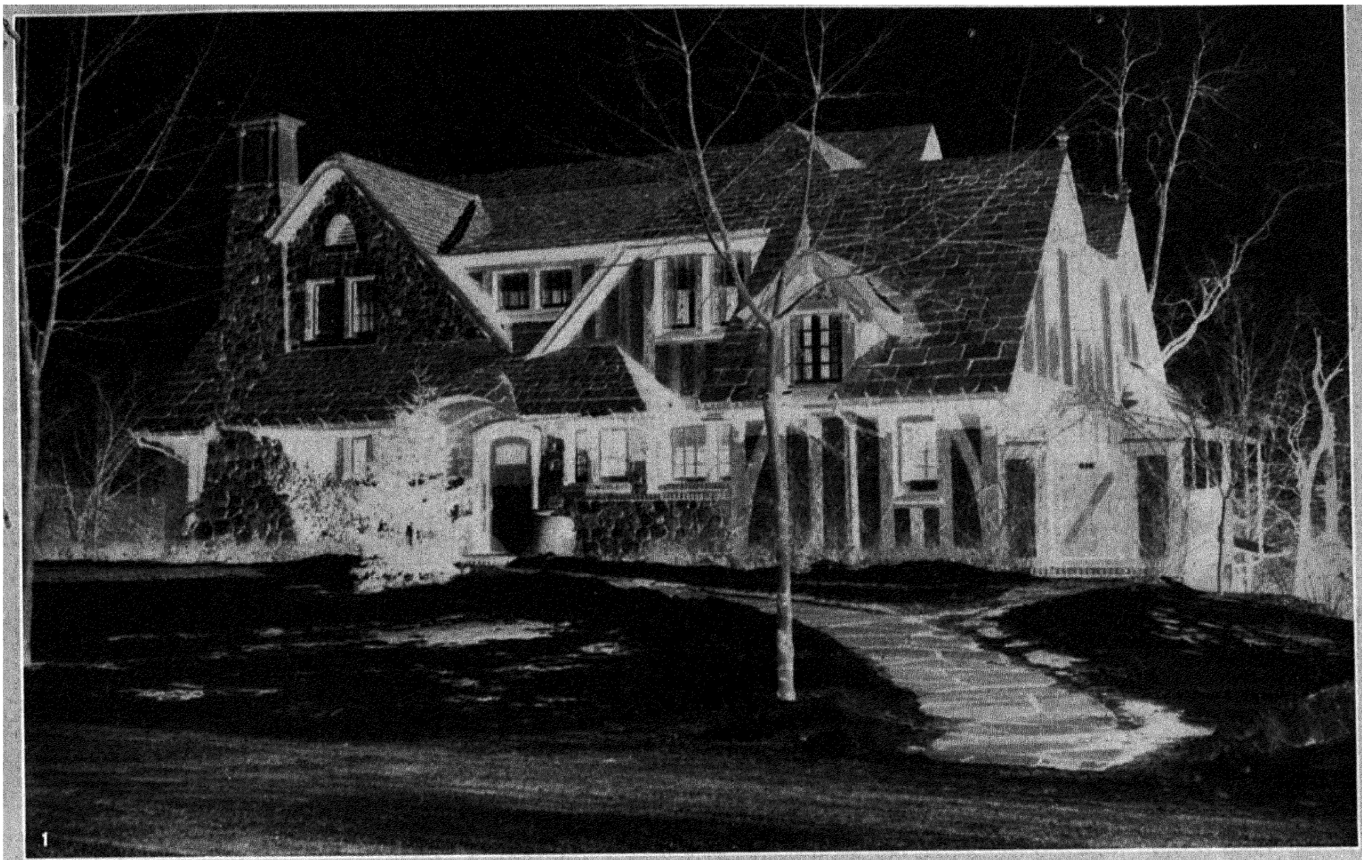
The next three years were required to perfect the process of heliography, as it was called, and in 1826 an etched metal plate was sent to M. Lemaitre, of Paris, to be printed. In order that the pictures should be more distinct, they were exposed to the vapors of iodine. The highlights of the plates consisted of hardened bitumen; the shadows, of the bare metal; thus the contrasts were very poor, which led to the use of tin instead of copper. Lemaitre suggested silvering copper plates. These two facts are of importance in the subsequent history.

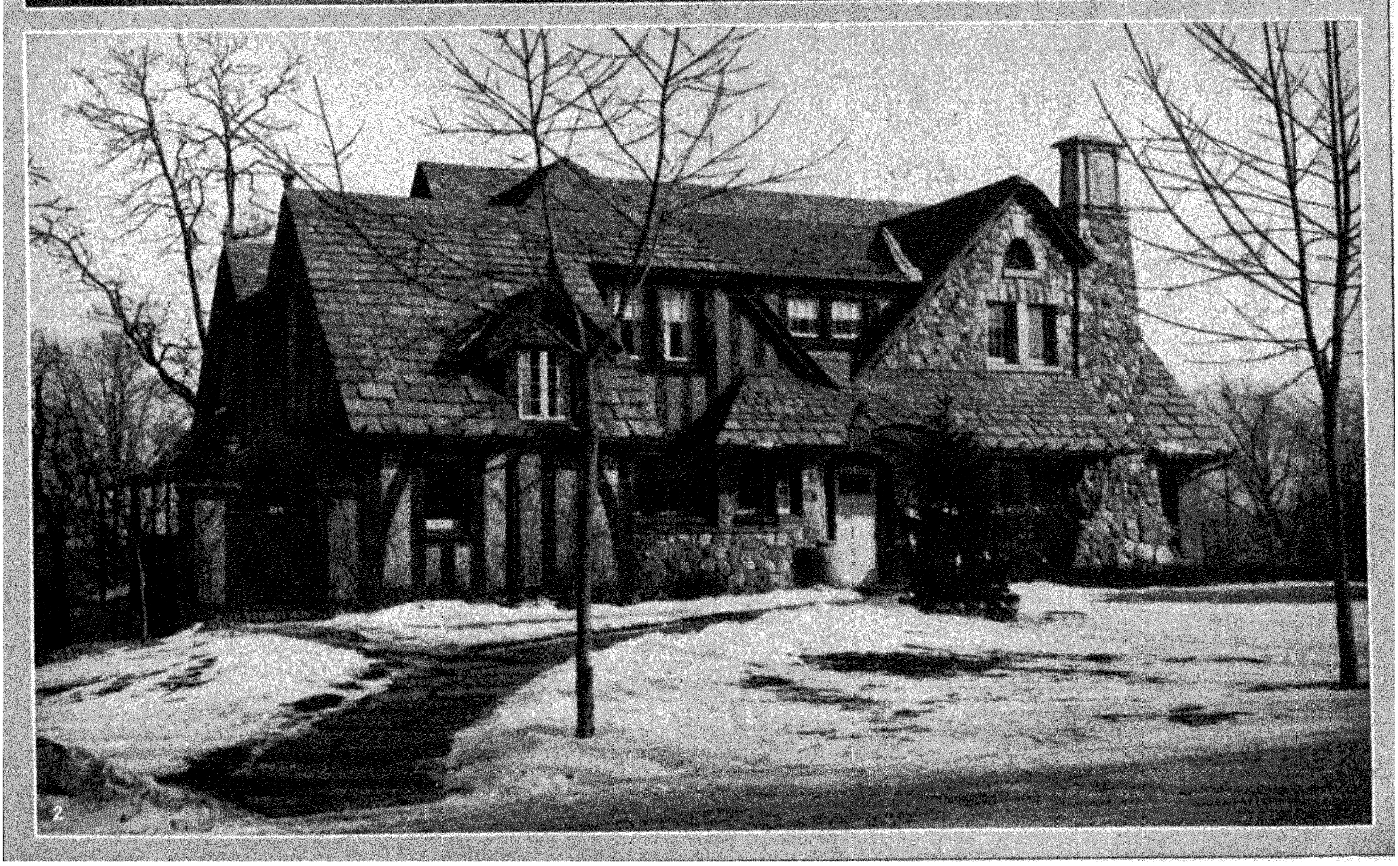
Daguerreotype.—In 1826, Daguerre, a painter who had experimented with silver salts, heard of Niepce's work and approached the latter as to the formation of a partnership. This was consummated in 1829. The work which Daguerre had done with Niepce had drawn their attention to the light-sensitiveness of silver iodide, and Daguerre discovered accidentally that the effect produced by exposing an iodized silver plate in a camera would result in an image if the plate were fumed with mercury vapor. The inventions of Niepce and of Daguerre were published to the world simultaneously by the French Home Minister in a bill presented to the House of Deputies proposing a national reward to the inventors. A full description of their methods was presented on August 19, 1839, at a meeting of the Academy of Arts and Sciences.

The introduction of the Daguerreotype process was attended by complete success. The process required much care and skill. A silvered copper plate was buffed and burnished to a high degree of polish. It was then iodized by careful fuming with iodine, and later (1840) resensitized with bromine, and then given an exposure the duration of which was of vital importance. At first, exposures of minutes in bright sunlight were necessary, but later exposures were secured in a few seconds under favorable conditions. The development was effected by placing the exposed plate over a cup of mercury heated to about 75° C. The image was then fixed with a solution of thiosulphate of soda and toned by treatment with gold chloride. The results obtained were excellent when all the operations had been carried out correctly, and the process flourished, especially for portraiture, until it was superseded by the wet collodion process in 1851.

Calotype.—A preliminary notice of Daguerre's success was made by Arago to the Academie des Sciences in Paris on Jan. 7, 1839. This caused Fox Talbot, an Englishman, to write to Arago claiming priority in regard to the obtaining of a picture in the camera, and having rendered it permanent. Talbot began his experiments in 1834, using the camera obscura with silver chloride and common salt or potassium iodide as fixing agents. A communication was made to the Royal Society of London on Jan. 30, 1839. But not until a month later did he disclose his working method, which then involved silver iodide with excess of the nitrate, and fixation with sodium thiosulphate. The solvent action of this for silver salts had been discovered by Sir J. W. F. Herschel in 1819. Talbot's process was called "Calotype," and the light image was developed with gallic acid, the action of which had been discovered independently by the Rev. J. B. Reade, but had not been published by him.

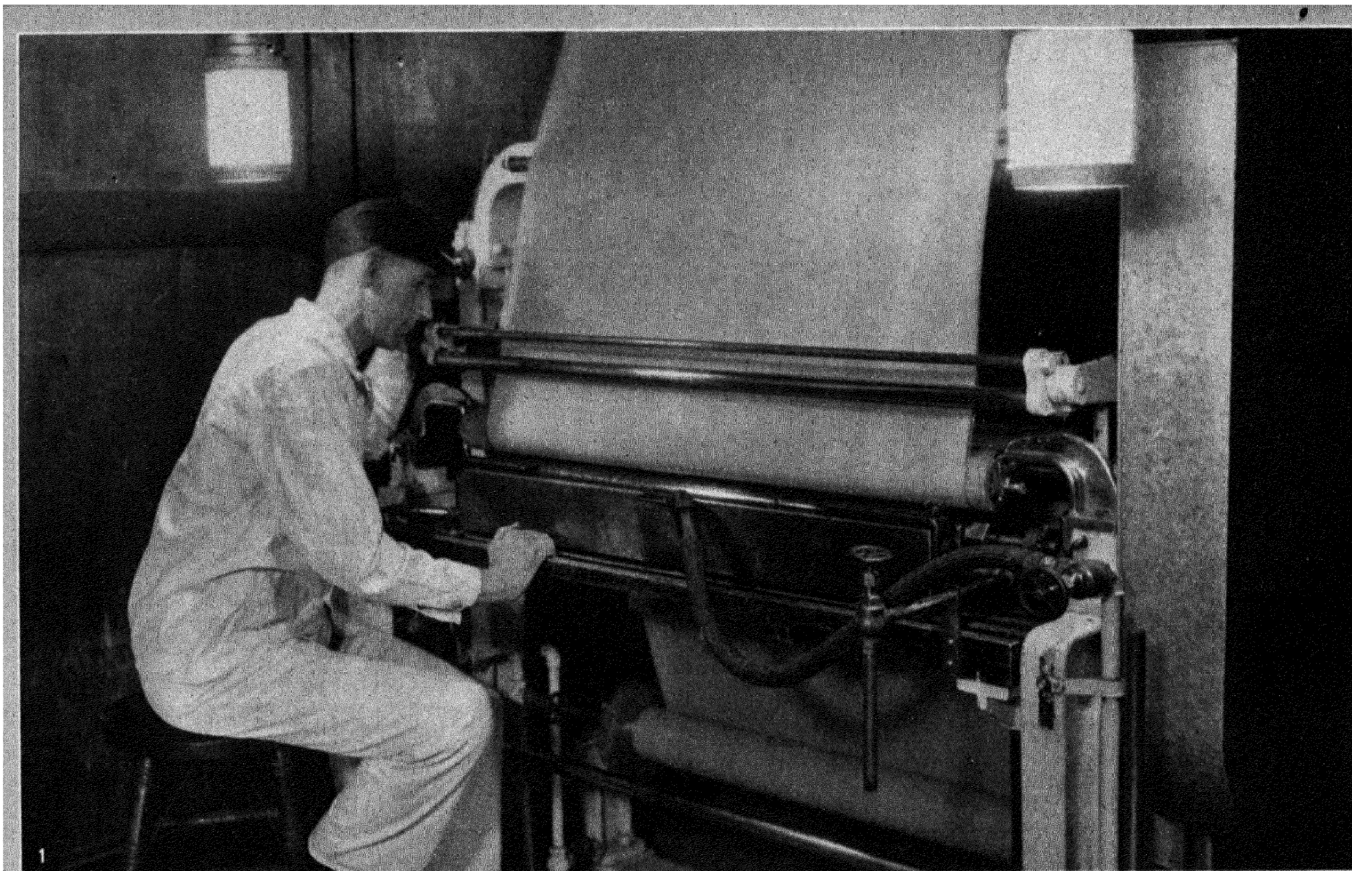
The developed image on a sheet of Calotype paper was the

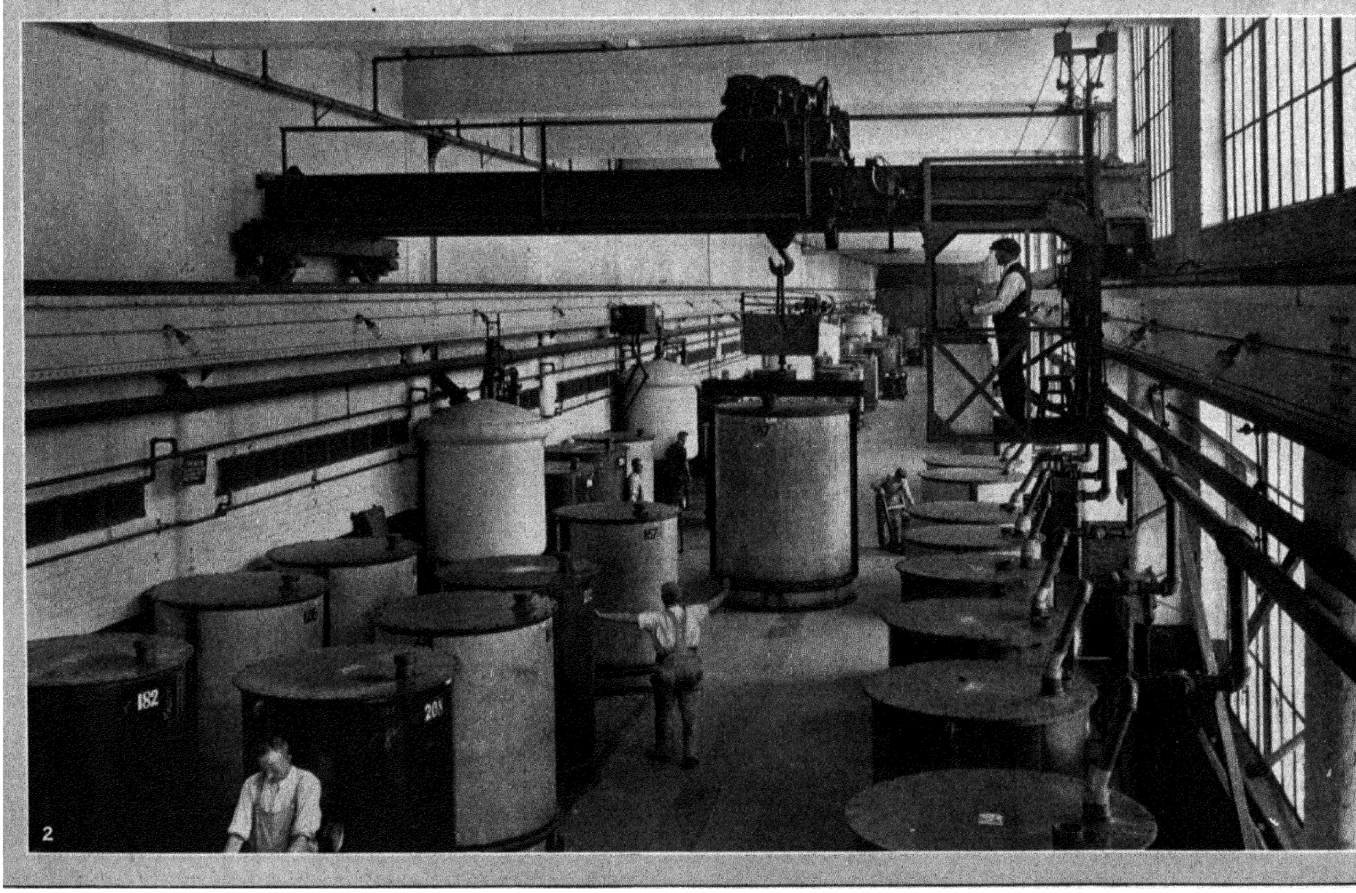




EXAMPLES OF NEGATIVE AND POSITIVE PHOTOGRAPHIC PRINTS

1. Photographic negative, after development. Light areas appear dark and vice versa; right side of picture appears left in the camera
2. Positive photographic print, made from negative in fig. 1





MACHINERY USED IN THE MANUFACTURE OF FILM

1. Film coating machine 2. Solvents in drums used in the manufacture of film base

exact reverse, as far as light and shade were concerned, of the original image. Such a picture was termed by Sir J. Herschel in 1841 a "negative." Since paper is a semi-transparent substance whose transparency could be increased by waxing or oiling on the side opposite to the image, Talbot was able to obtain true copies or positives of any negative by simple contact printing upon another piece of sensitized paper. Talbot's process should be considered as the first stage in the real line of photographic development, the notable inventions of Daguerre and Niepce being merely bypaths whose chief importance was the mental stimulus they gave to photographic evolution. The disadvantages of Calotype were the somewhat long time required for printing and the structure of the paper.

Herschel suggested the use of glass plates and the deposition of silver chloride thereon. In 1848 Niepce de Saint-Victor, the nephew of Nicéphore Niepce, suggested albumen as the vehicle for the sensitive silver iodide. This process, called "Niepceotype," held its own until 1851, when Scott Archer, an English architect, published his wet collodion process, which is still in use in photomechanical establishments.

Collodion Process.—Collodion, a solution of nitrocellulose in alcohol-ether, was first prepared by Maynard of Boston for medical purposes. Schönbein, the Swiss chemist, discovered nitrocellulose in 1846. To a solution of pyroxylin in ether and alcohol, Archer added a soluble iodide, usually with the addition of a little bromide, and coated a clean glass plate with the iodized collodion. In the darkroom, the iodized collodion was sensitized by immersion in a bath of silver nitrate and formed silver iodide with excess of silver nitrate. The plate was exposed wet in the camera, developed by pouring on a solution of pyrogallol containing acetic acid, and fixed with a strong solution of thiosulphate of soda for which cyanide of potassium was later substituted. Archer's collodion process was not patented, and in three or four years it displaced both Calotype and Daguerreotype.

The necessity for preparing the plates immediately before exposure and developing them immediately after considerably limited the practice of photography. Spiller and Crookes suggested bathing the prepared plates in a solution of a hygroscopic salt, so that they could be kept some time both before and after exposure. This was followed by the use of hygroscopic substances of all kinds.

Collodion Emulsion.—In 1864, B. J. Sayce and W. B. Bolton described the preparation of an emulsion of silver bromide in collodion. With this preparation, the nitrates—the by-products of the formation of the silver halide from the nitrate and alkaline halide—were left in the emulsion. In 1874, W. B. Bolton showed that it was possible to wash these nitrates out, and his methods are still followed.

Collodion emulsion was a practical advance on wet collodion but involved no improvement in the matter of sensitivity. Fundamental contributions to this were made by the introduction of alkaline development by Major Russell in 1862. A considerable increase of sensitiveness was obtained with collodion emulsion, but the full fruit of this was reaped only with the introduction of gelatino-silver bromide dry plates.

Gelatine Emulsion.—In 1871, Dr. R. L. Maddox made an emulsion of silver bromide in essentially the same manner as that used for making collodion emulsions but he replaced collodion by gelatine. The matter was followed up by other experimenters, among whom may be mentioned J. Burgess and J. Kennett. Kennett placed on the market a dry, washed emulsion which photographers could dissolve in warm water and use as a coating on glass and thus produce their own plates.

A great amount of experimental work was at once commenced on gelatine emulsions, the records of which filled the photographic journals between 1873 and 1885. The by-product salts were removed by washing. Abney recommended the use of iodide in small quantity with the bromide and found that this made it possible to obtain faster emulsions with less fog. Digestion, or "ripening" as it was called, came into use—long digestion at low temperatures being suggested by Bennett—in 1878, and digestion with ammonia was used in 1876 by J. Johnson and in 1879 by Monckhoven, who employed precipitation in ammoniacal solution as the basis of a process of manufacturing dry plates.

In 1877, the commercial plates of the Liverpool Dry Plate Company, Wratten and Wainwright, and B. J. Edwards were introduced, and by 1879 comparatively rapid dry plates were available on the market similar in type to the slower varieties of plates used to-day.

After this period, amateurs gradually ceased their researches, and mass manufacture became general. Considerable increases in sensitiveness were made between 1890 and 1900, but since the latter date there has probably been little advance in the maximum sensitiveness that can be obtained, although materials of high sensitiveness are made with much greater regularity and with greater uniformity than was the case formerly.

It is interesting at this point to record the advance made in photography in terms of the relative sensitivity of the process.

Process	Date	Time of exposure
Heliography	1827	6 hr.
Daguerreotype	1839	30 min.
Calotype	1841	3 ,,
Wet Collodion	1851	10 sec.
Collodion Emulsion	1864	15 ,,
Gelatine Emulsion	1878	1 to $\frac{1}{200}$ sec.
Gelatine	1900	$\frac{1}{1000}$ sec.

Colour Sensitivity.—The silver halides are sensitive chiefly to the blue, violet, and ultra-violet rays; hence, all other colours are reproduced as dark greys or blacks. In 1873, H. W. Vogel of Berlin discovered that the addition of certain dyes to the emulsion or immersion of the coated plates in a solution of dye increased the sensitiveness to the less refrangible colours.

Following this, Waterhouse found that eosin sensitized collodion emulsion, and shortly afterwards Clayton and Tailfer found that eosin would sensitize gelatine emulsions. They obtained a patent for its use in England and France, and their plates were placed on the market under the name of "isochromatic" plates. In 1884, eosin was replaced by erythrosine, which was found by Eder to be a better sensitizer, and since that date erythrosine has been used almost exclusively for the use of the so-called "isochromatic" or "orthochromatic" materials. In 1902, Miethe and Traube of Berlin found that ethyl red, an isocyanine dye, gave strong colour sensitiveness as far as the orange of the spectrum, and in 1905, Homolka, working at the Hoechst Dye Works, discovered Pinacyanol, a dye of structure somewhat similar

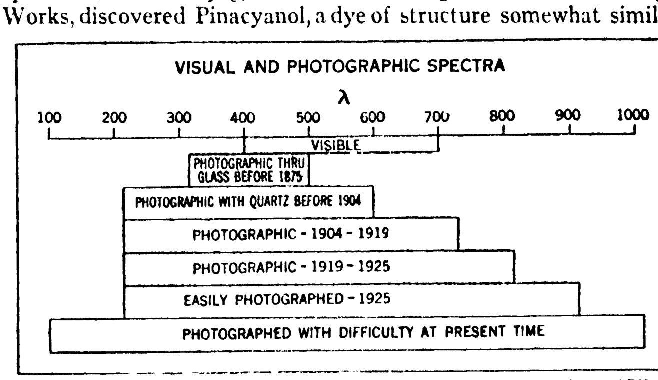


FIG. 3.—PROGRESS IN THE COLOUR SENSITIZING OF PHOTOGRAPHIC MATERIAL

to ethyl red but which sensitizes very powerfully throughout the red.

It was now possible to make "panchromatic" plates, which would photograph the entire spectrum without difficulty, and such plates were placed on the market in 1906. Further advances in colour sensitizing during recent years have extended the photographic spectrum into the near infra-red, and the accompanying figure illustrates the advance made since 1875 in widening the spectral range. (*See* fig. 3.)

Film.—The weight and fragility of the glass support led to attempts to replace it by lighter and flexible substitutes. In 1884, the film roll system of photography was invented by W. H. Walker, the emulsion being coated on paper, and a machine for

continuously coating photographic paper in long rolls was patented by George Eastman in 1885. The sensitized paper was loaded into a roll holder which could be attached to the back of a camera in the same position as a plate holder. At first, the paper was waxed to reduce the printing time, but later a stripping film was used, this consisting of a temporary paper base coated with soluble gelatine, which in turn was coated with a gelatine emulsion.

This stripping film was used in the first portable roll film camera marketed in 1888—a box type camera with two rolls, a supply spool and the wind-up spool. The pictures were circular, about two inches in diameter, and the operator had merely to point the camera and press the button. When the film was used up, the whole camera was returned to the manufacturing company, who developed and printed the pictures and reloaded the camera.

Eastman made experiments to produce a flexible film from collodion, but the ether-alcohol solutions would give only films which were too thin to be of practical use. Finally the use of wood alcohol as a solvent for nitrocellulose was discovered, and a flexible film base was marketed in rolls in 1889. In the same year, J. Carbutt introduced emulsion coated on flexible sheets of plastic nitrocellulose compound cut from blocks. The new flexible film was applied at once by Edison to the photography of motion pictures.

In 1891, daylight loading film was made. The film was wound on a wooden core inside a light-tight box and black cloth leaders were attached to the ends of the film. Later, the film was wound inside a protective sheet of black paper leaving sufficient overlength to permit loading of the camera without fogging the sensitive film. This was further modified in 1903, when a non-curling film was produced by coating the back of the film with plain gelatine.

In 1913, roll film packing was further modified by spooling the film in a thin and translucent red paper, the film being protected from light by the use inside this of "carbon" paper similar to that used for duplicating on a typewriter. After exposures are made, the photographer can write on the red paper with a stylus through an opening in the back of the camera. The pressure of the stylus removes some of the opaque black carbon from the sheet, so that on exposure to light the film is exposed along the tracks of the writing, and the image develops with the negative and serves for its identification.

In 1895, positive film was introduced for the printing of motion pictures, the film used previously being of the negative variety only. In 1909 slow burning motion picture film was first made by the substitution of cellulose acetate for cellulose nitrate as the plastic used in the preparation of the base.

Another method of packing films was invented in 1903 and was introduced on the market under the name of "film packs." These are now used mostly in cameras of the type originally designed for employment with dry plates. They have the advantage of not requiring a special roll film back. During the last ten years flat cut films have replaced plates to a considerable extent in professional photography, although large numbers of plates are still used in that field.

In 1917, X-ray films coated on both sides with emulsion were introduced. Owing to the transparency of the material to the X-rays, this enables double the density to be obtained, and the use of this film is now general throughout the world, it having almost entirely replaced plates in radiographic work.

In 1923, motion picture film 16 mm. wide on cellulose acetate base was introduced packed in such a manner that it could be loaded into small motion picture cameras without the use of a darkroom. This film was designed for finishing by a reversal process, in which the first negative is removed by a bleaching bath, and a positive is then printed on the remaining silver bromide. In France a similar film was made 9½ mm. wide. The introduction of this film has led to a great advance in amateur cinematography.

Developing Agents.—In the Calotype process gallic acid was used as the developer for the latent image, but in 1851 Regnault of Paris and Justus Liebig simultaneously discovered the more energetically-acting pyrogallol, which actually allowed shorter exposures to be given. This was used also at first for wet collodion, though it was later replaced by an iron salt, and for dry collodion plates. Until 1861, free silver nitrate was an important ingredient of developers; but in that year Wardley proved that pyrogallol alone could be used. C. Russell and J. Leahy independently announced alkaline pyrogallol development, the former suggesting also an alkaline bromide as restrainer. Even after the introduction of the gelatine plate, pyro-ammonia was the only developer used until 1884, when the alkaline carbonates became general. In 1880 Abney discovered the developing properties of hydroquinone. C. Egli and Arnold Spiller recommended the use of hydroxylamine in 1884. In 1888, M. Andresen of Berlin patented the use of paraphenylene diamine, paratoluidine diamine, and xylidene diamine as developers. In 1891, he patented the use of paraminophenol and its derivatives, especially monomethylparaminophenol, known under the trade name of "metol."

Printing Processes.—In turning to the positive processes, the first was with silver chloride and excess of silver nitrate on plain paper, which gave prints with a rather sunken appearance, the image being more or less buried in the fibres of the paper, and daylight was essential for printing. Blanquart-Evrard, in 1847, suggested the use of albumen to keep the sensitive salt more on the surface. In the same year, Romieu proposed salting with a mixture of alkaline bromides and chlorides containing gelatine and subsequent floating on silver nitrate solution. A few years later, the first coat of albumen was coagulated and a second applied, which gave a more brilliant glossy surface. The colour of prints obtained on these papers was an unpleasant foxy colour, and to darken this an acid was added to the fixing bath, thus causing sulphur toning. Le Gray, in 1850, proposed the use of a gold salt to improve the colour, and an alkaline gold bath was recommended by Waterhouse in 1858. De Caranza, 1856, recommended the use of platinum in lieu of gold. Albumenized paper made in this way and toned with gold remained the standard photographic printing medium until 1890.

A. Gaudin had suggested an emulsion of silver chloride in collodion for printing-out. This was revived by Wharton Simpson, in 1865. Paper thus prepared was introduced commercially by Obernetter three years later. Humbert de Molard, 1855, proposed to precipitate silver chloride, wash and suspend it in solution of starch or gelatine and paint the mixture on to paper. The same process was revived by Smith and Palmer in 1865 and by Abney in 1882. From this date, gelatino-chloride or printing-out paper came into general use, and eventually completely displaced albumen. Printing-out papers are still much used in Europe, chiefly collodion papers containing a gold salt that obviates the necessity of toning, but in America their use is limited to the production of rough proofs. Commercially they have been superseded by development papers.

Silver bromide with excess silver nitrate was used by Fox Talbot, and J. W. Swan in 1879 patented the use of paper coated with silver bromide emulsion not containing excess silver for development. It did not, however, come into general use until marketed by Eastman and by Just in 1883. Eder and Pizzighelli published, 1881, an exhaustive paper on gelatinochloride of silver with development, and the former, two years later, described a chloro-bromide emulsion. Chloride developing paper was introduced by Marion in England under the name of "Alpha" in 1889, and by Baekeland in America as Velox. Year by year since then the use of this paper has increased, special types, including a great variety of surfaces, being used for amateur and professional work.

Non-silver Printing Processes.—Robert Hunt was the first to utilize the light-sensitiveness of ferric oxalate in combination with a platinum salt in the hopes of obtaining images in that metal. But the process was a failure because he did not recognize that the ferrous salt, formed by the action of light, must form a complex salt in order to reduce the platinum salt to the metallic state. W. Willis in 1878 introduced the first workable platinum process. The great advantage of this process is that the pictures are permanent, as platinum is one of the most resistant of all metals. A modification of the process enables a platinum deposit of a sepia colour to be obtained, and for many

years sepia platinotype was the favourite printing process for results of the highest quality. The high cost of platinum and the ease with which development papers are worked has recently decreased the use of the process.

Vauquelin in 1798 had discovered the light-sensitiveness of silver chromate; Suckow, in 1832, observed that the bichromates were reduced by light in the presence of organic matter. Mungo Ponton, 1839, used paper treated with potassium bichromate. Becquerel, 1840, and Hunt, 1843, made improvements; but Fox Talbot first pointed out, 1852, that bichromated gelatine became insoluble in light, and this was patented as a resist for photogravure, for which it is still used.

Pretsch, Poitevin, Testud de Beauregard, Garnier and Salmon, and Pouncy, 1859, devised carbon processes, in which carbon itself in a finely divided state was used as the pigment in bichromated gelatine. But they failed to recognize the important point that, as the light acted first on the outer surface of the gelatine, those parts underlying the half tones and highlights would still be soluble; hence, on developing with warm water, they would have no anchorage to the support and would be washed away. J. W. Swan in 1864 patented the production of carbon or pigment prints by the transfer of the exposed pigmented tissue to a temporary support, on which it was developed from the back. Practically, his process is in use to-day, and its long scale of gradation, the possibility of using pigments of any colour, and the great stability of the pictures are much in its favour, though the necessity of day or arc-light for printing is against it.

T. Manly, 1905, patented a pigment process in which a developed silver print was squeegeed into contact with pigmented tissue saturated with potassium ferricyanide and bichromate. These salts migrated to the silver image, bleached it, and the reduction products wandered back to the tissue, rendering it insoluble in ratio to the amount of silver in the picture, as though the tissue had been exposed to light under the negative. A modification of this, known as "Carbro," was introduced some years ago.

In 1905, G. E. Rawlins reverted to an old process suggested by Mariot in 1866. Gelatinized paper is sensitized with bichromate, dried, exposed under a negative, freed from excess salt, and inked up with a greasy ink, which adheres to only the light-affected parts. Somewhat similar is the bromoil process first suggested in 1907 by E. J. Wall and worked out by Welborne Piper. This utilizes the principle stated by Howard Farmer in 1889 that finely divided silver imbedded in gelatine reacts with bichromates and renders the contiguous colloid insoluble. A bromide print is treated with a hardening and bleaching solution, fixed, washed and dried, then soaked in water, and inked up with a greasy ink, which takes only on those parts where there was silver. These processes have been used particularly by artistic workers, because there is complete control over the gradations and tones of the pictures, and any coloured ink may be used.

There is practically no advance to be recorded in the iron printing processes, which are chiefly used for architects' and draughtsmen's plans, since Herschel's introduction of cyanotype in 1842. G. Kögel has patented, however, the use of diazoanhydrides, nitro- or sulphonic derivatives of naphthalene, for paper that may be used for the same purpose; this process is known as "Ozalid." The advantage of it is that as the image is developed and fixed by gaseous ammonia there is no distortion caused by a wet treatment.

THE BRANCHES OF PHOTOGRAPHY

Amateur Photography.—The use of photography for making personal records has extended very greatly since portable cameras and sensitive materials were introduced, and the tendency is continually towards a simplification of the work to be done by the user and a diminution in the amount of expert knowledge required to get good results. This has resulted in the establishment of commercial firms to develop and print photographs made by the amateur, so that the great majority of photographs are now taken by those whose knowledge of the subject is limited to that necessary for making the exposures. The cameras used are chiefly of the folding type using a cartridge of film and are often of very small size.

The film can be loaded into the camera without the use of a darkroom and removed after exposure for development. For development, the films are hung by clips in deep tanks. They are printed by artificial light upon gas-light or developing-out papers, which are made in different degrees of contrast to suit the negatives obtained. As a general rule the photographic dealers will deliver prints from an exposed roll of film within two days. Enlargements are made upon bromide paper, frequently by means of enlarging cameras in which the focus is automatically maintained correct while the scale of magnification is varied. (*See* Plate III., fig. 5.) In addition to roll films, films in packs are largely used, each separate unit having a tab of paper attached to it by which it can be withdrawn after exposure. A small number of cameras still use plates or flat cut films in suitable holders.

Photographers who prefer to develop their own films usually employ a so-called "developing tank." (*See* Plate II., fig. 1.) The film is placed in a wooden changing box, in which it can be wound up with a light-tight flexible apron on to a spool. This spool together with the film is then transferred to a metal tank fitted with a light-tight lid, in which the film is developed.

When a darkroom is employed, the duration of development can be determined by one of three methods:

(1) By observation; the development is carried on until the strength of the image is judged sufficient. This requires much experience and is not to be recommended.

(2) By factorial development; this system was introduced by Alfred Watkins of Hereford, England. The number of seconds that elapse from immersion in the developer to the first appearance of the image is noted. This time is then multiplied by a certain number called the "developing factor," to arrive at the total time of development. The factor depends upon the material used and the composition of the developer. The method gives good results in the hands of an experienced worker.

(3) Development for a fixed time at a definite temperature. This method possesses the maximum of advantage and reliability. It is always used when negatives are developed in tanks and has largely displaced the other methods.

Printing can be done either in a printing frame or with a small printing box in which the negative is placed on a sheet of glass, the paper placed on it, and a platen then brought down which secures contact and simultaneously lights an electric lamp under the negative. A grade of paper suitable to the contrast of the negative is chosen, and exposure is judged from the density of the negative

Almost all the cameras used in amateur photography are designed primarily for use in the hand and are only occasionally used upon tripods. In addition to the small portable cameras, many amateur photographers use reflex cameras and folding cameras fitted with focal plane shutters. (*See* PHOTOGRAPHY: *Apparatus*.)

Advanced amateur photographers have contributed very much to the development of photography. They were among the first to employ colour sensitive plates, to use lenses of special types, such as telephoto or extremely wide aperture lenses, to study the printing processes, and to develop the artistic use of photography. (*See* PHOTOGRAPHY: *Pictorial*.)

Professional Photography.—The earliest photographic portrait appears to be the Daguerreotype taken of his sister by J. W. Draper of New York in 1840. The sitter was made up with white powder and photographed in full sunlight, an exposure of 5 minutes being given. The Daguerreotype process came into general use for portraiture, the plates being protected by glass in small leather cases, and these represented the common form of portraiture until the wet collodion process was introduced in 1851.

The early collodion portraits consisted of a glass negative developed so that the silver deposit was white and backed with a black varnish or material so that they appeared as positives resembling Daguerreotypes. They were sold in cases exactly

resembling those used for Daguerreotypes and are often mistaken for Daguerreotypes at the present time. They are properly known as Ambrotypes.

It was not until about 1860 that Ambrotypes were supplanted by albumen prints made from collodion negatives, these being made generally in two standard sizes—the carte-de-visite and cabinet. These were preserved in albums, and the period when the family album was in common use represented that of greatest prosperity for the professional photographer. These portraits were taken in glass covered studios arranged to supply the maximum of daylight. Elaborate backgrounds were used, and studio accessories of ornate and artificial type were commonly employed. Retouching on the negative was used often to an excessive degree, this being necessitated both by the vanity of the sitter and the pronounced ultra-violet sensitiveness of the collodion plate. In considering the evolution of portrait photography, it should not be forgotten that as early as 1843 D. O. Hill in Glasgow had used the Calotype process to make portraits which in dignity and artistic quality rival any that have ever been produced.

The "album" period lasted after the introduction of the dry plate, and modern photographic portraiture may be held to have had its beginnings only about 1900. The albumen process, however, was superseded by shiny, purple, gold-toned printing-out papers.

The modern development of portraiture has been influenced largely by "home portraiture" and by the use of artificial light in the home or elsewhere. The first arose from the entry into the profession of artists, usually without studio experience, who believed that they could obtain more characteristic portraits in the everyday surroundings of patrons, and of experienced photographers who operated over a wide field without the need of maintaining an expensive studio. This type of photography has become very successful, especially in the United States.

Artificial light was introduced primarily to make the photographer independent of the vagaries of the weather. Since the use of artificial light made any large room suitable for use as a studio, and the influence of home portraiture encouraged the replacement of artificial backgrounds and accessories by the natural surroundings of a room, the studio has lost much of its artificial character.

In a reaction from the elaborate backgrounds of the '90s, many photographers employed almost perfectly plain backgrounds for portraiture, these being conspicuous in the work of Hollyer, Craig Annan, and Furley Lewis in England, of Hofmeister and Perscheid in Germany, and of MacDonald in New York.

At the present time portraits of the better class are usually supplied of large size, 6×8 in. and upwards, and in folding mounts which protect the surface of the print.

In the United States negatives are taken very largely on flat sheets of portrait film, developed in tanks in a vertical position, and printed either by contact on developed chloride papers or by enlargement on bromide or chloro-bromide papers. The use of enlargement for making portrait prints has increased greatly recently owing to the introduction of automatically focusing projection printers. In Great Britain printing is done chiefly by contact on bromide paper and on the more sensitive grades of chloro-bromide. Retouching is still used very largely in portraiture, but the increasing use of panchromatic materials will undoubtedly diminish its extent in the future.

In addition to the high grade professional portraiture discussed here, there is a very large industry in the supply of cheap portraits to the masses, especially in the large cities and the pleasure resorts. The negatives are taken by artificial light on strips of film or in a camera so arranged that several can be taken on one plate and are printed as rapidly as possible on strips of paper which are usually cut to the size of post cards or even smaller. A still cheaper grade of portrait is produced by the "ferrotype" process on dry collodion coated on black japanned metal, this being the modern representative of the Ambrotype process. Similar pictures made with wet collodion have survived from 1860 as "tintypes."

A recent introduction consists of an automatic apparatus by which on the introduction of a coin into a slot a series of photographs are taken and finished by a reversal process, a strip of positives on paper being delivered to the customer in a few minutes.

Commercial Photography.—In addition to portraiture the professional photographer has been accustomed to make miscellaneous photographs of buildings, machinery, or articles of merchandise which might be required for commercial purposes, but in the last 15 years this branch of photography has developed so greatly that it has become the work of a specialized group of "commercial photographers," and except to a small extent it is no longer carried on by portrait photographers.

The work of the commercial photographer is of the most varied character, but it may be divided into three sections according to whether the photographs are intended for use as a record, often necessary in engineering and construction work, to replace samples for the salesman to carry in soliciting orders, or for use in advertising. In the second field the photographs are often coloured by hand, a process which is almost obsolete in other branches of photography but which is rendered necessary by the absence of any cheap and satisfactory process of natural colour photography upon paper. Photographs for use in advertising may be designed either to represent the article, as in those employed for catalogue illustrations, to show the actual use of the article in the hands of the consumer and thereby to create a desire for it, or merely to attract attention. This field of commercial photography gives great scope for artistic composition and has developed very greatly of recent years.

Two characteristics of commercial photography are its use of suitably trained models, who are chosen with the greatest care, and the employment of special means for the photography of coloured objects.

Panchromatic materials and light filters were adopted by commercial photographers as soon as they were available, and a thorough understanding of their use is essential to satisfactory work at the present time. The apparatus used in commercial photography is remarkable chiefly for its adaptability and portability; it is necessary to photograph all kinds of objects in all sorts of places, and only a small portion of the work can be done in the studio.

Commercial photography is growing very rapidly, and there is little doubt that it will continue to grow for a number of years.

Applied and Scientific Photography.—Photography is used in science and industry primarily to make a record which can then be studied and measured. It can also be used to facilitate the copying of documents, etc., photographic methods having the advantage of accuracy and speed. For this work a so-called "Photostat" camera is used in which a roll of paper is employed on which the document is recorded. (*See* Plate III., fig. 2.) The result is in the form of a negative and for many purposes these negatives are satisfactory; if positives are required, the negatives are re-photographed in the same camera.

In addition to its use in libraries, and so forth, for circulating extracts from books or copies of letters and other documents, photographic recording is now used very largely for the preparation of legal records, especially in connection with real estate. For such purposes a special "ledger" paper is used coated with emulsion on both sides, so that the photographs can be bound into books in the minimum space.

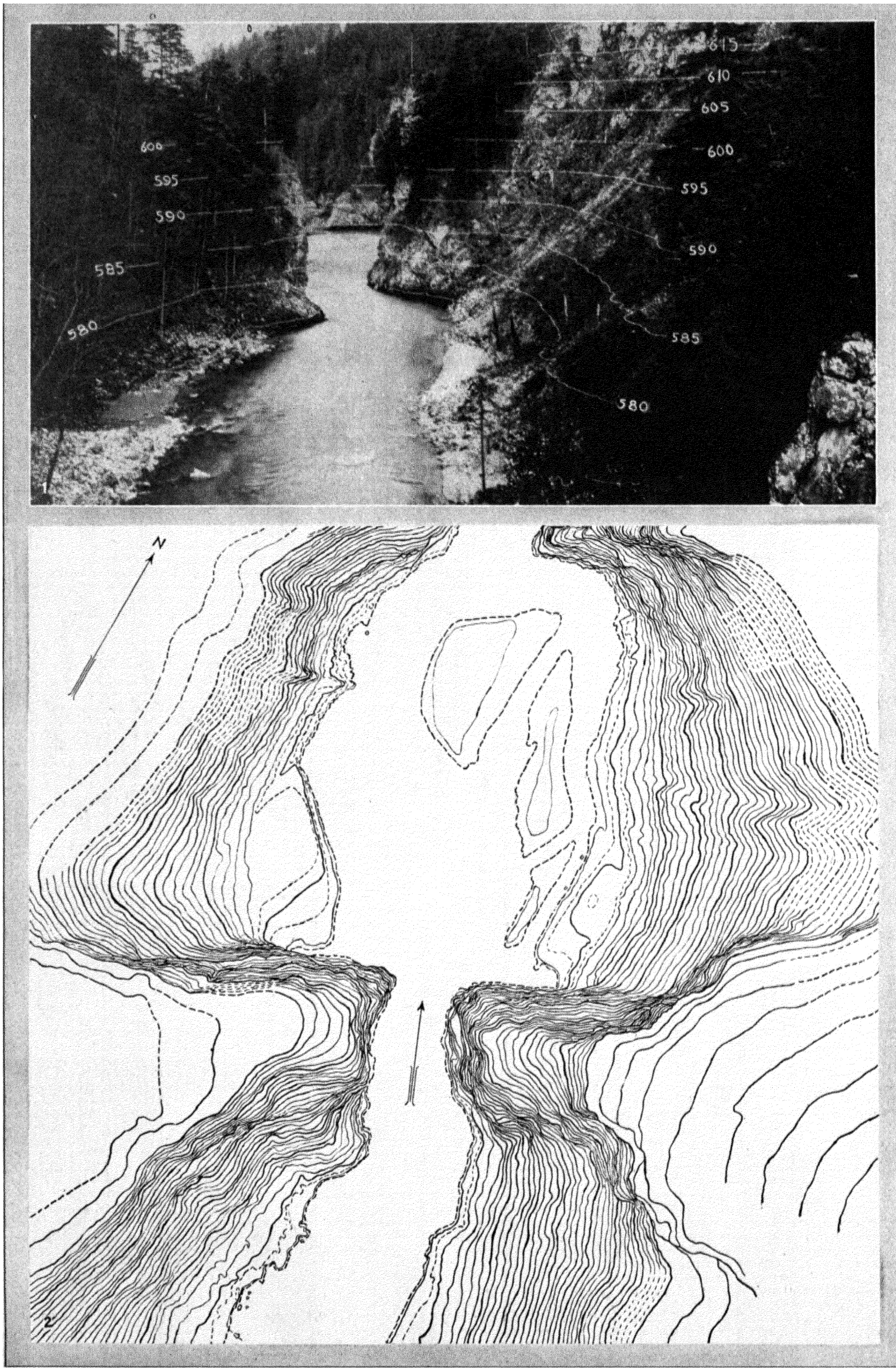
For the photography of ancient documents, T. Svedberg has made use of ultra-violet light, by means of which he has found it possible to decipher palimpsests.

Another application of photography to recording is that of the so-called "Factograph" camera. (*See* Plate III., fig. 3.) This camera includes a spool of sensitive paper on which the record can be made, a lens and lighting box being placed in front of it so that when the camera is pressed down on an object to be photographed lamps supplied by dry batteries will illuminate it and the object will be in focus on the paper. Perhaps the most important application of the Factograph camera is to the reading of telephone meters.

Another special device carrying out the same idea is that due

CAMERAS FOR SPECIAL TECHNICAL WORK

1. Hythe Gun Camera for training aviators in the use of the machine gun
2. Photostat Camera for the reproduction of documents
3. Factograph Camera for photographing meters
4. Zeiss Phototheodolite for surveying by photography
5. Autofocus Enlarger
6. Photograph of a wedge spectrum taken on plates sensitized with Dicyanine, Kryptocyanine and Neocyanine



PHOTOGRAPHY USED IN SURVEYING

One of a series of photographs taken with a phototheodolite, and a contour made from them

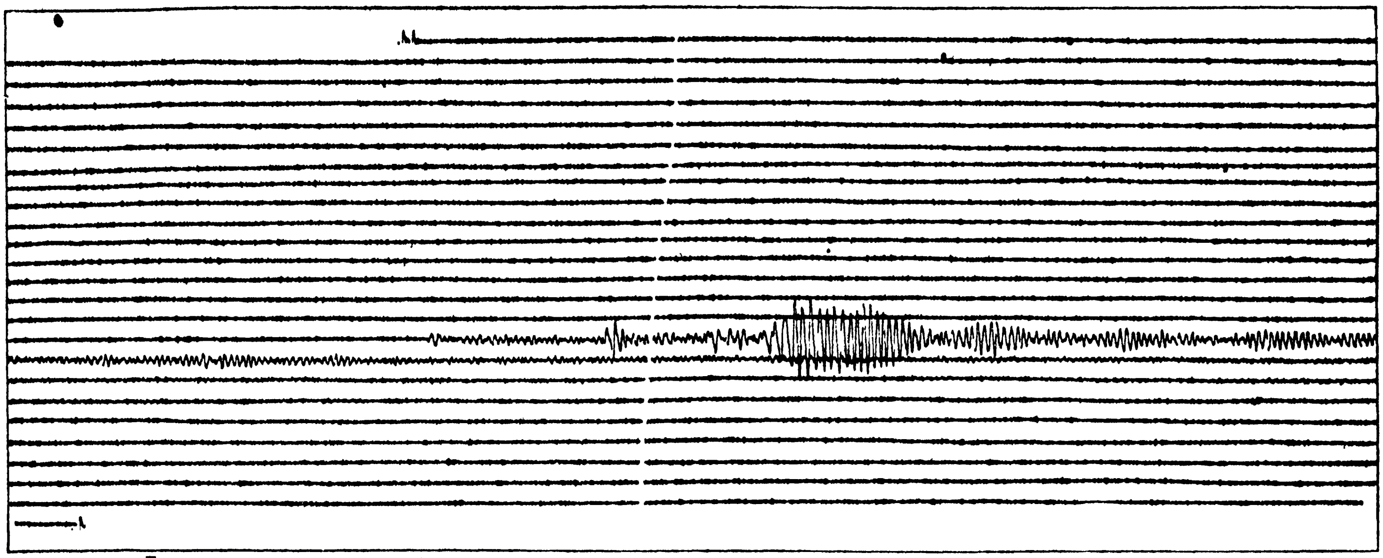


FIG. 4.—SEISMOGRAMS FROM THE U.S. COAST AND GEODETIC SURVEY MAGNETIC OBSERVATORY NEAR HONOLULU, HAWAII

to G. L. McCarthy, who has designed a camera intended to photograph upon a strip of motion picture film all the checks passing through a bank. This camera, which is known as the "Recordak," provides a permanent record which greatly diminishes the risk of fraud.

Special cameras have also been designed for photographing the inside of rifle barrels in order to study the erosion of the bore, for lowering into oil wells in order to photograph the shaft, and for use with cystoscopes to photograph the interior of the body. All these cameras involve the optical principles of the periscope (*q.v.*).

An interesting application of photography is the so-called "gun camera" designed by the Royal Air Force in 1916 and used for the training of military aviators. (*See* Plate III., fig. 1.) With this camera, which resembled in shape a machine gun, an aviator in training engaged in mock combat photographed his adversary, and on development the film showed the accuracy of his aim. In later models a time record was included, so that it was possible in a mock duel to determine which of the two "shot" the other first.

The greatest application of photography is, however, to general recording. The use of photography for recording the movement of physical instruments is mentioned as early as 1876 in Tissandier's handbook of photography. As a rule, any physical instrument can be made to record photographically. Thus, a galvanometer reflects a beam of light by means of a mirror, the movements of which are controlled by the current in the instrument. If the light is allowed to fall on a photographic material which is moving, a record will be obtained. Convenient cameras for this purpose use plates allowed to fall at uniform rates or rotating drums covered with paper or film.

A very wide application of photographic recording is found in the oscillograph, which is used for many purposes in addition to its primary one of recording the wave form of intermittent or alternating electric currents.

The electrocardiograph is an oscillograph adapted to the recording of the very weak currents produced by the heart.

The applications of photographic recording are innumerable; its use for magnetographs and seismographs should, however, be mentioned. (*See* fig. 4.) When the mirror is attached to a diaphragm, sound can be recorded and analysed. (*See* MOTION PICTURES.)

In connection with science, photography is used (1) for recording visible images; (2) for integrating radiation over long periods; (3) for detecting invisible radiation; (4) for measuring the intensity of radiation. Classes 1 and 2 covering the recording of visible images whether for a long or a short time cannot, of course, be separated and cover between them by far the most important applications of photography.

Astronomical Photography.—One of the branches of science to which photography is of the greatest importance is astronomy. At the present time visual observation in astronomy has been replaced almost entirely by photography. A photographic plate is used in the focal plane of the telescope, and the observer's work is reduced to directing the telescope towards the object to be photographed and correcting any irregularities in the driving clock, which would produce a shift in the position of the image upon the plate.

In the case of reflecting telescopes, the photographic focus is, of course, identical with the visual focus, since mirror systems do not involve chromatic aberrations, and for this reason as well as because of their lower cost, all modern telescopes of the largest size are of the reflecting type. A certain number of refractors have been made with photographic correction of their lenses, but most of the large refractors are corrected only for visual rays, and with these photography is done on green, sensitive plates through a strong yellow filter, so that the record is made by green light.

Stellar positions are now determined entirely photographically, the micrometer eyepiece no longer being used. In this connection, the astrographic chart should be mentioned. (*See* ASTRONOMY.) A notable advance made possible by photography is the accurate determination of the parallaxes of the nearer stars. The number of stars observable has been greatly extended by photographic means, the 100 in. reflector at Mount Wilson recording stars of the twenty-first magnitude; that is, about one million times fainter than the faintest stars visible to the naked eye. And it may be confidently anticipated that the projected 200 inch reflector, when completed and used photographically, will make a proportionate increase.

Spectroscopy.—In spectroscopy (*q.v.*), visual observation has also been replaced by photography. The ease, indeed, with which the ultra-violet and violet parts of the spectrum could be photographed has led perhaps to an undue amount of attention being concentrated on those regions. The photography of the longer wave-lengths of the visible spectrum became possible only after the discovery of the isocyanine and carbocyanine dyes, at the beginning of the twentieth century. Dicyanine made possible the photography of the extreme red but has now been replaced by Kryptocyanine, while a new sensitizer, Neocyanine, makes possible photography in the near infra-red up to 900 $m\mu$. (*See* Plate III. fig. 6.)

In the ultra-violet, ordinary photographic plates are satisfactory down to 230 $m\mu$, but below this the absorption of the gelatine becomes serious. V. Schumann first investigated the short wave-length region from 120 $m\mu$ to 200 $m\mu$ by means of plates prepared with a minimum of gelatine. Recently, satisfactory photographs have been made in this region on ordinary plates sensitized with fluorescent bodies, such as paraffin oil.

Photomicrography.—The application of photography to

microscopy covers a wide range. Small cameras are fitted to ordinary visual microscopes and used to make records of value chiefly for reference. In a more elaborate apparatus, a camera on a stand is swung over the vertical microscope, but for serious photomicrography, it is usual for the camera and microscope to be mounted on large stands or preferably on one rigid optical bench together with the illuminating system.

Recently, special photomicrographic apparatus has been built, in which the ordinary microscope is replaced by a part of the optical bench itself, such apparatus being particularly designed for the photomicrography of metal specimens.

For many years, the highest powers of the microscope were used only for the examination of bacteria and of test objects, such as the minute structure of diatoms, but the demands of the metallurgists and of research bacteriologists are now reaching to the utmost limit of the resolving power of the microscope.

Since resolving power is limited by the wave-length of the light used, photomicrography with ultra-violet light is now of value. It was used with remarkable results by Barnard in his study of micro-organisms connected with cancer and is also being applied to the study of the minute structure of metallic alloys. Apparatus for this purpose designed by A. Köhler was introduced by Carl Zeiss in 1914.

In the photography of stained specimens the control of the colour of the light is of great importance, and for this purpose sets of light filters have been designed by means of which stains can be photographed by light exactly complementary to that which they transmit. The maximum contrast is thus obtained.

Phototopography.—Col. Laussedat of the French army was the pioneer in the application of photography to surveying, and since photographic surveying is more suitable for mountainous countries, it is in the Alpine regions of Europe and the mountain chains of Canada that the largest areas have been surveyed photographically. Dr. Deville, late surveyor-general of the Dominion of Canada, studied the subject very exhaustively and wrote a number of books on the subject, and the Russian surveyors have also used photographic methods on a large scale, especially in their surveys of Siberia.

In order to make a photographic survey, two photographs are taken of the same area from different known positions which are plotted on the map. Lines are then drawn from the positions to each identifiable point on the map and object in the photograph until the complete survey is accomplished, this plotting being done after the manner of a plane table survey but with the advantage that the detailed plotting is done in the office and is therefore independent of the weather, the only work done in the field being the photography. The cameras used for the purpose are of rigid construction and have levelling mounts so that they can be levelled precisely. Elaborate photo-theodolites have been devised for the purpose, notably a beautiful instrument designed by Zeiss, but simpler cameras are also quite satisfactory provided that they are rigidly made. (*See* Plate III. fig. 4.) No considerable area can, of course, be mapped without a skeleton of positions determined relatively to each other with precision, and the primary triangulation is therefore made over the area to be mapped, other points then being interpolated from the photographs.

Another method of photo-surveying is by the use of the principle of stereoscopy. Two photo-theodolites are put at the opposite ends of a measured base and exposures made in which the same objects are included. From the photographs distances can be measured by the use of the stereo-comparator designed and perfected by Prof. Pulfrich of the optical research establishment of Carl Zeiss at Jena. A notable advance in this field of stereoscopic photo-surveying was made when Captain von Orel of the Austrian army developed the stereo-autograph, which is a three-dimensional pantograph which can be used in conjunction with a stereo-comparator and will plot a map directly from the photographs. Stereo-photo-topography is now the most advanced of photographic methods of survey; its accuracy is high, and it is very rapid. Its drawbacks are the high cost of the instruments, the necessity for base measurement, which is not always easy, and the considerable weight to be transported. (*See* Plate IV.)

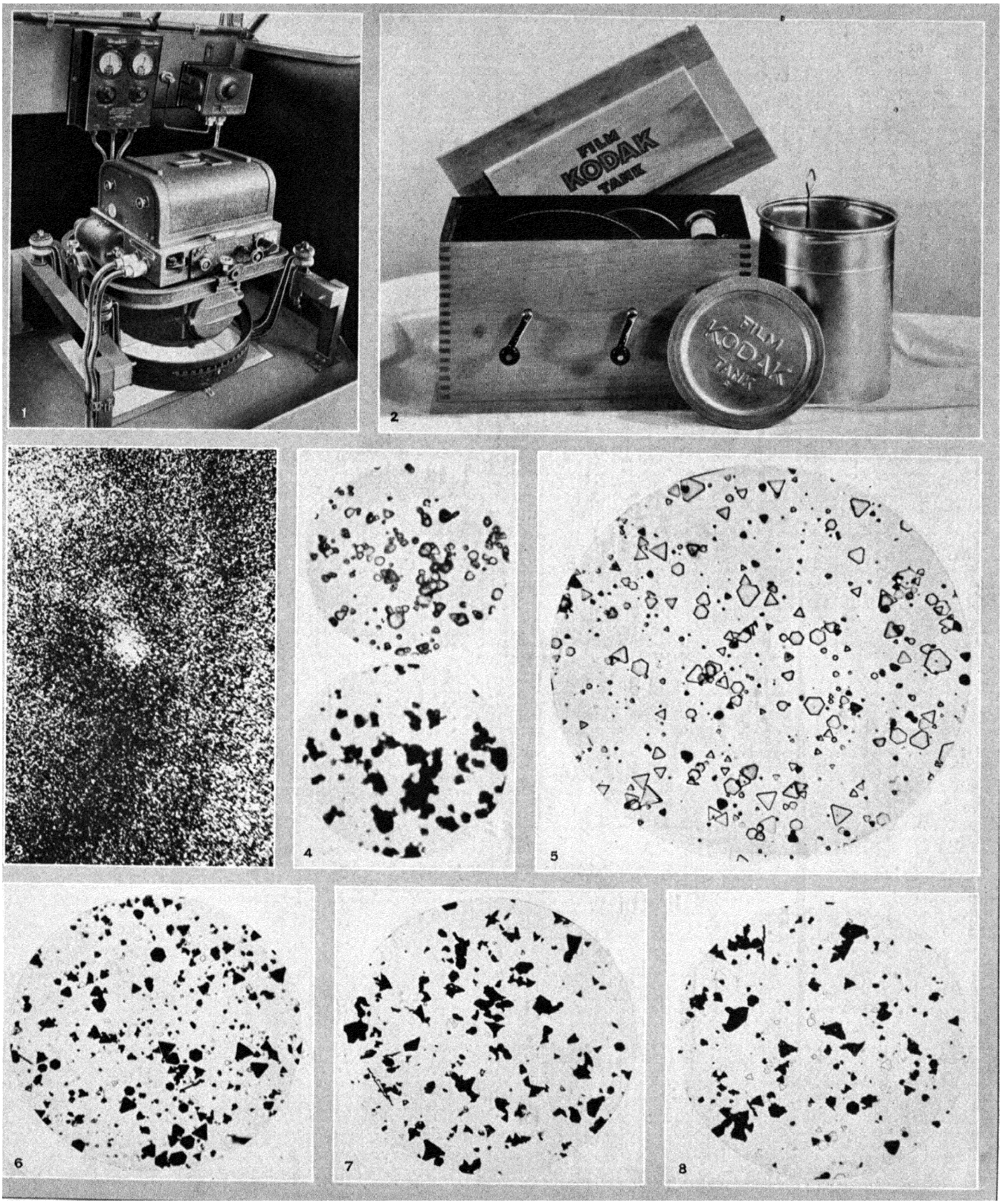
Aerial Photography.—Photography from the air is utilized for military purposes as well as for surveying. Its use during the World War was very extensive, thousands of negatives being taken every day by the armies. The first aeroplane cameras were modifications of standard cameras with usually a focal plane shutter, and the material was generally plates carried in holders and later in magazines adapted for quick changing. Hand-operated cameras using magazines were later developed and were used largely in 1916 and 1917. Later, semi-automatic plate cameras were designed in which the observer released the shutter while the mechanism operated the changing of the plates. In the last years of the war these cameras were made of very considerable size and weight, sometimes as many as 50 plates 18 cm. × 24 cm. in size being carried on a camera at one time. Towards the end of the war film cameras were developed carrying rolls of film giving 100 exposures 18×24 centimetres. The great advantage of such cameras is, of course, the light weight of the material used. In 1918 entirely automatic film cameras were made, the changing of the film and the exposure being carried out by means of a motor, either electrical or driven by the wind. (*See* Plate V. fig. 1.) Automatic film cameras are used almost exclusively in the United States while plate cameras—either automatic or hand-operated—are still employed by the European air services. But the general adoption of film cameras for aerial photography may be confidently expected, since with recent improvements their superiority is marked.

From the photographic point of view the most important phenomenon encountered when working from a great height, as in an aeroplane, is the scattering of the light by the atmosphere, an effect which is generally known as haze. Since this scattering is greater for shorter wave-lengths of light, it can be eliminated to a considerable extent by the removal of the blue light and by the use of only longer wave-lengths. In order to accomplish this, the materials used are generally sensitive to red light, and filters can be used with satisfactory results as to exposure; under such conditions great penetration through hazy atmosphere is possible. Excellent photographs have been taken from the greatest height which an aeroplane can attain.

While aerial photography is an immense aid to the military both for the detection of enemy operations and also for the preparation of maps, its application to precision surveying is subject to limitations. It is not possible to note with sufficient accuracy the height and angle of the aerial camera for a map to be made without correction for errors, and consequently aerial surveying requires the provision of bases of known position on the ground which can be included and used to scale and correct the photograph. This limits its use in surveying (*q.v.*) since such measured bases are not always available. Nevertheless there are many purposes for which aerial surveying is very well adapted. A fire survey of a city can be made with sufficient accuracy by aerial photography at less than one-tenth of the cost of a corresponding ground survey. This makes it possible to repeat the fire surveys of rapidly growing cities at much more frequent intervals than could be done otherwise. Surveys of lakes and forests can be carried out by the aeroplane rapidly and with sufficient accuracy for many different purposes. (*See* ARCHAEOLOGY; SURVEYING.)

Radiography. (*See* RADIOTHERAPY; RÖNTGEN RAYS.)—In this branch of photography very special conditions of work are involved. From its introduction in 1896, when X-rays were discovered by Röntgen, the field of radiography—almost entirely in connection with its medical application—has grown until at the present time approximately as many negatives are taken by means of X-rays as are made in portrait studies.

The earlier radiographs were made on plates of the same type as those used for portraiture; improvements were made by the introduction of large quantities of silver salt into the emulsion, while later attempts were made to load the emulsion by the addition of salts of other metals in such a way that the absorption of the X-rays would be increased and high sensitiveness obtained. There is reason to believe that these attempts were based on an incorrect understanding of the laws of the absorption of the



PHOTOGRAPHIC APPARATUS AND MATERIAL

1. Automatic military type (recording) aerial camera in the Fairchild mapping monoplane; also intervalometer, which controls the intervals between exposures
2. Roll film developing tank
3. Grain structure of an image
4. Silver-bromide grains, before and after development
5. Crystalline grains of silver bromide in an emulsion
6. Silver grains produced by development with hydroquinone
7. Silver grains produced by development with metol
8. Silver grains produced by development with diaminophenol

X-rays. A considerable advance in the technique was made when double-coated film was introduced, a special X-ray emulsion being coated on both sides of the film, so that the image was formed half on the front and half on the back. It is customary to use such films in combination with one or more, generally two, so-called intensifying screens. These intensifying screens consist of a layer containing calcium tungstate coated on a suitable support. The calcium tungstate fluoresces under the influence of the X-rays, transforming a portion of the X-rays into light which is active photographically. The general method of working, therefore, is to expose the film in a cassette; that is, a holder in which the film is pressed into contact with an intensifying screen on each side.

One of the great difficulties in obtaining radiographs of good quality, especially when photographing through portions of the body of considerable thickness, is the presence of scattered radiation or secondary X-rays produced by the scattering of the primary X-rays in the tissues. Measurements have shown that the scattered radiation generally accounts for as much as three-fourths of the entire density of a radiograph taken through the body, and since this scattered radiation does not contribute to the formation of the image, it naturally produces a great lowering of contrast and general loss of detail and quality. The best method of eliminating this is the use of what is known as the "Potter-Bucky" diaphragm, which consists of a grid formed of strips of lead foil pointing toward the source of the X-rays. This diaphragm is placed between the subject photographed and the film. In order to prevent its forming shadows, the diaphragm is moved during exposure, and under these conditions the strips of lead cut out much of the scattered radiation, which is not proceeding from the source of X-rays but is scattered in all directions, and thus enable the image to be formed to a much greater extent by the direct X-rays coming from the focal point (*See* fig 5)

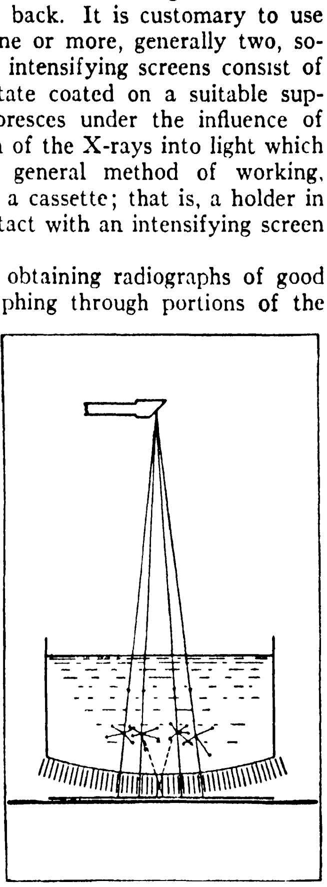


FIG. 5 —DIAGRAM SHOWING USE OF POTTER-BUCKY DIAPHRAGM

For dental work the film is supplied in special packages to be held inside the mouth usually with a backing of lead foil to stop secondary radiation and to enable the package to be moulded to the shape of the mouth Dental radiography has been extended very rapidly, and radiographs of the teeth are among the most valuable guides to the operations of the dental surgeon

(C E. K. M.)

THEORY OF PHOTOGRAPHY

The Sensitive Material.—If a photographic negative be examined under a microscope, it will be seen to consist not of a continuous homogeneous surface but of discrete, small silver grains occurring chiefly in clumps. (*See* Plate V., fig. 4.) These silver grains are derived from the structure of the original sensitive emulsion. This is shown in Plate V., fig. 3, where we see that the developed grains correspond in general form and position to the undeveloped silver bromide grains from which they were produced.

If the emulsion is removed from a sensitive film and spread out under a microscope in a thin layer, it will be seen that the silver bromide is in the form of crystals, these being usually flat crystals, generally hexagonal or triangular in shape. (*See* Plate V., fig. 5). These crystals are very small, $\frac{1}{10,000}$ in or less across; there are great numbers of them in a film, several thousand million in a square inch, and their size depends upon the way in which the emulsion was made.

If an emulsion is made by adding a solution of silver nitrate to one of bromide in the absence of gelatine, the silver bromide formed will settle out in coarse flocks, but if a small quantity of gelatine be added to the solution, the silver bromide will be precipitated in a much finer form and will remain in suspension. In making an emulsion, therefore, gelatine is added to the bromide solution, and the mixture is brought to the proper temperature, then the silver nitrate solution is added, and the whole is heated.

When first mixed, the emulsion by transmitted light appears of a deep ruby colour. As heating is continued, the colour changes, becoming finally a bluish gray. Examination of the precipitate by means of X-rays has shown that the silver halide is crystalline from the beginning, the changes in colour and absorption being due merely to an increase in the size of the crystals. As this increase in size proceeds, the emulsion gains in sensitivity, but the chief increase in sensitivity occurs after the bulk of the gelatine has been added After the emulsion is set it is cut up by squeezing it through a sieve and then washed to remove the soluble salts. It is then further ripened to obtain the sensitiveness required

The sensitiveness obtained depends to a very large extent upon the particular kind of gelatine used, some gelatine giving high sensitiveness, while other samples, apparently of the same chemical and physical properties, will not give good sensitiveness however long the heating is continued As will be shown later, this has been found to be due to a small impurity carried in the gelatine

The crystals in an emulsion vary very greatly in size, their size and distribution being controlled by the conditions under which the emulsion was precipitated and digested. The sizes of grains which occur in an emulsion are directly connected with photographic properties of that emulsion

When the grains cover a wide range of sizes, the emulsion is suitable for making negatives; it usually has a high degree of sensitiveness and a low degree of contrast When, on the other hand, the grains are small and uniform, the emulsion has a high degree of contrast and a lower sensitiveness, such emulsions being used for positive film or lantern slide making

If we suppose that the same amount of photo-chemical product (latent image) makes either a large or a small grain developable, then, other things being equal, the larger grain contributes a larger amount of silver to the image and thus gives more density for the same amount of light action than a smaller grain For this reason alone, emulsions containing large grains would be more sensitive than those containing small grains, but experiment has shown that this is not the only factor and that larger grains require less light action to become developable than small grains Further, it has been shown that the seat of this sensitiveness is concentrated in specks in the grains, and the sensitiveness of the grain depends upon the presence and the number of these sensitive specks

Being different in nature from the silver bromide itself, it was suspected that the specks were derived from the gelatine, since some gelatines give emulsions which are much more sensitive than others A material was extracted from gelatine which was identified by Dr S E Sheppard with allyl mustard oil, which in ammoniacal solution becomes allyl thiocarbamide. Allyl thiocarbamide reacts with silver bromide, and the compound of the two in alkaline solution produces silver sulphide, so that the sensitizing specks may be ascribed to the presence of minute traces of silver sulphide on the surface of the silver bromide grain The ripening process characteristic of the preparation of gelatine bromide emulsions may therefore be ascribed partly to the development of grains of larger sizes from those of small dimensions and partly to the production of the sensitizing specks of silver sulphide on the surface of the grain.

The exact action of light upon the silver halide and the nature of the product which renders the grains developable is not well understood, although recent work is tending to define the issue and to suggest that we are not far from the complete solution of the problem. The exposed silver halide, which changes to silver in development, is known in photography as the "latent image," and the problem of the nature of the latent image has been a

subject of speculation from the earliest days of the science.

The theories put forward as to the nature of the latent image may be roughly divided into chemical and physical:

The physical theories include theories of disintegration and of depolymerization as well as theories of the formation of the image without involving any assumption as to its actual nature, such as the theories of molecular strain and of photo-electric emission of electrons.

The latent image has certain definite chemical properties. It is normally stable, since it has been known to persist for many years. Its fundamental property is that of facilitating the deposition of silver in a reducing agent, such as a developer. It can be destroyed by powerful oxidizing agents, such as chromic acid or acid permanganate. These properties seem to call for the existence of some definite chemical individual, and it would appear, therefore, that the latent image must consist of some reduction product of silver bromide. Those which have been suggested are silver sub-bromide and metallic silver.

The existence of silver sub-bromide is doubtful; the formula $AgBr_2$ has been proposed but it has never been prepared in a pure state. All attempts to prepare it have resulted in mixtures or solid solutions of silver bromide with metallic silver. While the theory that silver sub-bromide was the material of the latent image was accepted for many years, it is now generally agreed that the image consists of metallic silver in very small amounts formed by the reduction of silver bromide.

When light falls upon a crystal of silver bromide, therefore, it produces a small quantity (perhaps a few hundred or a few thousand atoms) of silver, and provided this speck of silver is of sufficient size it will act as a nucleus and will render the crystal developable. The production of the silver appears to be greatly facilitated by the existence on the crystal of small specks of foreign material, presumably, from Sheppard's work, silver sulphide. The mechanism of this action is still under discussion.

Dr. Sheppard and his colleagues have developed a theory which they term the "concentration speck theory," according to which the action of the sensitizing speck is to concentrate the energy falling upon the silver bromide and enable silver to be liberated at the boundary of the speck.

F. C. Toy and A. P. H. Trivelli have suggested independently that the chief action of light is to increase the conductivity of the silver bromide, and Trivelli suggests that an electrolytic action then ensues as a result of which metallic silver is deposited in contact with the silver sulphide speck.

K. C. D. Hickman and others have postulated that a sensitizing speck must be an acceptor for the halogen set free, and many mechanisms have been suggested for the reaction.

Development.—In the process of development, the bromine is removed from the crystals of silver bromide, which are transformed into coke-like masses of metallic silver. With some developers, the silver takes the form of the silver bromide grains, while with others the grain is entirely broken up and distorted and is merely replaced by an equivalent amount of metallic silver. (*See* Plate V., figs. 6, 7, 9.) There are many chemicals which will reduce silver bromide to silver, but in order to act as a developer it is necessary that the solution should have the power of turning exposed silver bromide into metallic silver and should not be able to act on unexposed silver bromide, since if the solution acted on the unexposed as well as the exposed grains, the whole film would darken, and we should not get an image at all. Only a very limited number of substances have the power of distinguishing between exposed and unexposed grains of silver bromide, and there are therefore only a few substances which are suitable for use as developers. With the exception of ferrous oxalate and one or two other inorganic compounds which have fallen into disuse, all the developing agents used are phenolic or amino compounds derived from benzene or naphthalene.

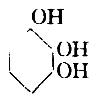
The chief developing substances are pyrogallol, or *pyro* as the photographer calls it; hydroquinone; and methylparaminophenol, which is known under trade names such as "metol" and "elon." All of these developing substances are chemically related to benzene.

It was shown by Lumière and Seyewetz and by Andresen that in order to be practically useful developers must contain at least two hydroxyl groups or two amino groups or one hydroxyl and one amino group attached to the benzene nucleus in the para or ortho position; meta compounds have no developing power.

The three developing agents chiefly used are thus hydroquinone,

which is para-dihydroxybenzene and is made by the oxidation of aniline and the reduction of the quinone formed; metol or methylparaminophenol,

which can be produced by the methylation of paraminophenol or by various other less direct reactions; and pyrogallol, trihydroxybenzene,

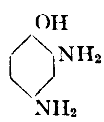


which is produced by the distillation of gallic acid.

In addition to these three, there are a large number of similar compounds which can be used as developing agents and for which advantages are sometimes claimed. In all probability, however, the three compounds given above will supply all the needs of the photographer.

Two compounds which have some wide use, however, are paraminophenol,

which is intermediate in its properties between methylparaminophenol and hydroquinone; and diaminophenol, or amidol, which is used for the development of papers.



With the exception of diaminophenol, these compounds are unable to reduce silver bromide in neutral or acid solution, and in order to make a developing solution, alkali must be added to the solution of the developing agent. In the case of the aminophenols the developing agents are used in the form of salts of the bases; thus, metol is the sulphate of paraminophenol, and it is usual to employ the chloride of paraminophenol and of diaminophenol. Enough alkali must therefore be added initially to liberate the base itself, which is usually insoluble in water, and to redissolve it as the alkaline phenolate. The most convenient alkali is sodium carbonate, and a typical developer would thus consist of pyrogallol with sodium carbonate added to it. As is well known, however, alkaline pyrogallol absorbs oxygen from the air very rapidly and would soon darken and lose its developing power. In order to make the developer keep, a small quantity of sodium sulphite is added to the solution. The sulphite protects the developer from oxidation and thereby enables it to retain its full developing power, although the sulphite, when used alone, possesses no developing power whatever.

The essential constituents of a developer, therefore, are the developing agent—pyro or hydroquinone or metol; the alkali, which is generally sodium carbonate; and the preservative, which is sodium sulphite. In addition, it is usual to add a small amount of alkaline bromide, which will act as a restrainer and prevent

the development of unexposed silver bromide, giving rise to what is known as "fog."

The various developing agents behave somewhat differently. Suppose, for instance, that we make up two developers, one with hydroquinone and the other with metol, and start to develop a film in each at the same time. In the metol developer the image will appear very quickly, and will appear all over the film at the same time, the less exposed portions which, of course, were the shadows in the picture, appearing at the same time as the highlights. On the other hand, with the hydroquinone the image will appear more slowly, and the most exposed portions, or the highlights, will appear first, so that by the time the shadows have appeared on the surface of the film the highlights will have acquired considerable density If development is stopped as soon as the whole image is out, the negative developed in metol will be very thin and grey all over, while that developed in hydroquinone will have a good deal of density in the highlights. Thus, of these two developers we may say that metol gives detail first and then slowly builds up density, while with hydroquinone the detail comes only after considerable density has been acquired It is for this reason that these two developing agents are used in combination; the hydroquinone gives the density and the metol the detail, and together they make a satisfactory developer.

These differences in the behaviour of developing agents are due to a property of the developer which is commonly known in photography as the *reduction potential*

The reaction of development may be represented by the following general equation:—

$$NaR + AgBr \rightleftharpoons Ag + NaBr + R'$$

The sodium salt of the reducing agent symbolized by R reacts with silver bromide and forms metallic silver, the oxidation product of the developing agent, which is symbolized by R′, and sodium bromide

The reaction will go in either direction according to the driving force available, and, in practice, quinone, the oxidation product of hydroquinone, together with sodium bromide, will bleach a silver negative, transforming the metallic silver into silver bromide. Now, the driving force in the direction from left to right depends upon the reduction potential of the developer. This is opposed by the reaction in the opposite direction, which is dependent on the concentration of soluble bromide and of developer oxidation product in the solution, so that if the bromide be increased, the rate of the reaction will be lowered It is thus possible to measure the reduction potential of a developer by the effect of potassium bromide on development, as was originally suggested by S E Sheppard A careful study of this was carried out by A H Nietz, who gives what are probably the most reliable data for the developers as follows —

Developer	Relative energy
Ferrous oxalate	0·3
p phenylene diamine hydrochloride (no alkali)	0·3
p-phenylene diamine hydrochloride (alkali)	0·4
Hydroquinone (standard) .	1·0
p-phenylglycine	1·6
Hydroxylamine	2·0
Toluhydroquinone	2·2
p-aminophenol (hydrochloride)	6·0
Chlorhydroquinone	7·0
Dimethyl p-aminophenol (sulphate)	10·0
Monomethyl-p-aminophenol (sulphate)	20·0
Diaminophenol	30–40

The most widely used developer for negative making is pyrogallol Owing to the fact that the pyro is changed during development into a substance having a yellow colour, some of which remains associated with the silver in the image, pyro tends to give a slightly yellowish or brownish image, which has very much greater printing power than the plain silver image. The yellowish stain is prevented from forming by sulphite, so that the more sulphite there is in a developer, the less colour the deposit will show. Pyro is, therefore, used only for the development of negatives, prints on paper or positive films in motion picture work being developed with metol and hydroquinone.

When a film is developed, it is only the grains of silver bromide which have been changed by the action of light that are affected by the developer. The grains that have not been changed are not affected.

At the beginning of development, there are a great many exposed grains ready to be developed, and then as development

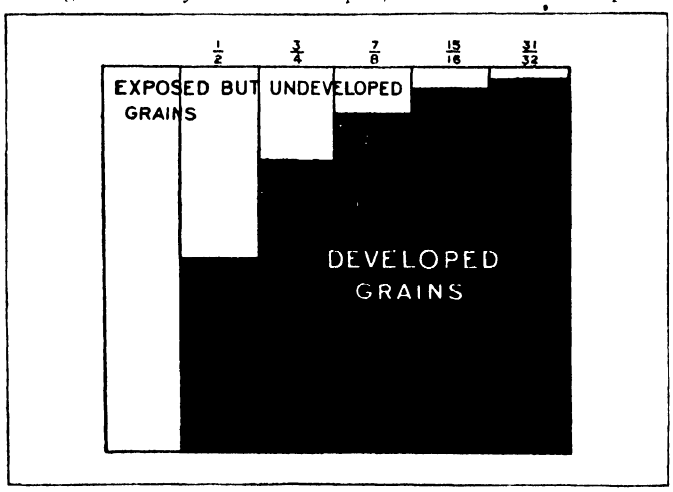


FIG 6.—DEVELOPMENT OF EXPOSED GRAINS IN A FILM WHICH IS HALF DEVELOPED IN ONE MINUTE

1st column, at beginning; 2nd, after 1 minute; 3rd, after 2 minutes; 4th, after 3 minutes; 5th, after 4 minutes; 6th, after 5 minutes

proceeds, these exposed grains are turned into grains of black silver, so that the number of developable grains decreases during development until at last there are no developable grains left, all those which can be developed have been acted upon, and the development of the image ceases The rate at which the grains develop depends upon the number of exposed but undeveloped grains left, and as the grains are developed and the number of undeveloped grains remaining becomes less, fewer and fewer grains develop in each minute, until finally it is not worth while to prolong the development in order to get any more density. (*See* fig. 6)

The growth of the image during development is referred to as a growth of density; that is to say, the density is a measure of the number of grains of silver which are produced at any given point because these grains of silver, after the film has been cleared by the fixing bath, obstruct the passage of light through the film

The density of an image is measured in units which are based on the amount of silver which will let through $\frac{1}{10}$ of the light, so that if only $\frac{1}{10}$ of the light falling on the negative gets through a certain part of it, that portion of the negative is said to have a density of 1 Similarly, when only $\frac{1}{100}$ of the light incident is transmitted, that part of the negative is said to have a density of 2 The blackest part of a negative may have a density of perhaps 2, the middle tones 1 or less, and the shadows, perhaps $\frac{1}{10}$ (*See* fig 7)

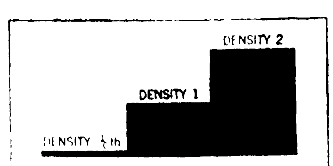


FIG 7—DENSITIES OF VARIOUS PARTS OF A NEGATIVE

1st division, shadows; 2nd, halftones; 3rd, highlights

The difference of density between the darkest portion and the lightest portion of the negative is called its *contrast*

Since the contrast depends chiefly upon the density of the highlights, it grows during development just as the density does (*See* fig. 8.) It grows rapidly at first, when there are many grains to be developed, and then more slowly until, finally, when the exposed grains are all developed, the negative will not give any more contrast however long development may be prolonged, and a continuation of development will result only in the production of fog The final contrast which can be obtained depends upon the kind of emulsion used. The fast emulsions, such as the negative emulsions, give moderate contrast, but the slow emulsions,

such as those used for copying purposes or for making lantern slides, are especially made to give great contrast when development is prolonged. (*See* fig. 9.)

The temperature coefficient of development is about 2 for 15° F, although it varies somewhat with the developer. Thus, if the development time at 65° be 4 min., it will be about 2 min. at 80° F, and about 8 min. at 50° F. Tables and curves showing

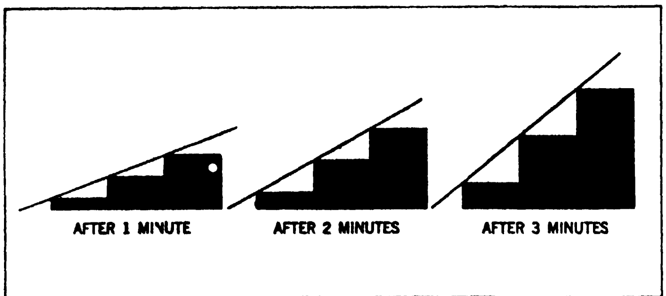


FIG. 8.—THE GROWTH OF CONTRAST DURING DEVELOPMENT

the relation between the time of development and the temperature are in common use in photography (fig. 10), which shows a curve supplied for use of X-ray workers giving the time of development for a standard developer at various temperatures.

After Processes.—After development, the undeveloped silver bromide is removed by immersion of the negative or print in what is called the "fixing" bath. There are only a few substances which will dissolve silver bromide, and the one which is universally used in modern photography is sodium thiosulphate, $Na_2S_2O_3$, which is known to photographers as hyposulphite of soda, or more usually as "hypo"—the name hyposulphite of soda being used by chemists for another substance.

Wet collodion plates were fixed by means of cyanide, which is a very active solvent for silver halides, but its poisonous nature and its tendency to attack the image has led to its disuse with gelatine plates. Sodium thiosulphate dissolves silver iodide only very slowly, and cyanide is therefore still used by photo-engravers who use the wet collodion process.

If free acid is added to a solution of thiosulphate, it is decomposed and sulphur is precipitated. This can, however, be prevented by the addition of sulphite. An acid fixing bath, therefore, is preserved, from decomposition, by sulphite which also serves to prevent the oxidation of developer carried over into it. The developer which is carried over into the fixing bath is, however, alkaline, and consequently a considerable amount of acid is required in a fixing bath which is used for any length of time, since if only a small amount is present, it will soon be neutralized by the developer carried over. For this reason the acids used in a

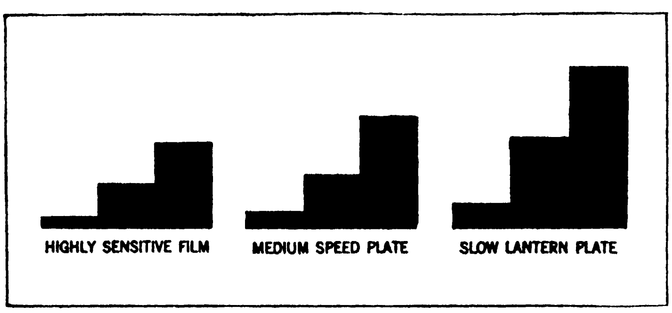


FIG. 9.—THE GREATEST CONTRAST WITH DIFFERENT EMULSIONS

fixing bath are those which are "weak," so that a large amount of acid can be added without raising the acidity of the bath to a level at which sulphur is precipitated; the best acid for the purpose is acetic acid. The commonest hardening agent is potash alum, and a typical fixing bath therefore contains 20% to 30% of its weight of hypo, about 1% of anhydrous sodium sulphite and of potassium alum, and 3% of 28% acetic acid.

The rate of fixing depends upon the concentration of the hypo and on the temperature. It increases to a maximum with about 40% hypo and decreases with stronger solutions owing to a decrease of the swelling of the gelatine and consequent difficulty of penetration.

A very important operation in photography is the washing of the negatives and prints in order to remove from them the chemicals of the fixing bath. If an exhausted fixing bath has been used, silver compounds will be present during washing, and it is most important that they should be removed by complete fixation.

The rate of washing depends largely upon the rate of diffusion of hypo out of the film into the water, provided the water in contact with the material is continuously removed. In washing,

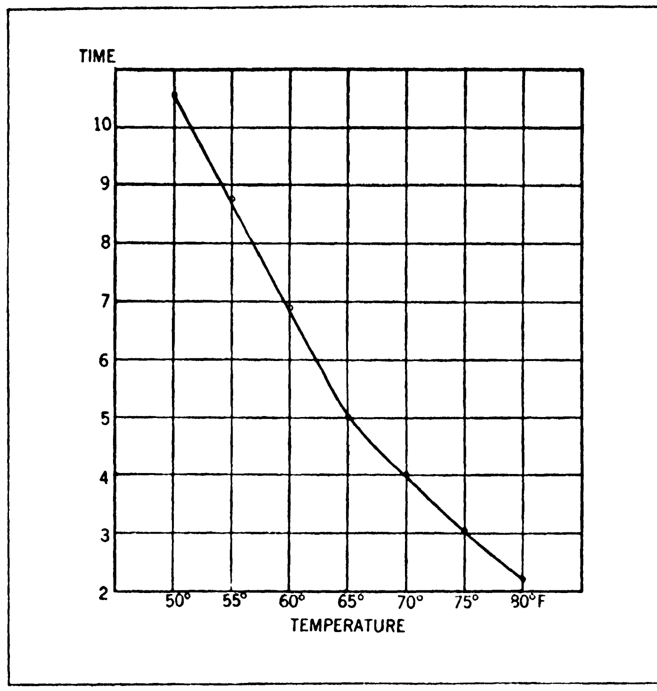


FIG. 10.—GRAPH SHOWING TIME OF DEVELOPMENT FOR X-RAY FILM AT VARIOUS TEMPERATURES

the amount of hypo remaining in the gelatine is continually halved in the same period of time as the washing proceeds. An average negative, for instance, will give up half its hypo in two minutes, so that at the end of 2 min., half the hypo will be remaining in it; after 4 min., one-quarter; after 6 min., one-eighth; after 8 min., one-sixteenth; 10 min., one-thirty-second, etc. It will be seen that in a short time the amount of hypo remaining will be infinitesimal. This, however, assumes that the negative is continually exposed to fresh water, which is the most important matter in arranging the washing of either negatives or prints.

Reduction.—When a negative is too dense, it is sometimes *reduced.* By reduction in photography is meant the removal of some silver from the image so as to produce a less intense image. Thus, in the case of an over-developed plate there will be too much density and contrast, and the negative may be reduced to lessen this. In the case of an overexposed negative there may not be an excess of contrast but the negative will be too dense all over, and in this case what is required is the removal of the excess density.

All the photographic reducers are oxidizing agents, and almost any strong oxidizing agent will act as a photographic reducer and will remove silver, but various oxidizing agents behave differently in respect to the highlights and shadows of the image. Reducing solutions can be placed in three classes:—

A. Cutting reducers
B. True scale reducers
C. Flattening reducers.

A. The cutting reducers remove an equal amount of silver from all parts of the image and consequently remove a larger proportion of the image from the shadows than from the highlights of the negative. The typical cutting reducer is that known as "Farmer's" reducer. This consists of a mixture of potassium ferricyanide and hypo, the potassium ferricyanide oxidizing the

silver to silver ferrocyanide and the hypo dissolving the latter compound.

Another cutting reducer is permanganate. The permanganates are very strong oxidizing agents, and if a solution of permanganate containing sulphuric acid is applied to a negative, it will oxidize the silver to silver sulphate, which is sufficiently soluble in water to be dissolved.

B. Proportional reducers are those which act on all parts of the negative in proportion to the amount of silver present; hence they exactly undo the action of development, since during development the density of all parts of the negative increases proportionally. A correctly exposed but over-developed negative should be reduced with a proportional reducer Unfortunately, there are no single substances which form exactly proportional reducers, but by mixing permanganate, which is a slightly cutting reducer, with persulphate, which is a flattening reducer, a proportional reducer may be obtained

C. In order to have a flattening reducer, we require one which acts very much more on the heavy deposits than on the light deposits of the negative and which will consequently reduce the highlights without affecting the detail in the shadows Only one such reducer is known, and this is ammonium persulphate Ammonium persulphate is a powerful oxidizing agent and attacks the silver of the negative, transforming it into silver sulphate, which dissolves in the solution It must be used in an acid solution and is somewhat uncertain in its behaviour, occasionally refusing to act, and always acting more rapidly in measure as the reduction progresses

Intensification.—Intensification is photographically the opposite of reduction, the object being to increase contrast This is done by the deposition of some other material on the silver image A silver image, for instance, can be very much intensified by toning it with uranium, the reddish-brown uranium ferrocyanide having very great printing strength and converting a weak negative into one having a great effective contrast for printing purposes Usually, however, intensification is performed by depositing a silver, mercury, or chromium compound upon the image, and many photographic intensifiers depend upon the use of mercury Experience has shown that mercury intensified images are not usually as stable as images produced by chromium intensification

The mercuric intensifier consists of a solution of mercuric chloride, a few drops of ammonium chloride or hydrochloric acid being added to the solution When the silver image is placed in this, it reacts with the mercuric chloride and forms a mixture of silver chloride and mercurous chloride The bleached image, which appears white, can then be treated in various ways If it is developed, for instance, both the silver chloride and the mercurous chloride will be reduced to the metal and to every part of silver there will be added an equal part of mercury Instead of using a developer, the image may be blackened with ammonia, which forms a black mercury-ammonium complex and produces a high degree of intensification

A very powerful method of intensification, used chiefly for negatives made by photo-engravers, is obtained by bleaching with mercuric chloride and blackening with silver dissolved in potassium cyanide The use of the cyanide cuts the shadows very slightly at the same time that the highlights are intensified, so that a great increase in the contrast of the negative is obtained This is usually known as the *Monckhoven* intensifier

In the case of the chromium intensifier the silver image is bleached with a solution of bichromate containing a very little hydrochloric acid, bichromate being an oxidizer of the same type as permanganate or ferricyanide The image is then re-developed and will be found to be intensified by the deposition of a chromium compound. This intensifier has found increasing favour owing to the ease and certainty of its operation and the permanency of the intensified image.

Sensitometry.—The first quantitative measurements of the result of the action of light on photographic materials were made by Sir W. de W. (then Captain) Abney in 1874. (Abney, *Phil. Mag.*, 48, pp 161–165, 1874) He constructed an instrument by which the transparency of the developed image could be measured, and by means of this he demonstrated that within limits the transparency of the deposit varied inversely as the logarithm of the exposure.

In 1890, F. Hurter and V. C. Driffield (*Jour. Soc. Chem. Industry*, vol ix, p. 455, May 7, 1890) published a classic paper entitled "Photo-Chemical Investigations and a New Method of Determination of the Sensitiveness of Photographic Plates," in which they studied systematically the relation between exposure, development, and the deposit of silver produced in the photographic process They first defined the photographic density D as being the logarithm of 1/transparency, or the logarithm of the opacity, which was defined as the inverse of the transparency.

Thus, if we have a light of intensity I incident upon a photographic deposit, and I' is transmitted,

$$T \text{ (the transparency)} = I'/I,$$
$$O \text{ (the opacity)} = I/I' = 1/T,$$
and
$$D = \text{density} = \text{logarithm of } I/I' \text{ or } -\log I'/I.$$

Hurter and Driffield showed experimentally that the density D of a given silver deposit was proportional to the mass of silver per unit area contained in the deposit This result was confirmed by J M Eder and by Sheppard and Mees, but it has recently been shown by Sheppard and Ballard that the relation is only approximate and that there may be considerable departures from true proportionality with variations of exposure and development A deposit transmitting approximately one-tenth of the incident light, that is, having a density of 1, is given by about 1/10 mg of silver per square centimetre of the film The following table of relations between density and transmission will be convenient:

Density	Transmission	Density	Transmission
0·0	1	1	1/10
·3	½	1 3	1/20
·6	¼	2	1/100
·9	⅛	3	1/1000

Basing their studies on their definition of density, Hurter and Driffield exposed photographic plates for definite times to a standard candle by means of a rotating wheel with cut-out sectors of various angles The plates were developed in a non-bromided developer, fixed, washed, dried, and the densities plotted on a

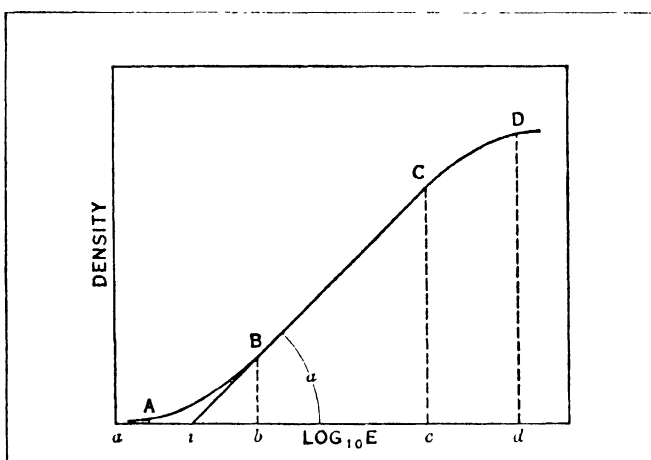


FIG 11 – CHARACTERISTIC CURVE OF AN EMULSION

chart with the logarithms of the exposure time as abscissae and densities as ordinates, as is shown in the accompanying diagram (*See* fig 11.)

This shows what is known as the characteristic curve of an emulsion There are three fairly well defined regions of the curve. Thus, from A to B we have the initial part convex to the log E axis, which may be termed the region of "underexposure"; between B and C, known as the period of "correct exposure," the increase of density is practically constant for each increase of exposure, being arithmetical for each geometric increase of

exposure; in the third region, from C to D, this arithmetical increase fails until the density becomes constant; this is the region of overexposure.

By prolongation of the straight-line portion of the curve, the log E axis is cut at a point which Hurter and Driffield termed the "inertia," which, when divided into a factor, gives the "speed" of the plate.

Hurter and Driffield adopted the factor 34 and provided that the "inertia" should be expressed in "candle-metre-seconds"; that is, seconds of exposure at one metre distance to one British standard spermaceti candle. The speeds so obtained were applicable to an exposure meter called the "Actinograph," which they designed. It is common in England to publish so-called "H. and D." speeds for photographic materials. Such speeds are not, however, always determined in accordance with the specifications of Hurter and Driffield, and the standardization of sensitometric matters has been much discussed, especially at the International Congresses of Photography held in Paris in 1925 and in London in 1928.

The spermaceti candle being quite obsolete as a standard light source, the character of the source to be adopted is of great importance, since its photographic effect will depend upon its colour. One candle power of daylight has more than ten times the photographic effect of one candle power of light from a spermaceti candle.

As most plates are exposed to daylight, it might be assumed that this should be the standard adopted; but the practical difficulties of ensuring a constant illumination of constant spectral composition are insuperable. The standard candle is notably poor in ultra-violet, violet, and blue radiations, being distinctly yellow in colour. The same objection applies to the Hefner-Alteneck amyl acetate lamp, which is used in Germany as standard. It is impossible to examine in detail all light sources suggested, but it is probable that eventually a lamp standardized to work at a colour temperature of 2,360° K with colour filters to reduce its spectral composition to sunlight will be taken as the standard. The spectral composition of the light is all important in view of the ever-increasing employment of colour-sensitive materials.

As was shown originally by Abney, an intermittent exposure does not give the same effect as a continuous exposure for the same total time. The use of the rotating sector is, therefore, undesirable, and instruments giving continuous exposures should be used.

Another important factor is the failure of the reciprocity law, $E=It$. As was first shown by Abney (*Proc. Royal Soc.*, 54, pp

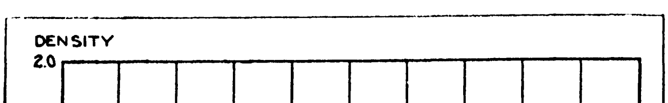


FIG. 12.—GRAPH SHOWING RELATION BETWEEN DENSITY AND INTENSITY, *It* BEING CONSTANT

143–147, 1894), the effect of an exposure is not independent of the intensity. Recent work has shown that the curve showing the relation between density and intensity, It being constant, has a maximum, this point being referred to as the "optimum" intensity. (*See* fig. 12.) The shape of the curve as well as its absolute values seems to vary with the type of the emulsion and also with the wave-length of the light that is used. The work of L. A. Jones and V. C. Hall has shown the great importance of the reciprocity law in sensitometric work. It would therefore appear desirable that exposures in sensitometric instruments should not only be continuous but of the intensity level likely to be used in practice.

The original photometer with two light sources used by Hurter and Driffield has been superseded by polarization instruments for measuring the densities, and these in turn appear likely to be superseded by physical photometers, such as those employing

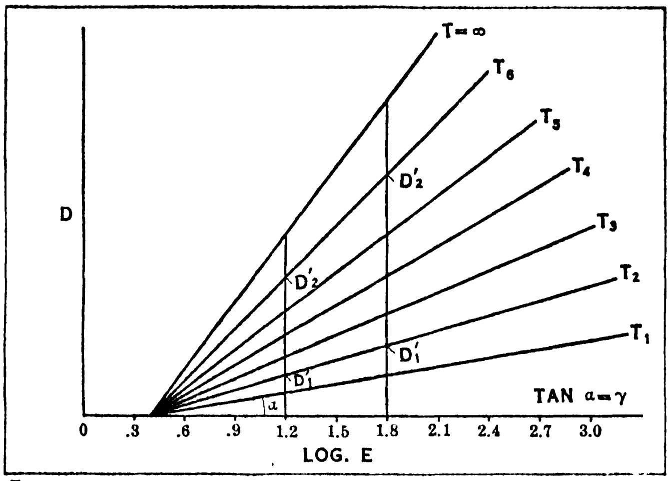


FIG. 13 —CHANGE OF DENSITY AND GAMMA WITH TIME OF DEVELOPMENT

photo-electric cells. The density obtained depends on whether it is read in contact with a diffusing screen, such as opal glass, or whether it is observed by parallel light from a collimator. With the latter, as was pointed out by Abney, Chapman Jones, and A. Callier, much of the incident light is scattered, so that the density has a higher value than when measured by completely diffused light. The ratio between $\frac{\text{density of parallel light}}{\text{density of diffused light}}$ was termed Q by Callier; it varied in amount from approximately unity to values as high as 1·6. The value of Q for average negatives is about 1·4.

Recently graduated wedges of neutral tint have been used very largely in sensitometry both for exposing and for the measurement of densities.

A point of considerable importance in speed determination is that of the fog inherent in the emulsion and developed without light action. Hurter and Driffield assumed that this was constant throughout all densities, or, in other words, through all exposure periods; but such is not the case, there being actually more fog in the underexposure period than in the more exposed parts, because there is less silver bromide available and also more bromide set free here than in the less exposed parts.

Returning to fig. 11, it will be observed that the tangent of the angle at which the straight line meets the exposure axis is marked a. This angle is of great importance in photography, since it defines the contrast of the image. The tangent of the angle, that is, the slope of the straight line, was termed γ by Hurter and Driffield and was called the "development" factor, since its value depends upon the time of development. During development, the value of γ increases, the increase tending to reach a limiting term, gamma infinity ($\gamma\infty$), which measures the extreme contrast of which a plate is capable. Thus, if we develop for different times plates which have been given a series of exposures increasing in geometrical proportion, measure the densities, and plot the resulting curves, we shall get the result shown in fig. 13, in which are shown curves corresponding to development times of 1 min., 2 min., 4 min, 5 min., and 6 min., while $T\infty$ corresponds to the maximum development that can be given before the contrast diminishes owing to fog.

If now we plot γ or density as a function of time, we get a curve of the type shown in fig. 14. It will be seen that the value of γ increases rapidly at first and then more slowly, finally reaching a limit $\gamma\infty$. This is an exponential curve, the rate of development

being proportional to the amount of exposed halide remaining to be developed, so that the reaction is identical in form with that of a chemical reaction of the first order. The velocity of the reaction of development depends therefore upon the value of $\gamma\infty$ which is a property chiefly of the sensitive material although also, to a minor extent, of the developing solution, and of K, the velocity constant of development, which is dependent upon the composition and temperature of the developer.

When bromide is present in a developer, the straight-line portions of the characteristic curve when produced do not meet upon

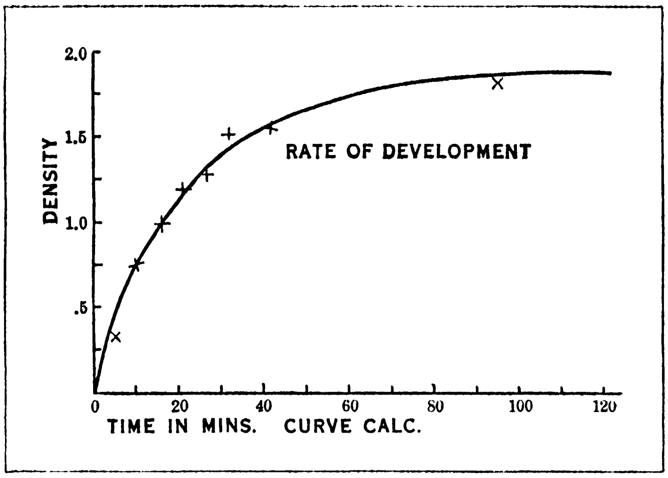


FIG. 14.—γT CURVE, SHOWING GROWTH OF γ WITH INCREASING TIME OF DEVELOPMENT

the exposure axis but at a point somewhat below it, the effect of bromide being equivalent to a constant depression of density in the straight line portion of the curve. (*See* fig. 15.)

The photographic characteristics of printing papers can be measured by a procedure similar to that used for negative materials, but in this case it is not the mass of reduced silver which is of chief importance but its relative reflecting power. The reflection density is thus the logarithm of the reciprocal of the reflecting power ($D = \log_{10} 1/R$), the reflecting power being measured with illumination at 45° to the plane of the paper. The characteristic curves obtained with different times of development are shown in fig. 16, and it will be seen that the effect of increase in time of development is to produce a regression of the inertia without change in γ except in the very earliest stages, where the curves are usually of a distorted form. The following constants may be derived:—

Constant	Symbol	Significance
(*a*) Maximum (reflection density) .	Dmax	Highest attainable density.
(*b*) Contrast element (reflection density) . .	$\frac{dD}{d\log I}$	Differential.
(*c*) Gamma element (reflection density) .	γr	Value of (*b*) for straight-line portion, or at inflexion-point.
(*d*) Latitude element (reflection density) . .	L	Range of intensities reproduced on straight-line portion.
(*e*) Rendering power (reflection density) . .	R	$\frac{10L}{S}$
(*f*) Total scale (reflection density) . .	S	Range of intensities reproducible by density differences.
(*g*) Standard exposure (reflection density) . .	Es	The exposure in m.c.s. necessary to print through a negative density of 2·o.

Tone Reproduction.—When a photograph of a natural object is made, the form can be represented only by differences in brightness. The accuracy with which the form is represented depends upon the precision with which the tones of the original subject are reproduced, and this question, generally known as the *theory of tone reproduction,* is fundamental to every photographic application.

Psychologically, it is the apparent brightness which is of importance, but this can conveniently be treated as the physical brightness modified and interpreted by the eye and brain, and since it can be shown that the apparent brightness is proportional

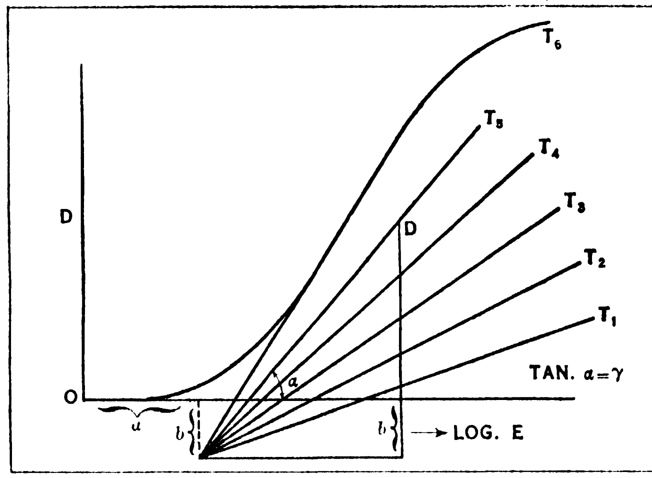


FIG. 15.—BROMIDE DEPRESSION CURVE. BROMIDE IN THE DEVELOPER CAUSES A DEPRESSION OF THE CONVERGENCE POINT

to the physical brightness throughout a wide range, it is generally sufficient for tone reproduction in photography to deal with the physical tones in the original and the reproduction.

The differences in brightness which occur in nature may be produced by differences either in the reflecting power of the different portions of the subject or by differences in the illumination. Since in natural scenes both the reflecting power and the illumination vary, some parts of a landscape consisting of clouds in sunlight and others of dark rocks in the shade, the range of contrast is often very considerable. For photographic purposes a scale or contrast of 1 to 4, in which the brightest thing is only four times as bright as the darkest, is low, and such a subject would be called flat; a contrast of 1 to 10 is a medium soft contrast; 1 to

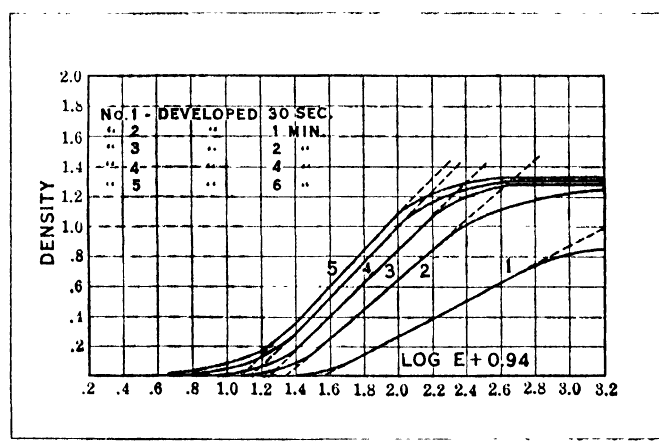


FIG. 16.—CHARACTERISTIC CURVE OF PAPERS WITH INCREASING TIMES OF DEVELOPMENT. INCREASING TIME OF DEVELOPMENT PRODUCES REGRESSION OF INERTIA WITHOUT AFFECTING γ EXCEPT DURING INDUCTION PERIOD

20, a strong contrast; 1 to 40, very strong; and 1 to 100, an extreme degree of contrast. All these degrees of contrast occur in subjects such as landscapes, street, and seashore scenes.

When a photograph is made, the operation is done in two separate steps. A negative is first made, in which all the tones of the original are inverted, the brightest part of the subject being represented by the deposit of silver in the negative which lets through the least amount of light, and the darker parts represented by the transparent areas; this negative is then printed upon a sensitive paper to form a print in which the scale of tones is again reversed.

In order to study the relation of the tones of the print to those of the original subject, the changes of those tones must be followed through both steps. In the making of the negative, the reproduction of tone will depend upon the characteristic curve of the photographic material shown in fig. 11.

If the exposure is so arranged that all the tones of the original subject fall on the straight-line portion of this curve, the inverse reproduction in the negative will be proportional, and if, in addition to this, development is so arranged that the negative has a γ, that is, slope of the straight line, of unity, then the reproduction will be correct. In the print it is necessary that γ should also be unity or, if the γ of the printing material is not unity, it is necessary that the γ of the negative should be modified suitably, so that γ_{neg} multiplied by $\gamma_{pos}=1$.

As is seen by reference to fig. 16, the straight-line portion of a paper curve is usually short, and it is necessary, moreover, in printing to utilize at least the underexposed portion of the paper curve. In making a paper print, therefore, the tone values are always distorted to some extent, especially those in the highlights corresponding to the underexposed portion of the paper curve, only the portion of the picture falling on the straight-line portion of the characteristic curve of the paper being correctly rendered.

The computation of the tone reproduction given in any photographic operation is of great importance, especially in the applications of photography, such as processes of colour photography or of the reproduction of sound; and for the methods which are used, the papers by F. F. Renwick and L. A. Jones should be consulted.

Resolving Power.—The resolving power of photographic materials may be defined as the closeness of two adjacent images which can be just distinguished. It is limited primarily by what is termed the irradiation or spreading of the image due to diffusion of the light in the film. This spreading of the image has been investigated by astronomers and used as a basis for a method of stellar photometry. (*See* PHOTOMETRY, CELESTIAL and PHOTOGRAPHY, CELESTIAL.)

In addition to the irradiation factor, the resolving power depends upon the development factor attainable in the material. The sharpness of an image, in fact, is theoretically equal to the development factor divided by the turbidity factor. Both of these factors are functions of the wavelength of the light used in exposure, so that the resolving power is naturally dependent upon the colour of the light. In addition to these two factors, a psychological factor enters into the resolution of the image.

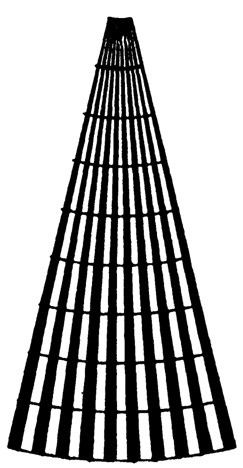


FIG. 17.—FAN TEST OBJECT, USED FOR MEASURING THE RESOLVING POWER OF PHOTOGRAPHIC MATERIALS

The practical resolving power of photographic materials can be measured by photographing (*see* fig. 17) and measuring the extent to which the lines are resolved.

Photographic images on development show with low power magnification, as used in projection and enlarging, a granulation which is objectionable in such operations. L. A. Jones and N. Deisch have shown that it may be measured and numerically expressed on the assumption that the graininess is directly proportional to the distance at which it becomes just visually imperceptible, this being compared with the distance at which a structure of known period, *e.g.*, a fine cross-line screen, just disappears. Suppose a screen of 2,000 lines to the inch to be equivalent in this way to a given granularity of the developed image; the latter may be said to have a graininess of 2,000.

The Photography of Coloured Objects.—Since photography makes a black and white reproduction of the tones of natural objects, all of which are to some extent coloured, the way in which different colours are reproduced in photography is of considerable importance. The earlier photographic materials were sensitive only to violet and ultra-violet light, and if an object containing blues, greens, and reds was photographed, the greens and reds were rendered dark while the blues were rendered much lighter than they appeared to the eye.

Following Vogel's discovery of the sensitizing power of dyes, this inaccuracy in rendering was to some extent mitigated by the introduction of so-called "orthochromatic" materials which, however, were sensitive only to the yellow-green in addition to their normal blue-violet and ultra-violet sensitiveness and were therefore unable to render the full scale of colours as seen by the eye.

After the production of the isocyanine and carbocyanine sensitizers, *panchromatic* plates were introduced, sensitive to the whole visible spectrum. These plates still retain the high sensitiveness to blue, violet, and ultra-violet characteristic of photographic materials generally, but by the use of light filters (*q.v.*) with them, it is possible to obtain an *orthochromatic* rendering; that is, one in which the reproduction of the different colours follows very closely their relative brightness as they appear to the eye. This is accomplished by the use of a yellow filter which absorbs all of the ultra-violet and most of the blue-violet, reducing the effective sensitivity of the material approximately to that of the eye.

By the use of yellow filters, therefore, and panchromatic plates and films, approximately correct colour rendering is now used very largely in practical photography. Sometimes, however, subjects have to be photographed which are visible to the eye by virtue of their colour contrast. Suppose we have two objects, one contiguous to the other and separated purely by their colour contrast, such as, for instance, a yellow straw stack against a deep blue sky. In this case, orthochromatic rendering would produce a photograph in which both would have the same intensity, and they would be indistinguishable. It is necessary in this case to use a colour filter which will introduce a certain amount of incorrect rendering in order to reproduce the colour contrast. This filter may, for instance, be a red filter, in which case the straw stack will appear brighter than the sky or, it may be a blue filter, in which the sky will appear brighter than the stack. The choice of such filters is an important task for the skilled photographer. Contrast filters are used very largely in photography for special purposes. They are of great value in photomicrography and are used in commercial photography to a large extent. The deepest possible filter is also used in aerial photography in order to take advantage of the power of the longer wave-lengths to penetrate haze. (C. E. K. M.)

PHOTOGRAPHIC MANUFACTURE

The manufacture of photographic sensitive materials is a very specialised industry. Approximately 40,000 people are employed in the whole photographic industry throughout the world, about 20,000 being engaged in the manufacture of materials sensitive to light, with which this section deals, and the remainder in the manufacture of cameras and in the wholesale distribution of the products to the retailer.

With the introduction of the gelatine dry plate, the preparation of materials by photographers for themselves diminished very rapidly, and the manufacture of ready-prepared material took its place. The first dry plates appear to have been placed upon the English market in 1877. In 1880 the manufacture of gelatine dry plates was general in England and was commencing in Belgium, Germany, France, and the United States.

Until 1900 the photographic industry was usually carried on in small factories under the direct personal control of the founder. At the present time, however, photographic manufacture is organised chiefly in modern factories manufacturing on a large scale, and using specially designed machinery at every step of the process. In the largest of these factories, the output of motion-picture film alone exceeds 150,000 miles yearly. Over 5,000,000 lb. of cotton are used each year for the manufacture of film, and over three tons of pure silver bullion are used each week. The total power required exceeds 20,000 h.p., and the consumption of coal is over 500 tons a day.

The process of manufacture may be divided into three distinct

sections: (1) The preparation of the base; (2) the preparation of the emulsion; (3) the coating of the emulsion on the base and the cutting and packing of the material so prepared.

Preparation of the Base. *Glass Plates.*—Photographic glass is the specially selected, best quality of thin sheet glass made in a factory which prepares sheet glass for all purposes. Even under the best conditions only about a quarter of the sheets made are fit for photographic use, the remainder being used for glazing. Photographic glass is made very largely in Belgium in the factories near Charleroi, and in England at St Helens. A considerable amount is also made in the United States. The glass is supplied cut to sizes which are multiples of those used by photographers. The glass arrives packed in straw in boxes holding usually about two gross sheets, and after unpacking and preliminary inspection, is cleaned by an automatic machine into which it is fed. The glass plate is received between rollers and passes through a strong solution of soda between revolving brushes which remove the dirt from the surface, and at the end of the machine is coated with a substratum, usually a weak solution of gelatine containing chrome alum, by means of which the emulsion is made to adhere to the glass. The glass is then dried in a heated oven, examined for defects, and if passed is packed in a tray and transferred to the coating room

Film Base.—In the manufacture of film base the first step is the preparation of cotton linters for nitrating, the treatment consisting of cleansing the linters very thoroughly and drying them. They are then nitrated in centrifugal machines, and when they have absorbed the necessary amount of nitrogen, 12 to 13%, the resulting nitro-cotton is soused in water and the washing commenced. This washing is a long process, and is continued until the material is entirely free from absorbed acid, after which it is dehydrated, the water being then displaced by alcohol The dehydrated nitro-cotton is then dissolved in tumbling barrels or mixers in suitable solvents, those commonly employed being acetone and methyl alcohol, and at the same time the so-called softeners, such as camphor, are added, these resulting in a flexible film The viscous nitro-cotton solution, which appears rather like honey, is known in the United States as dope. This is now spread out into a thin film by coating it on a travelling surface. In the United States the coating is generally done on large wheels about four feet across and about fifteen feet in diameter which rotate slowly about their axes so that by the time one rotation is completed the solvents have been evaporated sufficiently to set the film, which can be stripped off the wheel, and dried further by passing over drums. The operation is thus continuous, the film base, as it is called, being prepared in rolls of about 2,000 feet In Europe it is customary to coat a film about 24 inches wide upon a metallic belt from which after one rotation the film can be stripped in the same way as from a drum The surfaces of these belts and drums must necessarily be prepared very carefully, the wheels being usually made with a highly polished nickel surface, while the makers of the belt machines recommend that they be coated with gelatine. The film has a high polish on both surfaces and may be used at once or stored or seasoned until required. Before coating with emulsion, one side is treated with a substratum, which is really an etching solution that slightly roughens it, and gives a tooth that holds the emulsion firmly. For camera film, the back is coated with a non-curling coat of hardened gelatine, which, imposing an expansion strain on this side, equalizes that of the emulsion on the other. Camera or roll film base is about 3½ thousandths of an inch thick; motion picture film, about 5½ thousandths; and cut film, such as portrait and X-ray, which are used flat, about 7½ thousandths. Still thicker cut films are sometimes used, about 10 thousandths, but the celluloid for these is cast into blocks and then sliced, the knife marks being removed by heat polishing.

Since cellulose nitrate is highly inflammable, itself supplying the greater part of the oxygen which it requires for combustion, much work has been done on the preparation of film which is not inflammable. The most promising substance for this purpose is cellulose acetate, prepared by treating hydrated cellulose with acetic acid and acetic anhydride in the presence of a suitable catalyst. Acetate film burns with about as much difficulty as thick paper, and should it catch fire it is very easy to extinguish. This acetate base is used under all conditions where proper precautions against fire cannot be taken, as where films are used in homes or schools. Sixteen millimetre film for amateur cinematography is made only on acetate base.

Photographic paper base is generally made by mills which specialise in its manufacture, but in the United States the bulk of the photographic paper base is made in the factory where the rest of the production of photographic paper is carried on. The paper is prepared very largely from rag stock, although refined cellulose from wood is sometimes added. After inspection the raw rag stock is washed and digested and is then treated in the beater until it will make a homogeneous, strong sheet Great care is necessary to exclude traces of impurities and especially of metals such as copper and iron from the paper stock The composition differs with the purpose for which the paper is used The finest kinds are prepared from linen rags, which are bleached with gaseous chlorine or hypochlorites, any excess being removed by treatment with sulphites or thiosulphates which are then washed out. Any residual trace of colour is neutralized by the careful addition of a complementary colour, such as indanthrene blue, or if a chamois or toned base is desired the bleaching may be omitted or indanthrene yellow added A resinous soap is usually incorporated with the fibres and precipitated with alum, and the paper may be later subjected to a sizing with gelatine Throughout all its treatment great care must be exercised to avoid the occurrence of metallic particles, which would act prejudicially on the sensitive emulsion. The paper is generally cast about 41 in. in width and from 500 to 1,000 yd in length It is calendered either to give it a closer texture or higher surface or to impart some special linen or fabric-simulating finish.

The paper is usually given a coating of baryta before it receives the photographic emulsion. In this process a suspension of baryta (barium sulphate) in gelatine is coated over the surface of the paper, several coatings being sometimes applied, and not infrequently the paper is calendered after baryta coating in order to get a perfectly smooth glossy surface Baryta-coated paper is transferred to the emulsion coating-room in rolls of about 2,000 feet.

Emulsions.—Emulsions are of two general types: washed and unwashed Emulsions to be coated on glass or film are always washed In the first case the precipitation of the silver salts is effected by adding a solution (about 10% in strength) of silver nitrate to a small quantity of gelatine dissolved in a solution of the halide salts which, in the case of negative emulsions, are usually potassium bromide containing a small proportion of potassium iodide. When precipitation is complete, the emulsion is digested in order to produce an increase of sensitiveness, and the bulk of the gelatine is added so that when cooled it will set to a jelly. Instead of increasing the sensitiveness of the emulsion by holding it at a high temperature for some time, it may be digested at a lower temperature in the presence of ammonia, and not infrequently the silver nitrate is precipitated with ammonia and then re-dissolved in excess before the precipitation of the halide is commenced. The set emulsion is cut up into small portions and is washed in running water in order to remove any excess of halide salts and also the soluble nitrate produced in the reaction. After washing it is given a final digestion and is ready for coating upon the base.

The emulsions used for printing papers are of three general types. bromide papers, which are made with a washed emulsion essentially identical with that used for coating upon glass and film for use in making lantern slides and positive motion pictures; unwashed chloride emulsions in which the emulsion is coated on the paper in the form in which it is mixed without any removal of the soluble salts by washing; and emulsions also made without washing but in which the silver salts are a mixture of chloride and citrate, and in which there is free silver nitrate present. These papers darken visibly when exposed to light and thus give a printed-out image which is then toned and fixed.

Coating and Packing.—Dry plates are coated by passing the

prepared glass sheets on a travelling belt under some device through which the emulsion is allowed to spread out over the surface of the glass. This may take the form, for instance, of a trough with a slit in the bottom or of a stepped weir down which the emulsion flows, reaching the plate by means of a flap which rests lightly on the surface of the plate. The coated glass travels forward on to a belt or rollers which are kept wet with ice-cold water, and there the emulsion sets. At the other end of the machine the plates are taken off, placed on the racks, and dried slowly and evenly. They are then cut to the requisite sizes by means of machines using diamonds and are packed in boxes of one dozen for supply to the market.

The most usual size of plates are $2\frac{1}{2}''\times3\frac{1}{2}''$, $4''\times5''$, $5''\times7''$, $8''\times10''$, $11''\times14''$, and $14''\times17''$, in the United States; $4\frac{1}{4}''\times3\frac{1}{4}''$ ("quarter plate"), $6\frac{1}{2}''\times4\frac{3}{4}''$ ("half plate"), $8\frac{1}{2}''\times6\frac{1}{2}''$ ("whole plate"), $12''\times10''$, and $15''\times12''$, in Great Britain (where the larger dimension is given first for inch sizes, the contrary practice being used in the United States); and 6×9 cm, 9×12 cm., 10×15 cm, 13×18 cm., 18×24 cm, 24×30 cm, and 30×40 cm., in countries using the metric system

For coating both film and paper the same type of machine may be used (*See* Plate V., fig. 2) The stock roll of the base is carried on a mandrel, freely revolving, and is led over and under rollers that keep it taut, to the coating trough into which the fluid emulsion is fed continuously and automatically at the rate at which the base takes it up The base passes under a roller, dipping into the emulsion, and it hugs this so tightly that no emulsion finds its way on to the back. The temperature and viscosity of the emulsion are kept constant, and the thickness of the coat is determined by the rate of travel of the base through the emulsion—the faster the travel, the thicker the coat, and vice versa The coated base then passes up a vertical run-up, which allows the film of emulsion to even itself out, or it passes over a chill roll and then through a refrigerating chamber, where cold air is blown on to the emulsion surface and thoroughly sets it. Leaving this chamber, the film is automatically looped into festoons varying from five to twenty feet in length and travels slowly through the drying tunnels. To these is supplied heated air which has been thoroughly washed with water sprays to remove all dust and deleterious gases The humidity and temperature of the air used for drying is adjusted very carefully and it is usually recirculated through the system, being driven in at one end of the drying room and exhausted at the other, and then reconditioned before entering the drying chamber again. Frequently the festooning apparatus makes a right-angled turn so that the prepared material is reeled up side by side with the coating machine; the operations of coating, drying, and reeling are continuous and automatic

Motion picture film is slit from the original roll to the exact width required, 35 mm ($1\frac{3}{8}$ in.) in the case of standard film, and before packing is perforated on the edges in accordance with the standard gauge used for the cameras and projection machines. The maker's name and private mark are light impressed on the margins, becoming visible only on subsequent development, while on negative film every foot is numbered in order to aid in the identification of the scenes. Negative film is supplied not only coated with ordinary emulsion, but also panchromatized, which gives far better rendering of all colours and permits considerable shortening of exposures, especially under the artificial illuminants, such as the mazda and other lighting systems now so much in vogue in the studios. The speed of the emulsion is very high and a special hypersensitised film is obtainable, which places in the hands of an operator the possibility of photographing poorly lighted subjects. Positive film is supplied either on nitrate base, that used most generally, or on acetate safety base, which is slow-burning. For amateur motion picture photography film is supplied 16 mm. in width on slow-burning acetate base only and is supplied in lengths of 100 ft packed with paper leaders at the ends and on a special protective spool so that the cameras can be loaded in daylight. This film is made to be reversed directly to a positive so that the same film that is used in the camera is employed for projection.

to the desired lengths, and spooled on wooden cores with light-excluding metal flanges. A light-protecting apron of black paper is wound with the film, so that the cartridge may be inserted in the camera in daylight; or red paper with an inset of carbon paper is used instead of the black, so that records may be made on the film after exposure. Film is also cut into sheets, to each sheet being attached a numbered tab, and the sheets are assembled into a film-pack, which is usable in any ordinary plate camera After each exposure, the tab is pulled, which draws the exposed film to the back of the pack, and the tab is torn off and thrown away.

For X-ray work, the film is coated on both sides with emulsion; this gives greater contrast and better rendering of shadow detail, for the rays can penetrate both emulsion layers with but little loss of action. The film is used in holders like those for plates, except for dental work Films for this purpose are packed in special flexible, light-tight holders ready for use

Paper is cut from the roll into sheets, and the sheets stacked on the top of each other are cut by means of guillotines to the size required for the market, each sheet being inspected for defects before packing. (G Ea.)

COLOUR PHOTOGRAPHY

In 1810 J T Seebeck obtained a coloured effect by exposing to the spectrum silver chloride which had been darkened by exposure to light This experiment has often been repeated, but as the colours obtained cannot be fixed, it has no practical value

In 1891 G. Lippmann of Paris produced the first picture by interference heliochromy, although the possibility of doing so had been pointed out by W. Zenker in 1868, Lord Rayleigh in 1887 and O Wiener in 1890 In this method a perfectly transparent grainless emulsion is coated on plate glass and exposed through the back with the sensitive surface in contact with a reflecting surface, such as mercury. The incident light is reflected back on itself, giving rise to interference, thus setting up stationary or standing waves in the emulsion with their crests or loops exactly half a wave-length apart. These standing waves produce exposure effects so that on development, the silver is deposited in laminae half a wave-length apart and reflects light of double the separation, giving bright colours Unfortunately the plates are very insensitive, and as the results can be viewed only in the hand or by projection with a special outfit, the method is not in general use

Tricolour Photography.—The methods which are used at the present time for reproducing objects in colours by photography are dependent upon the suggestion made by Clerk Maxwell in 1861 Any colour may be reproduced by a mixture of the three primary colours, red, green, and violet. In order to reproduce any colour, therefore, we may analyze the different proportions of these three primary colours in it and then synthesize the colour by superimposing the three primaries upon a screen in projection To illustrate this, Maxwell took three photographs of a coloured ribbon. one through a red solution, one through a green solution, and a third through a blue solution From these three negatives, three transparencies were made, each of which was projected by means of the coloured light by which it was taken, Maxwell adding a fourth picture taken and projected by yellow light

In 1869 Ducos du Hauron published a small book on colour photography, in which he laid down the principles of three-colour photography, on which all later work has been based, and at approximately the same time Charles Cros published an article in which he had independently come to much the same results. Du Hauron's book is astonishingly complete and contains a very clear account of the two fundamental processes of colour photography including their application by different methods. These processes are known as the "additive" (that employed by Maxwell) and the "subtractive" processes

The practical development of colour photography was, however, delayed for many years by the difficulty that the photographic materials available were sensitive only to the blue and violet of the spectrum; it was with the greatest difficulty that materials sensitive to the whole visible spectrum could be ob

The introduction of colour sensitizing by Vogel in 1873 first made colour photography possible, and the introduction of the isocyanine and carbocyanine sensitizers at the beginning of the 20th century made it practical.

The Additive Process.—Clerk Maxwell's picture was projected on to a screen by means of optical lanterns and was thus the so-called "additive" process; that is to say, the colours were formed by adding light to light. This method was also used by du Hauron and Cros in a special instrument called a chromoscope, in which the three pictures were viewed in superposition; a plan later used and developed by F. E. Ives also.

F. E. Ives developed the additive process in practice. He took photographs through three dyed gelatine filters upon materials sensitised with the best dyes available at that time and projected the transparencies by means of triple lanterns devised for the purpose, these synthetic colour pictures giving extremely good colour reproduction upon the screen.

The production of the negatives can be accomplished by three different methods. For stationary objects where an interval between the exposures is of small importance, it is convenient to fit the filters and sensitive plates into a sliding back attached to an ordinary camera. Exposures are then made through the three filters in succession either upon a single panchromatic plate or on three separate plates.

For the photography of moving objects, it is, of course, impossible to use successive exposures, and a great number of cameras embodying beam splitting methods either by means of prisms or by reflectors have been designed. The chromoscope already referred to as a "viewing" instrument can be converted into a camera in which mirrors are used for separating the three beams. Other cameras use elaborate combinations of prisms for the same purpose. In such cameras it is often convenient to use separate plates, since it is rather difficult to arrange for the three images to fall upon a single surface.

A system invented originally by du Hauron is to have the sensitive surfaces superposed on each other and to build up a plate or film pack; thus, in front, there may be placed a slow, very transparent yellow-dyed, blue-sensitive film; behind this, a moderately transparent film sensitive to green and dyed red or with a red filter attached to it; behind this again, a red-sensitive film. In this way, the blue record is made on the first film, the green record on the second, and the red on the third. A considerable number of patents have been taken out for variants of this method.

The Subtractive Process.—The subtractive process, which was described originally by du Hauron, depends upon the production of colours by subtractive absorption instead of by the addition of the colours to each other in projection. Suppose that over a sheet of yellow gelatine, which will absorb the blue light, is put a sheet of magenta gelatine, which will absorb the green light; then, since the yellow absorbs the blue light, and the magenta the green light, only the red light is transmitted; a red image can thus be obtained either by projecting it through a red filter or by putting a magenta image on the top of a yellow one. In the same way a green image can be obtained by putting a blue-green one on the top of a yellow one, when the yellow will cut the blue out of the blue-green and leave only green.

In working the subtractive process, the three negatives are printed in coloured dyes, the picture taken through the red filter being printed on gelatine dyed blue-green, the one taken through the green filter on gelatine dyed magenta, and the one taken through the blue filter on gelatine that was dyed yellow. Now, if the three are cemented together in register, the resulting transparent colour picture will reproduce the colours of the original subject and will be a transparency which can be viewed in the hand, or examined in front of an artificial light, or projected in a lantern.

Printing Methods.—Subtractive methods have naturally attracted the most attention as alone giving prints on paper.

The carbon process was used by du Hauron, the negatives being printed upon carbon tissue containing a pigment of colour complementary to that of the filter. After development, the three images are transferred to a temporary support, and then retransferred to a permanent support in accurate register. This method gives excellent results but requires considerable skill.

Very good results have also been obtained by the use of a process in which gelatine containing transparent dye was coated on thin film base. After sensitising with bichromate, this can be printed through the back and developed with hot water, so that a coloured relief image is obtained on the film. The three images can then be transferred in superposition on to a paper support without the use of double transfer.

A modification of the carbon process, suggested by T. Manly under the name of "Ozobrome" and later revived by H. F. Farmer as the "Carbro" process, is also used for colour work. In this a silver image is squeegeed into contact with pigmented gelatine saturated with bleaching solutions whose reduction products harden gelatine. These chemicals migrate into the silver image film, and the reduction products return to the tissue, rendering it insoluble in ratio to the amount of metallic silver present in the image. The tissue is then treated exactly as in the carbon process. Bromoil transfers are also used by some artistic workers.

In addition to these processes, colour images have been made by using for dyes the mordanting power of chemical compounds and especially the ferrocyanides of the metals. The ferrocyanides of uranium, copper, vanadium, and silver, and the iodide or sulphocyanide of silver mordant basic dyes very strongly. From the negatives silver images are therefore prepared and transformed into these compounds. The blue image is commonly composed of iron ferrocyanide itself, this being a very suitable shade of blue for colour work. Yellow and red images are obtained by mordanting basic dyes, such as auramine and safranine, on to transparent deposits of metallic compounds. The three images are then superposed as usual.

In one group of processes the dye images themselves are transferred from the printing plates, which are formed of colourless reliefs, these being stained up and then placed in contact with gelatine so that the dye migrates and forms an image in the gelatine. Such processes are known as "imbibition" processes. The transfer plates may be made in several ways: thus, bichromated gelatine on film may be exposed through the back and developed with hot water, or a silver image produced by exposure through the back of an ordinary emulsion coated film may be caused to harden the gelatine either during development, since some developers harden the gelatine contiguous to the image, or by treatment with a bath similar to that used in the ozobrome process already referred to. After treatment, a relief can be obtained by washing off the unhardened gelatine with hot water, and after removal of the silver a colourless relief is obtained. In a process known as the "Pinatype" process, bichromated gelatine is exposed under a positive and is then treated with dye which penetrates only the soft gelatine, the hard gelatine remaining uncoloured. This dye can then be transferred by imbibition to a layer of soft gelatine coated on paper, and the three images can be transferred in turn to produce a colour picture.

In a modification of this, used in motion picture colour photography, the local hardening is produced not by the light exposure of a bichromated surface but by the formation of a silver image and its treatment with a bleach bath which hardens the gelatine in contact with the developed silver.

There are numerous modifications of these printing processes all of which can be employed with more or less success but all of which require a considerable amount of skill if really good results are to be obtained.

The largest field for the subtractive process of colour photography is in connection with the use of the printing press. The three negatives are used for the production of printing plates, usually by the half-tone process, and prints from the three plates, frequently with a fourth black plate added, are superimposed, the plates being printed in red, blue, and yellow inks which are approximately complementary to the colour of the taking filters. This three or four colour half-tone process is very widely used for the preparation of illustrations and is by far the greatest application of colour photography. (*See* PHOTO-ENGRAVING.)

Screen Plate Processes.—In his book, Ducos du Hauron suggested a modification of the additive process which has since become of practical importance and is known as the "screen plate" process. He suggested that the surface of the glass plate or film might be covered with tiny filters—red, green, and blue—the sensitive emulsion being coated on top of these and photographed through the filters.

A modification of this method was suggested by J. Joly of Dublin and by J. W. MacDonough of Chicago in 1892; the colour elements were on a glass plate which was pressed during exposure into close contact with a separate panchromatic plate after development of the negative; a positive in silver was made in the usual way and viewed in contact with a special viewing screen, in which the colours approximate those required by theory. The advantage of this method is that should any error be made in exposure of manipulation, the negative plate alone is lost, the taking screen being still available for further work, whereas with the combined methods the screen-plate is ruined. The disadvantage is that it is applicable only to regular, geometrical patterned elements, the fineness of which is therefore limited to some extent.

In 1907 Messrs Lumière and Co., of Lyons, brought out their "Autochrome" plates in which they utilized an irregular screen composed of coloured grains. Glass plates are coated with an adhesive medium over which there is spread a mixture of starch grains, of microscopic fineness, stained violet, green, and orange, the interstices being filled in with fine carbon powder to form a tri-colour screen, dark by reflected, and of a pinkish, pearly appearance by transmitted, light. This is varnished and coated with a thin panchromatic emulsion of gelatino-silver bromide The plates are exposed in the camera from the back, through the tricolour films, a special compensating orange-yellow screen being used also before or behind the lens. They are then developed as usual, producing a negative coloured image in the complementary colours, which is then reversed so as to produce a positive coloured image showing the picture in its proper colours. The results thus obtained are remarkably good and practically solve the problem of direct colour photography in a simple and fairly inexpensive manner, the results being of course confined to transparencies.

Other screen plates which have been introduced include the Agfa plate, invented by Christensen, in which the elements are slightly larger than those of the Autochrome, and the Lignose colour film with still larger elements. In both these the colour units are stained resins, which like the starch grains are applied either by a dusting-on or sedimentation process.

The Duplex, originally known as the Paget, belongs to the separate system, and taking and viewing screens are used, the former with a panchromatic plate. This screen is produced by printing the units on bichromated gelatine in contiguous squares.

Screen plates are conveniently studied under the following heads:—

I. Method of production of the screen.
II. Examination of the screen as a whole.
III. Examination of the filter units.
IV. Examination of the emulsion.
V. Adjustment of the compensator and emulsion to the filters.

I. The screen may be either regular or irregular. The methods of production may be classified as follows:

(1). Ruled lines. Method used by Joly and MacDonough.

(2). Dusting-on methods. Employed to produce irregular screens in the Autochrome, Agfa, and Lignose processes.

(3). Printing by means of bichromated colloids. These are used in the Warner-Powrie and Duplex processes.

(4). Various methods of section cutting. The best known example is the Krayn screen introduced in Germany in 1907 and taken off the market shortly afterwards.

(5). The use of mechanical printing or a combination of mechanical printing and dyeing. Experimental screens made in this way were the Omnicolore and the Lumière regular screens, neither of which was marketed commercially.

(6). Other processes. A variety of patents have been taken out for experimental screens which must be classed under this heading.

II. The screen as a whole when examined should appear to be of a neutral shade. This is known as the "first black condition." The adjustment is obtained by alteration of the area of the units as far as possible rather than by adjustment of the depth of colour. The total visual absorption should be as low as possible.

III. The separate filter units should have the purest possible colours, preferably without overlap in the spectrum. The best possible compromise is for a red filter transmitting from λ590 upwards; a green filter from λ590–490; and a blue filter from λ 500 down to the violet. The size of the screen units is determined by their invisibility. In order to get bright colours, however, it is necessary that they should not be too small, since otherwise the emulsion will not have sufficient resolving power, and the images behind the units will overlap. For regular screens the units should not be larger than $\frac{1}{300}$ nor smaller than $\frac{1}{600}$ of an inch. For irregular screens it is necessary that the units should not be larger than one-third the dimension of regular screens, since the average unit will tend to be a clump of about 10 grains; that is, having approximately three times the diameter of the single unit

IV. The emulsion should be sensitive to the whole visible spectrum and of a resolving power depending on the size of the units. In the case of the small units of irregular grains, its resolving power must necessarily be high, so that the emulsion must be slow and fine grained. It must also be coated in very close contact with the screen, since otherwise the scattering of the light in the intervening space will affect the colour.

V. The emulsion should be so sensitized that the effects produced under the red and green filters are equal if possible. The compensating filter used on the lens can then be adjusted to the emulsion and to the filter units, so that the "second black condition" is fulfilled; that is, a scale of greys is rendered as grey after exposure, development, and reversal

The effective speed of a screen plate is governed by three factors: (1) The sensitiveness of the emulsion, (2) the multiplying factor of the screen; (3) the multiplying factor of the compensator. The effective speed of the screen plates on the market is very low—from 1 to 2 H and D

Owing to the very thin emulsion necessary to give sufficient resolving power, the latitude of the process is small, and in subjects with wide contrasts the shadows may be underexposed, while the highlights lose colour owing to overexposure and the consequent irradiation Except with very flat subjects, there is practically no latitude in the exposure given in the camera, the results depending entirely upon the accuracy with which the exposure is determined

A process which is in some respects analogous to the screen plate process is one invented by R. Berthon in which film is embossed on the back with minute lenses A tricolour diaphragm is then placed at the lens of the camera and the film is exposed through the back so that the lenses form images of the coloured filters on the emulsion

After exposure and processing by reversal, the film is projected with a multi-colour diaphragm attached to the lens of the projector, and the colours of the original object are thus reconstituted on the screen. This process is used entirely in motion picture work.

Bleach-out Processes.—Since many dyes are destroyed by the action of light, and since Grotthus and Draper showed that dyes are bleached by light of the colour which they absorb, it is clear that a printing process can be produced by mixing three colour dyes which are sensitive to light. Thus, if we make a mixture of auramine—which is bleached by blue light; erythrosine—which is bleached by green light; and methylene blue—which is bleached by red light; and coat this mixture in a layer of paper, we shall get a black surface Now, if this be printed under a coloured original, the dyes which absorb the colours will bleach, and a coloured reproduction will be obtained, the accuracy of which will depend upon the correct adjustment of the conditions. The most important of these conditions is the relative sensitiveness of the different dyes and the choice of dyes which have the correct ab-

sorption. Since dyes such as those mentioned have little sensitiveness to light, it is necessary to increase it by sensitisers, and a great deal of work has been done in this field in the development of suitable sensitisers, of which the best known are Anethol and compounds of a similar nature.

A commercial bleach-out paper was placed on the market under the name of "Utocolour" paper and was employed particularly for the printing of screen plate originals. The results obtained were not very satisfactory, however, and great difficulties have been experienced in achieving any improvement in the process. It is difficult to adjust the three dyes to equality of bleaching. It is very difficult to remove the sensitiser and the bleached dye, and it is particularly difficult to stabilize the unbleached dye so as to produce a permanent picture. These various difficulties have prevented the process from coming into any general use. (For colour photography as applied to motion picture work, *see* MOTION PICTURES.)

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APPARATUS

Photographic apparatus may conveniently be discussed under the following heads:—(1) Cameras and Enlargers, (2) Stands, (3) Lenses, (4) Light Filters, (5) Instantaneous Shutters, (6) Exposure Meters, (7) Prepared sensitive plates, films and papers, (8) Developing and Printing gear, and (9) Studio and Dark-room appliances. In the case of (1) and (3) further subdivisions will be needed. Owing to the multiplicity of models it will be necessary to curtail greatly the space devoted in former editions to historical development in order to deal at all adequately with features of construction, in relation, more particularly, to modern types. Even here severe compression has rendered unavoidable the omission of many details of mechanical and optical interest. For closer study of these the reader is referred to the works particularized in the short bibliography appended to this Section.

Incidentally, the consideration of photographic apparatus is complicated at the time of writing by certain prospective developments. Camera construction, and to some extent the manufacture of lenses and other gear, has hitherto been influenced mainly by three factors, the introduction of dry plates, enabling development of the latent image to be postponed indefinitely, the substitution of gelatine film for glass, and the perfection of methods of enlargement. Two factors are being added—the improvement of existing processes of colour photography and the swift expansion of cinematography—the precise effect of which cannot as yet be estimated. Already the production of amateur cine-cameras is enormous and, although "still" photography can never be completely ousted by motion picture production, the design and supply of apparatus for the former may conceivably be as seriously affected by the latter as the popularity of the old "stand" camera was by the appearance of the revolutionary Kodak.

CAMERAS AND ENLARGERS

The original aim of the pioneers in Photography was to fix the image in the camera obscura (*q.v.*), and Wedgwood and other early workers chiefly employed that cumbrous apparatus in their experiments.

Historical.—Between 1816 and 1839 Nicéphore Niepce, Fox Talbot and Daguerre used smaller box cameras, and it is on record that the expanding bellows-body principle was applied to some of the first cameras made in France for the production of Daguerreotypes. In England this construction was not adopted until much later, the usual practice being to make the camera in the form of two open boxes, one sliding within the other in order to provide the adjustment necessary for focussing. The two parts were supported on a rigid baseboard, the adjustment being fixed by a screw. A portable stereoscopic camera with parallel bellows

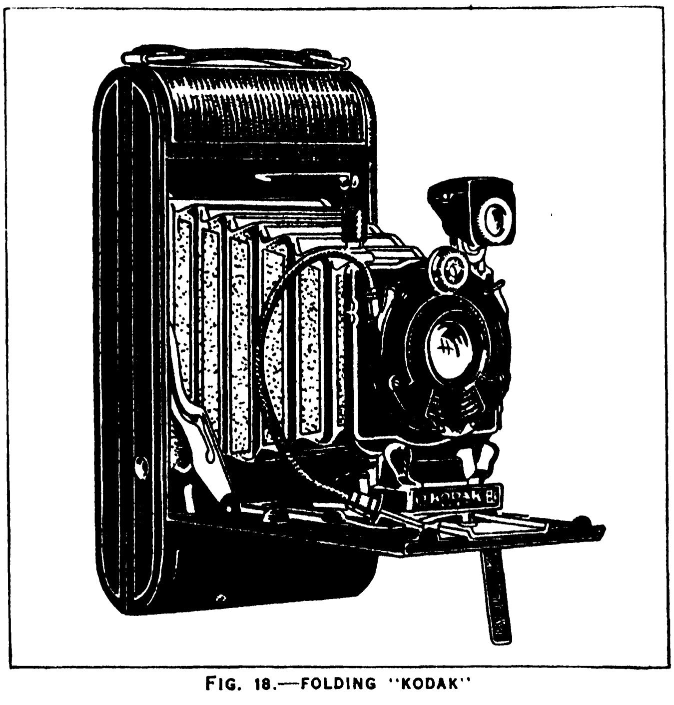


FIG. 18.—FOLDING "KODAK"

designed by J. Atkinson in 1857 was followed in 1858 by C. T. H. Kinnear's lighter pattern with conical bellows for general work. Thenceforward the manufacture of British cameras progressed rapidly in the hands of P. Meagher, G. Hare, W. Watson and other competent makers, one of the later models of the last-named, known as the "Premier," having survived to the present day as a typical "square-form" pattern for technical work.

Information on early cameras will be found in the photographic journals, in C. Fabre's *Traité encyclopédique de photographie*, Vol. 1, and in J. M. Eder's *Ausführliches Handbuch der Photo-*

graphie, 2nd ed., Vol. I, pt. ii.

With the advent of dry plates the demand for more portable cameras increased and has continued steadily to the present day when, the limit of compactness having probably been reached, attention is being concentrated on the provision of various movements, and of accessories such as shutters and finders, with no loss of rigidity and no increase of weight or bulk. Up to 1888, when the roll-film camera known as the "Kodak" was introduced by the Eastman Co. of Rochester, U.S.A., the early portable cameras were for the most part on the lines of the present "hand-or-stand" type.

Roll-film quickly produced a succession of Kodaks, box-form and collapsible, the latter culminating in a folding design which has been widely imitated in this country and on the Continent. To-day the output of roll-film cameras greatly exceeds that of any other type, but several other forms continue in request. Cut films, either put together in film-packs (*q.v.*) or exposed in sheaths, have increased the popularity of the extremely portable "hand-or-stand" cameras, such as the "Sybils" of Newman and Guardia and the more substantial "Una" of James Sinclair and Co. Stereoscopic cameras of exquisite workmanship and extreme precision such as those of J. Richard, Voigtländer and Leitz have many users. The Reflex, both ordinary and folding, is a favourite for Nature study and other special work, and collapsible cameras, based on the original Goerz-Anschütz pattern, are very freely employed for Press photography.

The outstanding feature of latterday camera manufacture is the preponderance of instruments to take plates and films of the smaller sizes. Thanks to the "fine grain" of modern emulsion even negatives made with "vest-pocket" cameras will yield excellent half-plate enlargements. Naturally this facility appeals to the average amateur and also, in a measure, to professionals. In fact to-day the enlarger is complementary to the camera to such an extent that in any modern photographic exhibition the proportion of contact prints from negatives taken directly in cameras is conspicuously small.

Construction.—In some portable cameras the application of the "fixed focus" principle renders any focussing adjustment superfluous, but otherwise the latter is a primary constructional requirement. In the earlier field cameras the extension—almost invariably by means of leather bellows pleated accordion-wise—was regulated by an endless screw operated from the back. The method is still employed in big copying apparatus, but has been largely supplanted by a rack-and-pinion action, on the back of the camera if the bellows are parallel and racked out from the front, and on the front where conical bellows are racked out from the back. The front, sometimes the back also, is kept rigid by struts or other supports affixed to the baseboard, and the lens, usually mounted on a sliding panel, can be lowered or raised to modify the amount of foreground included. Convergence of vertical lines caused by tilting the camera can be corrected by a swinging back or front, which enables the base of the sensitive plate to be kept horizontal, and its sides vertical, irrespectively of the tilt. A "swing-back" or a "side-swing" is also occasionally useful for bringing into focus a foreground, or a near object on one side or the other of the subject, without "stopping down." Focussing is ordinarily carried out with stand cameras by viewing the image formed by the lens on the piece of finely ground glass constituting the *focussing screen,* a cloth being thrown over the camera to exclude extraneous light. In some cameras, notably those of the reflex type, a focussing chamber enables the focussing cloth to be dispensed with, and in most hand cameras the focussing screen is replaced by the finder (*q.v.*). For certain scientific purposes it is preferable to focus on a piece of plain glass with a focussing magnifier which thus virtually becomes the eyepiece of a telescopic system; but "aerial focussing," as it is called, is unsuited to ordinary photography in which composition of the subject as a whole must be studied.

The focussing screen, and, later, the dark slide or other receptacle for the sensitive plate or film is now usually held at the back of stand cameras in a frame which is reversible for pictures taken with the plate lengthwise or upright.

"Dark slides" to hold sensitive plates or cut films in sheaths are made to interchange with the focussing screen, the sensitive surface of the plate or film being in accurate register with the ground surface of the screen. Slides are commonly made to hold two plates or films back to back, with a metal partition to prevent the passage of light. There are two patterns, "book-form," hinged to open like a book, and solid, the latter generally known as plate-holders. With some hand cameras single metal slides are supplied. In all slides light is temporarily excluded from the front of the plate or film by a sliding or roller shutter which is removed or opened, of course, for exposure, and replaced or closed when the latter is completed.

In the case of *studio cameras* (*q.v.*) a "repeating slide" enables two plates to be quickly exposed in succession without removing the slide itself. In field cameras other methods are adopted, both to facilitate speedy consecutive exposures and to permit the carriage of a number of plates or cut films in less space than is possible with separate slides or plate-holders. Some patterns of changing-box are very compact and convenient. The usual construction is in the form of a box with a sliding door at the back, to the open top of which a small bag of light-tight material is affixed. The sliding door at the back having been removed the plates or cut films in sheaths are packed into the box, and a spring at the back ensures constant and even pressure upon all the sheaths in the pack, with the result that the front plate or film is always in register with the focussing screen. In the front of the box there is, as in the case of the ordinary dark slide, a shutter which is withdrawn for, and replaced after, exposure. The front plate after exposure is either lifted or levered up into the light-tight bag at the top of the box, and transferred with the finger and thumb to the back.

Slides, plate-holders and changing-boxes have largely been superseded for amateur use by roll-film cameras based on the Eastman Kodak system. In the earlier applications of the latter the roll of film was carried on a spool in a separate holder with removable back and shuttered front, which thus became a sort of changing-box. But the roll-holder is now incorporated in the camera itself, with appreciable increase of portability and convenience and no loss of efficiency. The film itself in a long strip sufficient for several exposures is backed by a longer strip of black paper on which at suitable intervals the number of the exposure is boldly stamped. The excess of black paper at either end of the film provides a safety covering during the process of loading the spool into the camera, and thus enables the latter operation to be performed in daylight. In practice, the lens being normally capped by a central shutter, the back of the camera is removed, and the spool inserted at one side of the roll-holding arrangement. At the other side an empty slotted spool should be in position. The seal of the full spool having been broken a portion of the safety covering is unwound and threaded into the slot of the empty spool. The back, which is provided with a small red "window," is now replaced. By means of a winder more of the black paper is wound off until the number (1) appears in the little red window. The section of film for the first picture is now in position, and exposure by operating the shutter follows.

An alternative method of daylight loading is provided by the film-pack system, originally introduced in connection with a special camera called the "Premo," but now adapted to nearly all classes of portable camera. The pack itself consists of a number of cut films with attached and interleaved pieces of black paper provided with numbered tags, the whole pack being backed by a sheet of metal provided with springs. By pulling out one of the tags a sensitive film is brought into position for exposure, the preceding film having been simultaneously transferred to the back of the pack.

With all hand cameras some form of *finder* is required. The earliest finder was a second camera, and this idea survives in twin-lens and binocular cameras. But the more usual finder is an attachment either of the "direct-vision" kind, with or without a lens or lenses, or in the form of an angled reflector in which an image produced by a miniature lens, and representing on a small scale that transmitted by the lens in actual use, is viewed,

either on the mirror itself, or on a tiny ground glass screen. The simplest form of direct-vision finder is a wire frame which, held at a correct distance, represents the proportions of the plate, the view included being identical with that photographed. In other direct-vision finders the subject is collected in a small rectangular negative lens, and this miniature image, accurately proportioned to the size of the plate, is viewed through an eye-hole or eye lens.

TYPES OF PHOTOGRAPHIC CAMERA

There are two principal kinds of photographic camera, studio and field, the former type a comparatively small category almost exclusively used by professional portraitists. The *studio camera* forms as a rule part of a combination (fig. 19), in which a substantially built stand, capable of adjustment as to height and inclination, is included. Such a combination should be movable to any part of the studio, preferably on casters. The camera is fitted with square bellows and focussing is by a double rack and pinion movement, sometimes supplemented by a draw-out extension for quickly obtaining a coarse focus. Extra rigidity is given to the fully extended instrument by a wooden centre frame. The front has a rising and falling movement and is very solidly built to carry large and heavy portrait lenses. In many cameras of this type there is an internal flap shutter which can be worked noiselessly by a bulb held in the operator's hand. Apart from portability the main difference between a studio and a field camera lies in the arrangement of the back.

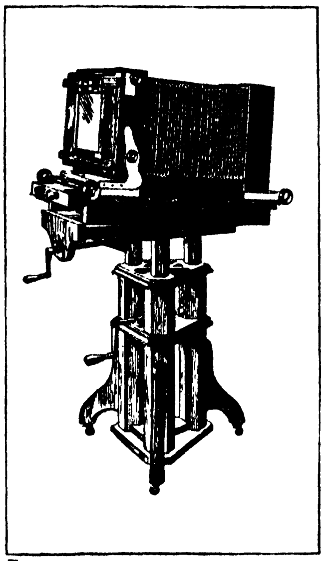
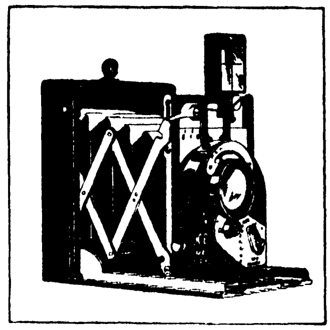


FIG. 19.—"ENSIGN" STUDIO CAMERA AND STAND

Field cameras are of many sorts and sizes and include several classes to which separate attention is being given. But the description "field" may be said to belong properly to the kind of camera used in the open, and on a stand, for general work which is not ordinarily attempted in the studio, such as large groups and *genre* studies in natural surroundings, as well as architecture and landscapes. Such a camera must be reasonably portable if plates of a fair size have to be exposed, and it should possess, in addition to a swing back (or front) and a rising and falling front, an extension sufficiently variable to enable lenses of relatively long or short focus to be used. Thus a half-plate camera, the lens normally employed with which would probably have a focal length of 8 in., should have a full extension of not less than 16 in. and it should be possible to rack it in to take wide-angle lenses with a focal length of not more than 4 in. As it is essential that a field camera should be quite rigid when fully extended the design of an instrument possessing this qualification, in addition to that of portability, presents some difficulties.

The "square-form" camera equipped with parallel bellows remains a favourite with many for field work, owing to its rigidity and adaptability to all classes of subjects and all types of lens. Only moderate portability, however, is possible with this model, and a rather substantial tripod is needed to support it at all satisfactorily. For sizes above half-plate, accordingly, a lighter form of camera with conical bellows is frequently preferred, and, provided that the design is good, and the material and workmanship all they should be, a field camera on these lines will meet all requirements. Only a well made conical bellows camera will carry a variable telephoto lens without risk of vibration, and for that particular branch of photography the "square form" is distinctly preferable. Some conical bellows models have baseboards in which a circle has been cut out and a metal ring inserted, thus constituting a tripod head to which ordinary tripod legs can be attached.

Owing to improved facilities for enlargement field cameras in the larger sizes are not now so freely used as formerly, and the convenience of roll film has rendered diminutive Kodaks, Carbines and other "pocket" instruments increasingly popular. But there is an intermediate type which, as an efficient compromise, is perhaps the most useful form of camera in existence. This is commonly known as the "hand or stand" variety, of which the Watson "Alpha" was the best early model. The later productions of Newman and Guardia, which owe their perfection chiefly to the mechanical genius of A. S. Newman, and those of Adams, the Houghton-Butcher Co., Ernemann and other makers, are modern examples of "hand or stand" design in which every conceivable requirement in the way of movement and extension is met in extremely portable instruments. In the "Sybils" (fig. 20) of the first named firm extra rigidity is secured by a neat and effective "lazy-tongs" method of extension. Another representative model of this type is the Sinclair "Una" which, while less compact than the "Sybil," is sufficiently portable and only a trifle less efficient than the "square form." The "Sanderson" of the Houghton-Butcher Co. is remarkable for the length of its extension, the latitude of its rising, falling, and swinging front movements, and the ingenious provision made for the use of very short focus lenses.



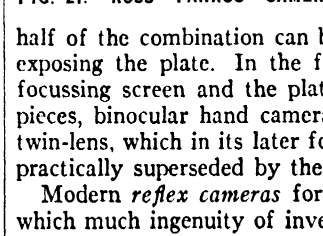
BY COURTESY OF NEWMAN & GUARDIA

FIG. 20.—NEWMAN AND GUARDIA "BABY SIZE" SYBIL

Collapsible hand cameras are largely used for Press photography. They form a type apart of which the Goerz-Anschütz was the pioneer model. A typical modern camera of this class is the Ross "Panros" (fig. 21) which is not only extremely convenient for hand work but can be so effectively used on a stand that it was adopted by the Royal Engineers for the field equipment of their Printing Companies, by whom it was extensively employed in the World War. Cameras of this kind are fitted with focal-plane shutters (*see* p. 828) and very rapid lenses, f/4·5 being a usual aperture. In the "Ermanox" made by the Zeiss Ikon Co. an Ernostar anastigmat working at f.1.8 has been fitted with which instantaneous photographs can be secured in a theatre with ordinary stage lighting.

Magazine cameras in which a number of plates or films are packed and brought forward successively for exposure, somewhat on the principle of the changing-box, are now comparatively seldom used. Unless of the simplest construction, in which case they are bulky, the changing mechanism is apt to give trouble.

Binocular and *twin-lens cameras* represent an endeavour to provide the operator with a view of the object up to and including the moment of exposure. They are literally, as their name implies, combinations of two separate cameras and two separate lenses, the focussing adjustments being correlated so that one half of the combination can be used for focussing, the other for exposing the plate. In the form of an inverted field glass, the focussing screen and the plate taking the place of the two eyepieces, binocular hand cameras are still to be met with, but the twin-lens, which in its later forms was an early "reflex," has been practically superseded by the single-lens reflex.



BY COURTESY OF ROSS

FIG. 21.—ROSS "PANROS" CAMERA

Modern *reflex cameras* form a class apart in connection with which much ingenuity of invention has been displayed and many patents have been taken out. The principle is explained in the accompanying diagram (fig. 22) but, as in practice the reflex is usually held in the hand, it is now fitted with a collapsible vertical hood which enables the operator to look down through it on to the focussing screen. A second mirror can, if desired, be fitted in

the hood for horizontal viewing, and focussing can be assisted by the use of a binocular focussing magnifier. Constructionally the reflex camera is a box containing a movable mirror interposed between the plate and the lens, and facing the latter at an angle of 45°. This throws up the image on to the horizontal focussing screen, on which it is viewed through the hood. The outstanding mechanical feature of the reflex is the co-ordination of the movement of the mirror with the shutter release. The removal of the former to enable the image transmitted by the lens to reach the plate, and the instantaneous exposure of the latter by means of the shutter, are effected simultaneously. The shutter almost invariably fitted to these cameras is of the focal plane type, and more than a dozen models of reflexes by first-class makers are available. A typical pattern of the reflex camera, with movable mirror, horizontal focussing screen and viewing hood is the "Soho" designed by Kershaw and made by the Amalgamated Photographic Manufacturers Ltd. (fig. 23).

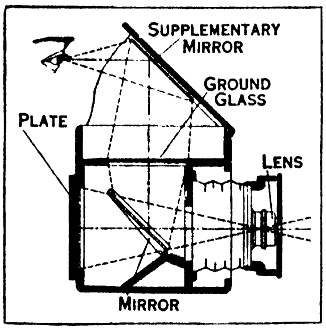


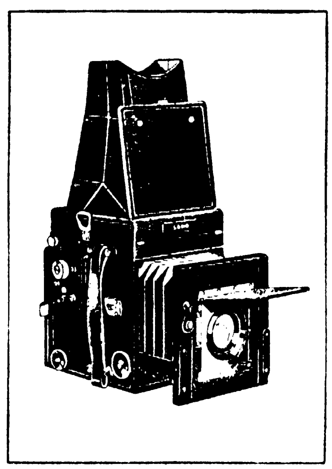
FIG. 22.—REFLEX CAMERA

Reflex Camera and design and construction are considered by A. S. Newman in the *Photographic Journal* for 1921, p. 219.

The basic idea of the *Roll-film camera* has already been discussed. The folding Kodak (fig. 18) remains the most popular instrument of the type, and the latest models of it embody practically every improvement that ingenuity has devised or experience suggested. Substantially the form has not altered. The metal door which closes the front of the camera falls down and forms a baseboard along which the panel carrying the lens, shutter and finder are drawn out until the required focussing adjustment has been made. In some models the fixed focus principle is applied; in others the focus can be altered, according to an affixed scale, to suit all distances from a few feet to infinity. Great cleverness has been displayed in ensuring the rigidity of both baseboard and lens panel. In the better models a fair rise of front is allowed.

Focussing roll-film cameras, more or less closely resembling Kodaks, but containing various structural modifications, are now made by a number of British and foreign firms.

For *panoramic* photography various special types of camera have from time to time been introduced in order to satisfy the scientific requirement that, in covering the abnormally wide angles usually embraced in this kind of work, the lens should rotate on its nodal point of emergence. But practically all the earlier panoramic cameras, an account of which was given in the *B.J.A.* of 1892, have disappeared, and even the interesting and efficient little Panoram Kodak (fig. 24), which takes pictures on a section of roll film $3\frac{1}{4}$ in. $\times$ $10\frac{3}{8}$ in. with a lens swinging on its own axis through the arc of a circle, has comparatively few users. A few professional panoramic cameras, such as the "Cirkut" and the "Korona"—the latter made by the Gundlach-Manhattan Optical Co. of Rochester, U.S.A.—are available. But in modern practice panoramic photographs are commonly made by exposing several plates to cover sections of the complete picture.


BY COURTESY OF THE AMALGAMATED PHOTOGRAPHIC MANUFACTURERS
FIG. 23.—"SOHO" REFLEX CAMERA

Special cameras for *map reproduction*—often of huge dimensions—and for *copying* in connection with "process" work need not be specifically described as to all intents and purposes they are elaborations of the studio form. For *Colour Photography* (*q.v.*) various particular forms of camera and dark slide have been devised, more particularly in connection with the taking of the three negatives required for trichrome work on paper. The simplest method of obtaining the latter is separate exposure of three panchromatic plates in ordinary slides, the lens being screened successively by green, red and blue-violet filters. Greater speed is obtained by use of the Sanger-Shepherd repeating slide in which the three filters are placed immediately in front of sections of a long plate, the sections with their respective filters being exposed in quick succession by passing the slide along a frame fitted to the back of an ordinary camera. A modification of this repeating slide has recently (1928) been introduced by F. Newens. A more elaborate system consists in obtaining the three negatives at a single exposure by means of a specially constructed camera in which the image transmitted by the lens is trebled by the addition of prisms, one image reaching its plate directly, the other two reaching theirs by reflection. In some colour cameras the prisms are replaced by a mirror system, a recent example of the latter type being the special camera issued in connection with the Jos-Pe process. Numerous cameras of both types have been proposed, and are discussed in Vol. XLV. of the *Photographic Journal*, p. 150 (1905) by W. Gamble.

However, at the time of writing it seems very highly probable that the various specialized forms of the one-exposure camera for all of the varied applications of colour-photography will within a brief period of time be rendered obsolete. This important change in the technical practice of colour-photography will be inevitably brought about by the notable improvements in the application of the tripack method. In this new technique a single simultaneous exposure is given to three films packed together. One of these films is green-sensitive, another is red-sensitive, while the third film is blue-sensitive. By this ingenious combination, which greatly simplifies the problem of taking colour-pictures, noteworthy practical advances may be confidently expected throughout the entire field of colour-photography.

The construction of cameras for stereoscopic photography (*q.v.*) has reached a high degree of perfection in models such as the "Verascope" of J. Richard, the Leitz "Heidoscope" and the Voigtländer "Stereoflectoscope," the two last having a reflex finder in which a full size image is shown by the use of a third lens (fig. 26).

In the practice of *Photo-micrography* likewise, a large choice of apparatus is available, ranging from cameras of very long extension with elaborate arrangements for securing correct alignment to simple attachments for use with ordinary cameras for low power work. In addition to horizontal apparatus some fine cameras have been designed by Zeiss and others to work vertically, while others, again, can be used in conjunction with the microscope in either position.

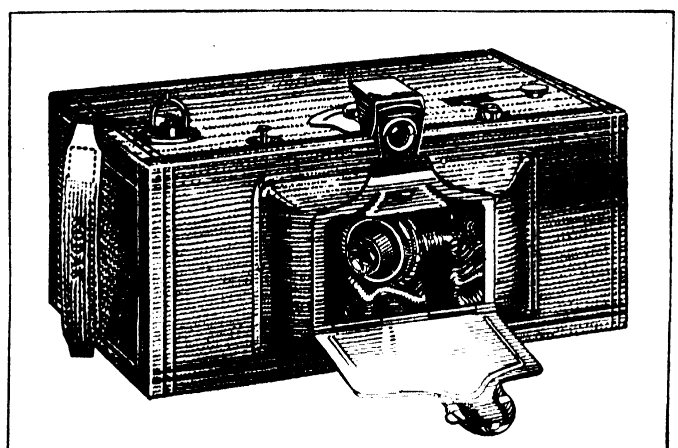
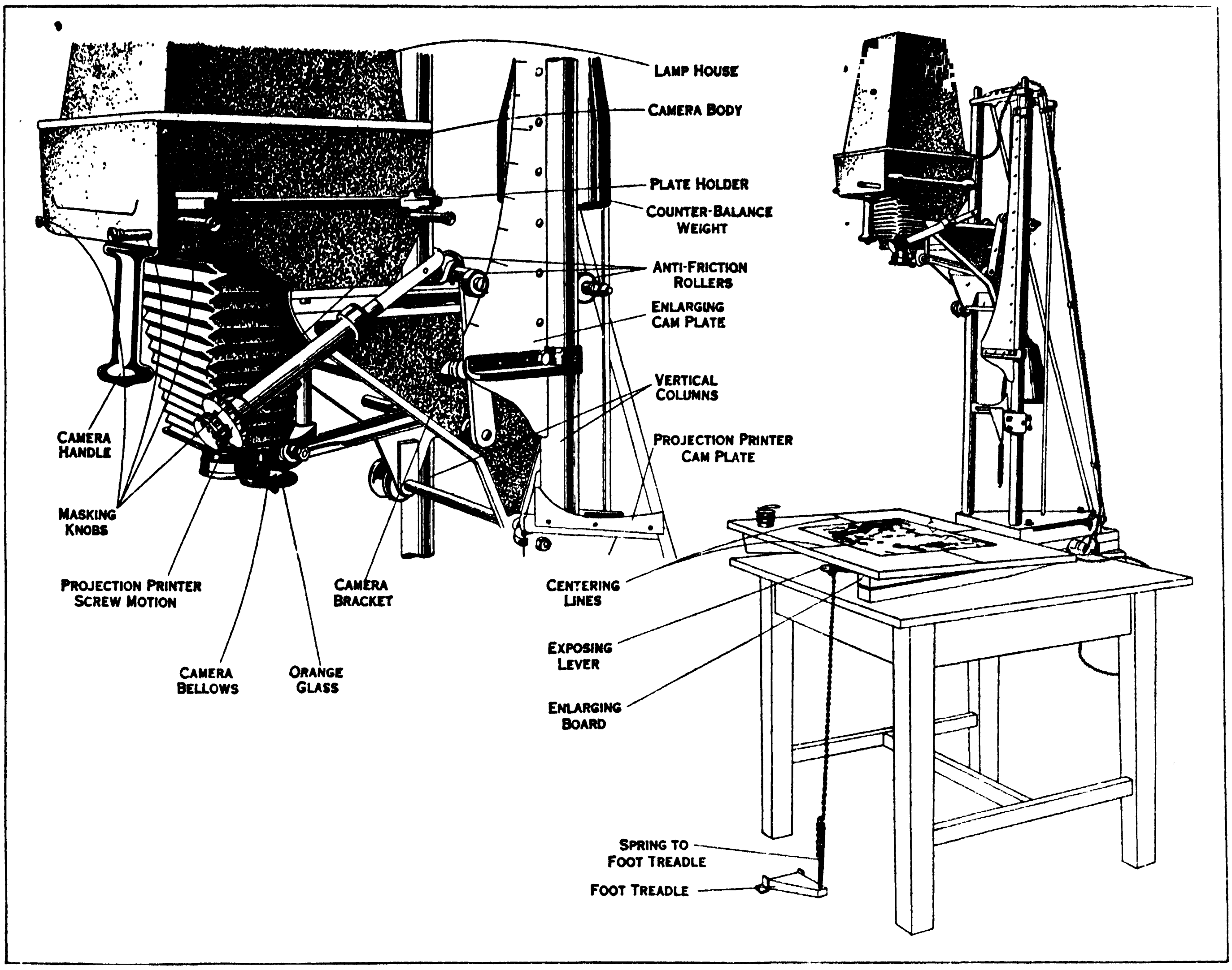


FIG. 24.—PANORAM "KODAK"

Since Cinematography, Aerial and X-ray photography are dealt with separately, the apparatus connected with them does not come within the scope of this Section.



BY COURTESY OF HOUGHTON-BUTCHER, GREAT BRITAIN

FIG. 25 —ALDIS ENSIGN ENLARGER

Cinematography is dealt with under MOTION PICTURES (*see* especially MOTION PICTURE TECHNOLOGY by C. E. K. Mees). Aerial photography is treated under AERONAUTICS and AVIATION, also under SURVEYING. X-ray photography is discussed under X-RAY; X-RAYS AND CRYSTAL STRUCTURE and related subjects.

Enlargers.—The old method of enlarging by direct photography with a short focus lens and an ordinary camera of long extension has for a number of years been largely discarded in favour of the employment of apparatus resembling the ordinary optical lantern. In the modern enlarger (fig. 25) a negative or a transparency takes the place of the lantern slide, the screen being represented by an easel to which a piece of bromide paper or a sensitive plate is, after focussing, affixed. A powerful beam of artificial light is passed, with the help of a condenser, through the negative or transparency and the enlarging lens with the result that an image is projected varying in enlargement according to the distances between the negative and the lens and between the lens and the sensitive surface of the paper or plate. The illuminant may be either electric light or gas, but the former is now generally preferred, partly because it facilitates the construction of vertical enlargers which have some advantages over the horizontal form. A number of vertical enlargers have been designed.

Enlarging can also be carried out without condensers by collecting the rays of an illuminant in a reflector of ellipsoid form from which a parallel beam of sufficient size is passed through the negative. The latter may be held in the dark slide of an ordinary camera which, with its lens, is thus made to take the place of the front portion of an ordinary enlarging lantern.

The *Photostat*, an American invention introduced about 1907 and since greatly developed, is a combined camera and stand with semi-automatic mechanism for the reproduction of various kinds of official and commercial documents by unskilled operators in any ordinary well-lighted office. Any scale of enlargement or reduction can be adopted, and copies can be developed and fixed in not many seconds A very rapid colour-sensitive paper is used, rendering the system extremely valuable for copying engineers' and architects' plans, etc. See *B.J.A.* for 1928, p. 180.

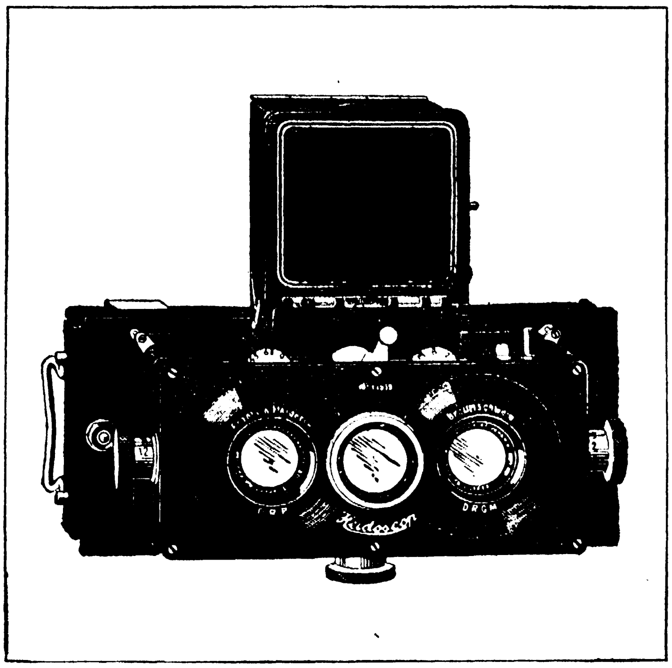
Stands.—For studio cameras (*q.v.*) as previously noted, stands of substantial "pillar" construction are usually provided With copying and other large cameras the stand is more often in the form of a table, but also provided with raising, lowering and tilting movements. For enlarging purposes the stand and easel are sometimes combined, runners enabling the conjugate distances to be readily varied. But for all general photographic purposes the tripod form of stand is the most practical, and almost innumerable patterns in wood and metal have been evolved For very small cameras tripods with telescoping legs of an aluminium alloy and a top of harder metal meet the demand for extreme portability, but for serious work a substantial wooden pattern is greatly to be preferred. The legs should telescope to make them not only more portable but also adjustable to uneven ground. For special work a revolving or tilting head may be desirable, and in some patterns provision is made for increasing the height of the camera from the ground by means of a second head raised on an adjustable rod above the normal level of the stand.

For steadying cameras for incidental snapshot work a "unipod" may be convenient. A unipod arrangement can also be employed to supplement the ordinary tripod as a support for a tele-

photo or other heavy lens affixed to a camera which is of frail construction.

PHOTOGRAPHIC LENSES

Historical.—The earliest form of photographic objective was an adaptation of W. H. Woolaston's single periscopic meniscus lens as applied by him to the camera obscura in 1812. This was achromatised by C. Chevalier for use about 1839 by Daguerre,



BY COURTESY OF OGILVY & CO.

FIG. 26.—"HEIDOSCOPE" STEREO-REFLEX CAMERA

but was not corrected for chemical focus. The first photographic lens corrected for chromatic aberration (*see* later under *Construction*), was a doublet made about 1840 by Andrew Ross for H. Collen, and consisting of two achromatic compounds, one at each end of a tube (fig. 27).[1] Many single lenses of good performance were produced by the early photographic opticians, T. Grubb's "Aplanatic" (1857) and J. H. Dallmeyer's "Wide Angle Landscape" (1865), "Rapid Landscape" (1884), and "Rectilinear Landscape" (1888) being notable examples.

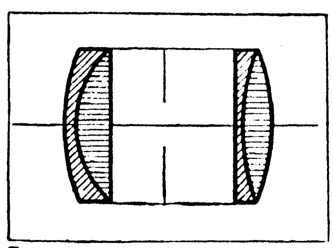


FIG. 27.—FIRST ENGLISH PORTRAIT LENS

In 1841 a remarkable advance was achieved by Voigtländer's introduction of a rapid portrait lens designed by Professor Petzval of Vienna (fig. 28), to whom is due the historic condition that the sum of the focal powers of the individual lenses in a photographic combination, multiplied by the reciprocals of their respective refractive indices, should be equal to zero, or $\Sigma \frac{1}{\mu f} = 0$. This pioneer portrait lens consisted of two dissimilar achromatic combinations widely separated, the front element being a plano-convex composed of a biconvex crown cemented to a plano-concave flint, while the back element was a double convex composed of a bi-convex crown separated by an air-space from a concave-convex flint. The form was notably improved by J. H. Dallmeyer who in 1866 reconstructed the back combination by substituting a meniscus crown for the bi-convex element, and a shallow concave-convex positive meniscus for the negative meniscus, reversing the positions, and introducing an air space.

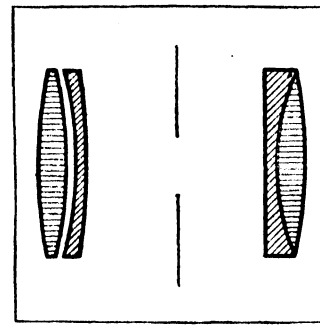


FIG. 28.—PETZVAL PORTRAIT LENS

In 1861 J. H. Dallmeyer produced a triplet very fully achromatised, non-distorting, and giving excellent definition, but since obsolete on account of its bulk and slowness.

Between 1841 and 1866 a number of doublets were brought forward by British and Continental opticians with the object of increasing rapidity and eliminating distortion, and towards the end of this period a simple and efficient type of "rectilinears," "symmetricals" and "aplanats" had become established. In the manufacture of these a high degree of excellence was attained particularly by Dallmeyer and Ross in England and by Steinheil in Germany (fig. 29). Wide-angle symmetrical doublets with greatly deepened curves appeared about the same time, some exhibiting remarkable qualities of definition combined with covering power. Dallmeyer's "Rapid Rectilinear," f/8 (1867) set what remained as the standard for photographic lenses for ordinary purposes until the perfection of the anastigmat. Among slower combinations the "Portable Symmetrical" of Ross was remarkable for its flatness of field and a compactness which enabled a number of lenses of widely different foci to be fitted into the same flange.

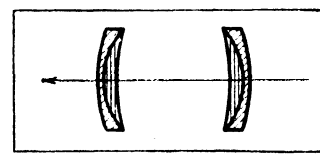


FIG. 29.—RAPID RECTILINEAR LENS

The issue in 1886 by Schott and Genossen of the "Jena glasses" formulated by Professor Abbe placed in the hands of photographic opticians a means of eliminating astigmatism by setting high refractivity with low dispersion against low refractivity with high dispersion. Some of the early Jena glasses were unstable and progress in construction was at first slow. In 1888 Dr. Shroeder worked out for Ross an anastigmat afterwards known as the "Concentric Lens" but the first thoroughly successful objective made with Jena glasses was that designed in 1889 by Dr. Paul Rudolph of the Zeiss firm, and classed as Series II. f/6·3. The details of construction are to be found in the *Eder Jahrbücher* for 1891 and 1893. This excellent lens was followed by several other anastigmatic singles and doublets, a new line being struck out by the symmetrical cemented doublet of C. P. Goerz known as the "Dagor," which has since been widely imitated. Almost simultaneously the single "Protars" of C. Zeiss came to be combined in doublet form. These improvements soon showed themselves to be as excellent in practice as they were in theory.

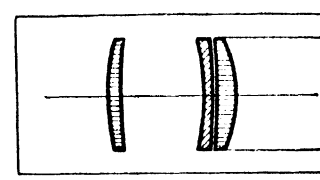


FIG. 30.—"COOKE" LENS, SERIES III

In 1895 Taylor, Taylor and Hobson produced a remarkable and entirely novel anastigmat designed by H. D. Taylor and known as the "Cooke" lens (fig. 30). It consists of three single lenses, a biconvex crown in front, and a very flat biconvex crown behind, with a biconcave of light flint in between, and close behind the front crown. Also in 1895 H. L. Aldis calculated for Dallmeyer a new convertible anastigmat consisting of two dissimilar compounds, thus giving a choice of three foci. The "Stigmatic," as it is called, is still issued but in a non-convertible form. In 1902 H. L. Aldis produced at the new works of Aldis Brothers at Birmingham a much simpler anastigmat composed of a

[1]In the diagrams of lenses which follow, a uniform system of indicating the nature of the glass employed by means of the shading has been adopted.

Flint glass is indicated thus:— 

Crown glass of low refractive power thus:—

Crown glass of high refractive power thus:— 

(These two are used indiscriminately in lenses made before the introduction of the new Jena glass.)

Extra light flint glass thus:— 

In most cases the front of the lens is on the right.

cemented meniscus in front and a single double convex back lens (fig. 31). Several series have been issued and very widely distributed. In 1902, again, Ross and E. Busch of Rathenow simultaneously produced anastigmats consisting of four separate lenses, the Ross combination, known as the "Homocentric," being of Jena glasses, while in the Busch "Omnars" as originally constructed normal glasses were employed. In 1907 H. C. and C. Beck made another new departure in the Isostigmar, remarkable as violating the Petzval condition, the inventor's theory being that the condition does not apply to lenses the individual elements of which are separated by large intervals (fig. 32). In 1913 J. W. Hasselkus worked out for Messrs. Ross a singularly fine anastigmat which has since become famous under the name "Xpres." It is a non-convertible doublet, the conspicuous feature of which is a cemented back combination consisting of three lenses, the first a biconcave or plano-concave of low refraction, the second a meniscus of medium refraction, and the third a biconvex of high refraction.

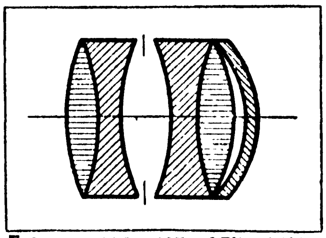
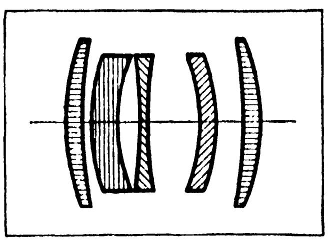


FIG. 31.—ASTIGMATIC LENS, SERIES III

From 1898 in addition to the above-named, and in partial supersession of the doublets of Zeiss, Goerz, Steinheil and Voigtländer, there has been a steady stream of new lenses, mostly triplets—"Tessars," "Pentacs," "Serracs," "Heliars," "Aviars" and others—chiefly remarkable for increase of aperture but also of brilliant all-round performance (fig. 33). At the time of writing a high-water mark of rapidity seems to have been reached in a lens made by Ross for a special purpose to work at f/1·3, but there is also a prospect of reaction from such extremes and of a return to practical apertures, such as f/6·3, at which beautifully corrected lenses can be made of small dimensions and at moderate cost.



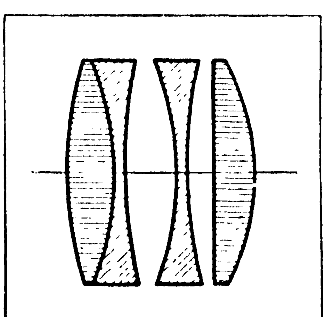
BY COURTESY OF R. & J. BECK

FIG. 32.—BECKS' "ISOSTIGMAR" LENS

In 1891 T. R. Dallmeyer in London, A. Miethe in Berlin and A. Dubosc in Paris simultaneously worked out telephotographic combinations consisting of positive and negative elements, variations in the separation of which produced magnification according to the camera extension employed.

CONSTRUCTION OF PHOTOGRAPHIC LENSES

The construction of technically good photographic lenses, of which some indication has been given in the preceding historical summary, depends largely upon the elimination of certain defects of which the principal are (1) Spherical aberration, (2) Coma, (3) Astigmatism, (4) Curvature of field, (5) Distortion and (6) Chromatic aberration. Spherical aberration is due to the fact that a spherical surface does not bend or focus light to one exact point, in other words the rays passing through the edge of such a surface do not focus to the same point as those passing through the centre. It can be partly corrected in a single lens by the use of a diaphragm, and in combinations by varying the curves of the component lenses. Coma and astigmatism are functions of spherical aberration, the first being a blur due to lateral spherical aberration of oblique rays. It is partly eliminated by the diaphragm. Astigmatism manifests itself in inability to focus accurately at the same time both vertical and horizontal lines near the margin of the field. It is partially cured by the use of a small diaphragm, and can be wholly eliminated by the selection of special glasses and the precise calculation of curves. Curvature of field is due to the failure of rays passed by a lens with a spherical surface to come to a focus on the same plane, the defect increasing, like astigmatism, with the obliquity of the rays. Here, too, the diaphragm can be of great service. Distortion is of two kinds, "barrel" and "cushion," a square appearing in the former shape if photographed with a single meniscus lens with the concave side outwards and the diaphragm placed in the front of the lens, and as a "cushion"—*i.e.*, with concave sides—if photographed with a single lens convex side outwards and with the diaphragm behind. It is corrected naturally in symmetrical doublets, since the barrel distortion of one component compensates the cushion distortion of the other. Chromatic aberration is caused by the dispersion of the white light passing through the lens, and is due to the fact that the different coloured rays come to a focus at different distances from the visual focus, according to their wavelengths. It is corrected by compensating lenses of different refractive powers. (*See* OPTICS.) In the general construction of photographic lenses the defects which were enumerated above, together with a number of others, are neutralized by regulating the curves of the different positive and negative component lenses, the refractive and dispersive indices of the glasses used, and the distances of the refracting surface, in this manner making the objective truly stigmatic or focussing to a point.



BY COURTESY OF CARL ZEISS

FIG. 33.—ZEISS'S "TESSAR"

The performance of an adequately corrected lens depends chiefly upon its effective *aperture* or the diameter of the clear ray actually used in impressing the image on the plate. This diameter is not necessarily that of the diaphragm employed, but the latter is used for the purpose of mechanical regulation of aperture, *i.e.*, reduction from "full" to the smallest possible. In early lenses the diaphragms or "stops" were of the Waterhouse pattern, with thin pieces of metal with circular openings of different sizes which could be inserted in a slot in the lens mount. This pattern is still employed in portrait and other large lenses. A variation is the rotating stop, a circular plate containing a series of apertures which can be brought into position as desired. Most modern lenses are fitted with iris diaphragms which Messrs. R. and J. Beck claim to have been the first to apply to photographic lenses in 1880. These consist of thin leaves of metal or ebonite so arranged that by operating a ring to which they are affixed apertures of different diameters can be formed at will. Several systems of numbering diaphragm apertures are in use, the most common being the F number method in which the aperture marked is the focal length of the lens divided by the effective diameter of the stop. Thus an effective diaphragm opening of ½ in. in the case of a lens of 8 in. focus would be f/16. In other words the aperture marked is a definite proportion of the focal length. Another system is the U.S., or Uniform Standard, proposed by the Royal Photographic Society in 1881 and adopted in the Kodaks. This takes f/4 as the standard, the markings corresponding to the F. numbers being as follows: f. values, f/4, f/5·6, f/8, f/11·3, f/16, f/22·6, f/32, f/45·2. U.S. Nos., 1, 2, 4, 8, 16, 32, 64, 128.

On the Continent the sequence of F. numbers is usually 3·16, 4·5, 6·3, 9, 12·5, 18, 25·3, 36, the exposure in each of the last seven cases being, as in the two preceding systems, double that which is found necessary in the case of the preceding number.

PROBLEMS OF FOCUS

The fact that *depth of focus* is conditioned not only by aperture but also by focal length has an important bearing upon the construction of very large aperture lenses. It is obviously of small use to build a cumbrous and costly lens with a focal length of, say, 12 in. and an aperture of, say f/3 for ordinary work, in which the lens would almost invariably need to be stopped at any rate to f/8 to secure reasonable "depth." But, with the extended use of diminutive cameras carrying very short focus lenses, the demand for very wide apertures has grown enormously, and

lenses working at f/3·5 are now comparatively common.

An important consideration in the construction of a photographic lens is the *angle of view* it embraces. If over 50° it is usually described as wide, if under 35° as narrow. The angle depends on the focal length of the lens in relation to the size of the plate, and in practice the focal length should not be less than the diagonal of the plate In the case of a half-plate this diagonal is 8 in, in that of a quarter-plate 5·3 in. Tables of view angles are published in the *B.J A.* showing the number of degrees embraced according to the quotient arrived at by dividing the diagonal of the plate by the equivalent focus of the lens. In the case of an 8 in lens used on a half-plate, the quotient arrived at being 1, the angle according to the table is 53°.

The term *focus* is explained in the general article on LENS (*q v.*), but it may be pointed out here that the equivalent focus of a photographic lens must be measured from the nodal point of emergence which is sometimes, as in the case of the Aldis and in that of Telephoto lenses, in front of the front component

The historical genesis of the principal forms of photographic lenses having already been discussed, their actual construction, apart from the optical considerations dealt with in the general article on LENS (*q.v.*), may now be glanced at. The single lens is seldom produced commercially to-day except as a component of a doublet or triplet, or in connection with the cheaper amateur outfits In the latter case it is a simple achromatic meniscus composed of a biconvex crown cemented to a biconcave flint The single components of the better types of "Rapid Rectilinear" are constructed in a somewhat different manner Anastigmat singles, such as those used to make up the combinations of the Zeiss "Protar," the Ross "Combinable," the Steinheil "Orthostigmat," the Watson "Holostigmat" and the Voigtlander "Collinear," are usually triple compounds of special Jena or Chance glasses. In addition to the symmetrical doublets formed by the combination of two simple singles there are a number of variously composed asymmetrical doublets, some with cemented, others with air-spaced components, are also notable combinations which, although assembled in two cells, are more or less frankly triplets. The Zeiss Tessars, which are entirely asymmetrical, consist of three separate components, that in front being a cemented lens, the other two uncemented, the intermediate one being a double concave In the construction of most modern doublets and triplets air-spaces play an important part (*See* LENS) Multiple combinations, such as the Beck Isostigmar, in some forms of which five separate lenses are used, are not in common use, although in the case mentioned a high degree of correction is attained

Apart from, or in connection with, their standard models some lens-makers have designed *supplementary lenses* to lengthen or shorten the foci of ordinary objectives. In their simplest form such lenses are either long focus negative or positive singles which can be attached to the front of an ordinary objective with, necessarily, some disturbance of the original corrections As far back as 1894 an advance in this direction was made by Taylor, Taylor and Hobson in connection with their "Cooke" lens by producing a suitably corrected rear extension lens for increasing the focal length. More recently the same principle has been applied by the Zeiss firm to its Tessars in a series of "Distars" and "Proxars," the former lengthening, the latter shortening the focal lengths of the original objectives.

The construction of telephoto combinations is altogether distinct from that of ordinary photographic lenses It is based on the fact that, if a negative lens is placed behind a positive lens at a separation not less than the difference between their focal lengths (which constitutes the Galilean telescopic condition), and not more than the focal length of the positive element, a photographic combination is formed, the focal length of which increases as the separation is decreased The "back focus," or distance from the back lens of the combination to the plate, is not, however, correspondingly increased, being dependent wholly on the focal length of the negative element, a very important consideration as it enables considerable magnification of the image transmitted by an ordinary lens to be obtained with the same or less camera extension. In 1907 Capt. Owen Wheeler introduced a system of combining tele-negatives to produce compounds of extremely short focal lengths, with which magnification up to X 30 is possible with a camera extension of only about 13 inches. A good feature of this system is that by making the rear lens of the combination one of relatively large diameter the covering power is greatly increased. Advantage was taken of this fact in a special complete tele-lens freely used by the Royal Engineers in the World War, which had a focal length of 30 in. and covered a 5×4 plate with a camera extension of 6 in only.

Originally telephoto lenses were "variable power" ones—*i.e.*, the separation of the elements could be altered at will to produce different magnifications with the same or with different tele-negatives. Also an ordinary photographic lens was generally used as the positive element. These arrangements were defective owing, firstly, to the disturbance of the corrections of the positive by a shifting negative element, and, secondly, to the comparative slowness of the combination due to the fact that the aperture of any telephoto lens is the aperture of the positive multiplied by the magnification Thus, in the case of a variable power combination in which, in order to obtain good definition, the positive is stopped to, say, f/11, the aperture at only 5 magnifications would be f/55.

Another drawback in the case of variable power combinations is their liability to internal reflections owing to the relatively long separation of the two elements. This is partially overcome by lining the lens tube with some non-reflecting substance or material, but a more effective plan is fit a *hood* on the lens to cut out the extraneous light—a method often adopted with advantage in the case of ordinary objectives. With high-power telephoto combinations hoods several inches long may be needed, and may be made with telescoping tubes

Variable power telephoto lenses are still used by specialists and extraordinary results are attainable with them But in modern practice single-focus combinations are much more common In these the positive element is a cemented single lens of extremely wide aperture, the defects of which are corrected in the negative element The earliest examples of this form were the f/9 Busch Bis-Telar (1905) and the f/14 Zeiss "Magnar" (1906), both since improved, but these have been put into the shade by recent productions of Ross, Dallmeyer, Taylor, Taylor and Hobson, Zeiss and others The principles and construction of the Telephoto Lens are discussed at length by H W. Lee in the *Photographic Journal* for 1925, p 392

TYPES OF LENSES

Little need be added here to the note in the historical summary above on the subject of *Portrait Lenses* It is a remarkable tribute to the genius of Petzval that the lines which he laid down in 1841 should be generally followed to-day in the lenses commonly used for portraiture, although naturally modifications and improvements have since been introduced by leading opticians. Ross, Dallmeyer, Taylor, Taylor and Hobson in Great Britain, and Voigtlander, particularly, on the Continent, have produced many portrait lenses of great excellence and, occasionally, of gargantuan proportions. In some modern studios, however, the portrait lens of old days is yielding place to the anastigmat, the wide aperture of which places it on a level with the Petzval construction in point of speed, while its more perfect corrections and covering power render it specially serviceable in the matter of studio groups In simple portraiture, on the other hand, extreme flatness of field is not always desirable, a round-fielded lens giving better "modelling" Since good portraiture has little use for "needle" sharpness of definition artist photographers since the days of Mrs Julia Cameron have sought in various ways to modify the critical rendering of objects in the same plane by a well-corrected lens. One method of producing "soft" effects is by means of the diffusion created by partly unscrewing one lens of a combination. Latterly soft focus lenses have been produced by several opticians in which diffusion is secured by special computation, the objective being duly corrected for flatness of field, distortion and colour, but yielding an attractively soft image of marked pictorial quality. A third soft focus method is the

employment of uncorrected lenses, as suggested by Bergheim, and carried out in the Dallmeyer-Bergheim lens (1895). Between 1903 and 1906 C. Puyo and L. de Puligny constructed several anachromatic systems for portrait and landscape work. More recently A. C. Banfield has experimented in the same direction with a view to keeping the aberrations in this form of lens within reasonable limits, the result being embodied in the Dallmeyer-Banfield Portrait Astigmat of focal lengths varying from 18 to 30 in. and working with a maximum intensity of f/6.

The variety of lenses in use for *field work* is so great that only a brief mention of a few leading models is possible. In these the reputation of the makers for design and workmanship is fully maintained, but it is fair to say that in many less well-known productions the requirements of all but specialists are adequately met, some important earlier patents having run out, and the supply of optical glass of high quality having been considerably expanded by the entry of Messrs. Chance of Birmingham into this field of manufacture. For all-round outdoor work the convertible cemented anastigmat is the most useful form, the performance of the single components in the case of doublets like the Zeiss "Protar," the Ross "Combinable," and the Watson "Holostigmat" being all that could be desired. With all these lenses asymmetrical as well as symmetrical combinations are practicable, thus giving a choice of three foci. In one series of the "Holostigmats" the single components can be used at the remarkably high aperture —for a single—of f/8·5. At the same time, the critical definition and increased rapidity possible with triple combinations like the "Tessars" makes them extremely popular, their usefulness being enhanced, where desired, by supplementary lenses such as those mentioned above. Of triplets and asymmetrical doublets, with components one or other of which is uncemented or a single glass, a wide choice is available from the lists of Ross, Dallmeyer, Taylor, Taylor and Hobson, Wray and Aldis Brothers in Great Britain, and of Zeiss, Goerz, Voigtländer and others on the Continent, the apertures ranging from f/2·2 to f/6·3 and the focal lengths from two to three inches up to as many feet.

In field work, more especially in connection with architectural studies in confined spaces, wide-angle lenses are often necessary, and much attention has been paid to this branch of lens construction both before and since the advent of the anastigmat. Of late years wide-angle lenses with comparatively large full apertures —very useful for focussing in dark interiors—have been made by Taylor, Taylor and Hobson, whose VII. B series, superseding their previous "Primoplanes," open to f/6·5 and at f/32 give sharp definition throughout a field of 100°. The Wide-Angle Aristostigmat of H. Meyer, the 4 in. model of which covers a half-plate at f/9, is another successful lens of this type. For the particular purpose of Aerial surveying, but also very useful for many other classes of work, a new wide-angle Ross Xpres, embracing an angle of 80° and covering sharply from centre to margin at the very high aperture of f/4, is a remarkable achievement, the report of the National Physical Laboratory on this objective showing extraordinarily good corrections. Where an abnormally wide-angle lens is needed the Goerz "Hypergon," which consists of two hemispherical lenses, and has a frontal star diaphragm to equalize the light, may be used to cover an angle of 135°.

Modern *Telephoto lenses* are, as previously indicated, very different from the early variable power type, and much better adapted to latterday requirements. The magnification is small, at the most X3, but this is compensated by critical definition enabling enlargement to be carried out to the same extent as with negatives made with ordinary objectives. For the modern telephoto lens is corrected throughout as carefully as the best ordinary anastigmat, being in fact itself an anastigmat, fully achromatised, free from curvature, spherical aberration and coma, and, within its limits, non-distorting. Also, as now made by half-a-dozen leading opticians, it is rapid enough for all practical purposes, even putting aside the latest "ultra-speed" models in which an aperture of f/3·5 has been reached. The only drawbacks are bulk and somewhat restricted covering power, but these do not constitute a high price to pay for a lens which will do very nearly all that the best ordinary lens will do at half the camera extension required by the latter. The most advanced lens of this type is the Ross Three Power "Teleros" which gives an image almost three times as large as that given by an ordinary lens from the same standpoint, and works at f/6·3. In the Two Power Teleros the aperture has been widened to f/5·5. There is also a Teleros of 40 in. focus, working at f/8, which is specially constructed for photographing cricket and other sports. Messrs. Dallmeyer, in addition to their "Grandac" and other variable power telephoto lenses, make a number of fixed-focus objectives giving magnification from X2 to 2½ and working at apertures from f/3·5 to f/7·7. The "Ultra-Speed Dallons" are only made in focal lengths up to 12 in. for covering quarter and 5X4 plates, but there is a very useful series working at f/5·6, the 24 in. model of which requires an extension of only 12 in. from the back cell to the focussing screen, and covers a whole-plate. Messrs. Taylor, Taylor and Hobson's "Cooke" Telephoto Anastigmats, Messrs. Wray's "Plustrar," the Zeiss "Tele-Tessar" and the Voigtländer "Tele-Dynar" are other fine examples of fixed-separation telephoto lenses. The "Cooke," like the "Dallon," is made with apertures of both f/3·5 and f/5·6, but with the former in two focal lengths, 8 in. and 10½ in., only.

In colour photography a high order of colour correction is necessary and for three-colour "process" and other colour work in which very great accuracy is essential it is desirable that the correction should be carried to the furthest practicable limit. This is done by means of special computations and glasses in *apochromatic lenses* made by Ross, Taylor, Taylor and Hobson, Zeiss and others. With a view to complete correction for colour a few quartz *lenses* have been made by British, French and American opticians, and further progress along that line may be looked for.

Lenses for cinematography receive mention in the article on MOTION PICTURES, but passing allusion may be made to them here since those employed in cine-cameras are photographic objectives pure and simple, made in most cases to standard formulae. Some extraordinary results have been attained in these tiny lenses, the Dallmeyer "Dalmac" having been adapted to cinematography in the 16 mm. sub-standard size in a variety of models, one of which has a focal length of 1 in. only, with an aperture of f/1·5. A number of tele-cine-lenses are also available.

Very short focus photographic lenses are also used in *photomicrography*, but are not so suitable for work at high powers as microscope objectives in conjunction with suitable eye-pieces.

ACCESSORIES

Light Filters.—The principles on which orthochromatism and panchromatism are based having already been explained (page 814), the discussion of light filters for cutting out some rays and emphasizing others need not occupy much space, although the subject, when closely considered, is of great scientific and technical interest. For the production of such filters various expedients have been tried, including small glass tanks filled with suitably coloured solutions, but in modern practice either specially coloured glasses or dyed gelatine strips cemented between glass squares or discs—preferably "optical flats"—are commonly employed. The making of gelatine "strip" for such filters demands some skill and patience, a perfectly levelled glass plate being required on which to spread the dyed gelatine solution. The latter must, of course, be as clear as possible, and stained a spectroscopically correct colour. A number of suitable dyes are available for making yellow and green filters, for use with orthochromatic plates, and blue (or violet), green and red filters, for panchromatic plates when the latter are employed in three-colour photography. Yellow filters are usually graded according to the extent to which they increase exposure. In addition to giving correct rendering of yellows and greens they are frequently of the greatest value in cutting out haze and enabling clouds and distant hills to be effectively reproduced.

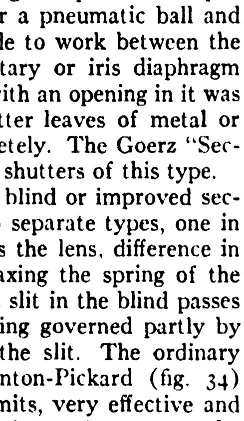
Certain commercial filters, such as the Ilford "Gamma" and the Imperial "Impan," give accurate rendering of all colours when used with panchromatic plates from the same source of supply. The "Impan," by attaining this result, when used with

Imperial "Special B" panchromatic plates, with an exposure only $2\frac{1}{2}$ times that required without a filter, has set a new standard in this respect and greatly widened the application of panchromatism to hand camera work.

For the special filters used with Autochrome and mosaic screen plates *see* under *Colour Photography.*

Instantaneous Shutters.—The spread of the modern emulsions necessitates some means of opening and closing a lens in a fraction of a second. To this end a large variety of "instantaneous shutters" has been evolved. The earliest shutters were of the drop or flap pattern, the former merely an oblong strip of wood or metal, with an opening cut in it, and working in a frame fitted to the front of the lens. The dropping of the shutter through the frame effected the exposure by opening and closing the lens. The flap shutter, which is still used in the studio either on the lens or inside the camera, consists of one or two hinged flaps made to open outwards or inwards by either a pinion or a pneumatic ball and tube movement. Later, shutters were made to work between the lenses of a combination on either the rotary or iris diaphragm principle. In the former case a metal disc with an opening in it was revolved by means of a spring, in the latter leaves of metal or ebonite were made to open or close completely. The Goerz "Sector" and the "Georgen Central" were early shutters of this type.

Modern shutters are either of the roller blind or improved sector kind. Roller blind shutters are of two separate types, one in which the blind as a whole opens or closes the lens, difference in speed being obtained by tightening or relaxing the spring of the actuating mechanism; the other in which a slit in the blind passes behind the lens, the speed of exposure being governed partly by the tension and partly by the width of the slit. The ordinary roller blind shutters, of which the Thornton-Pickard (fig. 34) is the standard model, are, within their limits, very effective and dependable. Speeds from about $\frac{1}{15}$ to about $\frac{1}{90}$ sec. can be given by adjusting the spring, and a separate attachment to the bulb enables time exposures up to 3 sec. to be made automatically. The theory of such shutters is explained by Abney in his *Instantaneous Photography* (1895) and by W. B. Coventry in *The Technics of the Hand Camera* (1901). Of the focal-plane shutter, as the slit blind variety is called, there are numerous patterns geared and with adjustable slits to work at speeds from $\frac{1}{10}$ to over $\frac{1}{100}$ sec. The theory is explained by Coventry (*see* above) and by C. Fabre in *Traité encyclopédique de photographie,* Vol. 1, Suppl. C, 1902. This shutter works immediately in front of the plate and is normally built into the camera. The Goerz-Anschütz pattern is very typical of the entire group of focal-plane shutters. However, the focal-plane shutters embodied in several styles of cameras produced by British makers have special advantages in the matter of ease of adjustment and smoothness of operation.

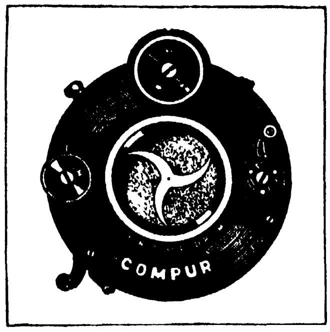


BY COURTESY OF THORNTON-PICKARD CO.

FIG. 34.—MECHANISM OF THORNTON-PICKARD ROLLER-BLIND SHUTTER

The central lens shutter is now generally made with only two or three leaves or blades so constructed that practically the opening of all parts of the lens for exposure is simultaneous. Such shutters are made entirely of metal, and in the best patterns the mechanism is of the same precision as that of a watch. The exposure is effected by means of springs supplemented sometimes by an air-brake. A shutter known as the "Multi-speed" has been made to work between the lenses of a combination at speeds up to an alleged $\frac{1}{2000}$ sec., but in the best ordinary models a reputed $\frac{1}{300}$ sec. is the highest speed attainable. The speeds marked on central lens shutters are seldom to be depended upon, an exception being the "Newman-Sinclair Patent," which does not work at less than $\frac{1}{100}$ sec., but which will also give exposures as long as $\frac{1}{2}$ sec., the figures marked being absolutely trustworthy. *See* also *Photographic Shutters: Methods of Construction and Measuring their Speeds,* by A. S. Newman.

An alternative to the pneumatic shutter release is the "Antinous" or "cable" release consisting of a steel wire passing through a long chain of small steel beads. Pressure on a stud actuates a spiral spring, which, by its resultant action, produces either a "pull" or "push" movement in the shutter to which the release is affixed.



BY COURTESY OF FRIEDR. DECKEL

FIG. 35.—"COMPUR" BETWEEN LENSES SHUTTER

Exposure Meters.—There are now two main types of exposure meters, actinometric and visual observation, the latter commonly known as "extinction" meters. In the former sensitised paper is exposed to the light falling on the object, and the exposure is based on the time which the paper takes to darken to a certain tint. A narrow strip of specially prepared silver bromide paper which darkens rapidly on exposure to light is usually employed, a fresh section of it being exposed in juxtaposition with a fixed standard tint. The number of seconds, or minutes, counted before the standard tint is reached is called the actinometer time. This is correlated with the known speed of the plate and the stop in use, and the result read off on a dial. The leading British patterns of exposure meters are the Watkins and Wynne, both available in watch form. In the Watkins method plate-speeds are distinguished by numbers, in the Wynne meter by an F number, both designations being roughly comparable with the more precise H and D measurements. In "extinction" meters the visual intensity of the light reflected from the shadows is measured by direct observation. In many patterns, of which the "Heyde" is typical, the instrument is adjusted until the subject viewed in the meter appears to lose its shadow detail. In the more recent "Justophot" of E. Meyer (1924) the setting of the instrument is controlled by the moment of appearance of a small numeral as a bright figure in the centre of a dark field. (O. Wh.)

Developing and Printing Apparatus.—The apparatus used for producing finished prints from exposed sensitive materials differs according to the conditions under which the work is to be done. An amateur photographer who develops and prints his own photographs uses relatively simple apparatus. A portrait or commercial photographer is equipped to deal with larger sizes and to produce a larger output, while a trade finisher who develops and prints large numbers of films exposed by amateurs uses quite elaborate apparatus.

Plates and flat films are generally developed by amateur workers in flat trays, roll films in a special developing tank in which the film is held in the convolutions of a roll of celluloid which can be immersed in the developing solution. Sometimes plates are placed vertically in the grooves of a tank or of a rack which can be placed in a tank.

In connection with his factorial system of development (*q.v.*), A. Watkins produced in 1894 a factorial calculator and a dark room clock. With the later extension of "time and temperature" and tank developing methods, a number of dark room clocks and tanks of various patterns have been introduced, some of the former being provided with alarms which can be set to ring on the expiration of a given number of minutes, while others merely mark the progress of time on a dial with large hands.

For printing, the simplest method is to place the negative in a "printing frame" used to hold the sensitive paper in close contact with it during exposure to light. Pressure is usually by means of springs acting on the back, which is hinged to enable the progress of the printing to be watched in case printing-out paper is used. Even for amateur use, however, the replacement of other printing materials by developing papers has involved the general employment of simple printing boxes containing an electric light for which the current is controlled by a switch which is actuated when a platen is brought down on the negative and sensitive paper placed in contact with it.

Professional photographers develop their plates very largely in tanks, and the flat films, which to a considerable extent have replaced plates in professional work, are developed in holders which are placed in tanks and transferred from the developer to the fixing bath and then to the washing tank and finally to a drying cabinet. In this way a large number of negatives can be handled together and the day's work can be developed and made ready for printing very expeditiously.

Almost all of the printers used in professional work are of the printing box type, exposure being made to electric light operated when the platen is closed over the negative and printing paper. Professional printers are provided with attachments for masking the negatives and for the insertion of special masks of ground glass or celluloid on which local work can be done, so that parts of a negative can be printed to a lesser extent than other portions.

Prints are usually developed in large dishes and after fixing and washing may be dried either on racks covered with muslin or, if the output is very large, on one of the various belt driers.

Commercial photographs are often made with a glossy surface produced by squeegeeing the print on to a lacquered metal plate known as a "ferrotype plate" and are usually mounted in contact with backing cloth or paper in order to stiffen the print.

For mounting prints, a method of dry mounting by means of tissues which have been saturated with shellac is frequently adopted. Tissue and print are laid on the mount in the dry mounting press, in which heat is applied, which causes the shellac to melt, with the result that the print is cemented to the mount.

The business of "photo-finishing," as it is termed in the United States or "developing and printing" (D. & P.), as it is generally known in England, is now a very considerable portion of the photographic industry, many firms developing several million spools of amateurs' cartridge film every year. In the case of the large photo-finishers, the finishing plant collects film through the agency of a number of photographic dealers and returns the finished pictures to the dealers for distribution to the retail customer. Two important factors in the business are the short time in which it is necessary to get the work done, often 24 hours or less, and the great variation in the amount of business throughout the year, the output in England, for instance, being ten times as much at the maximum in August as at the minimum in January. This variation in the amount of business is causing great attention to be paid to the provision of automatic machines in order to diminish to a minimum the amount of skilled labor required. When the rolls of film come in, they are unwrapped in the dark room and numbered, the number being either punched into the film or light-printed on it. They are then held in clips which can be slipped over rods, so that the films with a weighted clip at the end are immersed in deep tanks of developer. After a fixed time of development, they are transferred to a rinse tank, fixed, washed, and again transferred to a drying cabinet.

Several forms of continuous machines have now been devised for developing the rolls of film. In these, the rods carrying the films held in clips are moved continuously by a conveyor system through a system of tanks and finally through a drying cupboard.

The dried negatives go forward to a printing room, where they are printed by contact upon developing paper, the printers being adapted for rapid operation, frequently by foot treadles, and equipped with numbering devices. Automatic power driven printers have been designed but have not yet come into general use.

From the printers, the paper goes to the developers, and at this stage also there is a tendency towards the use of machines of the conveyor type which carry the print through the necessary solutions and finally deliver them to a washer. Most prints, however, are developed in flat trays, fixed, and then washed in a rotating cage immersed in flowing water or in a series of flat trays through which water flows, this being used particularly in England, where it is known as a "cascade washer." The washed prints are dried by being placed between two fabric belts which travel over a heated drum, these machines being known as "belt driers," which deliver the prints dry within a few minutes.

Glossy prints are dried upon ferrotype plates in cupboards or, with the most recent machines, upon polished metal drums to which they are carried while wet by traveling belts.

The finished prints may be trimmed at the edges in order to give them a smooth finish and are usually delivered unmounted.

(C. E. K. M.)

Studio and Dark Room Appliances.—*Studio Lighting.*—Aside from furniture and blinds for adjustment of lighting by day a feature of most modern studios is the provision made for exposure by artificial light. Of the numerous effective systems in use some employ arc, others half-watt lamps in combination with suitable reflectors. Very serviceable special types of studio lighting apparatus have been evolved. A recently introduced studio lighting accessory is the "spot-light," borrowed from the stage.

Although seldom used in important studios the flash-lamp may be briefly mentioned under this heading. It consists of a pan in which a powder, usually composed largely of magnesium, can be ignited to produce a large flame of highly actinic quality.

Dark Room Fittings.—Mention has already been made of dark room clocks and of developing and bromide printing apparatus. In addition to these every year sees the introduction of new designs of lamps and other dark room equipment of sorts and sizes adapted to the nature and importance of the work in question. Of dark room lamps and lanterns in particular there is an endless variety, the most practical being those in which either white light or light which, while relatively bright, is "safe" for the plates in use, can be turned on at will. The incandescent electric lamp is naturally that chiefly used for such dual arrangements. To the making of different "safelights" suitable for all kinds of plates and bromide papers careful attention has been given, and, in order to cope with the extreme sensitiveness of modern emulsions, lanterns have been devised by Wratten and others in which only reflected light is proved through the safelight. This precaution, however, is being rendered superfluous by the new methods of desensitizing. While these methods are not sufficiently effective to enable very rapid panchromatic plates to be developed by naked candlelight, illumination is permissible after desensitizing which would formerly have been out of the question. In the autumn of 1928 the Ilford Co. introduced a new safelight for use with desensitized panchromatic plates, giving a pleasant green light by which development can be watched in comfort as well as in security.

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PICTORIAL PHOTOGRAPHY

By pictorial photography we mean photography applied to the production of pictures in the accepted artistic tradition, but whether such pictures are to be admitted as art is a matter upon which the critics are still at variance. The subjects with which photography can deal most successfully are those in which realistic representation is permissible and not such as demand an imaginative treatment.

The Nude.—For that reason photography of the nude, which has always been a tempting subject, fails for the most part, not because it presents any greater technical difficulties but because the realism inseparable from photography makes it almost impossible to combine it with an idealistic conception, whilst it is equally difficult to use it convincingly in subjects drawn from ordinary life. To present the nude by photography simply as a study of the beauty of the human form involves firstly the finding of a model of perfect proportions and secondly extreme delicacy of artistic treatment to prevent degeneration into the recording of mere nakedness. In modern times this class of work is mostly done in the studios of the professional photographers who have greater facilities than the amateurs, but however excellent their work may be technically, it is usually quite meaningless from the artistic point of view. The finest use of the nude is to be found in the work of the Americans, especially those living in California where conditions are exceptionally favourable, and particularly in that of Annie Brigman, Arthur Kales and Walter Collinge

Still Life.—In other directions photography has more scope. Landscape, portraiture, domestic genre and still life all offer ample opportunities to the camera worker with artistic education and a trained eye. Still life, in particular, offers endless possibilities for imaginative treatment by photography and some very beautiful work of the kind has been done in the past by Baron de Meyer, J. M. Whitehead and E. Seymour. It is a branch of photography which the Japanese of the American Pacific coast have developed upon lines of their own in recent times, grafting the American love of startling eccentricities upon their own inborn sense of design. In their aptitude for seeing a pattern or decorative effect in chance combinations of the most commonplace kind they are unequalled. The exploitation of effects of pattern of an eccentric or sensational nature, if it did not actually originate in America, certainly reached its greatest development there some twenty years ago as a method of self advertisement. Such it still remains.

The sounder development of modern pictorial photography shows itself in a feeling for broader and simpler effects, in a stronger sense of pattern and in more attention to the form than to the content of the picture, in other words the picture is no longer expected to tell a story. As a graphic art, photography has certain disabilities, for it cannot suppress facts and cannot omit unwanted details at will. It can modify the presentation of the facts but any suppression or alteration has to be done by subsequent manipulations, usually involving handwork upon the negative or print, the legitimacy of which has been questioned.

IMPROVED PRACTICE

Fox Talbot.—The story of pictorial photography is largely bound up with the progressive improvements in the materials with which the photographer had to work. Fox Talbot's Calotype provided the first method of making pictures by the agency of light and so added photography to the graphic arts. In the year 1833 he was at Lake Como endeavouring to make sketches with the aid of the Camera Lucida but, lacking the necessary skill of hand, sought to devise a means of recording automatically the view as seen on the paper. After five or six years of experiment he was able to demonstrate his discovery of the process which is the basis of modern photography and two years later patented an improvement of this under the name of Calotype. He himself was a scientist rather than artist and it cannot be said that any of his surviving photographs show an artistic impulse.

D. O. Hill.—The first to put the new invention to a pictorial use was a Scottish artist, David Octavius Hill, who, having been present at the meeting at which the disruption of the Scottish Churches occurred, conceived the idea of painting the historic scene. It involved the inclusion of some hundreds of figures. To get sittings and draw all these portraits would have meant a year or two of labour and many might be dead before he could secure their likenesses. His friend, Sir David Brewster, an eminent scientist of the day, told him of the newly invented photography and at the same time introduced a young student of science, Robert Adamson of St. Andrews, to attend to the technical manipulations. For three years he worked at it and produced that series of portraits of Scottish notabilities that are amongst the greatest, as they are the earliest, masterpieces of the photographic art. An album containing fifty of the original prints of these was issued in 1848 and is now in the possession of the R.P.S.[1]

In 1846 Hill returned to his painting, became secretary of the Scottish Academy of Arts and died in 1870 so completely unknown to fame as a photographer that not a single photographic paper chronicled the event. Although references to his pictures occur earlier (*Photographic Journal*, 1854, vol. I., p. 177, also 1864, vol. IX., p. 63), it was not until James Craig Annan began to interest himself in Hill's work in the early nineties and published a series of photogravure plates from the original paper negatives, that he really became known.

It was Hill's artistry and not his photography that achieved greatness and it is well to bear this in mind when pictorial photography is twitted with not having done anything finer than Hill did so many years ago. Such a reproach is no more just than would be a similar one to the artists of today for not excelling Titian and Raphael and Michelangelo The "Girl in a Flowered Gown" is an example of the work of Hill.

Little is known of any of Hill's contemporaries. Dr. White of Aberdeen used photography for pictorial purposes and a collection of his landscapes was shown at the R.P.S. in December 1922 (*Photo. Journal*, vol. LXIII., p. 5) but the process was as yet so imperfect that the long exposures and lack of colour sensitiveness of the negative material made photography chiefly a recording medium for the scientist, whence arose the tradition of sharp uniform definition that distinguished its practice until the advent of Mrs. Cameron in 1864.

Albumen Paper and Collodion.—The introduction of albumen paper in 1848 and of the collodion process of Scott Archer in 1850 marked the next progression. Picture making was a serious business in those days when the negatives were made the full size of the finished print and had to be sensitized and developed in the field and when enlarging was as yet unknown. Already in the winter of 1851 there was a small group in London meeting regularly and by 1852 this had grown to such an extent that it was felt the time was ripe for a photographic society.

ROYAL PHOTOGRAPHIC SOCIETY

The First Exhibition.—The holding of the first recorded exhibition of photographers at the Gallery of the Society of Arts in December of that year gave an additional impetus and in January 1853 the Photographic Society of London came into being. Other societies quickly followed and photographers multiplied. At the first meeting of the London Society, one of the Vice Presidents, Sir William Newton R.A., a distinguished artist, read a paper in which he put forward several ideas that countered the false standard of pictorialism accepted as the result of its practice by those whose only qualifications were scientific.

The most admired features of a picture at that time, we read, were sharp definition all over and a blank expanse of pure white for the sky. Sir William made two suggestions that were a direct attack upon the existing position. One was that the pictorialist should aim at a broad and general effect for which end it was not necessary that the whole of the picture should be in sharp focus. The other was that artificial means should be adopted to obtain some suggestion of a sky, either by local reduction or by dabbing pigment on the back of the negative to simulate clouds. These rather ruffled the photographers but the leaven worked and by 1862 there was general agreement on the desirability of adding skies to pictures since it was then impossible to secure them on the same plate as the landscape. Already in 1856 a print

[1]Royal Photographic Society of Gt. Britain.

of a marine subject by a Frenchman named Le Gray exhibited at the Photographic Society's soirée at King's College had created a sensation and helped to break down the blank-sky convention.

Composites.—The next phase that developed naturally from the prevailing conditions was the production of composite pictures built up from two or more negatives. A method of doing this had been suggested as early as 1848 but the earliest exhibited example known was by Berwick and Annan in 1855 in which a figure had been introduced into a landscape. The first and most famous picture of this kind, of which we to-day have any knowledge, was "The Two Ways of Life" (R.P.S. collection). This interesting picture is a large print measuring 31x16 inches and built up from more than thirty separate negatives, by O. G. Rejlander, a Swede practising as a photographer at Wolverhampton. This remains the most ambitious attempt of its kind. Rejlander sent it to the Manchester Art Treasures Exhibition of 1857 where the original was bought for Queen Victoria. A second copy was purchased by Sir David Brewster who writes that he paid ten guineas for it, and a third copy, now at the R.P.S., was retained by Rejlander himself until 1870. There is no record of his making further use of the composite method although he worked for another twenty years, and all his other pictorial work is mainly in the class of domestic genre in which only one or two figures are used.

His example, however, stimulated Henry Peach Robinson (born at Ludlow in 1830), a young professional photographer at Leamington, to employ his leisure time in attempting similar methods of picture making. He had had some artistic training; he had carved one of the statues of the reredos of Ludlow church and one of his paintings was accepted by the Royal Academy before he was twenty-one. He started life in the bookselling business at Ludlow, Bromsgrove and London and whilst at Bromsgrove in 1850 learnt the daguerreotype process and subsequently Calotype and Collodion in preparation for a photographic career. His earliest pictorial attempts are unknown with the exception of the small "Juliet with the poison bottle" (R.P.S. collection) but in 1858 he produced a picture, entitled "Fading away," from five negatives which was first shown at the Crystal Palace and afterwards at Leeds. It excited a violent controversy on the permissibility of exhibiting so painful a subject (a girl dying from consumption) to the public gaze. Robinson's fame was thenceforward established and for the next thirty years he was the leader of British photography. His style was essentially Victorian, artistically sound but anecdotic. The principal idea was to make the picture tell a story. His three finest works "The Day's work done" (1877) "Dawn and Sunset" (1885) and "Carolling" (1887) are now preserved in the R.P.S. collection. The two former are magnificent examples of albumen printing, measuring 30x21 inches.

Further Inventions.—In the late 'fifties Pouncy's Gum Bichromate process and Poitevin's Carbon process were added to the existing printing media. The former received little attention but Carbon was developed commercially by Swan and the Autotype Co. and was taken up slowly by photographers.

A Notable Amateur.—The advent of Mrs. Julia Margaret Cameron in 1864 marks the next stage in pictorial development. The casual gift of a camera and lens by her daughter led her to take up photography at the age of fifty with all the volcanic energy of her temperament. She was one of a highly gifted family and had been closely associated with Watts and the painters of the Pre-Raphaelite school so that she brought an unconventional mind to the exercise of the new art. Her lens was of an uncorrected type and without waiting to learn the correct adjustments, she proceeded to use it in the manner that suited herself. She broke through all conventions and produced a series of heads distinguished by great breadth of modelling; indeed, in the case of the Carlyle and Herschell, by a violence of treatment that rather horrified the photographers of her time. The reviews of the exhibitions made some caustic comments on her methods (*Photo. Journal,* 1864. Vol. 9, p. 87. 1865. Vol. 10, p. 117) which were perhaps not altogether unjustified. She received, however, praise and encouragement from G. F. Watts and other men of discernment. As she was on intimate terms with many of the most eminent people of her day, her pictures have an interest beyond that of their artistic merits. The best of her work must certainly rank amongst the photographic masterpieces of all time. "The Guardian Angel" is one of her best known works. She was apt to be careless in her methods. Most of her original silver-albumen prints have now faded and were it not that her principal works were issued in autotype carbon, we could now hardly form a just estimate of her achievement.

Platinotype.—Willis brought out his Platinotype process in 1873 but it made little headway at first as a license was required to work it. Yet it fulfils the chief desideratum of the pictorialist in that it gives an image in permanent pigment on pure paper without the interposition of a gelatine or other film. The Oil Transfer process is the only other one that meets the same requirement. The next few years were occupied in the transition from the wet collodion to the dry gelatino-bromide plate and from albumen to the gelatino-bromide printing papers. Pictorialism shows no very marked movement during this period and it was not until 1888 and onwards that a new move was discernible. The dry plate and the invention of the hand camera were vastly enlarging the numbers who were being attracted to photography as a hobby and this very largely contributed to the advancement of pictorial work. The leading names at this time were Col. Joseph Gale, Frederick Hollyer, Frank Sutcliffe of Whitby, Payne Jennings, B Gay Wilkinson and J. B. B. Wellington.

THE NEW PICTORIAL MOVEMENT

Dr. Emerson's "Naturalistic Photography" (1887).—The expansion of a lecture by Dr. P. H. Emerson, "Naturalistic Photography," to the Camera Club in 1886, was the beginning of the new movement. Unquestionably this book struck a powerful blow at the many conventionalities which had attached themselves to the practice of photography and had a powerful influence upon the younger pictorialists. In it he lays down that, "naturalism is an impersonal method of expression, a more or less correct reflection of nature wherein (1) truth of sentiment, (2) illusion of truth of appearance (so far as is possible), and (3) decoration are of first and supreme importance." He further advocated the differentiation of focus to secure separation of the planes, closer attention to the rendering of "tone," greater adherence to truth through the study of nature and generally a higher and more intellectual standard.

To what extent Dr. Emerson's book contributed to the new pictorial movement that made itself evident in the late eighties is doubtful. The movement originated no doubt from the ferment in the artistic world due to the influence of the French Impressionist school which was becoming known and appreciated. The leaders of the new pictorialism were George Davison, Alexander Keighley, James Craig Annan, A. Horsley Hinton and Alfred Stieglitz, and the consensus of opinion is that the first visible sign of the break with the older Victorian tradition is to be found in Davison's picture "An old farmhouse" or, as it was called later, "The Onion field." This famous picture received the Photographic Society's medal in 1890. The council of the society consisted mainly of scientists who, beyond holding the annual Exhibition, did little to encourage pictorial work, and as a result the new body of pictorialists soon came into conflict with them.

There was a secession and many whose interests were purely pictorial left the parent society to band themselves together as "The Linked Ring" with definitely pictorial aims and interests, one of which was the holding of a separate exhibition to be known as The Salon. Although the society's neglect of pictorial interests was advanced at the time as the reason, the schism originated in a quarrel in which H. P. Robinson, Davison and the assistant secretary of the Photographic Society were involved. The establishment of this energetic new organisation brought about a veritable renaissance which received a further stimulus by the revival of Pouncy's Gum-Bichromate process in a workable form by Ladeveze, a Frenchman, and by Alfred Maskell and others in England. At last the pictorialists had a really controllable

printing process. Demachy, Le Begue, Puyo and others in France co-operated and our pictorialism took on a new orientation. Two of the finest pictures of this period are Horsley Hinton's "Melton Meadows" and Alex. Keighley's "The White Sail."

American Influence.—By the end of the century the first impetus of the movement was largely spent but a new era began in 1900 when F. Holland Day of Boston, U.S.A., exhibited at the R.P.S. house a collection of some 360 prints by members of the new American School. The exhibition proved a sensation and had a tremendous influence upon British photography, with the result that during the next six years pictorial photography reached a high level that it has never quite touched again.

The influence that was behind this wonderful American development was that strange genius Alfred Stieglitz, who after studying photography in Berlin, returned to New York about 1890 to begin his great task of building up an American School of pictorial photography upon foundations that were practically non-existent. The inspired achievements of the Americans from 1900 to 1908 are eloquent testimony to the success of his great work, for which in 1924 the Royal Photographic Society awarded him its Progress Medal, a unique distinction for a pictorial photographer. It is necessary to name only F. Holland Day, Yarnall Abbott, Gertrude Käsebier, Eduard Steichen, Frank Eugene, Clarence White, Alvin Langdon Coburn, Mrs. Annie Brigman and George H. Seeley to realise the number of photographers of real vision and genius who responded to the inspiration of Stieglitz.

Although the brilliance of the Americans overshadowed to some extent the work of the British school, that too reached a high level of excellence during the same period whilst its effort has been more sustained, so that in the subsequent twenty years British pictorial photography has taken more and more the leading position in the world's work, rather, perhaps, by reason of its sanity and sober pictorial excellence than by any quality of brilliance or progressive novelty of outlook.

The development of the colour sensitive plate, culminating in the Panchromatic plate in 1906, affected pictorial photography but little and even twenty years later, although most photographers use negative material that is orthochromatic to some extent, they are somewhat conservative in their attitude to panchromatics, principally because they are apt to give harsh results unless developed with more discretion than the average photographer possesses.

The introduction of the soft gradation Panchromatic plate by the Ilford Co. in 1928 may serve to break down this prejudice and get rid of the bugbear of "over-correction" which in most cases would be described more correctly as over-development.

The Oil Process.—A new method of printing, the Oil process, was introduced by G. E. H. Rawlins in 1904 and worked out by himself, Demachy in Paris and C. F. Inston in Liverpool. Based upon the action of light upon chromated gelatine, it consists in applying an oil pigment, such as lithographic or printing ink, to the damp gelatine surface by means of special brushes and so building up an image whose development can be controlled and modified according to the skill of the worker.

A very useful modification of this, known as Bromoil, was worked out by C. Welborne Piper in 1907. In this a Bromide print or enlargement is bleached in a special solution and can then be inked up in the manner described. The latest modification consists in transferring the inked image by means of pressure to a sheet of plain paper. This is the transfer process and bids fair to be the chief pictorial printing medium of the future, for the image then consists of a permanent pigment on pure paper, the whole process is under the photographer's control, and as many printings can be superimposed as may be necessary to secure the desired result.

PROGRESS OF PICTORIAL MOVEMENT

Great Britain.—In 1909 internal dissensions brought about the disruption of "The Linked Ring" and the exhibition of that year was the last of the original Salon. A few of the members formed themselves into a Secession which held a small but notable exhibition in 1910 which, however, was not repeated, and the other supporters of the Salon came together under the lead of F. J. Mortimer and established in 1911 the London Salon which still continues. Amidst all these changes the R.P.S. Exhibition continued its even way. For a year or two after the secession in 1892, the seceders held aloof but gradually they came back and most of the prominent pictorialists exhibited at both shows, so that there was little to choose between the two.

During the World War, and especially towards the end, pictorial photography was carried on under great difficulties and the Exhibitions fell almost to the vanishing point. Since then a gradual revival has set in but it has taken nearly ten years to return to normal. The feature of late years is the levelling up that has taken place in the work of the general body of photographers as well as the great increase in its practice. To the R.P.S. Exhibition of 1928, 460 workers sent in more than two thousand prints.

The position of British photography to-day is largely the result of the highly organized nature of its pictorial efforts, the very large number of photographic societies all over the Kingdom, their grouping into Federations and unions which cater for their needs and stimulate their activities, the scheme by which a large number of the societies are affiliated to the Royal Photographic Society for the same ends, and lastly the R.P.S. itself which has become not only the parent society of the British empire but, to an ever increasing extent, of the American and continental pictorial groups and associations as well. The numerous photographic exhibitions held in Great Britain, of which the most important are the R.P.S. Annual Exhibition, the London Salon, the exhibition of the Professional Photographers Association, the Salon of the Scottish Federation, the Northern Exhibition and the Midland Salon, have done much to foster the growth and appreciation of pictorial photography and afford the British public greater facilities to see good pictorial work than can be found in any other country.

America has several notable Salons held annually at Pittsburgh, Buffalo, Los Angeles, San Francisco and Seattle. The work there is inclined to be decidedly experimental and novelty is perhaps more sought after than beauty though this may be merely a stage in the development and the prelude to the evolution of a style and school such as was possessed in the great days before 1908.

France, under the inspiration of Robert Demachy in 1900, was the leader in photographic pictorialism but since the great men of that period retired from active participation in the foreign exhibitions, the French school is less known outside that country than formerly; although an exhibition of work by members of the French Photographic Society at the R.P.S. in 1926 revealed several new pictorialists of eminence.

Germany and Austria have, during the past thirty years, always held a prominent place in the pictorial movement with individual characteristics of their own. Before the World War the pictures of Duhrkoop, Perscheid, Kuhn and the large gum prints in colours by the brothers Hofmeister were notable features of the leading exhibitions. Since the World War the Germans have not participated to any great extent in foreign exhibitions, but the work of Otto Vogelsang of Pomerania, Dr. Koppitz of Vienna and Franz Drtikol of Prague has shown that there are pictorialists of the front rank.

Other Countries.—Italy has progressed rapidly in recent years under the inspiration of the *Gruppo Piemontese* of Turin and the work of the new school is virile whilst based on the best traditions. Spain possesses one pictorialist of eminence in J. Ortiz Echague but no national school, whilst in the Scandinavian countries the pictorial work appears to be done entirely by the professional photographers of whom Aage Remfeldt of Oslo and Ferdinand Flodin and Dr. H. B. Goodwin of Stockholm are the best known. In Holland and Belgium there are several active workers and Borrenbergen and Berssenbrugge in the former and Leonard Misonne in the latter are well known at the exhibitions in this country.

COLLECTION OF PICTORIAL PHOTOGRAPHS

The organized collection of pictorial photographs generally seems to have presented few attractions to any public institutions or to individuals, and it is a regrettable fact that no complete record exists of the achievements of the past. The importance to posterity of such a record was not realised in the early days and, in

any case, the housing and exhibition of such a collection would have presented insuperable difficulties to any body other than a municipal or government institution. Small individual collections have been made no doubt at all times but in only one or two cases could they claim any importance. The Duchess of Sermoneta is known to have possessed a fine collection but it is reported to have been dispersed at her death. Mr. Harold Holcroft of Wolverhampton has made a fairly representative collection of contemporary work during the past thirty years and this will be preserved intact as he has presented it to the Royal Photographic Society.

In the early days, the Prince Consort, who was keenly interested in photography, apparently formed a collection for in 1859 he offered fifty prints to the Photographic Society of London to form the nucleus of a permanent collection. The Society appointed a committee to consider the Prince's suggestion as it then possessed no permanent abode, and that apparently is as far as the matter ever went. If the prints were ever received there is no trace of them now. It was not until after 1890 that the idea of forming a permanent collection was revived and the line taken was to acquire annually the pictures which received medals at the exhibition but even that small effort soon expired and the collection grew in desultory fashion by casual gifts.

In 1923, however, the President, who for once was a pictorialist, organised an effort to make the collection worthy of the society. A ready response was received, many pictures of great historical and pictorial importance were secured, gaps were filled, a curator appointed and the Society's Permanent Collection, although by no means complete, is by far the largest and most representative in the world. The addition of the Holcroft collection adds greatly to its value and importance. Collections of photography have been made by the Smithsonian Institution, Washington, U.S.A., and by the State Museum in Berlin and in recent times Mrs. Milson, a former Lady Mayoress of Sydney, N.S.W. formed a collection of pictorial photographs to become the basis for a permanent collection in Australia, but none of these can compare in size and importance with the R.P.S. collection which contains examples of the work of all the most notable photographers from D. Ó. Hill to the present day. The further expansion of this collection is assured by the recent gift by Mr. Stephen H. Tyng of New York of a fund for the purchase annually of outstanding examples of photographic art. The administration of this fund is placed in the hands of the Pictorial Group of the R.P.S., an organization within the Society specially designed to encourage and foster pictorial interests in every possible manner.

Photographic Press, Weekly and Monthly.—This, while dealing with pictorial matters, has catered chiefly for the general reader and the publications dealing exclusively with pictorial interests have been comparatively few. The first of this nature in Great Britain was a series of monographs on the work of the leading pictorialists of the day, each volume being devoted to the work of one man and illustrated in photogravure by four of his pictures. The whole was issued in 1890 under the title of "Sun Artists." In 1895 the proprietors of *The Photogram*, a monthly magazine, issued a special volume devoted to an account of the photographic activities of the year in this and other countries, with 90 illustrations of selected pictures. This has grown to be a feature of annual interest and, under the editorship of F. J. Mortimer, F.R.P.S., is now the principal record of the photographic pictorialism of the world. A volume of somewhat similar aim but limited to the pictorial work exhibited at the R.P.S. has since 1926 been issued under the auspices of the Society by F. C. Tilney, F.R.P.S., who supplies a critical commentary on the pictures reproduced. In addition the Society issues in the October number of its *Journal* an account of the year's work both pictorial and scientific, with abundant illustrations. Of late years the *Société Française de Photographie* and the *Gruppo Piemontese* have issued sumptuously illustrated records of the Salons held by them annually, which constitute valuable records of the work done in their respective countries, and now Japan is doing the same on a slightly less ambitious scale in the *Japan Photographic Annual*.

The most beautiful of all these records of photography, however, we owe to Alfred Stieglitz who, in fifty-four volumes of *Camera Work* issued between 1903 and 1917, gave us the finest pictorial work of the principal masters in photogravure reproduction that are a joy to the connoisseur. This was the most perfect thing of its kind that has ever been attempted and involved Stieglitz in heavy financial loss in return for the devotedly unselfish labours of nearly twenty years.

In conclusion, pictorial photography would appear to have reached a point where no marked progress can be expected along the present lines and we await the coming of the genius who will give a new orientation to its aims. Perhaps the development may be in the nature of a direct colour process for with the addition of colour the scope of photography would be vastly widened.

(J. D. J.)

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SUBMARINE PHOTOGRAPHY

Water is often so calm and clear that it might seem easily possible for one above its surface to photograph fishes or other objects beneath it. This may, indeed, sometimes be done, but usually the attempt results in complete failure. The explanation is simple. At the moment of exposure the rays from the near submerged object are sharply focussed upon the plate. But at the same time more intense light from distant objects, out of focus, after being reflected from the water's surface reaches the plate also, which, when developed, consequently shows nothing. To set up an opaque screen shading the water's surface above the subject overcomes the difficulty. Through the shaded area, as through a window, one may photograph what lies below. However, the method is limited in its application. When the water exceeds 3ft. in depth it is usually better to use a submerged camera.

Dr. L. Boutan of Paris—pioneer in this field—between the years 1893 and 1898 attempted submarine photography at the Roscoff laboratory in Brittany with cameras of several sorts and appropriate and ingenious subsidiary apparatus. One of his cameras, made of metal, was directly submersible. Sea-water reached its interior, bathing both lens and plates. Although the result obtained was unsatisfactory because no thoroughly suitable lens was available, the principle seemed good to him. Other trials in which the camera was enclosed in and protected from the water by a metal box, through a glass window in which it looked out, were by comparison highly successful. This sort of apparatus, variously modified, has been used in all later work.

Boutan's cameras were of the simple detective type. Reighard, ten years after, at Tortugas, Fla., first used a reflecting camera protected in a water-tight box weighted down with lead till the window through which the camera looked was submerged, although the focussing hood remained above water and permitted him at all times to see what might be in the field. Excellent pictures were obtained within wading depth, beyond which he did not go.

Williamson Brothers, commercial motion photographers, probably as an independent invention, enclosed not only the camera, but the photographer as well, in a chamber suspended by a non-collapsible open tube from a floating scow. Perfect pictures of the sea bottom and animals in shallow water were obtained in the clear water of the Bahamas, as the scow stood still or was towed slowly along. These writers must be credited with the first attempt to secure a photographic record in colour of submarine life in its natural setting. By using selective filters they secured films which when projected upon the screen gave an idea of the variety of colour upon a tropical reef, but since the yellows registered as reds the attempt can scarcely be considered entirely successful.

Longley, with Reighard's apparatus reduced to manageable size and improved, having recourse again to diving equipment as Boutan had done, gave the submarine camera greater mobility and a wider range of usefulness. It now lends itself to instantaneous or timed exposures of any ordinary subject at moderate depths. In the tropics, where sunlight is intense, snapshots, it is interesting to note, may be taken as readily as upon land, but with somewhat longer exposure. Dr. Paul Bartsch, at Tortugas, and S. C. William Beebe, in Florida and the West Indies, have succeeded in obtaining pictures with a motion-picture camera similarly employed. Finally, Longley and Martin, working together and employing pound charges of flashlight powder set off electrically above water under a white cotton reflecting screen supported on pontoons by the same motion by which the submerged photographer exposed his plate, demonstrated the feasibility of submarine colour photography. The flash was so bright that even the slowly acting autochrome plate could be used for instantaneous exposures. Some of their photographs are reproduced in the article upon COLOURS OF ANIMALS.

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(W. H. L.)

PHOTOGRAPHY IN MEDICINE

There are three principal applications of photography in medical work, namely: (a) Radiography; (b) Photomicrography, and (c) Record photography, *i.e.*, the photographing of patients, specimens, apparatus, etc.

The last named section is a particular branch of technical photography and often the results obtained are unsatisfactory or even useless. This is usually because the camera is regarded as an automatic recording apparatus which can only give one impression of a subject. Hence when it is found that the original is reproduced in an unfamiliar form, with essential details unaccented and irrelevant ones exaggerated, it is naturally thought that the process is inefficient. The truth is that the camera will not discriminate between those details which are required and those that are not; but it is possible to accentuate the former by lighting, etc.

Neglecting for a moment the question of colour, a photograph reproduces in a series of tones the light reflected from the corresponding areas of the subject. If the exposure has been sufficient and the development adjusted to the printing paper used, this representation is correct over a considerable range. The conditions specified are not by any means always fulfilled and much of the failure of photographic recording is due to faulty technique at this stage. The range of tones is limited by the white of the printing paper itself and the black of the deepest deposit, which is about 20 to 1 and, if the intensities of the original subject cover a greater range, accurate reproduction is impossible in a print.

The compressing of an extended scale of tones into a shorter range is not very apparent but, on the other hand, there is a typical photographic distortion of the perspective which is often very noticeable. The perspective as reproduced by the lens of a camera is always mathematically correct but may yet appear unnatural to the eye. The explanation lies in the fact that to see the subject as the lens saw it, it is essential to look at the print from a distance equal to that which separated lens and plate when the exposure was made. The photograph which shows abrupt perspective was taken with a lens of short focal length and, if the print is moved up to that distance from the eye, the perspective will be seen to have become normal in appearance.

To avoid this distortion, it is clearly of importance to use a long focus lens. It is impossible to specify the exact length as that depends on the size of plate used. Such a lens is large and expensive and requires a camera with a long extension and plenty of room in the studio. An alternative method is to use a shorter focus lens on a small plate and make an enlarged print provided the loss in detail is not too great.

Another reason for the failure at times of the photograph lies in the difference between the eye and the plate in their response to light of different colours. An untreated plate is sensitive to the blue and violet end of the spectrum. By treating the plate with certain dyes, it has been found possible to extend the sensitivity first to the green and yellow (orthochromatic plates) and finally to the whole spectrum (panchromatic plates). The latter still retain their excessive sensitivity to the blue end of the spectrum and, in order to obtain a true rendering of the relative intensities of different colours, they must be used with their appropriate light filter. This consists of a piece of dyed gelatine usually yellow in colour placed over the lens.

In some cases, *e.g.*, faint reddish markings on the skin, a correct rendering would be unsatisfactory and here it is necessary to exaggerate the degree of contrast. An ordinary untreated plate, to which red is the same as black is to the eye, will give a more valuable if less correct photograph. Another case where increased contrast is desirable is when the print is to be reproduced by some half-tone process in a publication. The tones of the photograph are broken up into dots and the consequent reduction in contrast implies a somewhat harsher print.

THE PHOTOGRAPHING OF PATIENTS

In the photographing of patients, the most difficult problem lies in obtaining sufficient light. It is frequently necessary to stop down the lens considerably as parts of the subject will be at different distances and the aim of the photographer is a large scale photograph with good detail in every part. Again the slight movement due to breathing, etc., will be sufficient to spoil the finest detail if the exposure is at all prolonged. Hence on both counts, the light must be powerful. Daylight is variable and often not available. In cases where the patient can be moved into a studio, the most serviceable source of artificial light is a battery of large gas-filled electric lamps. The light is under control, any special lighting can be repeated and the volume of light is virtually constant.

Record work in the wards of a hospital is often of extreme difficulty owing to the weakness of the light. Here a magnesium flash lamp enclosed in a fabric bag can often be used. The exposure is practically instantaneous and the bag is afterwards removed and the smoke released outside the room. Care, however, should be taken not to use the apparatus when the slight explosion of the powder might cause distress.

When it is probable that a series of photographs will be required of a subject taken at certain intervals of time, it is most important that the conditions of lighting, position, etc., should not vary, so that the series may be comparable. Especially important is it that each photograph should be taken on the same scale. This is most readily ensured by measuring the distance from the front of the lens to the principal plane of the object and repeating this for the subsequent exposures.

To estimate the value of the degree of reduction, a clearly marked scale divided in feet or inches should be placed at the same distance from the lens as the principal plane of the object and in such a position that it is included in the photograph. The photograph of the scale is measured and the degree of reduction readily calculated.

With the object of making the records more comparative, it is of advantage to work with a series of standard reduction ratios, *e.g.*, $\frac{1}{4}$, $\frac{1}{3}$, $\frac{1}{2}$, etc. The distance lens-to-object is found for each ratio and then the camera placed at that distance and focussed.

The lens for record medical work should be a long focus anastigmat, capable of rendering the finest detail. Very big aperture lenses are seldom of much use in this work owing to their lack of depth of focus. The camera and stand should be rigid with a big range of adjustment. (B. D. H. W.)

PHOTOGRAPHY, CELESTIAL. The invention of photography by Daguerre in 1839 led to a great step in astronomical progress. The first application of the daguerreotype to the science was made by John William Draper of New York who photographed the moon on March 23, 1840, the exposure being 20 minutes. Experiments in the new method were made under the direction of W. C. and G. P. Bond at the Harvard college observatory, with the assistance of Messrs. Whipple and Black,

photographers of Boston, as operators, and the first photograph of the moon was taken there on Dec. 18, 1849, with the 15 in. object glass. A daguerreotype picture of the moon shown in London by George Bond at the Great Exhibition of 1851 attracted much attention.

Historical.—In England, Warren De la Rue, having seen the Harvard pictures, took up the subject and presented to the Royal Astronomical Society, in 1857, positive copies from a negative picture of the moon made by a collodion process that he had found practicable five years earlier. In 1864, Dr. Lewis Rutherford, of New York, made a telescope with object-glass of 11¼ in. aperture so corrected as to bring the photographic rays to focus. About the same time Dr. Henry Draper excelled his father's efforts by taking photographs of the moon with a 15 in. reflector, and early experiments in lunar photography, among them those by Hartnup of Liverpool, should not pass unnoticed.

It is said that the first photograph of a star was a daguerreotype of Vega taken at Harvard observatory on July 17, 1850, but want of sensitiveness made this process rather impracticable, and there was little success in stellar photography until the invention of the collodion plate that was used in America and England in 1852. In November 1857 a photograph of ζ Ursae Majoris with its companion Alcor taken at Harvard was sent for exhibition at the Royal Astronomical Society by W. C. Bond, an exposure of 80 sec. having been given to photograph the 6th magnitude star with the 15 in. refractor. De la Rue at this time was making experiments on the actinic power of Jupiter and Saturn compared with that of the moon, but his photographs did not show any details of the planetary surfaces. Under his direction also, and to his design a photoheliograph was made and set up at Kew observatory for the Royal Society, and the work of taking daily photographs of the sun, that has since been carried on successfully, at Greenwich and elsewhere, began at Kew in March 1858. In an attempt to photograph Donati's comet of that year, De la Rue was not successful though it was photographed by Usherwood, of Walton Common, in 7 sec. with a portrait lens of short focus.

Daguerreotypes of the sun taken by Foucault and Fizeau in 1845, and photographs of the solar eclipses of 1851 and 1854 were interesting as experiments, but the photographs taken by De la Rue and by Secchi of the total solar eclipse in 1860 were the first of this kind of real scientific importance, since they established beyond doubt that the solar protuberances were really appendages of the sun and not of the moon. Ten years later, at the eclipse of Dec. 12, 1870, excellent photographs taken by A. Brothers at Syracuse supplied evidence that the corona was also of solar origin; and from that time a photographic picture of the sun's surroundings has always been an item in the programme of eclipse observation. A series from 1896 to 1922 is published in the *Phil. Trans.* vol. 226 A, and as Appendix to vol. xiv. of the *Memoirs* of the Royal Astronomical Society.

In the years after 1870 research and experiment in photography generally were made by many, among these being the researches of Capt. W. de W. Abney, R.E., made specially for their application to astronomy. It was decided, mainly at the instigation of De la Rue, that photography should be used by the British expeditions in addition to visual observation for the Transit of Venus in 1874, and a considerable sum was granted for the expense of the work, which, so far as the process was concerned, was put in Abney's charge. He realized that the circumstances of the occasion would make a wet-plate process inapplicable and, after experiments conducted at Chatham, recommended the adoption of an albumen dry process, using a highly bromized collodion and strong alkaline development.

Without attempting to give any complete account of Abney's researches mention of the titles of two papers by him—*On Dry Plate Processes for Solar Photography* and *On the Photographic Method of Mapping the Least Refrangible End of the Solar Spectrum*—will indicate their bearing on astronomy. These papers represent a remarkable achievement in that Abney succeeded in producing a special photographic emulsion, sensitive to red light, which he used to map the solar spectrum far into the infra-red. The limit of Abney's measures at 9867A apparently was not reached by any other investigator until the introduction of neocyanin as a sensitizer in 1926.

It was pointed out by the younger Bond that photography might be successfully used to measure the relative positions of stars, of a group, or of double stars and in a letter to the Hon. William Mitchell, dated July 6, 1857, predicted, in effect, the application of photography to stellar astronomy on the magnificent scale that actually exists to-day. Rutherfurd, in 1864, began to make a long series of photographs of star clusters and of the bright double stars; but measures of these appear not to have been completed. In 1870–84 Dr. B. A. Gould in an expedition to the Southern Hemisphere accumulated negatives of the principal double stars and clusters; but in taking these series the wet plate process was used, and with this it was not possible to give an exposure long enough for faint stars to imprint themselves. With the invention of the gelatine dry plate, which had been used by Huggins for spectrum photography in 1876 and came into general use about 1880, this difficulty did not exist and modern astronomical photography became possible. Circumstances connected with the comet of 1882, which was specially magnificent as seen from the Southern Hemisphere, led to developments. A photograph, taken with a camera strapped for the purpose to the great equatorial of the Royal observatory of the Cape of Good Hope, showed not only the comet but great numbers of faint stars around it, and this at once gave David Gill, H.M. Astronomer at the Cape, the idea of the possibility of making star charts by photography. Effects of various kinds followed. At Paris the brothers Henry of the National observatory were engaged in the laborious task of plotting the positions of stars found by eye observation to make charts of the stars near the Ecliptic; but this work was abandoned and their efforts were devoted to making a telescopic object-glass suitable for photography. Ainslie Common in England turned to the art and with a three foot silver-on-glass mirror took a photograph of the Orion Nebula on Jan. 30th, 1883, with an exposure of 37 min., a feat that earned for him the Gold Medal of the Royal Astronomical Society in 1884, and was referred to as "epoch-marking" by Abney when presenting the medal to another non-professional astronomer for similar work eleven years later. A photograph of this object taken by Dr. Henry Draper of New York on Sept. 30, 1880 is said to be the first of a nebula obtained, but it is agreed that this was not a satisfactory representation. The later recipient of the medal above mentioned was Isaac Roberts, a business man of Liverpool, who in 1885, had made a 20 in. silver-on-glass reflector of nearly a 100 in. focal length for the purpose originally of making star-charts by photography, but altered his plans and devoted the instrument to photographing star-clusters and nebulae. The excellent pictures produced at his observatory at Crowborough, Sussex, are in two volumes published during his lifetime, supplemented by a third prepared and issued by his widow in 1928.

A copy of Common's remarkable photograph of the Orion nebula in the possession of Holden had much to do with the acquisition by the Lick Observatory in 1895 of the 3-foot reflector with which it had been taken. This mirror, made by Calven, was presented to the observatory by Mr. Crossley of Halifax, England, and the instrument is known by his name. In Keeler's hands it yielded a superb series of photographs of nebulae which for the first time demonstrated the great advantages of the reflecting telescope for certain classes of astronomical photography and led to the construction of the great modern reflectors.

Charts of the Heavens.—The advantage that photographs of clusters and nebulae have over visual observation is obvious. A glance at a photograph shows the whole of the object in all its beauty. The field of view of a telescope is small, and a complete conception of the nebula has to be built up from successive elements. It has already been mentioned that Gill foresaw the possibility of recording the positions of stars from a single plate; the next step was to connect individual plates to make a complete survey of the heavens, as had been, and is, the final aim and purpose of transit-observing. The first effort in this direction was made by Gill, who (1885–89), took photographs covering the sky from the South Pole to declination 18° S. which, measured by

Kapteyn of Groningen, gave approximate co-ordinates and magnitudes of nearly half a million stars that form the Cape Photographic Durchmusterung. In a more ambitious scheme initiated in 1887 by Admiral Mouchez, director of the Paris observatory, 18 observatories of the world combined to make the Astrographic Chart, or a picture of the whole sky, which should show all stars down to the 14th magnitude, to which was added later the making of a catalogue of all stars to magnitude 11, now considered the more important part of the work. Space does not permit description of its details and methods. It must suffice to say that a great portion of the catalogue is already published and that, though some sections of the Chart are completed, the end is not yet in sight.

In this connection mention is to be made of a series of plates that came later, taken by Franklin Adams, a man well known in business circles in the City of London, in 1903, 1904, at the Cape of Good Hope and afterwards at Godalming, Surrey, with a photovisual objective (*v.* p. 837) of 10 in. diameter, devised for the work by the firm of Cooke and Sons. These plates each cover an area of $15° \times 15°$.

The extreme delicacy of the gelatine film, especially during development and fixation, led in the beginning to a certain distrust of measurements made on photographic plates. Experience has shown these fears to be groundless and that photographic methods are well suited to measurements of the most exacting kind. With properly designed instruments, the economic factors are also favourable. A recent undertaking, proposed by Schlesinger, which effectively utilizes these advantages, is the photographic reobservation of the zones of the great Astronomische Gesellschaft catalogue, originally measured with meridian circles at many different observatories. As an early example of astronomical work effected by the measurement of photographs mention may be made of the determination of stellar parallaxes by Pritchard at the Oxford University Observatory in the year 1887, and the remark made at that time that this initiated a new method of finding the distances of stars is amply justified, for to-day many observatories are pursuing that plan. Most researches that depend on the measurement of small distances are now made by means of the photographic plate, close double star observing being an exception. Hertzsprung has devised methods involving the use of a grating and colour filters to ensure freedom from error in finding the distance between the components of double stars and their position angles, but it is considered that the photographic method is unsuited for pairs whose separation is less than about a second of arc. Photographing stars through a grating of parallel wires placed before the objective, which produces a pair, or perhaps a series of pairs of diffraction images of each star, is a scheme practised in other branches of modern astronomy and astrophysics.

Besides the advantages already mentioned, others that pertain to the sensitive plate are that its impressions are cumulative to an indefinite extent; it can see where the eye is blind. Its impressions are permanent and constitute evidence that can be referred to at pleasure. Faint comets are discovered by photographing the region in which the object is believed to lie and searching the developed plate. A similar method for finding minor planets has been very fruitful and examination of the series of celestial photographs of the Harvard College Observatory has brought to light many Novae that have appeared in past years but have escaped detection. This collection of photographs which has been accumulated systematically over many years constitutes a record of the state of the sky at approximately regular intervals. It has been especially fruitful in the discovery of variable stars.

Modern Applications.—Besides lending its aid to these branches of astronomy of the older kind, photography is now an asset in the newer astrophysics. It was recognized early that the brighter the star the larger the image it imprints on the plate, and hence that it is possible to use photography for purposes of photometry. The relation between the size of the image and the intensity of the star's light is complicated. So many factors difficult of control are involved that an empirical method of calibration is usually employed, though some progress has been made with methods based on the laws of photographic action. Usually a star is not of the same magnitude photographically and visually because the ordinary plate is sensitive only to the blue and violet rays of the spectrum, whereas it is the yellow light that mainly affects the eye. Since the relative amount of blue and yellow light depends on the colour of the star, the difference between photographic and visual magnitude varies with colour. This difference—colour index—affords a useful measure of this physical characteristic, and, through this, of the star's temperature. Visual magnitudes may be closely reproduced by photographing stars on colour-sensitive plates, through a filter which cuts out the blue and violet light and transmits the green and yellow. The whole field of stellar photometry is thus brought within the reach of photographic methods, with a great gain in precision and homogeneity of results. The equivalent of visual magnitude determined photographically is called photo-visual, and by comparing this with the ordinary photographic magnitude colour index is determined free from any personal eye effects. The colour index of a star correlates with its spectrum, and takes its place as a quality that can be discussed in relation to others such as temperature, mass and motion.

A slight extension of the method has led to interesting and important results in connection with nebulae.

A comparison by Hale of ordinary photographs of the Orion nebula with exposures on panchromatic plates through a red filter shows conspicuous differences in colour in different parts of the nebula which indicate a variation in the mixture and radiation of its gaseous constituents. Again, similar photographs of spiral nebulae by Seares show that the central nuclei of these objects are yellow, in agreement with spectroscopic results, but that the knots and condensations on the spiral arms are blue. These results indicate a characteristic difference in physical conditions in different parts of these nebulae.

Photography through coloured screens or filters of various kinds has been applied recently to the planets. Photographs of Mars and of Jupiter, by Wright of the Lick Observatory, taken with rays of the infra-red portion of the spectrum, with yellowy light, and with ultra-violet rays, show distinct differences, consideration of which appears to lead to knowledge of peculiarities of the surfaces and atmospheres of these bodies. Similar photographs of Venus by Ross give important information bearing on the physical characteristics of this planet.

Colour photographs of the kind described represent a crude kind of spectrum analysis, in which attention is directed to the total radiation over a considerable range in wave-length rather than to the number, position and intensity of the spectral lines. The method is important and useful for objects too faint for detailed spectroscopic examination.

The astronomical applications of photography would be seriously restricted were there no means of extending the normal blue-violet sensitivity of the ordinary photographic emulsion.

Vogel in 1873 discovered that various dye substances, notably naphtalinrot, conferred sensitiveness to other spectral regions. Vogel's results were confirmed and extended by E. Becquerel, by Waterhouse, who discovered the efficiency of eosin; by Eder, who introduced erythrosin; and by many others. Schumann announced the effectiveness of cyanin as a red sensitizer, and Valenta and Eberhard, 1897–1904, made extensive studies of a great number of sensitizers, which led shortly to the production of panchromatic plates. Dicyanin and, more recently, kryptocyanin and neocyanin have played a great part in extending the sensitivity far into the infra-red. All modern research in colour sensitization has been concerned with the study of dye substances. Abney's special red-sensitive emulsion seems never to have been reproduced.

The first great astronomical achievement resulting from the preparation of colour-sensitive plates was Abney's map of the infra-red region of the solar spectrum to which reference has already been made; the next, Rowland's photographic map of the solar spectrum and the Table of Wave-Lengths of Spectrum Lines, extending from 2975A to 7331A, from measurement of photographs. Rowland himself made the photographic plates that he used; the method of colour sensitization he employed is unknown. A recent application of colour photography to astronomy led to Hale's

iscovery of magnetic fields in sun-spots Using Wallace's 3-dye ensitizer consisting of pinacyanol, pinaverdol, and homocol, Hale hotographed with the spectroheliograph the distribution of hydro- en (Hα) over the solar disc. The presence of vortex structure entered about sun-spots suggested the possible existence of mag- etic fields, which special observations soon fully confirmed.

Spectroscopic observation itself is now almost entirely photo- raphic. In 1863 Huggins obtained photographic images of the ectra of Sirius and Capella but no clearly defined lines were own, and attempts of this kind were suspended for some years . is said that the first photograph showing spectral lines of a ar was taken by Henry Draper in 1872, and in the years imme- iately succeeding both these astronomers were successful in this ay with the brightest stars In 1882 each of them obtained a sat- factory photograph of the spectrum of the Great Nebula in rion. In 1886 a new spectrographic method was initiated at the arvard College Observatory in connection with a scheme known s the Draper Memorial, a prism being placed before the object- ass by which the spectra of *all* the stars in the field are formed d photographed simultaneously on the plate. The instrument en used was a photographic lens of 8 in aperture with a prism in. square fastened before it. The refracting angle of the prism as 13°, and the refracting edge was placed parallel to the equa- r, so that breadth could be given to the spectrum by altering e rate of the driving clock Stars to about the 7th magnitude ere thus shown In 1887 Vogel introduced the photographic ethod at the Astrophysical Observatory at Potsdam for the etermination of stellar radial velocity, and from that time, which generally said to mark the beginning of accurate work of the ind, all important spectroscopic work has been done in this way. nprovements and refinements in design of the spectrograph, specially the introduction of a temperature control for use uring observations, were made by Campbell at the Lick Ob- ervatory. These afforded a new standard of precision in ectroscopic measurements, and led to an extended programme volving the systematic observation, at Mt Hamilton and at antiago, of 6,182 stars mostly brighter than visual magnitude ·51 The resulting catalogue of radial velocities, issued in 1928, ould not have been prepared without the aid of photography.

Photographic methods have proved themselves equally indis- ensable in every other field of spectroscopic observation The easurement of the distance of a star from observations of its ectrum, by a method discovered by Adams and Kohlschutter nd developed by Adams at Mount Wilson, essentially requires e determination of the relative intensity of certain pairs of ectral lines Star light, in general, is far below the limiting tensity which would permit even the crudest visual observation f these intensities, and this is often true of laboratory sources f light which must be studied as a means of interpreting the bservations of celestial bodies Even for the sun, which gives an bundance of light, measures are most advantageously made on hotographs. In the infra-red and ultra-violet regions, outside the mits of visual perception, photographic methods alone are pos- ible. The novel instrument known as the spectroheliograph con- eived independently by Prof Hale and M Deslandres, director of he National Observatory, Paris, is an ingenious adjunct to spectral hotography. On a plate moving behind a second slit at the rear of spectroscope at the same rate as the image crosses the primary lit, or by an equivalent device the sun is photographed by the ght of a particular wave-length and pictures result which show he calcium or the hydrogen alone, in the successive envelopes of he sun, and so add vastly to our knowledge of its structure. The elp that photography brings to eclipse observation by making complete record of the spectrum of the chromosphere or of the orona in the very short time available on such occasions, that ay be studied at leisure, need not be dwelt on

Photographic Telescopes.—In the ordinary telescopic objec- ive the lenses are so shaped that the rays of the spectrum about he yellow are brought as nearly as possible to pass through the ame point as focus, for these are the rays to which the eye is ensitive; but for photography it is the blue and violet rays that ust be brought to a focus, for it is these that most affect the plate An objective of two lenses may be made to do this, but necessity has led to the making of photo-visual objectives of three lenses that are perfectly or nearly achromatic, and focus all the rays (*v.* p. 836, Franklin-Adams). It is possible to use a visual telescope for photography by adding a correcting lens, and another scheme for the purpose, adopted for the 40 in. refractor of the Yerkes observatory about 1900, is to take photographs through a yellow colour screen or filter placed almost in contact with the photographic plate, which is made specially sensitive to yellow light The yellow screen transmits freely to the plate the sharp yellow image produced by the visual objective and excludes the blue and other wave-lengths which would otherwise destroy the sharpness of the photographed images In the case of a reflector which brings all rays equally to the same focus this necessity for colour correction does not arise

In this particular the advantage of the reflector over the refrac- tor is very great. The field of view of the reflector, however, is relatively small For a focal ratio of 1 to 5 the aberrations of the reflector are disturbing at distances from the optical axis exceeding 12′ to 15′, and there is considerable loss in limiting magnitude for even smaller distances, whereas a properly designed refractor affords excellent definition over a field several degrees in diameter Measures with reflectors are therefore limited to double stars or satellites of planets, or to the determination of proper motions and parallaxes, etc , while the refractor finds advantageous application to general charting and cataloguing purposes

That the optical possibilities are by no means exhausted is indi- cated by the quadruplet lens recently designed by F. E. Ross which, with an aperture of 3 inches and a focal ratio of 1 to 7, gives excellent definition over a field of 25°, and in two hours exposure reaches a limiting magnitude of 15 4.

The choice of aperture and focal ratio for a photographic tele- scope depends on the purpose for which the instrument is to be used and is determined by the same principles that apply in ordinary photographic practice Increased focal length means in- creased scale or magnification in the photograph For a given focal length, increased aperture means greater brightness in the optical image, and hence greater photographic efficiency, which may be utilized either to reduce the exposure time or to photograph fainter objects than would otherwise be possible For extended objects like planets or nebulae, the brightness of the image is proportional to a^2/f^2. The photographic efficiency is independent of the linear dimensions, and the chief advantage of a large instrument is that of magnification At the same time, the instrument must not be too small, otherwise the power of resolution or minimum separa- tion which varies inversely as the aperture, will suffer For point sources, such as stars, the diameter of the central diffraction disc of the image decreases as the aperture increases This introduces an additional factor a^2, whence the brightness is proportional to a^4/f^2 For a given focal ratio there is in this case an important gain in efficiency with increasing aperture, although it is less than the elementary theory would indicate Aberrations and absorption and reflection losses in the objective, imperfections in the optical surfaces, and tremor of the diffraction disc, caused by atmospheric disturbances, all operate in diminishing the theoretical gain

The application of these principles to different classes of obser- vational problems is well illustrated by some of the instruments of the Mount Wilson Observatory For observations of the sun, both direct and spectroscopic, high magnification is desirable Since there is an abundance of light, the focal ratio need not be large, and, further, since a moderate aperture affords adequate resolution for photographic purposes, the dimensions chosen for the larger Tower telescope are $a=1$ foot, $f=150$ feet, with a ratio of 1 to 150 For the efficient photography of very faint stars, both the focal ratio and the linear dimensions should be as large as possible Hence in the Hooker reflector we find $a=100$ inches, $f=500$ inches, with a ratio of 1 to 5 Under favourable atmospheric conditions, the theoretical gain over the 60-inch reflector, of the same focal ratio, in photographing stars is very nearly attained. Aside from differences of scale, these two instruments are of equal efficiency in photographing nebulae. For planets, however, the 100-in is practically the more effective For the same magnification (enlarg-

ing lenses are commonly used in planetary photography) this instrument gives a brighter image than the 60-inch reflector. This permits the use of shorter exposures, which avoids in part the blurring produced by atmospheric disturbances. The useful field, the same for both reflectors, is necessarily small (*v.* p. 837). For photographs covering a large field, a triplet refractor is available ($a = 10$ inches, $f = 45$ inches, $a/f = 1/4{\cdot}5$). Because of the focal length, the scale is small. Otherwise, this instrument is of about the same efficiency for nebulae as the large reflectors, and because of the large field, is very advantageous for photographing widely extended masses of nebulosity. Its large focal ratio makes it an efficient instrument for stars, although the limiting magnitude attainable falls far short of that reached by the reflectors.

The limiting stellar magnitude attainable with a given instrument, as shown by F. E. Ross, does not increase indefinitely as the exposure time is extended. In order that a perceptible image of a star may be recorded, the contrast between sky illumination, which is always present in some degree, and sky illumination plus brightness of the central diffraction disc of the star image, must not drop below a certain minimum value. The effect of sky illumination is determined by the ratio a^2/f^2; with the reservations expressed above the brightness of the optical star image varies as a^4/f^2. Increase in the linear dimensions increases the latter, but not the former ratio. These ratios, together with certain photometric constants, determine the limiting magnitude attainable by prolonged exposure with any instrument. To photograph still fainter stars an instrument of larger aperture must be used.

The plate may be placed in the principal focus of the objective, and the image enlarged afterwards if desired; but the amount of the subsequent enlargement is limited by the grain of the original negative, which is equally enlarged by the copying process. On the other hand, a lens or combination of lenses may be interposed between the objective and the plate to give an enlarged image on the latter. In the Greenwich photoheliograph the image of the sun is enlarged on the plate in this way and the method is often used in planetary photography. For bright objects it is advantageous; but for fainter ones the exposures required may be impracticably long. The contrast also suffers, but this may be corrected by subsequent copying on plates of strong contrast.

In the early days of astronomical photography the inferior performance of the driving-clock of the equatorial was found to be a drawback, but this has been remedied, first by the introduction of electrical control and secondly by improvements in design and construction of driving-clocks, which are now of such perfection as to render electrical control unnecessary. The slight residual irregularities are eliminated by the use of the twin instrument consisting of two parallel telescopes of nearly equal size in the same frame, one of which is used visually by the observer to guide; or otherwise by the double-slide plateholder and duplicate guiding microscopes, to be used on two guiding stars on opposite sides of the field to detect the small rotation which may occur during exposures. (H. P. H.; F. H. S.)

PHOTOGRAPHY, SPARK: *see* SPARK PHOTOGRAPHY.

PHOTOGRAVURE (MACHINE). Photogravure (machine printed) is a photo-mechanical intaglio printing process. By this method prints are obtained from a plate or cylinder upon which the design is etched below the surface.

The subject to be reproduced is photographed and "reticulated" by means of a ruled screen, the "cavities" varying in depth according to the tones of the original; thus the solids are deeper and contain more ink than the middle tones, while the high lights are represented by the paper. The characteristic of this class of printing is revealed by its velvety depths and satin-like finish.

Machine photogravure was invented by Karl Klietsch, who, in conjunction with a firm of calico printers in Lancaster, produced prints by this method in 1895, although previous to this an employee of the firm, Samuel Fawcett, had been working an intaglio photo-engraving process of his own. The latter assisted Klietsch in perfecting the process now known as "Rembrandt" photogravure. The method of producing prints by the Rembrandt process was kept a close secret, and for many years those interested in reproductive processes had no authentic information as to how the printing plates were produced. In time, however, prints by similar processes were published, but these, at the time, were not equal to those printed by the Rembrandt process.

The principle of producing photogravure prints by machine is similar to that of printing calico and wallpaper, where engraved copper cylinders are used and printed on a rotary machine.

After the etching of the photogravure plate or cylinder has been completed the printing is of a mechanical character. The etched cylinder turns in a trough of printing ink of volatile qualities (sometimes a "water ink" is used), and as the cylinder rotates a fine steel knife, known as the "doctor," scrapes the surplus ink from the surface, leaving it clean. The cells or cavities, however, representing the tones of the design, retain the ink, which is transferred to a sheet of paper as it passes between the printing and impression cylinders.

Preparing the Printing Surface.—From the photographs of the subjects to be reproduced negatives are obtained. These are carefully retouched and reversed positives are made from them and, when necessary, again retouched. The positives—usually called transparencies—have then to be "planned" or laid out, *i.e.*, fixed by means of gummed tape upon a sheet of plate glass in the positions in which they will be printed.

A carbon print is next obtained on what is known as "carbon tissue" (a sheet of paper coated with a gelatine solution to which has been added a pigment—usually red—and sensitised by immersion in potassium bichromate, squeezed on to a sheet of glass, and dried). A piece of carbon tissue is cut slightly larger than the positives and placed along with the positives in a special pneumatic printing frame from which the air is extracted, thus bringing the positive and tissue into close contact. These are exposed to light, the positives are removed, and another exposure is given to the tissue through a specially ruled screen. The screen "breaks up" the tones of the photograph and provides the reticulation which is necessary for all printing processes. The usual ruling of the screen is 150 or 175 lines to the inch. The carbon tissue is next soaked in water and placed on the copper plate or cylinder which has previously been made chemically clean and free from grease. The tissue is then "squeegeed" in order to remove all moisture and air from between the tissue and the printing surface, which is then dried.

Developing.—The next operation is known as developing, and is done by placing the cylinder or plate, on which the carbon tissue has been fixed, in a tank of water heated to about 104° F and kept agitated until the paper is soaked off and the soluble parts of the gelatine film washed away. The parts where the light passes right through the positive become hard and are insoluble, whilst those parts where the light is retarded by the tones in their various gradations are more or less soluble.

When the development is completed the cylinder, with all that is left of the gelatine film, is removed from the water bath and thoroughly dried. This film acts as a resist to the mordant. All parts of the printing surface which are not required to be etched are protected by an acid-resisting preparation. This is painted on by hand, or, as it is termed, "lacked out."

Etching.—The printing surface has then to be etched, which is done by placing the cylinder in baths of varying concentrations of ferric chloride ranging from 45° to 37° Beaume. The thinner parts of the hardened gelatine acid resist are attacked first by the mordant, the thicker parts requiring further etching by the weaker solutions.

It is possible to use the copper cylinders over and over again, the old work being removed by grinding and polishing. In this way cylinders are prepared to receive the new work. In time, however, the grinding wears the cylinder, but this may be brought back to its original circumference by electrolytic deposition.

Machines.—Sometimes flat plates are used. In this instance the machine is of an ordinary flat-bed type upon which a plate is mounted on a bed and covered over with ink, the "doctor" scraping the surplus ink from the face of the plate back into the trough; the general method, however, is to employ cylinders.

Recently, a method has been invented whereby a thin sheet

of copper is stretched round a cylinder. There is reason to believe that this will supersede the cumbersome cylinders now in use

The paper is fed into the machines either one sheet at a time or from a reel. The sheet-fed machine is generally used for small editions of art reproductions, whilst those that are reel-fed are used for long runs of magazines and newspaper supplements and other commercial requirements.

In a rotary press the cylinder revolves in a trough of ink, and a few inches above the trough is a "doctor"—a steel plate with a fine edge which has a slight reciprocating movement that scrapes the surplus ink off the surface, the ink dropping back into the trough. The paper, which is on a reel, passes between the etched cylinder and an impression cylinder In this way an impression of the etched design is transferred to the paper The paper then passes over a drying drum, and if the sheet is to be "perfected," *i e*, printed on the reverse side, it goes through another pair of cylinders before reaching the delivery end of the machine, where the paper is cut up into sheets or delivered folded according to requirements

It is possible by the photogravure method to print type matter at the same time as illustrations, and successful results are now being obtained when printing colour supplements by machine photogravure

Machine printed photogravure is known under various names, usually containing a prefix, such as rotogravure, indicating that it is printed on a rotary machine

See PHOTO-ENGRAVING, COLOUR PRINTING.

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PHOTO-LITHOGRAPHY: *see* LITHOGRAPHY

PHOTOMETRY is, as its name signifies, the measurement of light (Gr. φῶς, φωτός, light, μέτρον, a measure) Just as metrology includes the measurement of various related quantities, *e.g*, length, volume and density, so photometry includes the measurement of luminous intensity (candle-power), luminous flux, illumination and brightness. It will be convenient first of all to consider the relationships between these four fundamental quantities and the units in terms of which they are expressed, so that the methods of measurement adopted for each may be more readily understood Every object which can be seen emits or reflects radiant energy in the form of aether waves which are capable of affecting the retina of the human eye so as to produce the sensation of light In the case of a self-luminous body (or source of light) such as the sun, a candle or an electric lamp, the light emitted is obtained by the transformation of some other form of energy, generally chemical or electrical In the case of a body which is not self-luminous the light which it sends to the eye is derived originally from some self-luminous body, and is reflected by it in a manner depending on the character of its surfaces.

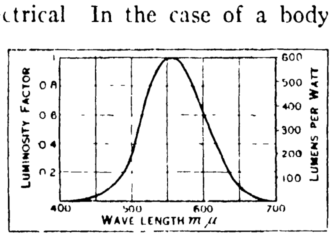


FIG 1 —LUMINOSITY CURVE OF RADIANT ENERGY FOR THE AVERAGE EYE

The effect produced on the eye by the reception of a given amount of energy per second depends on the wave-length (λ) of the aether waves by which that energy is conveyed, in fact only those waves for which λ lies between about 400 and 750 millionths of a millimetre $m\mu$ can produce the sensation of light at all As the wave-length changes from the shorter of these limits to the longer, the effect produced on the eye alters in two respects In the first place the colour of the light changes from violet, through blue, green, yellow and orange to red. In the second place the intensity of the sensation produced by a given rate of influx of energy starts from zero at 400 $m\mu$, rises to a maximum at $\lambda = 555$ $m\mu$, and then gradually falls away again to zero at 750 $m\mu$ The curve of fig 1 shows the relative magnitudes of the visual effect produced by the reception of equal amounts of energy per second at different wave-lengths. This curve is called the *luminosity curve* (sometimes the *visibility curve*) of radiant energy. It is naturally slightly different for each individual, but the curve shown is that now adopted internationally as representing the effect on the "average eye" The scale of ordinates at the left is an arbitrary one so arranged that the ordinate of the curve is unity at the wave-length of maximum luminosity On this scale the ordinate corresponding to any wave-length is termed the "luminosity factor" of radiant energy at that wave-length.

Luminous Flux.—The light given by every source in common use is composite in character, *i e*, the energy is conveyed by waves of various lengths, the distribution of energy among these wave-lengths (or the *spectral energy-distribution*) depending on the source It is clear that the total effect produced on the eye by a given rate of emission of energy of known spectral distribution can be determined by weighting the energy content at each wave-length in accordance with the *luminosity factor* for that wave-length The quantity obtained in this way represents, in fact, the efficacy of the energy for producing the sensation of light, and this quantity is termed *luminous flux* The formal definition of this term is. The rate of passage of radiant energy evaluated according to the luminous sensation produced by it

The unit in which luminous flux is expressed can be more simply defined later It is sufficient here to state that it is called the *lumen* and that it has been found that for the average eye, one watt of radiant power at the wave-length of maximum luminosity (555 $m\mu$) is equivalent to about 600 lumens The scale of ordinates at the right of fig 1 gives the lumen equivalent of 1 watt of power at each wave-length The watt equivalent of 1 lumen of flux at the wave-length of maximum visibility, viz, 0·0016 watt per lumen, is often termed the *mechanical equivalent of light*

Luminous Intensity.—The luminous flux emitted from any practical source of light is not distributed uniformly in all directions In the case of an electric lamp of the vacuum type, for instance, the flux emitted within a cone of given solid angle is greater when the axis of the cone is horizontal than when it is vertical It follows that some quantity is needed to express the light-giving power of a source in a specified direction The natural quantity to use for this purpose is the angular flux density in the direction considered This will be clear from fig 2 If BLC be a cone of very small solid angle ω, having its apex at L, the position of a source of light, then the angular flux density in any direction such as LA is equal to the flux emitted by L within the cone BLC, divided by the solid angle ω, the ratio being taken in the limit when ω becomes vanishingly small This ratio is termed the *luminous intensity* of the source L in the direction LA It will be seen that the definition of luminous intensity is analogous to that of pressure at a point, viz, the ratio of the force exerted on a given surface containing the point to the area of that surface, the ratio being taken in the limit when the area is vanishingly small The formal definition of luminous intensity is as follows —The luminous intensity of a point-source in any direction is the luminous flux, per unit solid angle, emitted by that source in that direction (The flux emanating from a source whose dimensions are negligible in comparison with the distance from which it is observed may be considered as coming from a point)

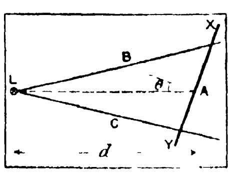


FIG. 2

The relation between luminous flux and luminous intensity being thus defined, it is possible to choose units for these two quantities such that their magnitudes are related rationally to each other It so happens that, for historical reasons, the primary photometric unit is that of luminous intensity This unit is the *international candle*, the magnitude of which was originally defined as the luminous intensity, in the horizontal direction, of a candle of specified dimensions burning at a specified rate Many years ago this form of standard was found to be unsatisfactory, and it was replaced by flame lamps of various kinds, viz, the Hefner in Germany, the pentane in this country and in America, and the Carcel lamp in France These standards have been generally abandoned, however, and the magnitude of the unit is preserved by means of specially constructed electric lamps deposited

at the various national laboratories throughout the world, viz., the Laboratoire Central d'Electricité, Paris; the National Physical Laboratory, Teddington, England; and the Bureau of Standards, Washington. The formal definition of the "candle" is as follows:

The unit of luminous intensity is the international candle, such as resulted from agreement effected between the three national standardising laboratories of France, Great Britain and the United States in 1909. The unit of luminous flux is now very simply obtained from that of luminous intensity by considering an ideal source of light which has a uniform luminous intensity of one candle in all directions. The lumen is the amount of flux emitted by such a source within a cone of unit solid angle.

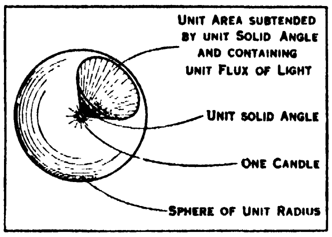


FIG. 3.—RELATION BETWEEN THE PHOTOMETRIC UNITS

The relationship is shown pictorially in fig. 3 where the ideal point source is imagined at the centre of a sphere of unit radius. Since the solid angle of any cone with its apex at the centre of such a sphere is numerically equal to the area of the spherical surface cut off by the edge of the cone, it follows that the cone shown shaded in the diagram embraces unit solid angle, so that the flux emitted by the source within this cone is 1 lumen. Since the area of the whole sphere is 4π times the square on the radius, it follows a uniform point source of 1 candle emits altogether 4π lumens. Since the total flux emitted by a source is independent of the way in which that flux is distributed, the total number of lumens given by a source is equal to the *average* value of its luminous intensity, measured in all directions in space, multiplied by the factor 4π. The luminous intensity of a source, when expressed in international candles, is termed the candle-power of the source. The average value of the candle-power measured in all directions perpendicular to the geometrical axis of the source is termed *the mean horizontal candle-power* (M.H.C.P.), while the average candle-power measured in all directions in space is termed the *mean spherical candle-power* (M.S.C.P.). It will be seen that, for any source, M.S.C.P. $= 4\pi \times$ (flux output in lumens).

Illumination: The Inverse Square and Cosine Laws.—Illumination is measured by the amount of luminous flux which reaches unit area of an illuminated surface. From this definition and the fact of the rectilinear propagation of light there follow at once the two basic laws of photometry, viz., the inverse square and the cosine laws. They will be most clearly understood by reference to fig. 2. If BLC be an elementary cone of light emitted from a source L, the area intercepted by this cone on any plane such as XY varies (i.) as the square of the distance (d) of L from the plane, and (ii.) as the secant of the angle (θ) which the normal to XY makes with the axis LA of the cone. Since the illumination produced by a given amount of flux varies inversely as the area over which that flux is distributed, it will be seen at once that the illumination of a surface varies (i.) inversely as the square of its distance from the source illuminating it (this is the inverse square law), and (ii.) directly as the cosine of the angle between the normal to the surface and the light rays (this is the cosine law).

Now let the average luminous intensity of the source L in all directions lying within the cone BLC be I candles, and let the area intercepted by this cone on the plane XY be s. Then the solid angle of the cone is equal to $(s \cos \theta)/d^2$, and the flux F emitted within the cone is $I\,(s \cos \theta)/d^2$ lumens. Since, by the definition, the illumination, E, of the surface is equal to F/S, it follows that

$$E = (I \cos \theta)/d^2$$

It will be seen that the magnitude of the unit in which E is measured must depend on the unit used for d, *i.e.*, on the unit of length. If d be expressed in feet, the unit in which E is measured is termed the *foot-candle* and, clearly, one foot-candle is the illumination produced when an area of one square foot receives one lumen of flux. Similarly, if d be expressed in metres, the unit of E is the *metre-candle* or the *lux*, and one lux is equivalent to an illumination of one lumen per square metre. It will be seen that 1 ft.-candle = 10·76 lux.

Brightness.—The last of the four fundamental photometric quantities is brightness, which is thus defined: The brightness in a given direction of a surface emitting light is the quotient of the luminous intensity measured in that direction, by the area of this surface projected on a plane perpendicular to the direction considered. The unit of brightness is the candle per unit area of surface. Thus if a flame of uniform brightness has an apparent area of one square inch when viewed in a given direction, and if the luminous intensity in that direction be 10 candles, the brightness is 10 candles per square inch. Similarly, if a surface has an area of two square metres and if its brightness when viewed normally is one candle per square metre, it has a luminous intensity of 2 candles in the direction of the normal.

The surfaces of bodies may be divided broadly into two classes, polished and diffusing, according as they reflect specularly the light they receive, after the manner of a mirror, or scatter it in all directions. A surface which scatters the light which it reflects or emits in such a way that it appears equally bright in all directions is called a "perfect diffuser." No such surface exists in perfection, but good white blotting-paper, or ground opal glass provide a fair approximation. It is sometimes convenient to use as a unit the brightness of an ideal perfect diffuser emitting or reflecting one lumen per unit area. It can readily be shown that such a surface has a brightness of $1/\pi$ candles per unit area. Thus the following relationships are derived:

1 lambert $= 1/\pi$ candle per sq.cm.
1 millilambert $= (0{\cdot}001)/\pi$ candle per sq.cm.
$= 10/\pi$ candles per sq metre.
1 foot-lambert $= 1/\pi$ candle per sq.ft.
$= 1{\cdot}076$ millilamberts.

Absorption, Reflection and Transmission.—It has been said already that bodies which are not self-luminous are visible by reason of the light which their surfaces reflect to the eye. It will be clear that, since a surface which has an illumination of one foot-candle receives one lumen per square foot, its brightness would be one foot-lambert if it were a perfect diffuser and if it reflected all the light it received. Actually, all surfaces absorb some fraction (α) of the light which reaches them and reflect or transmit the remainder. α is termed the absorption factor, while the fractions reflected and transmitted are termed respectively the reflection factor (ρ) and the transmission factor (τ). For opaque bodies it is clear that $\alpha+\rho=1$, while for all surfaces $\alpha+\rho+\tau=1$. In general the values of these three quantities depend on (a) the direction of incidence of the light on the surface, and (b) its colour. Only in the case of white or grey surfaces is the colour of the light immaterial. The brightness of a surface due to reflected light is clearly equal to $E\rho/\pi$ candles per square foot or $E\rho$ foot-lamberts, E being the illumination in foot-candles and ρ the reflection factor for the particular conditions of illumination and the direction of view considered.

Every photometric measurement depends, ultimately, upon a measurement of the illumination produced at a surface. In the case of candle-power determination, the source to be measured and a standard of known candle-power respectively illuminate two white diffusing surfaces in a photometer head which is, in essence, a device for enabling the eye to compare the brightness of these surfaces as accurately as possible. The chief conditions for accuracy are (a) that the surfaces shall be presented to the eye side by side with the finest possible dividing line, and (b) that the illumination of one or other of the surfaces may be varied according to a known law, so that the two may be adjusted to equal brightness. This is necessary because the eye cannot *measure* accurately, but can only judge of a condition of equality.

The Lummer-Brodhun Photometer Head.—The form of photometer head generally used to-day for accurate work is the Lummer-Brodhun contrast-head, the construction of which is shown in fig. 4(A). S is a matt white screen, the two sides of which are respectively illuminated by the two sources to be compared. Light from each side of S is reflected by the mirrors (or total

reflection prisms) M_1 and M_2 to the compound glass cube P. An enlarged view of P is shown in fig. 4(B), from which it will be seen that the cube really consists of two right-angled prisms. One of these, P_1, is plain, while the other, P_2 has its principal face etched or sand-blasted with the pattern shown shaded in fig. 4(C). The two prisms are pressed together so that the unetched parts of the surface of P_2 make optical contact with the surface of P_1. The

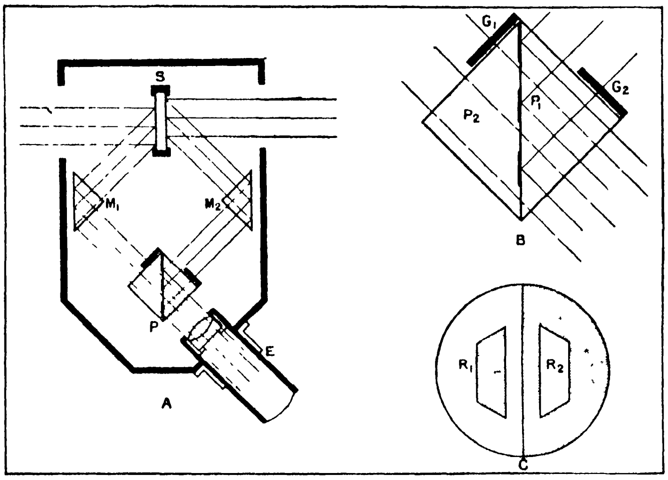


FIG 4 —THE LUMMER-BRODHUN HEAD

light from M_1, therefore, is transmitted through these portions just as if there were no discontinuity The light from M_2 is also transmitted through these portions of the face of P_1, but over the remainder, the portion shown shaded in fig 4(C), it is totally reflected and emerges side by side with the light transmitted from M_1 It will now be seen that if the eyepiece E is focussed on the interface of P, the appearance of the field is that illustrated in fig 4(C), the portion shown shaded being occupied by an out-of-focus image of the right-hand side of S, while the portion shown clear is filled by the left-hand side of S. *Assuming complete symmetry of the instrument*, it follows that when both sides of S are equally illuminated, the field of view will appear uniformly bright, and the lines of demarcation of the various parts will almost vanish if P has been skilfully constructed.

It has been found, however, that this is not the criterion of equality which the eye can appreciate with a maximum of precision, and the accuracy of its judgment can be materially improved if the criterion is changed from equality of brightness to equality of contrast This is easily arranged by placing two thin glass plates G_1 and G_2 (*see* fig 4[B]) so that they are respectively in the paths of the light beams occupying the patches R_1 and R_2 of the field of view (fig. 4[B]). Owing to reflection losses at the surfaces of these plates, their interposition causes the brightness of R_1 to be about 9% less than that of the background to R_2, while R_2 is the same amount darker than the background to R_1 It will be seen at once that, with this arrangement, if the two sides of S differ in brightness by 1%, the contrast between patch and background, instead of being 9% in both halves of the field, is 8% in one half and 10% in the other, a difference which is much easier to detect than a simple 1% difference of brightness.

The Photometer Bench.—The simplest method of varying the illumination of one of the comparison surfaces in a photometer head is to move one of the sources towards or away from the head. The law of variation of illumination is then the law of the inverse square The operation may be carried out most conveniently on some type of photometer bench This may consist of two parallel steel bars, supported at a suitable distance apart by a rigid iron framework Upon the bars run three carriages which respectively bear the light sources and the photometer head These carriages run on spool-shaped wheels so that they move easily on the bars They are provided with means for raising or lowering the sources, and for enabling them to be turned about a vertical axis Each carriage also bears a framework on which is engraved a line situated in the vertical plane which is at right angles to the axis of the carriage pillar. This framework moves over a graduated scale attached to the bench framework. By this means the distances between the centres of any two carriages may readily be found.

The most obvious method of comparing the candle-powers of two sources on the bench would be to place them one on each side of the photometer head, and adjust their positions until a balance was obtained On the assumption that equality of brightness of the two surfaces in the photometer head implied a similar equality of illumination, the candle-powers of the sources, I_1 and I_2 and their respective distances d and d' from the photometer would then be related thus:—$I_1/d^2=I_2/d'^2$ This assumption, although plausible, is never safe in practice and in all accurate photometry at the present time the substitution method is employed.

The Substitution Method.—A "comparison" lamp of constant, but not necessarily known, candle-power is placed in the carriage at one end of the bench, and this carriage is rigidly attached, by means of a rod, to the carriage holding the photometer head so that the two carriages move on the bench as one unit Thus one side of the photometer field has a constant brightness Other lamps can now be placed in turn at the other end of the bench, and the distances can be found at which the illuminations they produce at the photometer will give a balance with this constant brightness. These illuminations must, then, be equal to each other so that, if the candle-powers of the lamps be I_1, I_2, etc , and their respective distances from the photometer head at the position of balance, d_1, d_2, etc , it follows that $I_1/d_1^2=I_2/d_2^2=$ . . Thus if one of the lamps be a sub-standard of known candle-power, the candle-powers of the other lamps are found at once In all photometry it is most important that only the light directly emitted by the sources to be compared shall reach the photometer head, and stray light from external sources, or that reflected from objects in the room, must be shut off by means of suitably placed black screens

Although, owing to its convenience, the inverse square law is that most commonly used as the law governing the illumination of one of the comparison surfaces of a photometer head, there are other laws which are adopted, for special reasons in certain types of instruments The cosine law is seldom employed, but the proportionality between luminous intensity and area in the case of a surface of uniform brightness is sometimes used to provide what is, in effect a comparison source of variable candle-power The reduction of intensity of a polarized beam by the rotation of a nicol prism placed in its path (*see* LIGHT) is a favourite device in spectrophotometry (*see* p. 844), while a transparent plate of graduated transmission factor (*e g* , a small-angle wedge of neutral glass), is also useful for special purposes

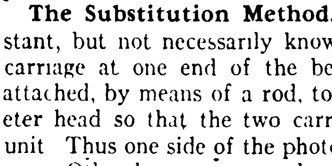


FIG 5 —PRINCIPLE OF THE SUBSTITUTION METHOD ON THE PHOTOMETER BENCH

The Sector Disc.—A very accurate method of controlling the illumination of a surface is to interrupt the light reaching it at regular and frequent intervals. It has been found that the apparent brightness of a surface intermittently illuminated bears to the actual brightness when steadily illuminated, the ratio of the time of exposure to the total time, provided the intermittency is sufficiently rapid to avoid any appearance of flicker This law is known as Talbot's law and, though it has no theoretical foundation, it has been proved experimentally that it holds with great accuracy for all ratios down to 3% or less The law may be applied by placing in the path of the light to be reduced an opaque disc having a radial slot cut in it, so that the light only reaches the photometer as the slot passes between it and the lamp If, for instance, there are three slots in the disc, each 6° in breadth, the ratio of reduction is 1/20 Such discs are exceedingly valuable as auxiliaries to other photometric apparatus, but it will be clear that, as their reduction ratio is fixed, they cannot themselves be used to produce the variation of illumination needed in a photometer For this purpose some form of disc with variable sectors is needed, and many attempts have been made to produce satisfactory apparatus of this kind.

The mechanical difficulties are, however, very great and probably the most satisfactory type of variable sector disc is that in which the disc remains stationary while the beam of light rotates. Fig. 6 shows the principle of the apparatus. The light from the lamp is reflected twice, as shown by the fine line, traverses the slot in the disc S and is again reflected so that it resumes its original direction. The reflecting surfaces may be mirrors or, preferably, the 45° surfaces of rhomboidal prisms as illustrated. In any case the four surfaces are rigidly fixed to one another in the relative positions shown, and the combination is rotated about its horizontal axis. It will be seen that the effect at the photometer surface P is precisely equivalent to that which would be produced by lowering the disc and spinning it in the usual way. As, however, the disc remains stationary, there is no difficulty whatever in making it easily adjustable by the observer, while a setting can be at once read off by having a scale on one disc and an index line on the other.

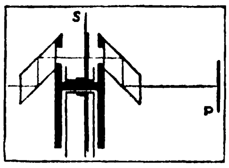


FIG 6—BRODHUN SECTOR DISC

Sub-standard Lamps.—The sub-standards used for candle-power measurement are usually tungsten filament lamps of special construction such as that shown in fig. 7. Great care has to be taken in the manufacture of these lamps so as to avoid fluctuations of candle-power due to loose contacts between the filament and its supporting hooks; the bulb, too, has to be specially selected so that there are no striations in the glass to cause slight alterations of candle-power as the lamp is rotated through a very small angle on either side of the position adopted for the standardization measurement. The candle-power of such a lamp is determined at a standardizing laboratory by comparison with the fundamental standards. The value of candle-power measured is that in the direction normal to the plane of the filament, when a given voltage is applied to the lamp contacts or when a given current is passing through the filament. These quantities have to be very accurately controlled since, in the case of a tungsten filament, a 1% change of voltage, or a 0·5% change of current, produces a change of about 3·7% in candle-power.

Flux Measurement.—Owing to the fact that most light sources are now rated in lumens instead of in candles (*see* the *British Standard Specification for Electric Lamps,* issued by the Brit. Engineering Stds. Assn), the measurement of luminous flux has now become an even more important operation in every-day photometry than the measurement of luminous intensity. The fundamental method of finding the flux output of a source is to measure its candle-power in a very large number of directions uniformly distributed in space, and thus to obtain the mean spherical candle-power which, when multiplied by 4π gives the flux in lumens (*see* p. 840). This long and tedious process may be avoided in the case of certain sources, such as a tungsten filament vacuum lamp of ordinary filament form, when the light is distributed fairly symmetrically about the axis. Such a lamp can be spun while the photometric measurements are being made, so that the figure of candle-power obtained at any given angle with the axis is, in reality, the mean value in all directions making this angle with the axis. It is therefore only necessary to make measurements in a limited number of directions, say 20, which lie in a single plane passing through the axis of the lamp.

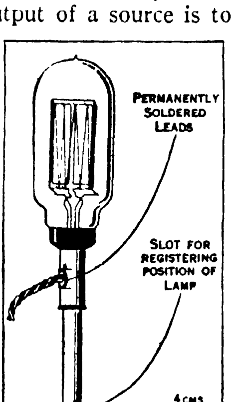


FIG 7—TUNGSTEN FILAMENT STANDARD OR SUB-STANDARD LAMP

Apparatus suitable for this purpose is shown in fig 8 which is almost self-explanatory. The lamp is mounted in a holder which can be rotated mechanically at a speed of, say, 150 revolutions per minute. The mirror system can be turned by hand about the horizontal line passing through the centre of the lamp, the photometer head and the comparison lamp. It can be shown that, if the directions in which the measurements are made be suitably chosen, the arithmetic mean of the 20 individual candle-powers gives the mean spherical candle-power with satisfactory accuracy. Such a lamp, then, may be used as a sub-standard of luminous flux, and all that is now required is a method for measuring the flux output from more irregular sources by comparison with this sub-standard.

The Sphere.—The method which is almost universally adopted to-day is based on the demonstrable fact that, if a source of light be placed inside a hollow sphere covered internally with some perfectly diffusing coating, the same amount of light is received at all parts of the sphere surface by reflection from all the other parts. The light received directly from the source naturally differs according to the candle-power distribution of the source, but the light which has been reflected once or more often from the walls of the sphere is distributed perfectly uniformly, no matter how unsymmetrical the original distribution from the source itself may be.

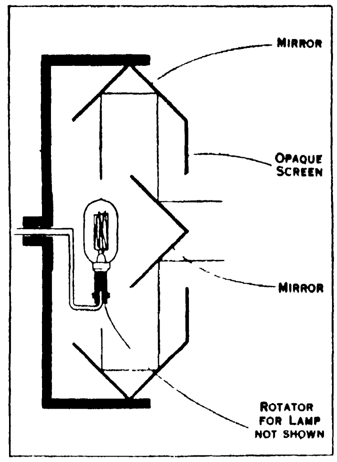


FIG 8—MEASUREMENT OF MEAN SPHERICAL CANDLE-POWER (POINT-TO-POINT METHOD)

It will now be clear that, in order to compare the total flux from two sources of light, it is only necessary to place them in turn within a sphere of the kind described, to screen a small portion of the sphere surface from direct light, and to measure the illumination of this screened area in the two cases The ratio of the illuminations will then be strictly equal to the ratio of the flux outputs of the sources. There are, of course, certain precautions which must be observed in the practical application of the method, owing to the unavoidable departures from the ideal conditions assumed in the theory The chief of these departures are (i) lack of perfect diffusion by the internal coating of the sphere, and (ii) the interference with the reflected flux brought about by the presence not only of the lamp and its accessories but also of the screen necessary to shield the measured part of the sphere surface from the direct light of the lamp

The illumination of the screened area of the sphere surface may be measured by any convenient method. It is clearly unnecessary that this measurement should be absolute, since only a ratio is involved. One method is to have a small opening in the sphere and to cover this with a window of opal glass or some other translucent material The luminous intensity of the outer surface of this window in the normal direction is then measured by means of a photometer head and comparison lamp moving on a bench attached to the sphere. Alternatively the sphere opening is left uncovered and the luminous intensity of that portion of the sphere opposite the opening is measured.

The difficulty of constructing a sphere has led to the frequent adoption of a cube as a sufficiently near approximation for work of moderate accuracy. When a cube is used, the light source should be placed in the centre, with its axis of symmetry perpendicular to the line joining it to the window, the latter being in the centre of one face of the cube. It is clear *a priori* that, if the light distributions from the sources to be compared are exactly the same, the form of the enclosure employed is immaterial. So long, therefore, as the distributions do not differ too much, a cube gives quite satisfactory results.

Illumination Photometers.—The third photometric measurement of importance is that of illumination. This is now so universal in illuminating engineering that many different types of portable photometer have been designed as illuminometers. Although these differ in design, each consists of three essential parts, viz, (i.) a test plate or standard surface placed at the spot at which the illumination is to be measured and generally, but not always, detached from the remainder of the instrument; (ii.) a surface inside the instrument, which is illuminated by a small battery lamp in such a way that its brightness can be varied at will by the observer, and (iii) some form of comparison device for

comparing the brightness of the internal surface with that of the external test plate.

The most natural form of instrument is one in which the inverse square law is used to obtain the necessary variable brightness. Such an instrument consists, generally, of a long tube blackened internally and containing a lamp in a small diaphragmed enclosure. This enclosure is attached to a rod moved by a rack and

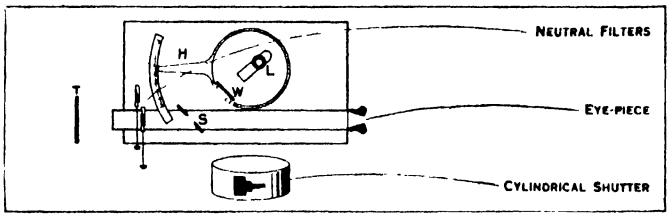


FIG. 9.—HOLOPHANE "LUMETER"

pinion so that the lamp may be brought towards or away from a piece of opal glass placed near the end of the tube. The brightness of the opal glass is compared with that of an external test surface by means of a small Lummer-Brodhun cube viewed through an eyepiece attached to the side of the tube. An inverse square scale is attached to the rod and the constant of this scale is adjusted to unity by previous calibration.

An instrument in which the inverse square law is not employed is the *Holophane lumeter,* shown in fig. 9. The lamp L is enclosed in a whitened box of shallow cylindrical form This box is provided with a window of diffusing glass W, the light from which illuminates the opaque outer parts of the comparison screen S. The eye views the test surface T through the central transparent part of S, and the two parts of the field are adjusted to equality by altering the exposed area of W. This is achieved by means of a cylindrical shutter which can be rotated about the lamp enclosure by means of the handle H. The shutter is provided with an opening of the form shown in the figure It will be clear that if W is uniformly bright, the scale of the instrument will consist of two parts, one corresponding to each of the breadths of opening, the scale being even within each part.

In most illumination photometers the scale of the instrument may be extended by the provision of neutral glass screens with transmission factors of one-tenth If these are inserted between the test surface and the eye, the scale is extended upwards, the instrument reading having to be multiplied by 10 or 100 according as one or both of these screens is inserted. If the screens are inserted between the internal lamp and the comparison surface, the instrument reading must be divided by the appropriate factor The lamp is supplied from some form of portable battery, preferably, an "accumulator." A rheostat and a voltmeter or ammeter are provided for adjusting the current through the lamp to the value at which the instrument was calibrated This adjustment has to be made with the greatest possible care since, owing to the characteristics of the small battery lamps which have to be used, an error of 1% in the current setting may result in an error of as much as 10% in the readings

The calibration of every portable photometer should be checked at frequent intervals This may be done by setting up the test surface at the zero point of a photometer bench and placing a sub-standard of known candle-power at convenient distances from it so as to give even values of illumination at the surface The test surface should approximate as closely as possible to a perfect diffuser. Ground opal glass or sandblasted opaque white celluloid are frequently used.

Measurement of Brightness and Reflection Factor.—Any illumination photometer which employs a detached test surface may be used for measuring the brightness of a surface, or its reflection factor if it is not self-luminous. This will be made clear by means of an example. When the instrument is set to a reading of, say, E foot-candles, a balance is obtained when the illumination of the test surface has this value. If, now, the reflection factor of this surface be ρ, its brightness under these conditions is $E\rho/\pi$ candles per square foot, or $E\rho$ foot-lamberts. Hence if, when the photometer is sighted on any other surface, a balance is obtained at the mark E on the instrument scale, the brightness of this surface must be $E\rho/\pi$ candles per square foot. Thus to convert the scale of illumination on the instrument to a scale of brightness it is only necessary to multiply by the constant factor ρ/π. Similarly, it is clear that, if two surfaces be equally illuminated, their brightnesses are proportional to their reflection factors. If, therefore, a surface of reflection factor ρ' be substituted for the test surface of an illumination photometer, the reading obtained will bear to the actual illumination the ratio ρ'/ρ where ρ is the reflection factor of the test surface.

It will be seen that for the measurement of either brightness or reflection factor a knowledge of ρ, the reflection factor of the photometer test surface, is necessary. This may be obtained by setting up the surface at one end of a photometer bench, illuminating it with a lamp of known high candle-power at a known distance, and measuring the candle-power I of the surface by means of a photometer head and comparison lamp in the ordinary way If E be the illumination of the test surface in foot-candles and s its area in square feet, $I=\rho Es/\pi$, so that ρ is found.

Heterochromatic Photometry.—No mention has so far been made of what is, perhaps, the greatest difficulty in all photometric measurement, viz., a difference of colour between the lights to be compared. The modern electric lamp gives light which is much "whiter," *i.e*, contains a larger proportion of blue, than that given by the carbon filament lamp.

Since the primary photometric standards are carbon filament electric lamps, operating at an efficiency of about 4·8 watts per candle, it is clear that, at some stage or another in the measurement of modern light sources, large colour differences have to be bridged with as little loss of accuracy as possible. There are three generally recognized methods of doing this, viz , (i.) the cascade method, (ii) the flicker method, and (iii) the colour filter method based on spectrophotometry Each of these methods will be described briefly in turn, but mention must first be made of a peculiarity of the eye which complicates the problem The curve shown in fig 1 gives the relative response of the eye to equal amounts of energy at different parts of the spectrum This curve, however, only applies when the brightness of the field of view is 0·15 candle per square foot or over Below this limit the curve shifts gradually to the left so that at low brightnesses the maximum is at a wave-length of about 505 $m\mu$. It follows that, if two fields are illuminated, one by red and one by green light, it may quite well happen that, when the brightness of both fields is high, the red may appear the brighter of the two, while, if both be reduced in brightness in the same ratio, the balance may appear to shift over so that the green may appear brighter than the red This effect is known as the Purkinje effect, and it has to be guarded against by ensuring that the brightness of the field of view is well in excess of the limiting value mentioned above

In the cascade method of heterochromatic photometry, the colour difference between the two lights to be compared is divided into a number of small steps by the interposition of other sources giving lights of intermediate colour. The method, however, is not entirely satisfactory since, clearly, an observer who weights the "whiter" light, will do so throughout the series of comparisons, and so his errors at each step will add up in the final result

The Flicker Photometer.—The flicker method depends on the fact that, when the field of view is illuminated alternately by lights which differ in colour and in intensity, flicker due to colour difference vanishes at a lower speed than flicker due to brightness difference A photometer head constructed on the flicker principle is designed so that the two surfaces which make up the comparison field are presented to the eye, not side by side, but one after the other in rapid alternation At low speeds the field is observed to flicker whatever the position of the photometer head, but as the speed is raised the flicker gradually decreases until finally it can be made to disappear at one position of the head only. If the speed be maintained at this critical value, a slight movement of the head from the position of balance causes a flicker to appear. The critical speed depends on the colour difference between the lights, being naturally higher the larger the difference. Any increase in speed beyond that just necessary to

remove flicker at the point of balance results in a decrease of sensitivity. It is therefore a first essential of any flicker photometer that it should be provided with an easy and rapid speed adjustment.

It is by no means self-evident that the results obtained by this method will agree with those obtained either by the cascade method or by a direct comparison involving the whole colour

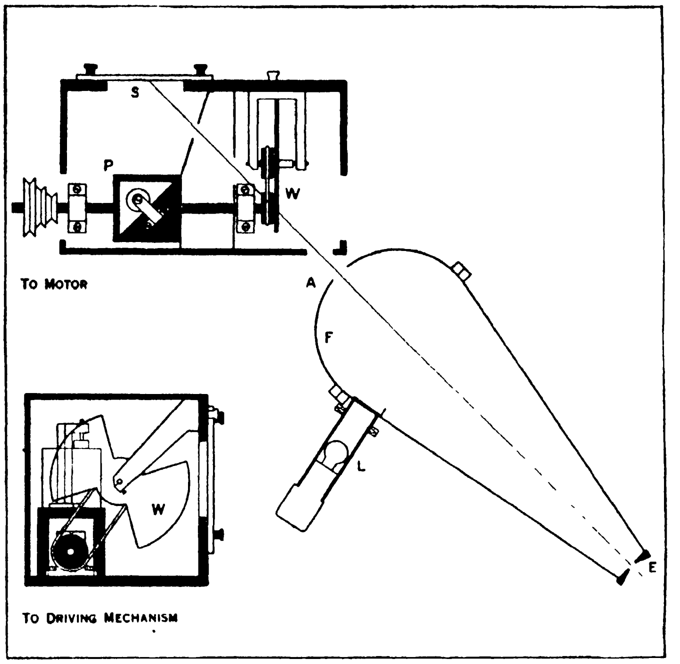


FIG. 10 —FLICKER PHOTOMETER

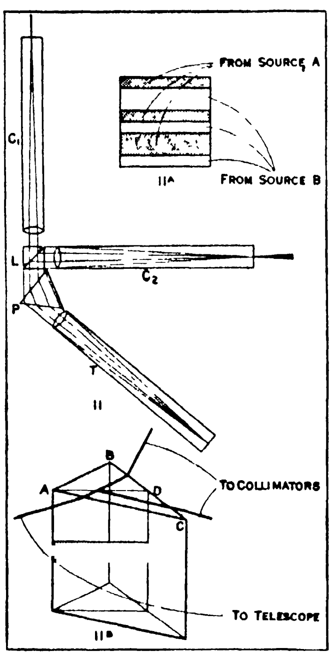
difference and carried out by a large number of observers using, say, the Lummer-Brodhun photometer Much experimental work has been done on this subject and it has been found that the two methods are in agreement when the following conditions are complied with in the flicker measurement: (*a*) a flicker field of about 2° diameter, and (*b*) a field brightness of about 8 candles per sq. metre. Since a 2° field is very small, and is most tiring for continuous work, the flicker field should be surrounded with a steady extended field of the same or slightly lower brightness

Many different types of flicker photometer have been developed. Of the more accurate, the one shown in fig. 10 is, perhaps, the simplest in principle, and will serve to illustrate the method S is a white surface illuminated, by way of the total reflection prism P, by the light from one of the sources to be compared W is a sector disc, which can be rotated at any desired speed about a horizontal axis. Its surface is white and is illuminated by the other source of light so that, when viewed by the eye at E, the field of view seen through the small aperture A is alternately occupied by W and by S. A is of such a size as to subtend an angle of 2° at E. It is cut with a sharp (back-bevelled) edge in a concave surface F, which is evenly illuminated by the small lamp L. L is adjusted to give F a brightness of about 8 candles per square metre, and the distances of the sources to be compared are then arranged so that the brightness of the field at A has approximately the same value The test lamp and photometer are then fixed and measurements are made by moving the comparison lamp, the speed of rotation of W being reduced until flicker can be made almost to disappear. Settings of the comparison lamp are then made to the point of minimum flicker. It will be noticed that the criterion of equality used in this instrument is not disappearance of flicker but minimum flicker, as it has been found that in practice this gives a rather more sensitive test of the balance point.

The Spectrophotometer.—The third method for overcoming a colour difference in photometry is to place between the photometer head and one of the sources of light a sheet of some transparent medium of such a colour that it produces a colour-match with the light from the other source. If, then, the transmission factor of this medium be known for the light given by the source with which it is used, the problem is solved The only method of obtaining this information is to determine (*a*) the spectral energy distribution of the source, and (*b*) the transmission factor of the medium at each wave-length. The overall transmission factor τ is then given by $\int \tau_\lambda K_\lambda E_\lambda / \int K_\lambda E_\lambda$, where E_λ is the energy emitted by the source in a given wave-length interval at wavelength λ and K_λ is the corresponding luminosity factor.

The instrument used for determining both the above sets of data is called a *spectrophotometer,* since it is essentially a device for enabling the intensities of two lights to be compared at any given part of the spectrum instead of as a whole Every spectrophotometer, therefore, consists of two parts, (i) a spectrometer (*see* SPECTROSCOPY) for enabling any given wave-length interval of the lights to be isolated, and (ii) some device for causing the portions of the lights so selected to illuminate the two parts of a comparison field, and a means for altering the brightness of one part of this field.

The principle will be made clearer by means of an example Fig. 11 shows diagrammatically the Lummer-Brodhun instrument which consists of an ordinary spectrometer with the addition of a second collimator C_2 and a Lummer-Brodhun cube The latter is constructed similarly to the cube used in the ordinary photometer head (*see* p. 841) but the form of the field is that shown in fig 11. The two sources to be compared respectively illuminate the slits of C_1 and C_2 which may be covered with diffusing glass For the adjustment to a photometric balance various devices may be used, *e g* , a variable slit in one collimator, alteration of the distance of one source from its slit, a sector disc or neutral wedge in one beam, or a pair of nicol prisms (one capable of rotation through a measureable angle) mounted in one of the collimators The last-mentioned device is used in the Brace-Lemon instrument which is a modification of the Lummer-Brodhun spectrophotometer, the dispersing prism being used also to form the comparison field This prism is shown in fig 11 As in ordinary photometry the substitution method is generally employed The source used as a standard of spectral distribution is frequently a tungsten filament



FIGS 11, 11A —LUMMER-BRODHUN SPECTROPHOTOMETER
FIG. 11B —BRACE-LEMON PRISM

vacuum lamp, since the spectral distribution of this type of lamp is very closely determined by its efficiency Alternatively any suitable lamp may be used, the spectral distribution of which has been determined at a standardizing laboratory.

One of the most important uses of spectrophotometry is to determine at each part of the spectrum the transmission factor of a coloured medium, a chemical solution, etc This may be done quite readily by first obtaining a balance for two sources of light at any one wave-length, and then inserting the coloured medium between one of these sources and the photometer. The amount by which the intensity of the other beam has to be altered to restore the balance enables the transmission factor of the medium at the particular part of the spectrum isolated to be reduced

Physical Photometers.—Many attempts have been made at various times to develop some physical instrument which can be used instead of the eye for making photometric measurements The instruments proposed may be divided, roughly, into three classes. The first of these includes the vast number of chemical photometers in which the illumination is measured by the rate of change it produces in the constitution of some chemical mixture. This form of photometer survives in the photographic

method used in some branches of spectrophotometry and in stellar photometry (*see* below). The chief disadvantage of the method is, as in all physical photometry, that the response of the sensitive substance to equal rates of energy reception in the form of light of different wave-lengths is quite different from that of the eye. In other words, the luminosity curve of the physical photometer is not even approximately the same as the curve of fig. 1. This, clearly, is of no importance in spectrophotometry where the comparison is made separately at each part of the spectrum. The principal difficulty associated with photographic spectrophotometry is the lack of proportionality between exposure (illumination × time) and blackening Schwartzchild's law that, for equal photographic densities, Et^p is a constant (p has a value between 0 75 and 1 depending on the plate) holds for short ranges of E and t.

The second class of physical photometer is that depending on the change (usually increase) of electrical conductivity of the element selenium when illuminated A sensitive selenium bridge (frequently termed *selenium cell*) may be made by winding four strands of fine nickel or platinum wire round a sheet of some good insulator which has been covered on one side with a thin layer of purified amorphous selenium. If two alternate strands of wire are then removed, the remaining strands are separated by a long strip of selenium of the same breadth as the diameter of the wire By heating the bridge to a temperature of about 180° C for five minutes or longer the selenium is changed to the metallic form and the conductivity of the path between the wire then varies with the illumination of the bridge. Many other forms of cell have been developed for various purposes. This type of physical photometer is not only subject to the disadvantage that its luminosity curve is different from that of the eye and is, moreover, not the same at all intensities of illumination, but it has the additional defect of a lag both in response to stimulation and in recovery after the illumination has been cut off.

Photoelectric Photometry.—The most promising form of physical photometer is the photoelectric cell described elsewhere (*see* PHOTOELECTRICITY) Although the luminosity curve of any such cell is very markedly different from that of the eye and is, moreover, slightly different even for two cells made similarly with the same photoelectric metal, it has been found that a combination of a potassium cell with a suitable yellow filter (Wratten K3) gives a curve which approximates to that of fig. 1 sufficiently closely for a device of this nature to be used as a physical photometer.

Various methods may be employed for carrying out a measurement with such a cell-filter combination The simplest is to have the combination illuminated in succession by the sub-standard and the lamps to be measured, and to balance the photoelectric current in each case by that from a simple photoelectric cell illuminated by a comparison lamp mounted on a bench (*see* fig. 12). The two cells, with their batteries, are connected in a Wheatstone bridge arrangement with a sensitive electrometer, and the distance of the comparison lamp from the cell it illuminates can be altered until the electrometer ceases to show a deflection The illumination of the cell-filter combination is then proportional to I/d^2 provided both cells follow the same law connecting photoelectric current and illumination. It is unsafe to assume that this is the case over a very extended range of illumination, so that the sub-standard and the test lamps must be arranged to give illuminations of the same order at the cell-filter combination In the case of a measurement of luminous intensity this can be done quite easily, but when the cell is being used in combination with a sphere or cube for the measurement of luminous flux, some auxiliary means must be adopted for adjusting the value of the illumination. A sector disc may be used since Talbot's law is rigorously obeyed by a photoelectric cell, its response to light being practically instantaneous. For increasing the sensitivity of a photoelectric cell, a three-electrode valve is often employed. Such a combination will, in conjunction with a suitable galvanometer and chronograph, enable records of a varying illumination (*e.g.*, daylight) to be obtained

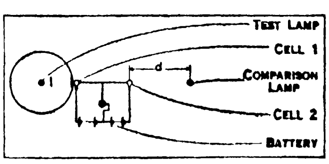


FIG 12.—PHOTO-ELECTRIC PHOTOMETER

See also J. W. T. Walsh, *Photometry* (1926); Dobson, Griffith and Harrison, *Photographic Photometry* (1926); "The Measurement of Mean Spherical Candle-Power," *Illumination Research Technical Paper* No 5 (H.M. Stationery Office, 1927). (J. W. T. W)

CELESTIAL

The earliest records we possess as to the positions of the stars have always been accompanied by estimations of their relative brightness; the stars being arranged in "magnitudes" according to their apparent luminosities Thus, in the catalogue of stars published by Ptolemy (*c.* A.D. 150) but which had probably been formed 300 years previously by Hipparchus, the stars visible to the unaided eye were divided into six classes or magnitudes, the brightest stars being designated "first magnitude stars" and those just visible to the naked eye forming the "sixth magnitude." Each class was further sub-divided into three sub-groups. This process of arranging the stars by eye estimates (with the unaided eye at first and subsequently with the aid of telescopes) was further developed by Flamsteed and the Herschels, and culminated in the work of Argelander, Schonfeld and Kruger, who published three catalogues (1859–62) of celestial co-ordinates and magnitudes known as the *Bonn Durchmusterung*. This catalogue included the enormous number of 324,188 stars. An additional volume containing 133,659 stars south of the equator was published in 1886 and the work was further extended in the southern hemisphere by B. A. Gould, J M Thorne and others In the *Bonn Durchmusterung*, or "B D ," each magnitude is sub-divided into ten divisions, a decimal notation being used.

So far no attempt was made to define the quantitative relationship between different magnitudes. In modern times a definition due to Pogson has arisen, and we define a difference of one magnitude between two stars as meaning that the light that reaches us from the first star is k times the light which reaches us from the second. The constant k is chosen so as to make a difference of five magnitudes correspond to a light ratio of 100 and this means that we must have $\log_{10}k = 0\ 4$. We cannot observe all the radiation emitted by a star. If the instrument used for registering the light be the human eye, it will not respond to radiation either in the extreme ultra-violet end of the spectrum or in the extreme infra red. Now if two stars are of different colours, the proportion of the whole radiation represented by the light which affects the eye will be different for the two stars, and the adoption of the above definition as it stands would lead to difficulties We can retain it, however, for stars of the same colour and then, as far as visual magnitudes are concerned, we define two stars of different colour as being of the same visual magnitude when they appear equally bright to the eye With the introduction of photographic methods, a photographic scale has arisen defined in the same way; two stars being of equal photographic magnitude when they produce equal photographic effects. Reference will be made below to certain difficulties arising out of these definitions With regard to the zeros or starting points of these visual and photographic scales, the zero of the measured scale of visual magnitudes has been fixed so that the magnitudes agree approximately with those in the "B D " for the mean of stars down to the sixth magnitude, whilst the zero of the photographic scale is defined so that for the white stars (of spectral type Ao) of the sixth magnitude (between visual magnitudes 5·5 and 6 5) the visual and photographic magnitudes are equal.

The actual methods of procedure, both visual and photographic, will be given in outline later in this article In recent years an enormous stimulus has been given to stellar photometry by the realization that it can lead us to good estimates of the distances of remote objects It was pointed out by Hertzsprung (*see* STAR), that the period of certain variable stars was related to their absolute magnitude, *i.e.*, to the magnitude that they would appear to have when viewed by an observer at a certain standard distance By observing the period the absolute magnitude can be deduced, and then, provided the apparent magnitude has been measured, the distance of the star can be inferred The discovery and elabo-

ration of methods such as these has led to the extension of the photometric scale down to the 20th magnitude. The scale of magnitudes defined numerically can of course be extended on the negative side, and, in point of fact, the visual magnitude of Sirius is −1·4 whilst that of the sun is −26·7.

MODERN WORK ON VISUAL MAGNITUDES

The bulk of observational work on visual magnitudes has been carried out at Harvard, and at the Harvard station in the southern hemisphere (but a considerable amount has been accomplished at Potsdam), and the standard catalogue of visual magnitudes for the brighter stars is the "Revised Harvard Photometry" (*Harvard Annals*, vol 50). This catalogue contains the computed magnitudes of 9,110 stars, of magnitude 6·5 and brighter, distributed over the whole sky A further catalogue (*Harvard Annals*, vol. 54) gives the magnitudes of 36,682 stars fainter than 6·5. The instrument used at Harvard was the meridian photometer designed by the late Prof. Pickering The principle underlying the instrument is the presentation of two stars in the field of view, the light from one being varied by a Nicol prism until the two stars appear of equal brightness. The ratio in which the incident light has been varied is read off from the angle through which the Nicol has been rotated, and the difference of magnitudes of the two stars thus obtained The stars were all compared with a standard star, which was the Pole star in the case of the brighter stars and λ Ursae Minoris for the fainter ones.

The photometer (*Harvard Annals*, vols. 14 and 23) consists of two telescopes placed side by side pointing due east, the light from the stars on the meridian being reflected into them by two mirrors inclined at an angle of 45° to this direction If there were a star exactly at the Pole, one of these mirrors would be absolutely fixed and would constantly reflect the light of this star down the axis of its telescope; in practice a slight motion can be given to the mirror so as to keep in view the polar star selected as the standard of comparison. The second mirror (which projects a little beyond the first so as to obtain an unobstructed view of the meridian) can be rotated round the axis of the telescope by means of a toothed-wheel gearing, and can thus be made to reflect any star on the meridian down the second telescope; it is also provided with a small motion in the perpendicular direction, so as to command a degree or two on each side of the meridian. Near the common eyepiece of the telescopes there is a double image prism which separates the light received from each into two pencils; the pencil of ordinary rays from one object-glass is made to coincide with that of extraordinary rays from the other, and the two remaining pencils are excluded by a stop The two coincident pencils then pass through a Nicol prism to the eye of the observer, who by rotating the prism round its axis can equalize them at a definite reading depending on their relative intensities. This reading gives in fact the difference of magnitude between the two stars selected for comparison. It may be remarked that the position of the double image prism is important. It should be just *within*, not *at*, the common focus; this position prevents any noticeable colour in the images, and gives the ordinary and extraordinary pencils a sufficient separation at the eye-stop to permit the entire exclusion of one without the loss of any part of the other. If the prism were exactly at the focus, and any part of the superfluous images were admitted, the resulting secondary images would coincide with the others and thus lead to errors in observing As it is, owing to the construction of the instrument, if the secondary images appeared at all they would do so only as additional stars, near those under observation and too faint to produce any inconvenience.

Each observation consists of four comparisons; after the first two the observer reverses the position of the star images in the field, and also reverses the double-image prism. The former precaution is necessary to eliminate a curious error depending on the relative position of the images, which may amount to several tenths of a magnitude. Errors of this kind affect *all* estimates of the relative brightness of two stars in the same field, as has been repeatedly shown; a striking instance is given by A. W. Roberts of Lovedale, South Africa (*Mon Not R A S*, 1897), who found that his eye-estimations of the brightness of variable stars required a correction depending on the position-angle of the comparison star and ranging over nearly two magnitudes. In the Harvard work on the brighter stars, the magnitude of the pole star was provisionally assumed to be 2·0 at the pole. Each observation had to be corrected for the effect of atmospheric absorption, the coefficient for which was obtained from observations of circum-polars at upper and lower culminations. The provisional magnitudes thus obtained were finally corrected by a constant chosen so as to make the mean magnitude of the circum-polars equal to the mean magnitude of the same stars as given in the "B D."

Other types of photometer are Zollner's (*Photometrische Untersuchungen*, h. 81), in which an artificial star is taken as the standard of comparison, and Pritchard's, in which the images of stars are viewed through a wedge and the wedge-reading at which the star is extinguished noted.

The comparison of different catalogues of visual magnitudes reveals small systematic differences which arise out of the difficulties of estimating when two stars of different colour are equal in apparent intensity The observation is complicated by what is known as the "Purkinje phenomenon" If a blue source of light and a red source appear equally bright to the eye, and if the intensity of each be diminished in the same ratio, they will no longer seem equally bright, the blue appearing the brighter From this cause, magnitudes observed with meridian photometers of different aperture will differ slightly It becomes obvious that visual magnitudes ought to be referred to some standard instrument, and possibly to some standard observer, and it is difficulties such as these which are at the present time leading to the replacement of visual magnitudes by what are known as photo-visual magnitudes.

PHOTOGRAPHIC PHOTOMETRY

Here, we are dealing with a problem which differs considerably in detail from the visual procedure. We can no longer vary the light of a star by some device such as a Nicol prism until it is equal in brightness to a standard But on a plate which has been exposed to a field of stars we can at any rate arrange the stars in order of brightness by measuring the diameters of the images, or by estimating their degrees of blackness, and we are then faced with the task of finding a means of relating our measures of blackness or of diameter to the true photometric scale defined as above

Two principal methods have been employed, the in-focus method and the out-of-focus method. In the in-focus method a field of stars is photographed twice on the same plate, the intensity of the light being reduced in some known ratio for the second exposure. This can be effected by stopping down the aperture of the telescope by a given amount. The plate is placed in the usual position, that is, in the focal plane of the object glass or mirror For each star we then have two images on the plate whose difference in magnitude is known Now suppose we measure the photographic effect of each image in some way and denote the measure by D A simple measure of photographic effect is the diameter of the image, in which case D is the measured diameter Suppose D_1 and D_2 be the measures on the two images of the same star The difference of magnitude between these two images depends only on the ratio in which the aperture has been stopped down and is consequently known. We thus get the magnitude difference corresponding to the difference of the measures D_1 and D_2. In other words, we are relating the scale of our measures of photographic effect to the magnitude scale, and we thus have a means of converting the measures into magnitudes and of obtaining the relative magnitudes of all the stars on the plate.

The principle of the method is as follows. Select a sequence of stars on the plate such that the diameter (or any other measure of photographic effect that may be adopted) of the fainter image of any member of the sequence is equal to the diameter of the brighter image of the next succeeding member. We then have a sequence of stars each member of which differs in magnitude from the following member by a known amount. In other words,

the magnitudes of the stars of the sequence are known, but with an arbitrary zero point. If then, the measured diameters of these stars be plotted against their magnitudes obtained in this way, a curve would be obtained from which the magnitude of any star on the plate can be read off from its measured diameter. In actual practice a mathematical process is used instead of a graphical one. Furthermore, the equality between the fainter and brighter images of two consecutive members of the sequence will not be exact and this must be allowed for.

So far this method only gives a means of determining the relative magnitudes of stars in the same region of the sky and which can therefore be photographed on the same plate, but if we expose every plate a second time on some standard area, the time of exposure being the same, we can determine the magnitudes relatively to some star or stars in the standard area (which may conveniently be the area of the Polar sequence); and it only remains to define the zero. This has been fixed, as already explained, so as to make the photographic magnitudes of the white stars of the 6th magnitude agree with their visual magnitudes on the Harvard scale. Instead of using a stop to reduce the light in a given ratio for a second exposure, it is preferable to use a coarse wire diffraction grating placed over the aperture of the telescope. Each image is then flanked by fainter lateral images differing in magnitude from the main image by a known amount depending on the thickness and spacing of the wires. The subsequent procedure is unchanged, but only one exposure is necessary. In order to give some idea of the appearance of such gratings, it may be mentioned that one of the gratings used at Greenwich in conjunction with the 26-inch refractor consisted of wires 0·69 mm. in diameter and spaced at intervals of 5 mm. (*Monthly Notices R.A.S.*, 1913).

At Harvard the out-of-focus method has been used. In this case a series of exposures are made and for each exposure the plate is placed at a certain distance from the focus. Each star is now represented by a blackened patch on the plate, instead of by the usual image, and the density of the silver deposited in each patch is measured by comparison with a graduated wedge. In the case of the different exposures to the same star at different distances from the focus, the relative quantities of light falling upon unit area of the plate are determined from straightforward geometry, and the relation between the measured densities and the magnitude scale thus determined (*Harvard Annals,* vol. 59). It may be remarked that the out-of-focus method lends itself readily to the determination of the magnitudes of planets. For the purpose of determining the magnitudes of the sun and moon, a pin-hole camera was used by the Harvard observers, and they obtained −25·83 m. for the photographic magnitude of the sun and −11·20 m. for that of the full moon (*Harvard Annals,* vol. 59).

In recent years a great deal of care has been lavished upon the determination of the magnitudes of a sequence of stars extending down to the 20th magnitude and situated at the North Pole of the sky. This having been done the magnitudes of stars in any other part of the northern sky can be obtained by photographing the field and the pole on the same plate and with the same exposure. In order to eliminate atmospheric absorption the exposures should be made at the same altitude. Measures (say of diameter) can then be made of all the stars in each field, and the measures calibrated from the determined magnitudes of the Polar sequence. Several secondary sequences have been determined in this way in various parts of the sky and the work is being pushed into the southern hemisphere.

Colour-indices and Standardization.—The visual and photographic magnitudes are not necessarily the same. A red star, for example, may affect the eye strongly, but its effect on an ordinary photographic plate, which is chiefly sensitive to blue light, may be small. The difference between the photographic and visual magnitudes of a star (which in extreme cases may amount to 1½ magnitude), reckoned in the sense photographic minus visual, is called its colour-index. However, a little consideration will show that photographic magnitudes determined with different instruments (or different plates) will differ from each other. For example, in a refractor a large portion of the ultra-violet light is absorbed by the lens, and in a reflector this light is let through to a much greater extent. Clearly the photographic magnitudes as determined with these types of instruments will be different. It is necessary to adopt some standard, and the International Astronomical Union, in defining the magnitudes of the standard polar sequence, has adopted the scale of the 60-inch reflector at Mt. Wilson. The magnitudes m of stars in any catalogue can be connected with the standard magnitudes m', which are referred to the scale of the 60-inch by an equation of the form

$$m = m' + a + bC$$

where C is the colour index and a and b are constants.

At Mt. Wilson Dr. Seares has devised a method of measuring colour-index directly. He photographs stars on colour-sensitive plates through blue and yellow filters and he defines the "exposure ratio" as the logarithmic ratio of the exposure times which produce blue and yellow images of the same size. The results have to be calibrated by comparison with colour-indices, but, this having been done, the method has the advantage of determining the colour directly instead of by differencing two separate magnitude determinations. A further direct measure of colour is provided by the "effective photographic wave-length" of a star. This may be defined as the wave-length of the light from the star which produces the maximum effect on a photographic plate. It is greater for the red stars than for the blue, and may be determined by placing a coarse diffraction grating over the aperture and then measuring the distance on the plate between the central image of a star and the most intense part of the lateral image produced by diffraction (*Monthly Notices R.A.S.*, 82, 1921). Effective wave-lengths having been determined, they can be calibrated by comparison with colour-indices.

Photovisual Magnitudes.—Just as different photographic determinations differ, so will visual observers using different instruments obtain different results. There is also the complication arising from the Purkinje effect. For this reason attempts have been made of recent years to replace visual determinations by photographic ones made on colour-sensitive plates through yellow screens. The resulting magnitudes are called photovisual magnitudes. They are roughly the same as the visual ones, at any rate for the brighter stars, and lend themselves readily to standardization. Photovisual magnitudes have been determined at Mt. Wilson for the stars of the polar sequence. When compared with the Harvard visual results they show differences depending on colour, which become more pronounced for the fainter stars, and may amount to as much as three-tenths of a magnitude for red stars of the 12th magnitude.

Spectro-photometry.—It has been long recognized that the colour-index of a star bears a relation to its surface temperature—the bluest stars being the hottest—and it is immediately suggested that the temperatures of the stars might be calculated from colour-index data. This would be possible if the visual and photographic magnitudes referred to definite wave-lengths, instead, as is actually the case, of being results integrated over a certain range of spectrum. Consequently the satisfactory determination of what are known as effective temperatures can only be obtained by spreading out the light into spectra and confining the photometric measurements to certain definite wave-lengths.

The effective temperature of a star may be defined, for the present purpose, as the temperature of a full radiator or "black body" for which the distribution of the energy in the spectrum most closely fits the observed distribution in the stellar spectrum. It is assumed that if, as is usual, measurements are confined to those spectral regions which are free from absorption lines, the stellar distribution of energy is very nearly that of a black body; and this is probably the case. The principle of the method may be stated thus. If for two stars the ratio of the light reaching us be measured for two separate wave-lengths, and if the effective temperature of one of them, which is thus regarded as a standard star, be known, then the effective temperature of the other can be calculated. The problem is thus reduced to determining this ratio for two separate wave-lengths, or, which comes to the same thing, the difference of magnitude for the two wave-lengths in

question. Actually it is not necessary to determine each of these differences, the *difference* of the differences is all that is required. The object of spectro-photometric measurement is thus to determine what is in reality a colour-index, determined with respect to two definite wave-lengths, say in the blue and the red regions of the spectrum. Then, if the effective temperature of the standard star be known, the effective temperatures of any others can be derived The standard star need not be an actual star, but an artificial source of light whose effective temperature can be determined in the laboratory

It is on these lines that research has been pursued at Potsdam, Edinburgh, Victoria, Greenwich and at other observatories The work is still in its infancy and it is impossible to go into details here. With the exception of Potsdam, photographic methods are employed, and one method is to measure the densities of the silver deposited in the spectra with some form of microphotometer. It then remains to relate the measures of density to the absolute photometric scale just as in the case of ordinary photometry. A graded series of images in light of the requisite wave-lengths must be imposed on the plate and the measures of density thus calibrated. In the case of the visual work carried out at Potsdam, the spectra were compared at each wave-length with a Nicol prism photometer in a manner analogous to the Harvard visual photometry. The results that have been so far obtained are not altogether accordant, and are subject to revision. The available observational data have been summarized by A. Brill (*Astronomische Nachrichten* 5,539, 1928), who has given a table connecting spectral types and effective temperatures. According to this table, the mean effective temperatures of stars of type Bo is 20,800° Absolute. For type Ao the effective temperature is 11,300° A and for type Go (the solar type) it is 6,050° A for the "giants" and 6,240° A for the "dwarfs." For the very red stars of type Mo Brill gives 3,200° A and 3,420° A for the giants and dwarfs, respectively.

A very recent development is the determination, by photometric methods, of the integrated intensities of absorption lines, *i e*, the ratio of the total amount of light absorbed in a line to the amount of light per unit of wave-length in the neighbouring continuous spectrum. Some very promising work on these lines has been carried out at Harvard and it is probable that it will be developed rapidly in the immediate future. (W. M. H. G.)

PHOTON: *see* COMPTON EFFECT.

PHOTOPERIODISM, the term employed to designate the response of organisms to length of day, with special reference to plants. Its possible application to animal life has not yet been adequately investigated, though there is some evidence of its connection with bird migration So far as known at present, sunlight may affect plant growth in three ways, in virtue of its composition, including visible and invisible radiation, in virtue of its intensity and its daily durations.

It has been found that, for the sake of convenience, plants may be considered to fall into three great groups, depending upon the initiation of sexual reproductive expression and flowering in response to different day-lengths. In one group, termed the short-day plants, day-lengths of 12 hours or less are most favourable to the initiation of sexual reproduction In a second group, the long-day plants, lengths of day in excess of 12 hours, amounting in some instances to continuous illumination are most favourable for reproduction and flowering A third group includes plants which attain sexual expression independently of any particular length of day. Such plants have been called indeterminate types, because they show no distinctive flowering response to either long or short days.

By the use of appropriate dark, ventilated chambers, or houses in which plants may be placed, cutting off the early morning and later afternoon light of the long days of summer, it has been found practical to study the behaviour of plants as affected by daylight exposures much shorter than the normal. During the short days of winter, greenhouses suitably heated have been used, with electric illumination afforded the plants at sunset to increase the daily illumination periods to the desired degree. The behaviour of responsive plants has been consistent under the two conditions, according as they are normally long-day, short-day, or indeterminate types of plants. *Poinsettia* is an example of a typical short-day plant, because the initiation of reproduction does not take place until the seasonal day-length has fallen below 12 hours. Buckwheat is an indeterminate type of plant, and Oswego tea or bee balm (*Monarda didyma*), a garden ornamental, demands the long midsummer days for flowering.

The distinctive response of the different species of plants appears to have much to do with their normal ranges in many instances, at least it is one of the factors in the environmental complex, which must also be considered in any study of natural distribution. Likewise the geographical limits of some of our cultivated crops probably depend to a greater or less extent upon this factor. Biloxi soy beans, for instance, a crop fruiting successfully in the Gulf States, cannot be grown for seed in the Washington region (latitude 39°), because they do not flower until the September length of day is reached. As a result, unfavourable temperatures with frost ensue and kill the plants while the pods are still immature.

As originally defined, photoperiodism refers to the normal 24-hour period of time, a constant condition which holds everywhere on the earth except at the poles. Breaking the normal daily duration of light during the long days of summer with a period of darkness of one to several hours in the middle of the day does not appear to produce any fundamental effect upon the normal reproductive development of typical long- or short-day plants.

In addition to its effects upon sexual reproduction day-length is known to modify composition, growth and development of plants in various ways, including tuberization, branching habit, root and rhizome development, stature, dormancy, leaf fall, senescence, rejuvenescence and cleistogamy.

In any analysis of plant behaviour, either in the field or in the laboratory, the factor of photoperiodism must be considered as operative in the environmental-complex. Just as plants are known to have their specific requirements with respect to temperature, moisture, light-intensity, etc., it is known that they have definite length-of-day requirement for promoting the different phases of vegetative expression of flowering and fruiting The character and extent of these expressions, the seasonal behaviour, stature, longevity, etc, may be more a matter of response to length of day than anything else. This principle has probably been unconsciously applied in the agricultural operations of man with his various economic and ornamental plants, just as the requirements of temperature, light-intensity, soil, moisture, etc., have been met. Definite recognition of the principle will unquestionably aid greatly in a more intelligent interpretation of plant behaviour, and prove a factor of no small importance in the successful introduction of plants from one region into another. The phenomena of photoperiodism were brought to the attention of the scientific world in 1920 by workers in the U S. Department of Agriculture

See K. F. Kellerman, *Quarterly Review of Biology* (1926).

(W. W. G ; H. A. A)

PHOTOSPHERE of the sun, the layer from which most of the sun's light is emitted which reaches us directly; *i.e.,* without absorption and re-emission The sun is a globe of gas with no sharply defined surface, and we look down into it through absorbing layers of very low density; the photosphere may be regarded as the layer which is the limit to which we can see into the interior. (*See* SUN.)

PHRAATES (p-hrah-ah'tās) (PHRAHATES), the name of five Parthian kings

1. PHRAATES I, son of Priapatius, reigned *c.* 175–170 B C. He subdued the Mardi, a mountainous tribe in the Elburz (Justin xli. 5; Isid. Charac. 7) He died young, and appointed as his successor not one of his sons, but his brother Mithradates I. (Justin xli. 5).

2. PHRAATES II., son of Mithradates I., the conqueror of Babylonia, reigned 138–127. He was attacked in 130 by Antiochus VII. Sidetes, who, however, in 129 was defeated and killed in a great battle in Media, which ended the Seleucid rule east of the Euphrates (*See* SELEUCID DYNASTY.) Meanwhile the

kingdom was invaded by the Scythians (the Tochari of Bactria), who had helped Antiochus. Phraates marched against them, but was defeated and killed (Justin xlii. 1; Johannes Antioch, *fr.* 66).

3. PHRAATES III., "the God" (Phlegon, *fr.* 12 *ap.* Photius *cod.* 97 and on some of his coins), succeeded his father, Sanatruces, in 70 B.C., at the time when Lucullus was preparing to attack Tigranes of Armenia, who was supreme in western Asia and had wrested Mesopotamia and several vassal states from the Parthian kingdom. Naturally, Phraates declined to assist Mithradates of Pontus and Tigranes against the Romans. (*See* TIGRANES.) He supported his son-in-law, the younger Tigranes, when he rebelled against his father, and invaded Armenia (65 B.C.) in alliance with Pompey, who abandoned Mesopotamia to the Parthians (Dio. Cass. xxxvi. 45, 51; Appian, *Mithr.* 104; Liv. *Epit.* 100). But Pompey soon overrode the treaty; he acknowledged the elder Tigranes, took his son prisoner, occupied the vassal states Gordyene and Osroëne for the Romans, and denied the title of "king of kings," which Phraates had adopted again, to the Parthian king (Plut. *Pomp.* 33, 38; Dio. Cass. xxxvii. 5 *seq.*). About 57 Phraates was murdered by his two sons, Orodes I. and Mithradates III.

4. PHRAATES IV., son of Orodes I., by whom he was appointed successor in 37 B.C., after the death of Pacorus. He soon murdered his father and all his thirty brothers (Justin xlii. 5; Plut. *Crass.* 33; Dio Cass. xlix. 23). He was attacked in 36 by Antonius (Mark Antony), who marched through Armenia into Media Atropatene, and was defeated and lost the greater part of his army. Believing himself betrayed by Artavasdes, king of Armenia, he invaded his kingdom in 34, took him prisoner, and concluded a treaty with another Artavasdes, king of Atropatene. But when the war with Octavianus Augustus broke out, he could not maintain his conquests; Phraates recovered Atropatene and drove Artaxes, the son of Artavasdes, back into Armenia (Dio. Cass. xlix. 24 *seq.*, 39 *seq.*, 44; *cf.* li. 16; Plut. *Antonius*, 37 *seq.*). But by his many cruelties Phraates had roused the indignation of his subjects, who raised Tiridates II. to the throne in 32. Phraates was restored by the Scythians, and Tiridates fled into Syria.

The Romans hoped that Augustus would avenge the defeat of Crassus on the Parthians, but he contented himself with a treaty, by which Phraates gave back the prisoners and the conquered eagles (20 B.C., *Mon. Anc.* 5, 40 *seq.*; Justin xlii. 5); the kingdom of Armenia also was recognized as a Roman dependency. Soon afterwards Phraates, whose greatest enemies were his own family, sent five of his sons as hostages to Augustus, thus acknowledging his dependence on Rome. This plan he adopted on the advice of an Italian concubine whom he made his legitimate wife under the name of "the goddess Musa"; her son Phraates, commonly called Phraataces (a diminutive form), he appointed successor. About 4 B.C. he was murdered by Musa and her son (Joseph. *Ant.* xviii. 2, 4).

5. PHRAATES V., or PHRAATACES, the younger son of Phraates IV. and "the goddess Musa," with whom he is associated on his coins. Under him a war threatened to break out with Rome about the supremacy in Armenia and Media. But when Augustus sent his adopted son Gaius Caesar into the east in order to invade Parthia, the Parthians preferred to conclude a treaty (A.D. 1) by which once again Armenia was recognized as in the Roman sphere (Dio. Cass. lv. 10; Velleius ii. 101). Soon after Phraataces and his mother were slain by the Parthians, about A.D. 5 (Joseph. *Ant.* xviii. 2, 4). (ED. M.)

PHRANTZA, GEORGE [GEORGIOS PHRANTZES] (1401–*c.* 1477), the last Byzantine historian, was born in Constantinople. At an early age he became secretary to Manuel II. Palaeologus, and rose to the position of great logothete (chancellor). At the capture of Constantinople by the Turks (1453) he fell into their hands, but managed to escape to Peloponnesus. After the downfall of the Peloponnesian princes (1460) Phrantza retired to the monastery of Tarchaniotes in Corfu. Here he wrote his *Chronicle*, with an account of the house of the Palaeologi from 1258–1476.

Editions by I. Bekker (1838) in the *Corpus scriptorum hist. byz.*, and in J. P. Migne, *Patrologia graeca*, clvi.; *see* also C. Krumbacher, *Geschichte der byzantinischen Literatur* (1897).

PHRAORTES, the Greek form of *Fravartish*, king of Media. According to Herodotus (i. 102) he was the son of Deioces, and began the Median conquests. He first subjugated the Persians, and then a great many other peoples of Asia, till at last he attacked the Assyrians, but was defeated and killed in a battle, after a reign of 22 years (about 646–625 B.C.; but perhaps, as G. Rawlinson supposes, the 53 years of Deioces ought in reality to be transferred to him). From other sources we obtain no information whatever about Phraortes; but the data of the Assyrian inscriptions prove that Assur-bani-pal (*see* BABYLONIA AND ASSYRIA), at least during the greater part of his reign, maintained the Assyrian supremacy in Western Asia, and that in 645 he conquered Susa. The Medians too were subject to him as far as the Elburz and the central Iranian desert.

When after the assassination of Smerdis all the Iranian tribes, the Babylonians and the Armenians rebelled against Darius and the Persian rule, "a man of the name of Fravartish (*i.e.*, Phraortes), a Mede, rebelled in Media and spoke to the people thus: I am Khshathrita, of the family of Uvakhshatra (Cyaxares)." He reigned for a short time, but was defeated by Hydarnes, and afterwards by Darius himself, taken prisoner in Rhagae (Rai), and executed in Ecbatana (520 B.C.; *see* inscription of Darius at Behistun). (ED. M.)

PHRENOLOGY, the name given to the empirical system of psychology formulated by F. J. Gall, about the year 1800 and developed by his followers, especially by J. K. Spurzheim and G. Combe. The principles upon which it is based are five: (1) the brain is the organ of the mind; (2) the mental powers of man can be analysed into a definite number of independent faculties; (3) these faculties are innate, and each has its seat in a definite region of the surface of the brain; (4) the size of each such region is the measure of the degree to which the faculty seated in it forms a constituent element in the character of the individual; (5) the correspondence between the outer surface of the skull and the contour of the brain-surface beneath is sufficiently close to enable the observer to recognize the relative sizes of these several organs by the examination of the outer surface of the head. It professes primarily to be a system of psychology, but its second and more popular claim is that it affords a method whereby the disposition and character of the subject may be ascertained.

The Faculties and Their Localities.—The system of Gall was constructed by a method of pure empiricism, and his so-called organs were for the most part identified on slender grounds. Having selected the place of a faculty, he examined the heads of his friends and casts of persons with that peculiarity in common, and in them he sought for the distinctive feature of their characteristic trait. Some of his earlier studies were made among low associates, in gaols and in lunatic asylums, and some of the qualities located by him were such as tend to become perverted to crime. These he named after their excessive manifestations, mapping out organs of murder, theft, etc.; but as this cast some discredit on the system the names were changed by Spurzheim, who claimed as his the moral and religious considerations associated with it. Gall marked out on his model of the head the places of twenty-six organs as round enclosures with vacant interspaces. Spurzheim and Combe divided the whole scalp into oblong and conterminous patches (see the accompanying figures) and separated the component faculties of the human mind into two great groups, subdivided as follows:—

I. Feelings, divided into—
  1. Propensities, internal impulses inviting only to certain actions.
  2. Sentiments, impulses which prompt to emotion as well as to action.
    A. Lower—those common to man and the lower animals.
    B. Higher—those proper to man.

II. Intellectual faculties.
  1. Perceptive faculties.
  2. Reflective faculties.

In the following list the localities are appended to the names, which are mostly the inventions of Spurzheim. Gall's names are placed in brackets. For topography, Broca's names are adopted.

Propensities.—1. Amativeness (*Instinct de la génération*),

median, below the inion.

2. Philoprogenitiveness (*Amour de la progéniture*), median, on the squama occipitis.

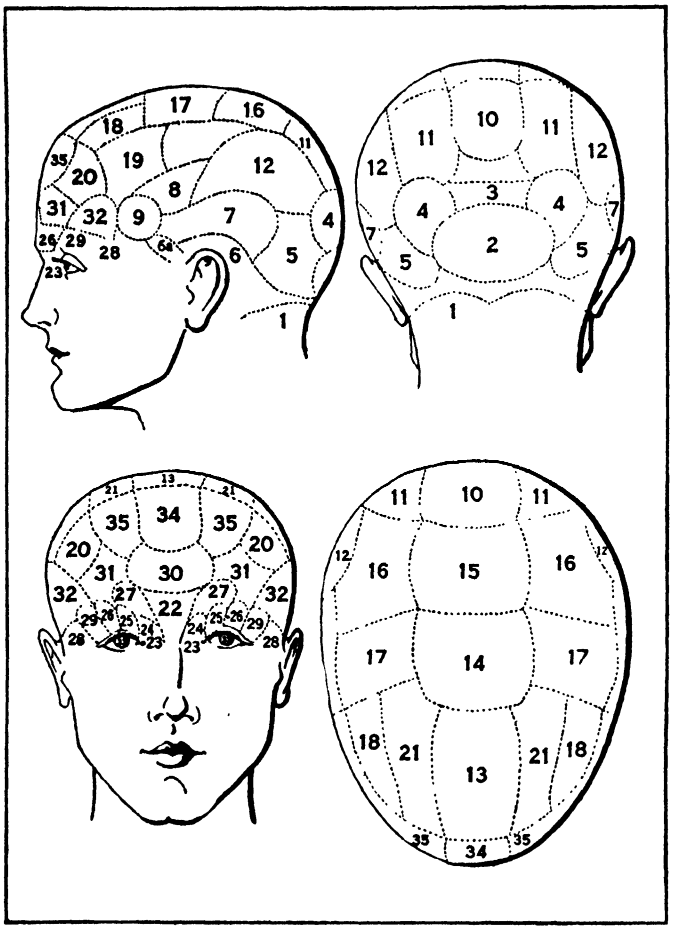
3. Concentrativeness, below the obelion and over the lambda.

4. Adhesiveness (*Amitié*), over the lateral area of the lambdoidal suture.

5. Combativeness (*Instinct de la défense*), above the asterion.

6. Destructiveness (*Instinct carnassier*), above the ear meatus.

6*a*. Alimentiveness, over the temporal muscle and above the ear.



7. Secretiveness (*Ruse, Finesse*), the posterior part of the squamous suture.

8. Acquisitiveness (*Sentiment de la propriété*), on the upper edge of the front half of the squamous suture.

9. Constructiveness (*Sens de méchanique*), on the stephanion. The organ of Vitativeness, or love of life, is supposed by Combe to be seated at the base of the skull.

Lower Sentiments.—10. Self-esteem (*Orgueil, fierté*), at and immediately over the obelion.

11. Love of Approbation (*Vanité*), outside the obelion.

12. Cautiousness (*Circonspection*), on the parietal eminence.

Superior Sentiments.—13. Benevolence (*Bonté*), on the middle of the frontal bone in front of the coronal suture.

14. Veneration (*Sentiment réligieux*), median at the bregma.

15. Conscientiousness, Believingness (Forster), unknown to Gall; recognized by Spurzheim usually from its deficiency, and placed between the last and the parietal eminence.

16. Firmness (*Fermeté*), median, on the sagittal suture from behind the bregma to the front of the obelion.

17. Hope, not regarded as primary by Gall, who believed hope to be akin to desire and a function of every faculty which desires and left this territory unallocated.

18. Wonder, said to be large in vision-seers and many psychic researchers. A second similar organ placed between this and the next is called Mysterizingness by Forster, and is said to be the seat of belief in ghosts and in the supernatural.

19. Ideality (*Poésie*), noted by Gall from its prominence in the busts of poets; said to be the part touched by the hand when composing poetry.

20. Wit (*Esprit caustique*), the frontal eminence.

21. Imitation (*Faculté d'imiter*), disposition to mimicry, placed between Benevolence and Wonder.

Perceptive Faculties.—22. Individuality, over the frontal sinus in the middle line.

23. Form (*Mémoire des personnes*), capacity of recognizing faces; gives a wide interval between the eyes.

24. Size, over the trochlea at the orbital edge.

25. Weight, outside the last on the orbital edge and, like it, over the frontal sinus.

26. Colour, also on the orbital edge external to the last.

27. Locality (*Sens de localité*), placed above Individuality on each side, and corresponding to the upper part of the frontal sinus and to the region immediately above it.

28. Number, on the external angular process of the frontal bone.

29. Order, internal to the last.

30. Eventuality (*Mémoire des choses*), the median projection above the glabella.

31. Time, below the frontal eminence and a little in front of the temporal crest.

32. Tune (*Sens des rapports des tons*), on the foremost part of the temporal muscle.

33. Language (*Sens des mots*), behind the eye.

Reflective Faculties.—34. Comparison (*Sagacité comparative*), median, at the top of the bare region of the forehead.

35. Causality (*Esprit métaphysique*), the eminence on each side of Comparison.

Anatomical and Physiological Considerations.—The teaching of anatomy with regard to phrenology may be summarized thus: (1) the rate of growth of brain is concurrent with the rate of development of mental faculty; (2) there is some degree of structural differentiation as there are varying rates of development of different parts of the cerebral surface; (3) there is no accordance between the regions of Gall and Spurzheim and definite areas of cerebral surface.

That the brain is the organ of the mind is now universally received. While it is probable that certain molecular changes in the grey matter are antecedents or concomitants of mental phenomena, the precise nature of these processes, to what extent they take place, or how they vary among themselves have not as yet been determined experimentally; the occurrence of the change can only be demonstrated by some such coarse method as the altered pulsation of the carotid arteries, the increase of the temperature of the head, the abstraction, during brain-action, of blood from other organs as shown by the plethysmograph, or the formation of lecithin and other products of metabolism in brain-substance.

Psychological Aspect.—There is a large weight of evidence in favour of the existence of some form of localization of function. So little is known of the physical changes which underlie psychical phenomena, or indeed of the succession of the psychical processes themselves, that we cannot as yet judge as to the nature of the mechanism of these centres. So much of the psychic work of the individual life consists in the interpretation of sensations and the translation of these into motions that there are strong a priori grounds for expecting to find that much of the material of the nerve-centres is occupied with this kind of work, but in the present conflict of experimental evidence it is safer to suspend judgment. That these local areas are not centres in the sense of being indispensable parts of their respective motor apparatus is clear, as the function abolished by ablation of a part returns, though tardily, so that whatever superintendence the removed region exercised apparently becomes assumed by another part of the brain. Experimental physiology and pathology, by suggesting other functions for parts of the brain-surface, are thus subversive of many details of the phrenology of Gall and Spurzheim.

The fundamental hypothesis which underlies phrenology as a

system of mental science is that mental phenomena are resolvable into the manifestations of a group of separate faculties. The assumption is contained in the definition that the exercise of a faculty is the physical outcome of the activity of the organ, and in several of the standard works this is illustrated by misleading analogies between these and other organs; thus the organs of benevolence and of firmness are said to be as distinct as the liver and pancreas.

Adverse Conclusions.—"Die Schädellehre ist allerdings nicht so sehr Irrthum in der Idee als Charlatanerie in der Ausführung," says one of its most acute critics. Even though no fault could be found with the physiology and psychology of phrenology, it would not necessarily follow that the theory could be utilized as a practical method of reading character; for, although the inner surface of the skull is moulded on the brain, and the outer surface approximates to parallelism thereto, yet the correspondence is sufficiently variable to render conclusions therefrom uncertain. The spongy layer or diploe which separates the two compact tables may vary conspicuously in amount in different parts of the same skull, as in the cases described by Professor Humphry (*Journ. of Anat.*, viii. 137). The frontal sinus, that *opprobrium phrenologicum,* is a reality, not unfrequently of large size, and may wholly occupy the regions of five organs The centres of ossification of the frontal and parietal bones, the muscular crests of these and of the occipital bones also, differ in their prominence in different skulls Premature synostoses of sutures mould the brain without doing much injury to its parts. In such cases there are compensatory dilatations in other directions modifying sometimes to an extreme degree the relation of brain-surface to skull-surface. The writer has found such displacements in extremely scaphocephalic skulls; the same is true of accidental deformations due to pressure on the infantile skull before it consolidates.

All these and other cogent reasons of a like kind, whose force can be estimated by those accustomed to deal with the component soft parts of the head, should lead phrenologists to be careful in predicating relative brain-development from skull-shape. Psychology, physiology and experience alike contribute to discredit the practical working of the system and to show how worthless the so-called diagnoses of character really are. Its application by those who are its votaries is seldom worse than amusing, but it is capable of doing positive social harm, as in its proposed application to the discrimination or selection of servants and other subordinate officials.

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(A. Mac.; X.)

PHRYGIA, the name of a large district of Asia Minor in ancient times, derived from a people whom the Greeks called Φρύγες; *i.e.,* "freemen." Taken at its widest extent, Phrygia comprised the whole north-west and centre of Asia Minor as far as the river Halys and the southern mountain-edge of the peninsula, and had sea fronts on the Black sea and the Aegean. But most ancient authors confined the name to an inland district stretching roughly from long. 29° to 32° or 33°, and from lat. 38° to 40°; and the real core of Phrygia at all times lay in the comparatively small plateau between the river Sangarius and the upper course of the Maeander.

Phrygia in its narrower sense is a table-land 3,000–5,000 ft., dotted with isolated mountains that rise to 8,000ft., and intersected by several river-systems, in particular that of the Sangarius in the north-east, of the upper Hermus in the west, and of the upper Maeander in the south. Its deep-cut valleys are well suited to the cultivation of cereals and of the vine, but in general the rainfall of the country is too scanty and irregular for the growth of crops or of forest, and the dry, bare uplands are best adapted to rough grazing. The mineral wealth of Phrygia is inconsiderable. Iron was formerly worked in the district of Cibyra, mercury, cinnabar and copper in the neighbourhood of Iconium; but the most notable product was the marble of Docimium, a white stone streaked with veins of violet.

The principal line of communications across Phrygia was a route which rose steeply out of the Hermus valley and traversed the entire length of the plateau in a somewhat irregular line, proceeding at first in a north-easterly direction to Dorylaeum, thence eastward past Gordium and Ancyra to the old Hittite capital at Boghaz-Keui. This road eventually formed part of the "Royal road," by which the Achaemenid kings of Persia connected Sardes and the Aegean seaboard with their capital at Susa. It appears at all times to have served a military and administrative rather than a commercial purpose. The southern edge of Phrygia was crossed by another trunk road which ascended the valley of the Lycus (a tributary of the Maeander) to Apameia-Celaenae, and thence led to Iconium and across Mt Taurus into Syria. This route was much used by the Seleucid kings of Syria and by the Romans, and was probably at every period the chief line for commercial traffic to the Aegean sea. The scenery of Phrygia is generally monotonous Even the mountainous districts rarely show striking features or boldness of character

The Phrygian Immigration.—It may be taken for granted that the population of Phrygia always contained a large element of that indigenous "Asianic" stock, whose survival to the present day has been noted by modern travellers. The persistence of this element in ancient times is indicated by the continued prevalence of native Asianic cults in Phrygia (*See* p. 853) But the Phrygians properly so-called were an immigrant folk According to Greek tradition they entered Asia Minor from Thrace or Macedonia; and this tradition is confirmed by the fact that their language was certainly Indo-European

For the date of the Phrygian immigration the best evidence is found in Homer, who represents the Phrygians as rendering aid to King Priam at the siege of Troy, in return for assistance which he had given to them in their wars against the Amazons (=the Hittites?) on the banks of the Sangarius This story indicates that the Phrygians had entered Asia Minor some time before 1200 B.C. A date not later than 1500 B.C. has been inferred from the furniture of certain burial-mounds in north-western Asia Minor, which resemble the contents of Macedonian tumuli of the early second or late third millennium

It would appear from Homer that the incoming Phrygians made their principal settlement in the Sangarius valley Their chief surviving monuments are also found in this valley (at Gordium), and on the adjacent plateau to the south-west of the Sangarius. But it is probable that about 1000 B.C. all the northern and central parts of Asia Minor had come under Phrygian occupation. The extension of Phrygian power to the western seaboard of Asia Minor may be inferred from a somewhat enigmatic Greek tradition, that in the 9th century B.C. they exercised a "thalassocracy" or "lordship of the seas" in Aegean waters, and from the abundance of Phrygian remains on Mt. Sipylus in the lower Hermus valley. The description of Sinope as a "Phrygian" town indicates a Phrygian settlement along the Black sea. Another Greek tradition, that the Armenians were an offshoot of the Phrygian stock, is supported by the resemblance between the

Phrygian and the Armenian tongues.

The expansion of the Phrygians into eastern Asia Minor is proved by the discovery of an inscription in the Phrygian language at Tyana in Cappadocia. This text, it is true, does not appear to be of earlier date than the 8th century B.C. But the presence of Phrygians on the borders of the Euphrates may perhaps be inferred from Assyrian records which relate victories by Tiglath-Pileser I. (*c.* 1120 B.C.) and by Sargon (717–709 B.C.) over a tribe named the Mushki. The fact that in one of Sargon's inscriptions the chief of the Mushki bears the name "Mita" suggests that the Mushki were Phrygian, or at least had Phrygian rulers, for "Mita" or "Midas" was a common name among the kings of Phrygia proper.

The relation between the Phrygians and the Hittites, who were the predominant people in Asia Minor *c.* 1500 B.C., is not yet quite clear. The existence of a group of rock-carvings in Hittite style, extending from Ancyra to Sardes and Smyrna, suggests that Phrygia proper may at one time have been under Hittite government, but the character of Hittite influence in northwestern Asia Minor still remains uncertain. On the other hand there is little doubt that the decline of Hittite culture and the disappearance of Hittite power from Asia Minor after 1000 B.C. was in large measure due to the expansion of the Phrygians over the peninsula.

Decline of Phrygia.—About 1000 B.C. the Phrygians had penetrated southward in Asia Minor as far as the Hermus and the Maeander, and eastward to the Halys, if not to the Euphrates. But over the greater part of this territory they were unable to consolidate their power, or to extend their culture. East of the Halys they disappear from history about 700 B.C. Their frontage on the Black sea was taken from them by the Bithynians, who probably entered Asia Minor from Europe soon after 1000 B.C. Their access to the Aegean was shut off at some unknown date by the Greek colonists of the coastland and by the Lydians of the Hermus valley. After 800 B.C. the only districts which remained in Phrygian occupation were the tableland between the Sangarius and the Hermus, and the borderland of the Dardanelles and the Sea of Marmora, known later as "Hellespontine Phrygia."

In the 8th century B.C. Phrygia proper achieved a considerable measure of prosperity under a line of kings who had their capital at Gordium and were called alternately "Gordius" and "Midas." The last and greatest of this dynasty was a king Midas who reigned, according to Greek chronologers, from 738 to 695 B.C. This ruler cultivated close relations with the Greeks. He was the first foreign ruler to dedicate offerings to Apollo at Delphi, and he took to wife the daughter of Agamemnon, king of the Aeolic Greek city of Cyme. His name may still be read on his tomb in the "Midas city," one of the most notable remains of Phrygian art.

Soon after 700 B.C. the reign of Midas was brought to a sudden end by the incursion of a Thracian people named the Cimmerians, of which Greeks, Lydians and Assyrians felt the force, but the Phrygians took the full brunt. By the second half of the 7th century the Cimmerians disappeared from Asia Minor without leaving a trace, but Phrygia was now so far enfeebled that it fell under the dominion of the neighbouring kingdom of Lydia.

Phrygia under Foreign Rule.—Under the Lydian rule Phrygia seems to have recovered some of its former prosperity. If the dates usually assigned to Phrygian monuments are correct, Phrygian art reached its highest development about 600 B.C. A resumption of commerce with the Greeks at this period is indicated by finds of Corinthian pottery at Gordium. But after the conquest of Lydia by the Persians (546 B.C.) Phrygia shared in the general decline which now befell western Asia Minor; nothing more is heard of its trade with the Greeks, except that it was a favourite hunting-ground for Greek slaves. It formed one large Persian province, but about 400 B.C. it was divided into two portions, "Great Phrygia" and Hellespontine Phrygia.

After two centuries of uneventful history under Persian rule Phrygia passed into the hands of Alexander of Macedon, who visited Gordium (333 B.C.) and there cut the "Gordian knot"; legend declared that this knot, which secured the yoke to the shaft of an archaic farm-wagon, had been tied by Gordius, the founder of the Phrygian dynasty, and that whosoever might unravel it should become lord of Asia. After Alexander's death Phrygia became a battle-ground for the contending forces of his former marshals. At first it formed the nucleus of the territory of Antigonus, who set up his capital at Celaenae; but after the decisive action at the neighbouring site of Ipsus (301 B.C.) it was transferred to Seleucus as an annex to the kingdom of Syria.

About 275 B.C. all the Phrygian lands east of the Sangarius came into the possession of a horde of Celtic invaders from the Danube lands and was renamed Galatia. The western portion of Phrygia at the same time was taken from the kings of Syria by the newly-founded monarchy of Pergamum. For nearly a century the Phrygian territory remained a bone of contention between the kings of Pergamum and Syria and the Galatian Celts, until in 189 B.C. the Romans expelled the Syrian kings from Asia Minor, confined the Celts to Galatia, and left the western half of the peninsula under the undisputed control of the Pergamene rulers. After the annexation of the Pergamene kingdom by Rome in 133 B.C., Phrygia west of the Sangarius became part of the province of Asia, and remained in this condition until *c.* A.D. 300, when the emperor Diocletian constituted it into two independent provinces, Phrygia Prima and Secunda. Under the Byzantine empire the name Phrygia disappeared altogether.

ECONOMIC LIFE AND CULTURE

Economic Conditions.—Phrygia was at all times an agricultural and, still more, a pastoral land. The only industrial products of greater importance were the marble of Docimium, which was exported in large quantities to Rome under the empire, and the dark-coloured woollens of Laodiceia and Colossae (in South Phrygia, on the River Lycus). The southern border of Phrygia, as we have seen, was traversed by a trade route which, in the days of Greek and Roman rule, attained considerable importance. On the other hand the Royal road, which ran through the heart of Phrygia, played no great part as a highway of commerce, and there is no evidence of any notable quantity of traffic having been carried along the valley of the Sangarius. Phrygia's chief source of wealth lay in its grasslands, which produced fine breeds of horses and of sheep. The horses were exported as far as Rome for use in the circus. The sheep provided a clip of wool which supplied the looms, not only of Phrygia itself, but also of Miletus, Pergamum and other Greek centres of the textile industry.

Under economic conditions such as these, Phrygia was always a land of villages rather than of cities. In the days of the native monarchy Gordium and the "Midas city" grew to be considerable towns, and Celaenae (subsequently renamed Apameia) was probably at all times a trading centre of some importance. Under the rule of the Syrian and Pergamene dynasties a number of new cities with a predominantly Greek population were founded, but most of these were little more than garrison towns or settlements of veterans: the only places that require mention here are the industrial cities of Laodiceia and Colossae (noticed above). The villages were usually built on the slopes of the lower hills, near the site of a temple or of a great landowner's manor-house. The soil for the most part belonged to the successive kings or overlords of the country, to their principal vassals, and to the priesthoods of the more important temples. The actual cultivators lived mostly in a condition of serfdom.

Culture.—The history of Phrygian art is not easy to trace, because the chronological order of the surviving monuments is not yet certain. Its most typical products are rock-cut tombs and houses, and ornamented rock-façades. The entrances to the tombs are often decorated with a gable like that of a Greek temple, supported on pillars in a primitive Dorian or Ionic style. The subjects most commonly represented in the sculptured reliefs are the native goddess Cybele, and pairs of rampant lions, heraldically opposed. Another characteristic ornament consists of a maeander pattern carved in flat relief. The native pottery is ornamented with geometric patterns in matt paint. In the relations of Phrygian art to that of other peoples the one clear point

is that its technique of rock-carving bears close resemblance to that of the Hittites, as exhibited at Boghaz-Keui and in eastern Asia Minor, and was probably borrowed from this people. The maeander patterns, which are no doubt in imitation of tapestry work, also appear to have been derived from Hittite models, and it was perhaps through a Hittite medium that the heraldic lions and the Ionic pillars were introduced into Phrygia from Mesopotamia. The gables and the Doric columns of the Phrygian rock-tombs are strongly reminiscent of archaic Greek art, and it is not unlikely that they are Greek in origin. In general, the Phrygian artists were not inventive, but they knew how to adapt to their own uses whatever they borrowed from their neighbours.

Phrygian music is only known to us from the descriptions of Greek critics, who considered it too florid and exciting. Its favourite instrument was a double flute, which the Greeks regarded as the prototype of their own *aulos*. But the double flute was also known in prehistoric Crete, and can therefore not be regarded as a Phrygian invention.

The alphabetic script of the Phrygians bears a closer resemblance to archaic Greek than to Phoenician; but its exact relation to either of these has not yet been determined. It is only represented by a few texts: all the later inscriptions from Phrygia are in Greek or Latin characters. The Phrygian tongue, which may best be studied in the fairly numerous texts (mostly epitaphs) of the early centuries A.D., is akin to Armenian. In the period of Greek and Roman rule it gave way to Greek in the towns, but on the countryside it remained in use until the 5th or 6th century A.D. (*See* ASIANIC LANGUAGES.)

Religion.—The religion of Phrygia was plainly a composite product. The Phrygian immigrants of *c.* 1200 B.C. brought with them several typical Indo-European gods, such as Papas, the equivalent of the Greek Zeus, and Men, a male moon-deity. The god Sabazius, who was usually equated by ancient writers with the Thracian Dionysus, may be referred to the same group. But the gods of the Phrygian invaders were never able to displace the original Asianic deities, of whom the foremost were Cybele, the "Great Mother," and Attis, a youth who died untimely but in death retained his beauty of figure. This couple, which had several parallels in the religions of the Near East, evidently represented the generative force of nature and the vegetation that withers and blooms with each new season. The worship of these deities was highly orgiastic, and their priests, the so-called "galli," carried their devotion to the point of self-mutilation. The principal sanctuary of Cybele stood at Pessinus, by Mt. Dindymus in central Phrygia, where a hierarchy of priests exercised theocratic rule over the inhabitants of the extensive temple estates. Not only did the cult of Cybele and Attis maintain itself against the religion of the Phrygian newcomers, but it partially absorbed them. Nay more, it more than held its own against the religions of Greece and Rome, and it competed against these on European soil. The worship of Cybele spread to Greece in the 5th century B.C.; in 204 B.C. it was officially established at Rome; in the days of the Roman empire it was carried on the tide of oriental immigration into every part of Italy and penetrated the western provinces as far as the Rhineland and Britain. Thus the religion of Phrygia was its most distinctive contribution to ancient Mediterranean civilization. The influence of the native Asianic religion may also be traced in the various heresies, and especially the heresy of Montanus (himself a Phrygian), that arose in Phrygia after the spread of Christianity. Nevertheless the conversion of Phrygia to Christianity was remarkably early and complete. Christian inscriptions begin there in the 2nd century and are abundant in the third. In all probability the mass of the people had been converted by 300, and Eusebius is no doubt correct in saying that in one Phrygian city at that time every soul was a Christian.

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PHRYNE, Greek courtesan, lived in the 4th century B.C. Her real name was Mnesarete, but owing to her complexion she was called Phryne (toad). She was born at Thespiae in Boeotia, but seems to have lived at Athens. She acquired so much wealth that she offered to rebuild the walls of Thebes, on condition that the words "Destroyed by Alexander, restored by Phryne the courtesan," were inscribed upon them. On the occasion of a festival of Poseidon at Eleusis she laid aside her garments, let down her hair, and stepped into the sea in the sight of the people, thus suggesting to the painter Apelles his great picture of Aphrodite Anadyomene, for which Phryne sat as model. She was also (according to some) the model for the statue of the Cnidian Aphrodite by Praxiteles. When accused of profaning the Eleusinian mysteries, she was defended by the orator Hypereides. When it seemed as if the verdict would be unfavourable, he rent her robe and displayed her bosom, which so moved her judges that they acquitted her. A statue of Phryne, the work of Praxiteles, was placed in a temple at Thespiae by the side of a statue of Aphrodite by the same artist.

See Athenaeus, pp. 558, 567, 583, 585, 590, 591; Aelian, *Var. Hist.* ix. 32; Pliny, *Nat. Hist.* xxxiv. 71.

PHRYNICHUS. 1. Son of Polyphradmon and pupil of Thespis, one of the earliest of the Greek tragedians. Some of the ancients, indeed, regarded him as the real founder of tragedy. He gained his first poetical victory in 511 B.C. His most famous play was the *Capture of Miletus.* The audience was moved to tears, the poet was fined for reminding the Athenians of their misfortunes, and it was decreed that no play on the subject should be produced again. In 476 Phrynichus was successful with the *Phoenissae,* celebrating the victory of Salamis and especially the deeds of Themistocles, who was choragus. Phrynichus is said to have died in Sicily. He introduced a separate actor as distinct from the leader of the chorus, and thus laid the foundation of dialogue. But in his plays, as in the early tragedies generally, the dramatic element was subordinate to the chorus. According to Suïdas, Phrynichus first introduced female characters on the stage (played by men in masks), and made special use of the trochaic tetrameter.

Fragments in A. Nauck, *Tragicorum graecorum fragmenta* (1887).

2. A poet of the Old Attic comedy and a contemporary of Aristophanes. His first comedy was exhibited in 429 B.C. He composed ten plays, of which the *Solitary* (Μονότροπος) was exhibited in 414 along with the *Birds* of Aristophanes, and gained the third prize. The *Muses* carried off the second prize in 405, Aristophanes being first with the *Frogs,* in which he accuses Phrynichus of employing vulgar tricks to raise a laugh, of plagiarism and bad versification.

Fragments in T. Kock, *Comicorum atticorum fragmenta* (1880).

3. PHRYNICHUS ARABIUS, a grammarian of Bithynia, lived in the 2nd century A.D. According to Suïdas he was the author of (1) an *Atticist,* in two books; (2) Τιθεμένων συναγωγή, a collection of subjects for discussion; (3) Σοφιστική παρασκευή or Sophistical Equipment. The work was learned, but prolix and garrulous. A fragment contained in a Paris ms. was published by B. de Montfaucon, and by I. Bekker in his *Anecdota graeca* (1814). Another work of Phrynichus, not mentioned by Photius, but perhaps identical with the *Atticist* mentioned by Suïdas, the *Selection* (Ἐκλογή) *of Attic Words and Phrases,* is extant. It is a collection of current words and forms which deviated from the Old Attic standard, and is interesting as illustrating the changes through which the Greek language had passed between the 4th century B.C. and the 2nd century A.D.

Editions of the Ἐκλογή, with valuable notes, have been published by C. A. Lobeck (1820) and W. G. Rutherford (1881); Lobeck devotes his attention chiefly to the later, Rutherford to the earlier usages

noticed by Phrynichus. *See* also J. Brenous, *De Phrynicho Atticista* (1895).

4. An Athenian general in the Peloponnesian War. He took a leading part in establishing the oligarchy of the Four Hundred at Athens in 411 B.C., and was assassinated in the same year (Thucydides viii.).

PHTHALIC ACIDS, the name given to the three isomeric benzene-dicarboxylic acids, $C_6H_4(CO_2H)_2$: (1) ortho, or phthalic acid; (2) meta, or *iso*phthalic acid; (3) para, or terephthalic acid. The most important is the first, as it forms the starting material in the production of many synthetic dyes and of the synthetic resin, glyptal, glyceryl phthalate.

Phthalic acid was obtained by Laurent in 1836 by oxidizing naphthalene tetrachloride, and, believing it to be a naphthalene derivative, he named it naphthalenic acid; Marignac showed Laurent's supposition to be incorrect, upon which Laurent gave it its present name. It was formerly manufactured by oxidizing naphthalene tetrachloride (prepared from naphthalene, potassium chlorate and hydrochloric acid) with nitric acid, or by oxidizing the hydrocarbon with fuming sulphuric acid, using mercury or mercuric sulphate as a catalyst (German pat. 91,202). These methods have been superseded by a catalytic process in which air and naphthalene vapour are passed over heated vanadium pentoxide; the yield is upwards of 80% of phthalic anhydride, which is readily separated by fractional sublimation from unchanged naphthalene. Phthalic acid forms white crystals, melting at 213° with decomposition into water and phthalic anhydride; the latter forms long white needles, melting at 128° and boiling at 284°. Heated with an excess of lime it gives benzene; calcium benzoate results when calcium phthalate is heated with one molecular proportion of lime to 330°–350°. The acid (and anhydride) are largely used in the colour industry. (*See* FLUORESCEIN; PHENOLPHTHALEIN; DYES, SYNTHETIC.)

Phthalyl chloride, $C_6H_4(COCl)_2$ or $C_6H_4(CCl_2)(CO)O$, formed by heating the anhydride with phosphorus pentachloride, is an oil solidifying at 0° and boiling at 275°. In some reactions it behaves as having the first formula, in others as having the second. Phthalyl chloride with phosphorus pentachloride gives two phthalylene tetrachlorides, one melting at 88° and the other at 47°. They cannot be changed into one another, and have been given the formulae $C_6H_4(CCl_3)(COCl)$ and $C_6H_4(CCl_2)_2O$. Phthalimide, $C_6H_4(CO)_2NH$, is formed by heating phthalic anhydride or chloride in ammonia gas or by molecular rearrangement of ortho-cyanobenzoic acid. It forms *N*-metallic and alkyl salts. Bromine and potash or alkaline hypochlorite give anthranilic acid, $C_6H_4(NH_2)(CO_2H)$. (*See* INDIGO.)

Isophthalic acid is obtained by oxidizing meta-xylene with chromic acid, or by fusing potassium meta-sulphobenzoate, or meta-bromobenzoate with potassium formate (terephthalic acid is also formed in the last case). It melts above 300°, and dissolves in 7,800 parts of cold water and in 460 of boiling. The barium salt ($+6H_2O$) is very soluble (unlike the barium salts of phthalic and terephthalic acids).

Terephthalic acid, formed by oxidizing para-diderivatives of benzene, or best by oxidizing caraway oil, a mixture of cymene and cuminol, with chromic acid, is almost insoluble in water, alcohol and ether; it sublimes without melting when heated.

PHTHISIS (tī'sĭs), a name formerly given (like "Consumption") to the disease of the lung now known as Tuberculosis (*q.v.*) from the wasting often observed. This wasting, however, depends mainly upon secondary infection of tuberculous areas by pyogenetic micrococci and is accompanied by much fever and profuse sweating. The modern tendency is to use the term "phthisis" only when implying the existence of this double infection.

PHYLACTERY, a term applied in Matt. xxiii. 5 to the *tefillin* of the Jews on the assumption that these were amulets (φυλακτήρια), against physical evil. *Tefillin,* either from טָפַל, to attach, or פָּלַל, whence תְּפִלָּה, prayer, are certain Pentateuchal texts which, in accordance with Exod. xii. 16 and Deut. vi. 5–9, were to be worn as constant reminders of God during the daily avocations. Hence they were not used on Sabbaths and festivals, as the day itself was a reminder and the schools and markets were closed. The idea of such an outward sign is common. The modern habit of wearing a cross on a watchchain may be compared. Romans had tablets for memoranda hanging from the wrists. Isaiah xlix. 16 evidently denotes this custom. Possibly the origin is to be sought in tattooing. Tefillin are worn on the hand and head, the verses being enclosed in leather boxes fixed in position by leather thongs. The hand phylactery has one compartment, in which the texts figure on one parchment, the head phylactery having four such compartments, each with one text. The extracts are Ex. xiii. 1–10:11–16; Deut. vi. 4–9, xi. 13–21.

BIBLIOGRAPHY.—For further details, illustrations and historical and critical views, see *Jewish Encyclopedia, s.v.* For the prayers and meditations, *see* S. Singer's *Authorized Daily Prayer Book*, pp. 19 *sqq.* For certain Jewish objections *see* A. Asher's *Collected Writings,* pp. 80–89 (1916, privately printed). Linked with *Tefillin* are the *Mezūzah* (door text) and *Çiçith* (fringes). The former is a text containing Deut. vi. 4–9 rolled in a glass or metal tube on the right-hand of each door, so that everyone who enters or leaves shall think of God (see *Jew. Enc. s.v.* Singer, *op. cit.*, p. 292). The latter (see *Jew. Enc. s.v.* Fringes) is based on Numbers xv. 37–41, which ordains the knotted tassel as a mnemonic.

PHYLE, a mountain fortress, on a pass leading from Athens into Boeotia on the south-west end of Mt. Parnes; famous for its occupation by Thrasybulus at the head of the Athenian exiles during the rule of the Thirty Tyrants in 404 B.C. Defending himself with the help of a snowstorm, he succeeded by a night march in seizing Munychia.

PHYLLITE, in petrology, a group of rocks which are in practically all cases metamorphosed argillaceous sediments, consisting essentially of quartz, chlorite and muscovite, and possessing a well-marked parallel arrangement or schistosity, so called from Gr. φύλλον, a leaf, probably because they yield leaf-like plates, owing to their fissility. They form an intermediate term in the series of altered clays or shaly deposits between clay-slates and mica-schists. The clay-slates have a very similar mineral constitution to the phyllites, but are finer grained and are distinguished also by a very much better cleavage; in the phyllites also white mica (muscovite or sericite) is more abundant as a rule than in slate, and its crystalline plates are larger; the abundance of mica gives these rocks a glossy sheen on the smooth planes of fissility.

A microscopical section of a typical phyllite shows green chlorite and colourless mica, both in irregular plates disposed in parallel order, with a greater or smaller amount of quartz which forms small lenticular grains elongated parallel to the foliation. Grains or iron oxide (magnetite and haematite) and black graphitic dust are very commonly present. Felspar is absent or scarce, but some phyllites are characterized by the development of small rounded grains of albite, often in considerable numbers. The minute needles of rutile, so often seen in clay-slates, are not often met with in phyllites, but this mineral forms small prisms which may be intergrown with black magnetite; at other times it occurs as networks of sagenite. Other phyllites contain carbonates (usually calcite but sometimes dolomite) in flat or spindle-shaped crystals, which often give evidence of crushing. Very tiny blue needles of tourmaline are by no means rare in phyllites, though readily overlooked. Garnet occurs sometimes, a good example of the garnetiferous phyllite being furnished by the whetstones of the Ardennes, in which there are many small isotropic crystals of manganesian garnet. Hornblende, often in branching feathery crystals, is a less frequent accessory. In some phyllites a mineral of the chloritoid group makes its appearance; this may be ottrelite, sismondine or other varieties of chloritoid, and occurs in large sub-hexagonal plates showing complex twinning, and lying across the foliation planes of the rock.

The structural variations presented are comparatively few. The most finely crystalline specimens have generally the most perfect parallel arrangement of their constituents. The foliation is generally flat or linear, but in some rocks is undulose or crumpled. From the imperfection of their cleavage phyllites are rarely suitable for roofing materials; their softness renders them valueless as road stones, but they are not uncommonly employed as inferior building materials. They are exceedingly common in all parts of the world where metamorphic rocks occur; as in the

Scottish Highlands, Cornwall, Anglesey, north-west Ireland, the Ardennes, the Harz Mountains, Saxony, the Alps, Norway, the Appalachians, the Great Lakes district in America, etc.

(J. S. F.)

PHYLLOXERA, a genus of insects belonging to the group Phylloxerinae of the family *Aphididae* which comprises the aphides (*q.v.*) or plant lice. The Phylloxerinae are sometimes placed in a separate family of their own, since they differ from true aphides in characters exhibited in the wing-veins, and also in the fact that the parthenogenetic forms lay eggs instead of producing living young. The genus *Phylloxera* includes over 30 species, the best known being the grape Phylloxera (*P. vastatrix*), which is native to the United States. It was imported into Europe between 1858 and 1863, when American vines were brought over for grafting purposes, and has since reached almost every vine-growing country in the world. The first definite European record was in England in 1863; soon afterwards it was identified in France where it rapidly spread through the vineyards of that country. By 1885 it had extended to most other European grape-producing countries and had reached Algeria, Australia, and the Cape. It was first discovered in California in 1880, but there is evidence that it was present in that State from about 1858, being introduced along with American vines from east of the Rocky Mountains. It was the advent of the highly susceptible European grape that led to the Phylloxera becoming a pest in the Californian vineyards. The presence of this insect is manifested by the vines being stunted and bearing smaller and fewer leaves. When the disease is advanced the leaves are discoloured and galls are present on their under surface. These galls are wrinkled and hairy and their cavity communicates by means of an opening upon the upper surface of the leaf. If the roots be examined, numerous knotty swellings are found upon the smaller rootlets; at first yellowish in colour and fleshy, they finally assume a brown or black colour and become rotten. At the same time the grapes themselves are arrested in their growth and their skins become wrinkled. The damage wrought by the Phylloxera is occasioned by the extraction of the sap by means of the piercing suctorial mouth-parts of this insect, and the subsequent deformation of the plant that is brought about. Millions of acres of vineyards have been destroyed by this pest, and, when at its worst in France, it is stated to have ruined 2,500,000 acres which represented an annual loss in wine-products of £50,000,000.

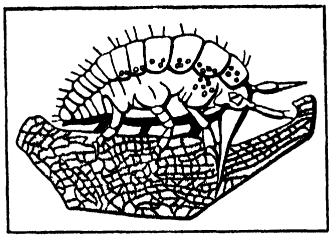


FIG. 1.—ROOT INHABITING FORM OF THE PHYLLOXERA, WITH ITS PROBOSCIS INSERTED INTO TISSUE OF ROOT OF VINE

The complete life-history of Phylloxera is briefly as follows: A single egg is laid by the fertilized female on the bark of the vine where it passes the winter. It hatches in spring into a wingless female or *fundatrix* which, creeping into an opening bud of the vine, forms a gall on the young leaf and lays therein a number of eggs. The latter develop into further wingless forms or *gallicolae* which multiply rapidly and produce new generations of gall-formers on the leaves. Among their progeny there appear, later in the season, wingless females of different behaviour, the *radicolae* (fig. 1), which pass to the roots. The *radicolae* continue reproducing generations of their own kind, but among them winged migrants (fig. 2) eventually appear. These occur from July until October and fly to other vines where they lay two kinds of eggs—small male-producing eggs and large female-producing eggs. The true sexual forms derived from these eggs (fig. 3) are small wingless individuals with vestigial mouth-parts and an aborted alimentary canal. Fertilization takes place and each fertilized female deposits a single over-wintering egg which hatches into a fundatrix as already described. All the rest of the reproduction of the species is by means of parthenogenesis (*q.v.*).

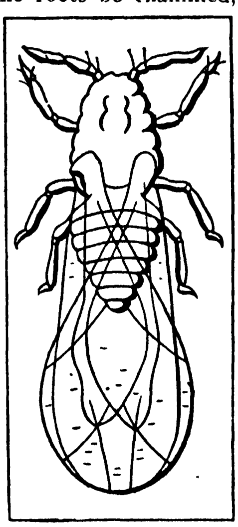


FIG. 2.—WINGED MIGRANT FEMALE
Hatched from the egg of the root Phylloxera, this form flies to other vines where it lays parthenogenetically, eggs of two kinds, male and female

It is noteworthy that in Europe and California the fundatrices

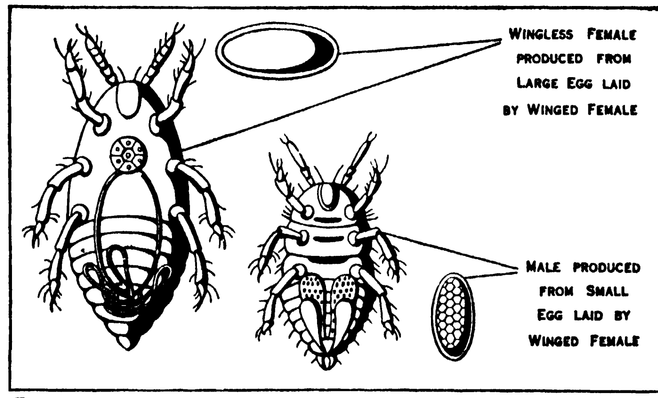
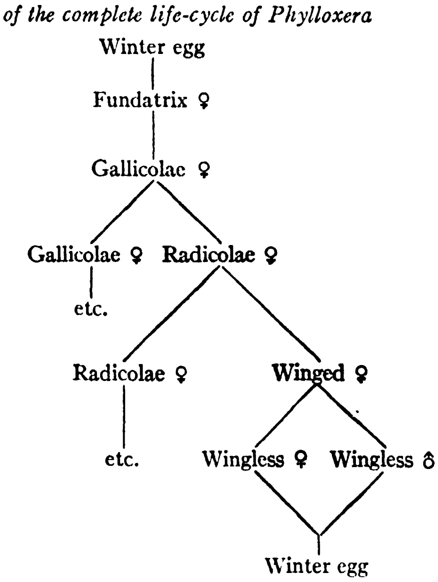


FIG. 3.—MALE AND FEMALE FROM EGGS LAID BY WINGED MIGRANT FEMALE
The female dies after laying a single egg which hatches out in the spring as a female insect known as a fundatrix. This form produces eggs from which are hatched gallicolae. Some of these remain in the buds while others descend to the roots as radicolae

usually fail to develop in the absence of certain American vines and the gallicolae generations are consequently rare. Reproduction and spread are brought about by the radicolae, many of which hibernate and continue multiplying in spring. According to the German authority Boerner, there is a race of Phylloxera found in Lorraine which produces galls on European vines, but not on most American varieties, and he has given this Lorraine race the distinctive name of *pervastatrix.*

Scheme of the complete life-cycle of Phylloxera



Many control measures have been suggested against the Phylloxera but few have been generally adopted in practice. The enforcement of quarantine regulations precluding the distribution of rooted vines from infested areas is important. The utilization of vine-stocks less susceptible to the root-feeding form of the insect is generally recognized. Varieties of American grapes, such as *Vitis riparia, V. rupestris, V. berlandieri* and their hybrids, are not seriously injured by the radicolae, and by growing these varieties, or using them as stocks upon which the susceptible European varieties have been grafted, injuries by the pest have been greatly reduced. In certain cases the injection of carbon bisulphide into the soil to kill the root form of the insect has been profitable. The flooding of infested vineyards has been a recog-

nized procedure where conditions are favourable.

BIBLIOGRAPHY.—The literature on the Phylloxera is voluminous. Valéry Mayet, *Les Insectes de la Vigne* (1890); B. Grassi, "The Biology of the Vine Phylloxera" (*Monthly Bulletin of Agric. Intelligence and Plant Diseases*, vol. vi., 1915); W. M. Davidson and R. L. Nougaret, "The Grape Phylloxera in California" (*Bulletin 903, U.S. Dept. of Agriculture*, 1921), are among the less technical writings. For a full bibliography *see* B. Grassi, *Contributo alla Conoscenza delle Fillosserine* (1912). (A. D. I.)

PHYSHARMONICA, a keyboard instrument fitted with free-reeds, a kind of harmonium much used in Germany. It resembles a small harmonium, but differs from it in having no stops. The physharmonica was invented in 1818 by Anton Häckel, of Vienna.

PHYSICAL CULTURE is the development of the body by exercise to promote and maintain good health or to correct defects or weaknesses of the body. Benefit to the body is the main object and recreation derived therefrom is incidental. Physical culture in its simplest form is taking exercises such as setting-up exercises or calisthenics. The use of equipment—dumb-bells, wands or weight machines—though not necessary, adds interest and variety to the exercises.

Development.—The value of exercise to promote health and physical strength has probably always been recognized by mankind. In ancient and mediaeval times building up of the body was principally for purposes of war, or, as in ancient Greece, preliminary training for sports. Systematic physical culture first appeared during the last part of the 18th century in Germany. In 1774, Basedow founded at Dessau a school in which running, wrestling, riding and manual labour were prescribed as exercise for the students. In 1785, Guts Muth started a system of gymnastics in a school near Gotha, and in 1793 published a book, *Gymnastics for the Young*. At about the same time Nachtigall in Denmark, and Ling in Sweden, were introducing physical training in those countries.

To Professor Ludwig Jahn of Germany should probably go the greatest credit for organizing physical training on a broad scale for the benefit of all the people of the country. Under the direction of Jahn, boys, youths and men of all classes of society took part in exercises for physical development throughout Germany (about 1810). Even with Jahn the idea was physical culture with the ultimate object of physically strengthening the manpower of Germany for war. Physical culture first appeared in the United States and England about 1825, and probably in other European countries at about the same time. It developed slowly between 1825 and 1875. Since 1875, due to the rapid growth of the machine, mechanical transportation and labour-saving devices, the occupations of millions of adults have changed from manual labour to office work; the play of children has been restricted in large densely populated cities, thus the necessity for and practice of physical culture has grown rapidly.

General Rules.—From 10 to 15 minutes daily is sufficient for physical culture exercises; preferably in the middle of the morning or in the afternoon. Exercise immediately before or after a meal should be avoided. Children should be given exercises under the supervision of teachers or parents. If the exercise must be taken before breakfast it should be immediately after rising and be followed by a warm bath and dressing leisurely; if the daily bath is taken at night the exercises should precede the bath. The air in the room should be fresh but not chillingly cold. Clothing should be light and loose. All parts of the body should be exercised during each period even when the object is to strengthen a particular part, but no part should be given more than two exercises in succession. For example, take an arm exercise, a trunk exercise, a leg exercise, etc., following some system of rotation. After an exercise that causes muscular strain, take one that loosens the muscles. Take the breathing exercise at the middle and end of the period. The exercises may be made harder by going to full positions, increasing the cadence or number of repetitions and by the use of equipment. They may be made easier by going to quarter positions and executing slowly. For those who are old or weak the milder exercises should be selected, and regulated to result in good circulation of the blood and loosening up and exercising the muscles without exhaustion.

Attention.—Start the exercises from the position of attention, heels together and on the same line, toes turned out equally at about 45°, weight resting on the balls of the feet, legs straight but not stiff, hips level, stomach drawn in, chest raised, back straight, shoulders back and sloping equally, neck and head vertical, chin raised, body and mind alert. In moving the shoulders back keep the stomach drawn in; otherwise a swayed back position will result. Standing with the back to a flat wall and attempting to make the back touch it from head to heel will indicate how the stomach must be drawn in to make the back straight. Repeat each exercise from 5 to 15 times. Words in parentheses, below, indicate parts of the body that will be benefited.

Exercises. *Arms Sideward*—horizontal, palms down, fingers extended and joined, arms stretched; (1) Close fists; (2) spread fingers to fullest extent. Repeat ten times. Variations: Move wrists up and down, or right and left, or with a rotary motion. (Fingers, wrists, biceps.)

Arms to Thrust—forearms horizontal and parallel at waist, elbows back, fists closed, back of hands down; (1) Thrust arms to front horizontal, palms down; (2) swing sideward, palms up, forcing shoulders back and chest out; (3) return to front position; (4) return to thrust. (Chest, shoulders.) Variation: At 2 swing arms upward.

Arms Sideward Upward—vertical, parallel, palms facing; (1) Bend trunk to right side; (2) recover starting position; (3) bend trunk to left; (4) recover. (Trunk, side and back muscles.) Variations: Bend trunk 30° forward and backward on 1 and 3. Bend trunk forward and circle right, back, left and forward.

Hands on Hips—thumbs to rear, tips of fingers on point of hip; (1) Quarter bend knees, spreading them and lowering trunk in its erect position as far as possible without raising heels; (2) recover. (Leg muscles and joints, balance.) Variations: Half bend—heels off floor; or full bend—sitting on heels, in all cases body erect.

Hands on Shoulders—tips of fingers touching shoulder, elbows to sides and pressed back, upper arm horizontal; (1) Rise on toes, stretching body upward; at same time extend arms to side horizontal, palms up; (2) recover. (Toes, calves, arms.) Variations: Extend arms forward, or upward, or to the three positions in rotation.

Hands on Hips—(1) Bend neck forward, chin in, stretching back of neck; (2) recover; (3) bend neck backward; (4) recover. Variations: Bend neck to sides or bend forward and circle head right, back, left, forward.

Arms Sideward Upward—lock thumbs, palms to front; (1) Full bend trunk forward, touching floor, knees straight; (2) recover; (3) bend trunk backward; (4) recover. (Stomach and back muscles.) Variations: Spread feet about 18 in. and swing hands down and back between legs, or twist trunk as it bends forward and swing arms to side of legs and backward.

Hop to Side Straddle—feet spread about 24 in., landing on toes and raising arms sideward upward; (2) recover attention on toes. Execute in fast cadence, loosening up all muscles of body.

Lunge forward with right foot 30 to 40 in., right knee bent, raising arms to side horizontal, palms up, upper body erect; (2) bend trunk forward, clasping right knee with both arms; (3) recover first position; (4) recover attention. Repeat lunging with left foot. (General exercise, arms, trunk and legs.) Variations: Lunge to sides and on 2 twist as well as bend the trunk so as to clasp the knee.

Bend to squatting position, hands on floor between the feet, knees spread; (2) extend legs backward, feet together, toes on floor, body straight, supported only on toes and straight arms; (3) recover squatting position; (4) recover attention. (General exercise, arms, shoulders, trunk, back, legs.) Variations: Extend one leg back at a time, alternating; or both legs back and at (3) spread feet 30 to 40 in., at (4) bring feet together; (5) recover squatting position; (6) recover attention.

Lie on Back—hands at sides, palms on floor; (1) Raise right leg to vertical, knee straight, toes pointed upward; (2) lower; (3)

raise left leg; (4) lower; (5) raise both legs; (6) lower. (Trunk.)

Sitting Position—arms to thrust, knees straight. Rowing exercise: (1) Bend trunk forward, extending arms to touch toes; (2) recover erect sitting position bringing arms to thrust with force. (Trunk and chest.)

Leap in air 8 or 10 in. (1) toes point down and back, knees straight, legs together, throwing arms upward, sideward and back, head back, looking at ceiling and arching back in midair, all in one count; (2) return to position of attention on toes. (General exercise all parts.)

Hands on Hips—(1) Swing right leg to front horizontal, bending trunk forward and extending left hand to touch right toe, rising on left toe; (2) recover; (3) same with left leg and right arm; (4) recover. (Loosening exercise, leg and trunk.)

Breathing Exercise—(1) Inhale slowly, rising on toes, raising arms forward upward, filling the lungs, raising chest and stretching the whole body upward; (2) exhale rapidly, bringing arms down and back to sides and resume attention. Repeat 5 to 10 times.

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(E. L. K)

PHYSICAL RESOURCES. Though the term "physical" or "natural" resources has no precise definition, it may be taken to designate those things, inert substances, living organisms and effective combinations or products of natural forces, which men utilize to promote their material well-being.

An analytical classification of natural resources might rest on any one of several bases. The historical method might be followed, since it is known that primitive men first made use of vegetable materials, later domesticated animals and finally arrived, at a relatively recent time, at a state of civilization in which the extensive use of minerals is the most important characteristic. As this coincides with fundamental distinctions as to the nature of the resources themselves, it will, in general, be followed here. Another basis of classification might be the human needs which they serve, but such a classification would be confusing, since both vegetable and animal products are used for such diverse purposes as food and clothing, while mineral products as well as the other two are used for shelter. Still another basis of classification might be a division into those resources which men use as a source of energy, and those which are used in connection with its application or production. This classification is also partly followed.

Underlying these considerations is the more fundamental view of natural resources as the principal things that are utilized in the satisfaction of human wants. The most fundamental of these are air, water, food and sunlight. Shelter, clothing and a variety of simple tools are more complex wants and illustrate the kinetic aspect of human needs. The horses, cattle, dogs and other animals of to-day do not (broadly speaking) want anything beyond what the same animals wanted in 5000 B C, while the wants of men have greatly increased and diversified during the same period Much of the material that is utilized to-day owes its usefulness to the way in which it satisfies mental and spiritual rather than purely physical needs. Raw materials therefore pass through repeated transformations and modifications before they serve their final end. A symphony concert, heard over the radio, is related in a remote and complex way to the lumps of ore and fragments of wood which are the basic components of the musical instruments. Though natural resources will be here discussed in their material aspects they are also involved, in a most important and essential way, in the mental and spiritual life of men.

Most of the energy-imparting resources have their basal origin in the radiant energy from the sun. The animal products which men utilize, have been derived by metabolism from vegetable life, and this is in turn the product of the action of living cells upon inert substance, resulting from the energy input of the sunlight. E. E. Slosson has estimated that the heat received by radiation from the sun in a growing season in the latitude of Washington, D.C., amounts per acre to more than would be produced by burning over 200 tons of coal, while the heat value of the corn (maize) grown on an acre in a season amounts to less than that in half a ton of coal. The energy content of coal is ultimately derived from sunlight, and evidence strongly indicates that petroleum and natural gas are decomposition products derived from organic material. Their energy content is derived from the same source.

Water is, similarly, another of the great natural resources, since it is an essential to the life of both plants and animals. The amount of it present in the atmosphere determines, to a large degree, the character of the vegetable and animal life in a given area, while in the descent over the land surface it may be utilized as a perpetual source of power.

The atmosphere is almost never thought of as a natural resource, because it is everywhere present and freely available to all. Yet its oxygen content is essential to all animal life and to the combustion by which power is derived from the hydrocarbons, and its rather small content of carbon dioxide forms, with water and sunlight, the basic components of vegetable life. It also furnishes the mechanism by which water is enabled to maintain its cycle of distribution. Its vital importance as a cooling agent to the human body, considered as a machine, and upon human health, has only become fully recognized within the present century.

Soil, as the rather complex superficial layer which covers the earth's surface is termed, is also an important basic natural resource. It furnishes not only the mineral constituents necessary for plant growth but also the physical conditions that are equally essential. The nature of the soil of a region affects, to a considerable degree, the civilization which may there develop. The character of the soil, in turn, is profoundly affected by climate. Vegetation, forests and animal life are in turn affected by soil and climate, so that these natural resources are complexly interrelated.

The inert natural resources, which may be thought of as static rather than kinetic, may be subdivided into those that are sources of energy, and those which are utilized in other ways. One significant difference is that the first group are destroyed in use, while the others are permanent, to a varying degree Most of the gold that has been produced is still available, while most of the coal that has been produced has been completely destroyed. The lead in storage batteries, on the other hand, is almost completely salvaged and re-used, while that used in paint is almost completely lost. The steadily growing use of natural resources such as these and the fact that the quantity of each now available by the present methods of production has, in every case, some limit and in many cases one that, at the present rate of increasing consumption, is near enough in the future to be a source of real concern, make it appropriate to include in an article on natural resources a discussion of possible substitutes.

The discussion given below is divided as follows: (1) energy group; (2) metallic and non-metallic group; (3) precious metals group; (4) rare metals group; (5) substitutes for natural resources. (T. T. R)

ENERGY GROUP

This classification here includes Animal Life, Vegetation, Soils, Water, Fisheries, Forests, Natural Gas, Coal and Petroleum A discussion of food supply is given in the article FOOD SUPPLY OF THE WORLD Under the article SUN there is a description of this form of energy considered as a natural resource

I. ANIMAL LIFE

The ability of animal life to perpetuate itself and in addition to supply man with a large proportion of his necessities and comforts has materially aided human progress Besides being one of the most interesting and valuable of the world's resources, animals have impressed a record of their own on the pages of history Ancient inscriptions portray the hunt, the feeding of live stock, milking scenes and the slaughter of domestic animals for food.

Man's migrations over the globe and his ability to sustain himself under diverse and adverse conditions have depended largely on animal life With the camel or horse, man can live in the desert. With sheep he can establish himself in regions of high elevation or sparse vegetation With the presence of wild life and a few dogs he can inhabit the frigid zones. Under the more

favourable conditions prevailing in temperate climates, man has built up extensive industries, producing meats, hides, wool, milk and other animal products in commercial quantities. For such purposes he has developed breeds and types especially adapted for his own use or for the demands of his markets.

It is clear, therefore, that the greatest usefulness of animal life to man depends on his wisdom and ability in regulating the number and kind of animals under his control so that they may best serve his needs. With the steady increase in human population, there has been a progressive tendency toward the raising of animals for definite human needs rather than depending on wild life. In recent years this trend has also included the breeding and raising of fur-bearing animals.

Live-Stock Production.—In the age-old struggle for the survival of the fittest, certain types of animal life have proved to be especially well adapted to man's requirements. These he has preserved, improved and protected until their production has become a major part of the world's agriculture. It is important to bear in mind that crop production and stock raising are closely allied enterprises, inasmuch as animals consume most crops that are not utilized by man directly. Moreover, land that is too rough for cultivation may support vast herds of cattle, sheep and goats. (See *Vegetation* below.) Thus live stock serves as a useful balance wheel in the mechanism of human nutrition. Famine rarely occurs in countries where live stock is abundant.

As in the production of other commodities, however, a great number of economic factors are involved. These influence the extent of animal breeding and feeding operations, thus determining the number of animals produced and their age and condition when marketed. As a consequence, animal life as a natural resource is the basis for an industry which, though of great magnitude, varies in extent from year to year, depending on supply and demand. Animal life is an elastic resource, responding closely to the demands made upon it. In most countries the principal domestic animals are counted or estimated periodically and this information serves as a guide for breeding and feeding operations.

Extent of Live-Stock Industry.—As a world resource, cattle exceed all other domestic animals in number and value, aggregating about 629,000,000 head, according to current estimates. This term includes all bovine animals, whether kept for beef production, dairy purposes or as draft animals or beasts of burden. In some countries, notably India, buffaloes are included in cattle estimates. Of the world total, Asia possesses about two-fifths, Europe about one-fifth, with South America, North America, Africa and Oceania following in the order given. Oceania includes Australia and New Zealand. Sheep are the next most numerous domestic animals of economic importance. The world's supply is estimated at about 593,000,000. Of this number Europe has nearly a third, Asia about a fifth and Oceania slightly less than a fifth. South America, North America and Africa follow.

Swine, though much fewer in number than either cattle or sheep, are noteworthy as a food resource owing to their fecundity and early maturity. The adaptability of pork for curing is also worthy of mention as it permits storage and long shipments without refrigeration. Throughout the world, swine are estimated to number about 255,000,000, of which Asia, Europe and North America, respectively, have the largest supply. On the other continents, the swine industry is relatively undeveloped. Though the world's animal resources include a great variety of other stock utilized for food, work and sundry purposes there is a dearth of dependable information regarding their numbers. Even in the case of cattle, sheep and swine, which have just been mentioned as of outstanding prominence, numbers alone give scarcely a true picture of their value to the populations of the various countries. The improved bovine animal, as found in North and South America and in the British Isles, where much attention has been given to breeding for beef production, is vastly different from the beast of burden types in India or Mongolia.

Types of sheep vary greatly, depending on the relative demand for their wool and meat. Similarly, man's influence on animal life has resulted in swine that excel in bacon production or a high yield of lard, depending on the breed selected. Differences in types of animals extend to horses, goats, poultry and pet stock. These differences have been brought about through systematic breeding for a long term of years, giving rise to the establishment of recognized breeds embodying the conformation and other qualities sought. Record associations for the various breeds have served to maintain uniform standards and otherwise to aid in development and improvement. Live-stock shows and expositions at which prizes are offered for animals of superior merit likewise have been influential in stimulating breeders to their best efforts. In the case of food animals especially man's skill in the selection of breeding stock has greatly increased the utility value of his herds and flocks. Whereas the dressed carcass of an ordinary hog weighs, usually, between 65 and 75% of its live weight, the proportion is more than 80% in the case of well-bred, well-managed swine. Moreover, good breeding tends to result in earlier maturity so that animals may be marketed profitably at younger ages, with a resulting saving in feed, labour and other expenses. So highly has this feature of stock raising developed that it is not unusual for a litter of pigs from one sow to weigh a ton or more at six months of age. Improved breeding has numerous practical benefits in the raising of other kinds of live stock. Consequently there is keen competition among progressive stock owners throughout the world in obtaining choice breeding animals.

Inasmuch as the population of the world is increasing steadily, much study has been given the conservation of animal life in order that it may yield more meat and live stock products per unit of area. In regions where land values have increased there is need also for economic reasons to reduce losses and to seek greater economy in production. As a consequence public officials and stockmen have engaged in co-operative endeavours to combat animal diseases and parasites and to stop the ravages of predatory animals. Improved housing and equipment likewise have reduced losses from exposure and the mortality among young animals.

Veterinary Medicine and Surgery.—Beginning originally in France as a means of saving horses injured in war, there has developed in the more important live-stock countries a system of medical service for animals. The science of veterinary medicine and surgery, though designed chiefly to conserve animal life, has made many direct contributions to human welfare. Knowledge of animal anatomy is the basis for the official inspection of meat and meat food products, and the veterinary inspection of dairy cows safeguards the milk supplies of progressive municipalities. With veterinary medicine there has developed also research into problems affecting the health and well-being of man and animals alike. The discovery, by veterinarians, of means to eradicate tick fever from cattle led shortly afterwards to success in combating malaria and yellow fever in man. Knowledge concerning tuberculosis among animals is leading similarly to a reduced incidence of this scourge in the human population, especially among children.

In the light of such information, any statistical measure of the world's animal resources and their usefulness to man in the form of food and clothing must necessarily be incomplete. There can be no accurate appraisement of the service rendered by man's noble friend, the horse, nor by his faithful companion and guarding sentry, the dog. And in the frozen wastes of the globe the oily flesh of animals constitutes the very home fires which maintain human existence. The lower animals are resources which adapt themselves to man's changing needs, and if wisely managed give promise of abundance for many generations to come.

(J. R. Mr.)

II. VEGETATION

If the great physiographic divisions are excempted, the earth's surface is marked more distinctly by vegetation cover than by any other feature. This fact early attracted man to the study of vegetation as distinguished from the study of the individual plant. Primitive man recognized the plant cover not only as a source of sustenance and protection, but also as a guide in his hunting and planting his food crops. Studies in vegetation and its relation to the factors of the environment began very early.

In the recognition of a plant community (a term used in a general sense to include all groups, large and small) the following criteria may be employed: Physiognomy, or the general appear-

ance, historically stands in first place, followed closely by floristic composition which has formed the basis of the science of floristic plant geography. Succession seeks to determine whether the vegetation has reached its final stage, complete adjustment to environment. The study of Habitat (*see* PLANTS: *Distribution and Ecology*) seeks to evaluate climate, soil and biotic factors.

The terrestrial vegetation of the world may be classified into the following great plant types: *Forest, Grassland* and *Desert.* The forests of the world may be divided into seven great formation groups covering a world area of about 22,000,000 square miles. Most of this area is valuable timber land, and about 14,000,000 sq.m. are capable of being converted into crop-producing land, of which about 6,000,000 are suitable for warm-weather crops, and 8,000,000 suitable for cool-weather crops. About 3,000,000 sq.m. of forest land are suitable for grazing only. The grasslands of the world are divided into seven great formation groups covering 13,000,000 sq.m. of valuable grazing land. Of this area 3,500,000 sq.m. are suitable for the production of cool-weather crops such as wheat, rye and oats; while 6,800,000 sq.m. are suitable for warm-weather crops such as sorghum and cotton; and 2,700,000 sq.m. are suitable for grazing only. The deserts may be divided into five great formation groups covering a world area of 17,000,000 sq.m., valuable chiefly as grazing land of low carrying capacity and, where water is available, for irrigation farming. The world contains about 26,000,000 sq.m. of land suitable for grazing; about 12,800,000 sq.m. of land capable of producing warm-weather crops, and about 11,500,000 sq.m. capable of producing cool-weather crops. Allowing no waste land it would limit the production area of the world to less than 25,000,000 square miles.

Forests.—*Tropical Rain Forest* is a luxuriant, evergreen forest with trees of unequal size and height and of varying age forming a dense canopy of thick, leathery leaves, and composed chiefly of Leguminosae, Lauraceae, Myrtaceae, Moraceae and Dipterocarpaceae—a true climax forest with trees of all ages and a mixture of many species. Temperature is uniformly high, air damp, and rainfall 60 to 200 in. per year. Soil is greyish or reddish-brown, poor in humus and containing a large amount of hydrolyzed iron and alumina. Animal life is abundant but chiefly arboreal. Primitive man has lived for the most part at the edge of this forest, and civilized man has utilized natural products such as rubber, gum, wood and bark. Cultivated crops are chiefly tropical such as rubber, sugar cane, cacao and tropical fruits, vegetables and fibre plants, though temperate ones can be grown. This forest covers 3,800,000 sq.m., in Africa, South America and the East Indies.

Temperate Rain Forest is even more luxuriant and varied than the tropical rain forest. It is a many-storied forest, rich in mosses, tree ferns and vines. It consists of the southern conifers such as *Podocarpus* and *Araucaria,* as well as *Ficus, Olea, Juniperus* and *Nothofagus.* The temperature is moderate and the rainfall 40 to 80 inches per year. Under cultivation it will produce temperate cereals and fruits. This forest occupies about 550,000 sq.m., chiefly in the highlands of Central Africa, South America, south-eastern Asia, East Indies and Oceania.

Deciduous Forest is characterized by a dense foliage of thin, grass-green leaves which fall and leave bare branches with heavy bark and scale-covered buds during a long, cold rest period. Oak, birch, beech, maple and ash dominate this forest. There are two distinct climatic seasons: a warm, moist season or growth period, and a cold, moist season, or rest period. Precipitation varies from 30 to 70 in. The soils are either light coloured podsols or grey forest soils. Under natural conditions this forest supports a fauna and fruits and nuts for primitive man. It produced much of the wood and hardwood lumber, and has given way to fields of temperate crops and deciduous fruits. There are three great areas of this forest: Eastern United States, western Europe, and eastern Asia. The total area is about 6,500,000 square miles.

Coniferous Forest presents a uniform stand of similar evergreen trees, and consists chiefly of pine, spruce and fir. The winter climate is rigorous; rainfall varies from 15 to 100 in. annually; the soil is young but the land is of little agricultural value. This forest is the source of much of the lumber used in commerce. It extends across America and Eurasia south of the tundra and pushes down over the highland as far as north Africa and Mexico. It covers about 7,600,000 sq.m. of which 5,500,000 are true forest, and 2,100,000 are woodlands. About 1,000,000 sq.m. are suitable for grazing, 40,000 sq.m. suitable for cool-weather crops and 30,000 sq.m. suitable for warm-weather crops.

Dry Forests are deciduous forests in the tropics and are often called monsoon forests. Leafless during the dry period, they have no cold rest period as does the deciduous forest of the temperate regions. These forests are usually composed of leguminous trees. The temperature is high and rainfall 30 to 40 in. during the growth period. Teak and quebracho are valuable forests of this type. The soil produces good crops of warm-weather cereals, vegetables and fruits. This forest is chiefly in Africa, South America, Australia, south-eastern Asia and Oceania, and occupies about 2,000,000 square miles.

Thorn Forest is composed of small thorn trees, vines and succulents. The trees are leafless during the long drought periods and are found in tropical or sub-tropical regions where the annual rainfall is from 10 to 20 in. Legumes, cacti, euphorbias and lilies are important. This area is unfavourable to primitive man and to animals, but produces gums, fruits, rubber and tanbark. It has no value agriculturally without irrigation, and covers about 330,000 sq.m. in Africa, South America, Mexico, Australia and the dryer portions of Asia.

Sclerophyll Brushland is a forest of small trees or a brushland with evergreen sclerophylls ranging from minute ericas to tree-like proteas, oaks and cherries. Botanically it is extremely variable. The temperature seldom falls below 26° F; rainfall is from 20 to 35 in. annually, and there is a drought period of three to five months. It is an unfavourable habitat for man and animals under natural conditions, but under cultivation it is most favourable for the production of citrus and deciduous fruits and cereals, alfalfa and vegetables. This forest covers about 1,100,000 sq.m. chiefly in the Mediterranean region, Cape Province, south-western Australia, central Chile and California.

Grasslands.—In the *High Grass Savanna* the luxuriant grasses range from 5 to 12 ft. high and consist chiefly of species of *Andropogon* and *Pennisetum.* The luxuriant growth period is followed by a drought during which the grasses are burned. Annual rainfall ranges from 25 to 75 in. The area varies each year from a grassy swamp to a dry desert. The natural production is not great, although the larger animals live here, and rubber, oils and ivory are produced. Under cultivation warm-weather crops of great variety can be produced. This savanna covers about 2,800,000 sq.m. in Africa, south Asia and South America.

The *Tall Grass Savanna,* known as Low Veld or Tree Steppe, consists of grasses from three to five ft. high with trees 10 to 30 ft. high scattered through. The grasses are chiefly andropogons and the trees legumes. The temperature is tropical or sub-tropical with rainfall of 30 to 80 in. It is excellent grazing land. It is a favourable home for primitive man and for civilized man, with rich agricultural lands producing cattle and cool or warm-weather cereals and vegetables. It covers a world area of about 3,900,000 sq.m. in South America, Africa, India and Australia.

Tall Grass, the prairie of North America, the pampas of South America, and the high veld of South Africa, are luxuriant, pure grasslands of blue-stems (*Andropogon*), spear-grass (*Stipa*) and wheat-grass (*Agropyron*). The climate is temperate; rainfall is from 20 to 40 in. annually, and the soil is unusually deep and rich, forming a true *chernozyóm* in the dryer portion. There is a short drought rest period, followed by a long, cold rest period. It is excellent grazing land; it supported great herds of wild game, and later cattle and horses, which have given way to its utilization as the richest grain fields of the world. It occupies about 1,580,000 sq.m. in the United States (chiefly east of the 100th meridian), Uruguay and the Argentine, south Russia and Siberia, Rumania and Hungary, South Africa and Australia.

Short Grass is only a few inches high, occurring in a temperate region with rainfall of 15 to 30 in., with a long drought and a cold rest period. The grama, buffalo-grass, spear-grass and needle-grass are valuable for grazing. The better portion of this land is used for dry farming. The soil is dark brown with an accumulation of

carbonate at a depth of 8 in. to 3 ft. below the surface. The world area of this grassland is about 1,200,000 sq.m., chiefly in North America, South America, Africa and Russia.

Desert Grass Savanna, sometimes called Orchard or Thornbush Steppe, consists of a carpet of short or low bushy grasses, including grama-grass, buffalo-grass, wire-grasses, and scattered small trees, with leguminous and other shrubs. Rainfall is from 10 to 20 in., and there is a long, hot drought period. About 2,300,000 sq.m. are occupied by this type of grassland; it is valuable as grazing land of low-carrying capacity. About 140,000 sq.m. are valuable agriculturally, producing cotton, sorghums and peanuts.

Mountain Grassland occurs on the high mountains in the tropics. The climate is temperate with 40 to 60 in. of rain. The grasses are chiefly species of blue-stem (*Andropogon*) (*Eragrostis*) and dropseed-grass (*Sporobolus*). It is generally valuable grazing land, and under cultivation produces temperate crops as well as bananas and coffee and is similar to the Temperate Rain Forest. The world area is about 790,000 square miles.

Marsh Grass occurs in the great swamp areas and consists of coarse grasses. It supports a fauna valuable for meat, furs and ivory, but without drainage is of no agricultural value. The world area is about 100,000 square miles.

Desert Shrub and Desert Grass consists of a sparse cover of low, woody or fleshy plants with desert grasses between. Botanical composition varies greatly, but legumes, composites, cacti and euphorbias are prominent. Rainfall varies from 5 to 20 in. annually. About 10,000,000 sq.m. of this type are valuable as grazing land of low-carrying capacity, but valueless for crop production without irrigation.

Salt Desert Shrub occupies the low, undrained saline basins in all desert regions. It is valuable for grazing land, but for agriculture it must be leached of salt. The world area is about 30,000 square miles.

Desert in the true sense is seldom found, but at least during much of the year many areas seem lifeless. The flora is abundant in species if not in individual, and the plants are adapted to the extremes of drought and uncertain moisture supply. The world area in Africa, Asia, South America and Australia is about 2,400,000 sq.m. and is of little value.

Tundra (including *Alpine Meadow*) shows mixed botanical composition. The growth period is short with a long, cold rest period. In summer the temperature rises gradually to 60° or 65° F, and during the continuously dark winters the temperature falls to 40° F below zero. This area is valuable for grazing land, though not especially productive. The circumpolar world area is about 4,400,000 square miles. (H. L. Sh.)

III. SOIL

In an inventory of the world's resources it is as important to consider the soil in its crop-producing capacity as it is to estimate the reserves of coal, copper and oil, substances more commonly thought of in this connection. All of our food, our clothing and many of our utensils, implements and ornaments come either directly or indirectly from the land. (*See* Food Supply of the World.)

The crop producing capacity of the soil is, however, a natural resource in a somewhat different way from that represented by coal or oil. These substances have a definite entity and can be estimated in tons and gallons. Once depleted they are manifestly gone. The soil, on the other hand, is a resource because of its ability to produce crop-plants. This capacity varies, it may be much reduced and then be definitely rebuilt.

While an accurate and complete tabulation of the soil resources of the world is impossible, the table in the next column gives some idea of the situation. (*See* Soil; Agriculture.)

Besides indicating the magnitude of the soil resources in acres, the table shows the proportion of the landed area available for crop-plants. This in connection with the population has an important bearing on the possible agricultural and silvicultural independence of each country. Such countries as Argentina, Canada, Australia and Russia can support much larger populations. Their forest resources in terms of population are also great.

Table Showing the Approximate Areas of Ploughed and Forest Lands of Some of the Important Countries of the World

Country	Ploughed lands			Forest lands		
	Acres in millions	% of land area	Acres per person	Acres in millions	% of land area	Acres per person
Argentine Republic	52·74*	7·1	5·1	264·00	35·8	25·5
Commonwealth of Australia	17·77†	·9	2·9	90·20	4·7	14·6
Dominion of Canada	56·13‡	2·3	5·9	596·75	25·3	62·7
France	56·49	41·5	1·3	25·51	18·8	·6
Germany	51·39	44·2	·8	30·90	26·5	·5
British India	427·10	63·9	1·7	86·51	12·9	·3
Italy	39·64	51·7	·9	13·96	18·2	·3
Japan (mainland)	14·27	15·1	·2	48·44	51·4	·8
Sweden	9·53	9·4	1·5	55·50	54·8	9·1
Great Britain	13·56	23·8	·3	2·74	4·8	·06
United States	391·46	20·1	3·2	550·00	28·3	4·5
Soviet Russia (U.S.S.R.)	107·17§	2·3	1·1	1,984·55	42·8	20·9

*Possible agricultural area estimated at 250 million acres.
†Cropped area will ultimately be much greater.
‡Possible agricultural area estimated at 300 million acres.
§Possible agricultural area estimated at 700 million acres.

With our rapidly increasing world population two major soil problems present themselves, *first,* the possibility of increasing the area of lands growing crops other than forests, and *second,* methods of preventing soil depletion and consequent crop decrease. The utilization of virgin and well watered grass lands and the reduction of our forest areas have met the first problem in times past. Unfortunately soils have often been deforested and put under cultivation when they should have been left with their forest cover.

The reclamation of swamps and the better drainage of crop-bearing lands have increased the area and effectiveness of the cultivable soils. (*See* Drainage; Reclamation of Land.)

The utilization of arid and semi-arid lands is particularly promising in certain countries. Such soils, developed under low rainfall, are potentially fertile. Thousands of acres of arable and very highly productive lands will ultimately be added to that now available for crop production through irrigation (*q.v.*).

Another important means of utilizing semi-arid soils is by dry-land farming. (*See* Agriculture.) By proper methods of cultivation, moisture is conserved in the soil and carried from one season to the next. Farming operations thus become possible in areas where the annual rainfall is as low as 20 inches.

The second major soil problem relates to the maintenance of soil fertility. Land can not be cropped without certain losses taking place. These losses are four in number: *first,* erosion or the removal of the surface soil, the most fertile portion, by water or wind; *second,* the loss of constituents by the drainage of water through the soil, called leaching; *third,* the removal of nutrients by plants; and *fourth,* the loss of organic matter as a result of bio-chemical oxidation and the liberation of carbon dioxide.

Water erosion may be controlled by small dams, by terraces, and by the use of sod crops. In spite of such possibilities, however, thousands of tons of fertile soil are swept annually into our rivers. In many cases this is the major cause of soil depletion and is closely correlated with deforestation and flood devastations.

The losses through drainage, crop removal and organic oxidation are susceptible of but little control. Farming operations, even the most careful, encourage rather than check such depletions.

The major features of soil fertility maintenance may be very simply set forth if it is taken for granted that the soil drainage is good, that tillage is adequate, that erosion is under control, and that a suitable crop rotation, if possible, is utilized. Under such conditions the problem is to add certain constituents in such amounts and proportions as at least partially to off-set the inevitable losses. At the same time the physiological balance of the plant nutrients should be maintained as nearly as possible.

While plants require ten nutrient elements for their normal growth and probably several more besides, ordinarily only four are likely to become especially critical, namely nitrogen, potassium, calcium and phosphorus. Sulphur also may be a limiting

factor particularly for such crops as alfalfa and sweet clover.

The nitrogen losses may be met by applying farm manure, turning under crop-residues and by utilizing, either as a crop in the rotation or as a green manure, certain legumes. Commercial nitrogen may be resorted to, although it is generally used to stimulate the crop directly rather than to reduce the drain on the soil nitrogen. Obviously the methods utilized in maintaining the soil nitrogen automatically add organic matter as well. As this material decays and humus is formed a definite ratio is established between the organic matter and the nitrogen. The nitrogen is always in the minimum and apparently controls the amount of humus that finally is present in the soil. The advantage of legumes as green manures over non-legumes is quite apparent, since they obtain nitrogen from the air and are especially rich in this constituent. The soil organic matter besides carrying nitrogen is a source of energy for various bio-chemical transformations and encourages a suitable physical condition of the soil.

The presence of this decaying organic matter tends to make available to plants certain soil constituents, especially potassium. Therefore it is often unnecessary to add a potassium fertilizer to a soil rich in this element if the organic matter is properly maintained and is actively decomposing.

Many soils are low in active calcium and as a consequence become acid. This deficiency also develops other conditions that may be detrimental to some plants but by no means to all. Liming, therefore, must be resorted to for certain crops and is thus an important feature in the maintenance of soil fertility the world over. (*See* FERTILIZERS.) The lime not only reduces the soil acidity but also adjusts other physiological soil conditions.

Phosphorus exists in the soil in small amounts and is often very slowly available to plants. In fact it is so slightly soluble as to be lost but sparingly, if at all, in the drainage water. The only way of dealing with this element is by direct addition of phosphorus fertilizers (*q.v.*).

As the losses of soil constituents increase, the necessity becomes greater for commercial fertilizers.

BIBLIOGRAPHY.—*See* reports and bulletins of the *Internat. Inst. of Agri. at Rome, Statesman's Year Book* and census reports for various countries. *Also* A. D. Hall, *Fertilizers and Manure* (1909) and the *Book of the Rothamsted Experiments* (1919); E. J. Russell, *Soil Conditions and Plant Growth* (1927), *Manuring for Higher Crop Production* (1917) and *Farm Soil and Its Improvement* (1923); C. E. Thorne, *Farm Manures;* T. L. Lyon and H. O. Buckman, *Nature and Properties of Soils* (1922). (H. O. B.)

IV. WATER

Water is probably the natural resource that is most essential to man's existence on the earth. It furnishes him food and drink, means of sanitation and transportation and in large measure the power necessary for his use of other natural resources.

Surface Water.—Run-off is directly the result of precipitation, but the rapidity with which run-off follows precipitation depends upon various conditions, most conspicuously the snow storage. In tropical and subtropical lands the sequence is rapid, but in extreme northern and southern areas it may be delayed several months. The areas from which run-off is supplied mainly by melting snow embrace in general all lands north of the Arctic Circle and all areas that rise above an elevation of about 5,000 ft. in the latitude of the northern United States and central Europe, and above 12,000 to 15,000 ft. in the tropics. In other areas run-off occurs most frequently during the rainy season. If the rainfall is fairly uniform throughout the year as it is in the eastern United States and most of western Europe, the distribution of run-off is also nearly uniform, but there is a considerable reduction during the summer, due to heavier evaporation. Areas in subtropical and warm temperate lands receive precipitation during a definite rainy season, which may not exceed half the year, and the run-off from such areas is, therefore, likely to be variable. On the other hand, streams that rise in areas having a permeable soil and subsoil or are underlain by cavernous rocks are likely to have relatively well maintained run-off. Lakes which cover a considerable part of a drainage basin tend to regularize run-off. Streams draining areas in which there are two or more of these type conditions have a composite run-off. Good examples are the Great Lakes of North America and the lakes at the head of the White Nile in equatorial Africa.

The utility of any stream for power, irrigation or municipal supply, depends in large measure upon the adaptability of its run-off to the demand. Storage must ordinarily be provided to assist in this adaptation. Natural sites available for use as storage reservoirs may contribute largely to the value of the water resources of a drainage basin. Areas that were covered during the glacial period by continental ice sheets or by extensive alpine glaciers generally abound in lakes, which in their natural condition regulate run-off in some degree, and some of these lakes may be converted into reservoirs of large capacity. High rates of run-off and attendant possibilities of power and irrigation development are generally associated with mountainous areas, such as the Sierra Nevada and Cascade Range, in western North America, the central Andes of South America, the Alps and Caucasus in Europe and the Himalayas in Asia.

Ground Water.—Practically all vegetable life depends for sustenance upon underground water. It has been estimated that 50% of the population of the United States depends directly upon wells for its water supply and the proportion for the world is no doubt nearly, or quite as great. A large part of the water used for irrigation is drawn from the ground, which contains water in immense quantities. The practicable use of this water is measured not by its total volume but rather by the extent to which it may be replaced by precipitation. In many areas the water table has been progressively lowered by excessive pumping. In some places the rate of recharge of the underground water from surface streams may be increased to offset the lowering of the water table, but large drafts on the supply inevitably reduce it. Seepage due to the excessive use of water for irrigation generally finds its way into the ground and in many places may be re-used after it is discharged from springs or recovered by pumping.

Water-power.—The developed water-power of the world, according to estimates made by the U.S. Geological Survey, was about 23,000,000 h.p. in 1920, 29,000,000 h.p. at the end of 1923 and 33,000,000 h.p. at the end of 1926, an increase of 43% in six years.

Summary of Developed Water-power of the World in 1926, and Potential Water-power at Ordinary Low Water in Horse-power

	Developed	Potential
North America	17,635,000	65,800,000
South America	751,200	54,100,000
Europe	13,100,000	58,100,000
Asia	2,068,000	69,200,000
Africa	13,680	190,950,000
Oceania	242,500	16,650,000
Total	33,810,000	454,800,000

The estimates given above are based on data of widely varying completeness and accuracy, but they afford a general idea of the water-power resources of the world. For Asia, Africa and South America, where great areas are practically unexplored, it has been necessary to rely largely on studies of precipitation and topography. It appears that the potential water-powers of four of the continents are approximately equal, that Africa's quota is equal to that of any other three, and that Oceania, including Australia, possesses a negligible quantity. Africa is essentially a great plateau on which the streams are large and from which they fall rather abruptly to the sea. Tropical Africa, particularly the Congo, comprises the largest land area within the belt of the equatorial rains, and this fact taken in connection with the characteristic topography of the continent, gives it by far the greatest concentration of potential water-power on the globe. Asia comprises vast elevated areas, including the highest mountains and plateaux, but in northern, western and central Asia the precipitation is low, and in its southern and eastern parts the rainfall is irregularly distributed through the year. The water power resources of Asia are therefore hardly greater than those of North America.

Irrigation.—Nearly one-third of the earth's surface receives only 10 in. of rain or less annually, and for another third the annual rainfall is between 10 and 20 inches. On the area receiving

less than 10 in. and on much of that receiving up to 20 in., irrigation is generally essential to the production of a profitable crop. The earliest civilization of which we have any knowledge was developed by means of irrigated agriculture. Not until near the Christian era did the world dominion and leadership in art and culture pass to nations inhabiting other than great irrigated lowlands such as Egypt and Mesopotamia. With the general decay of civilization during the dark ages, irrigation systems were neglected and some were entirely destroyed by invading armies. Egypt, protected by the sea and the desert, suffered relatively little. Mesopotamia, exposed to the full fury of successive surges of Mongolian nomads, received blows from which it has never recovered. With the advent of the Renaissance and the gradual growth of modern civilization, the centre of civilization gradually shifted to the more humid parts of northern Europe and eastern North America, and artificial moisture became a less important factor in the growing of the world food supply.

After 1875 new influences in world affairs gave a decided impetus to irrigation development. Railroad construction has opened up vast areas of arid and semi-arid lands requiring irrigation to bring them to a high degree of crop production. Construction equipment and methods have been greatly improved. Projects are now feasible which, a half century ago, would have been entirely impracticable. Dams are projected and under construction of a height and size undreamed of a few decades ago. Improved standards of living have increased the demand for certain products of irrigated lands such as citrus and deciduous fruits, and increased transportation facilities have made possible their widespread distribution. As a result, the irrigated areas in the newly developed countries of the Western Hemisphere have been increasing rapidly. The population of India, China and other lands of ancient civilization has been very largely limited by the area of tillable land, and this in turn by the supply of water available for irrigation. The very considerable growth during recent years in the population of India has been due in large measure to the effectiveness of the irrigation works constructed by the Government. Probably one-fourth of the population of the globe is now primarily dependent for food on the products of irrigated land.

The irrigated area of the world by countries in 1926 has been estimated by the U.S. Bureau of Reclamation as practically 200,000,000 ac., made up by continents as follows: North America, 26,834,000 ac.; South America, 6,613,000 ac.; Europe, 14,798,000 ac.; Asia, 140,760,000 ac.; Africa, 10,310,000 ac.; Oceania, 1,270,000 ac.; grand total 200,585,000 acres. (F. F. H.)

V. FISHERIES

The important fisheries of the world are found for the most part within the north temperate zone, chiefly between the 40th and 60th parallels of north latitude. In this region conditions are especially favourable to fish life, including large continental shelves with relatively shallow water and extensive coastal indentations, richly supplied with materials from the massed land areas of the region to support an abundant aquatic flora and fauna. The herrings, of which there are some 150 species, represent the most important family of fishes. The species are widely distributed in fresh and salt water and contribute a greater yield than any other family of fishes. They supply the raw materials for the highly important sardine industries of Norway, France, Spain, Portugal and the United States, the extensive herring curing industries of northern Europe and North America, extensive fish meal, fertilizer and oil industries of Norway, United States, Canada and Japan, as well as being widely used for food in the fresh state wherever they are found. As they feed on microscopic plant and animal forms, they are especially important as converters of plankton organisms at one step into food for man.

The gadoid fishes which include the cod, haddock, hake and pollock also rank high in their contribution to man's needs. The annual catch of cod along the Atlantic coast of North America exceeds 1,000,000,000 pounds. These are white-meated fishes, and the fat is stored in the livers, the basis for the cod-liver oil industry. Next in importance are the salmons, noted for their exceptional food properties, size, beauty and gameness. The family includes not only the salmons but the white fishes, the ciscoes or lake herring and the trouts. The most important members are the five species of salmons native to the North Pacific, entering the tributary rivers in North America and Asia to spawn. The annual catch amounts to about 1,000,000,000 lb. a year and is the basis for the important salmon canning and curing industry.

The mackerels, of which there are about 60 species, are widely distributed and highly prized for food in the areas where they are found in abundance. Included in this family are the highly prized tunas, the true mackerels of the north Atlantic, Spanish mackerel and the bonito. The shell-fish fisheries are also of considerable importance, including some of the choicest products of the sea and valued as food because of their distinctive flavour and their richness in iodine and minerals, essential elements of our diet. The oyster fisheries are of importance in the United States, France and Japan. Lobsters, crabs, clams and shrimp are widely sought after.

The fisheries are a most important source of food. In addition they supply many articles of importance in the arts and industries. Fish meal is gradually winning a place for itself as one of the most valuable protein feeds for hogs, cattle and poultry. Fish fertilizer is generally recognized and widely used as a plant food. The demand for and use of fish oils for soap making, for hydrogenation, including use in lard substitutes, and for many other purposes is increasing. About 60,000,000 gal. of whale oil alone is now produced annually. Shells of molluscs are an important source of raw materials of buttons and various artistic articles. From the shells of the fresh water mussels taken in the Mississippi valley region are produced about 3,000,000,000 buttons per year. From shark hides are made fancy leathers for artistic articles; from fish scales is derived fish scale essence used in the manufacture of imitation pearls; from Japanese pearl farms are derived artificial pearls and from numerous waters of the globe are taken genuine pearls. From the sea-weed industries are derived many products and from the sea itself the indispensable solar salt.

The annual world harvest of fish and fishery products amounts to not less than 30,000,000,000 lb. with a first value of about $1,250,000,000. In addition there is a very considerable draft on water areas by angler and fisherman for home consumption for which no satisfactory estimate can be made. Among the leading nations of the world in the prosecution of fisheries arranged in the relative order of the magnitude of their fisheries are: Japan with a catch of about 5,700,000,000 lb.; United States with 3,000,000,000 lb.; England, 1,700,000,000 lb.; Norway, 1,450,000,000 lb.; Russia, 1,200,000,000 lb.; Canada, 17,190,000,000 lb.; and Spain, 900,000,000 pounds. These seven countries produce about one-half of the world's fishery harvest. Among the other nations producing in excess of 500,000,000 lb. annually are: Scotland, Newfoundland, Germany, France and Portugal. (L. RA.)

VI. FORESTS

The world production and consumption of wood amounts to approximately 56,000,000,000 cu.ft., which is an average of 32 cu.ft. per caput. About 26,000,000,000 ft. is saw-timber, and 30,000,000,000 ft. is firewood.

Increase of Consumption.—As populations grow and as living standards rise and human wants become more complex, timber consumption increases, in spite of the extensive and growing use of substitute materials, and in spite of the tendency to utilize wood more economically. Railroad ties, newsprint and other products of wood pulp, automobiles, phonographs, radio cabinets and many other articles requiring large quantities of wood, all have come into extensive use within recent times.

In Great Britain timber consumption has increased much more rapidly than has the population. Even in France with a practically stationary population, timber consumption was slowly increasing until 1914; that of Germany more than doubled within the century; in the United States at least seven times as much lumber is (1929) used as in 1850. Judging from the rates of increase in these and other important consuming countries, the world's timber needs may be expected to double within approximately 50 years. The per caput consumption in North America of saw-timber (188 cu.ft.) is five times as great as that of Europe, and if the tropical countries south of the United States be disregarded, it is six and one-half times that of Europe. Europe,

South America and Australia use about equal amounts of wood per caput (39 cu.ft.). The proportion of saw-timber to total amount of wood used, however, is quite different, being only one-ninth in South America, two-fifths in Australia and over one-half in Europe. Asia and Africa use comparatively small amounts of wood (9 and 5 cu.ft. respectively).

The total quantity of wood grown in the world each year is roughly estimated at about 38,000,000,000 cubic feet. If this increment were spread evenly over the whole forest area, it would amount to only 5·1 cu.ft. per acre. It is apparent that the present annual growth of 38,000,000,000 cu.ft. is not replacing the present annual cut of 56,000,000,000 cubic feet. The amount of growth each year represents the growth of only a small part of the forest. Vast areas of virgin forests must be left out of the calculation, because in their present condition there is no net growth in them. If all the forests of the world were placed in a growing condition, with a moderate amount of management and protection against devastation, they could produce annually at least 355,000,000,000 cu.ft. of wood, or nearly 50 cu.ft. per acre.

The World's Timber Supply.—With about 5,500,000,000 ac. of productive forest area in the world, bearing heavy stands of virgin timber, having possible growth many times the world's present timber requirements, it would seem that there is enough timber to last for centuries. This would be true if all kinds of wood were equally capable of satisfying human wants. There are about 2,645,000,000 ac. of softwoods or conifer forests in the world; some 1,204,000,000 ac. of temperate hardwoods or broad-leaf forests, and 3,638,000,000 ac. of tropical hardwoods. Although the softwoods and temperate hardwood forests together form only one-half of the total forest area of the world, 91% of all the timber cut and used comes from the softwood and temperate hardwood forests of the Northern Hemisphere, and only 9% from the tropical hardwoods. The softwood forests are furnishing three-fourths and the temperate hardwoods one-fifth of the construction timber of the world. The temperate hardwoods, in addition, supply three-fourths of all the firewood. The amount of standing timber in the tropics is far greater than the amount remaining in the temperate regions, yet until recently, the tropical forests have played a minor part in supplying the world's timber. There has been prevalent an idea that the tropical forests are composed chiefly of cabinet woods, dyewoods and similar kinds of hard, heavy, deeply coloured wood, suitable for furniture and special uses, but not for construction. Recent explorations have shown that there are many excellent construction woods, equal if not superior to the woods of conifers for use in the tropics because more resistant to decay and termites. Before the tropical forests are able to supply a large part of the world's requirements there must be developed adequate systems of cheap transportation and adequate supplies of efficient labour. Another difficulty is that the tropical forests are mostly composed of a variety of species, intermingled in the greatest confusion, and can be exploited economically only if practically all the important species can be utilized. The crux of the world's timber supply problem, during the next two or three generations at least, lies in the available supplies of softwood and temperate hardwood.

Softwood Supplies.—The softwood forests are very largely confined to the cooler regions of the Northern Hemisphere, although some conifers occur in the Southern Hemisphere. The present growth of conifer timber is about 80% of the present cut. The forest capital is being depleted. The principal conifer regions are: (1) North America, including Canada, the United States, and the Sierras of Mexico; (2) northern Europe and central Europe; (3) Asiatic Russia, Manchuria and part of Japan.

In *Canada* the total amount of accessible merchantable saw-timber is estimated at approximately 61,500,000,000 cu.ft. and of pulpwood 52,000,000,000 cubic feet. The forests are being destroyed from two to two and one-half times faster than they are grown. At a total annual drain upon the forests of 5,000,000,000 cu.ft., the accessible stands of virgin forests would be exhausted in about 25 years. In the *United States* roughly only 385,000,000,000 cu.ft. of softwoods of saw-timber size remain. Softwoods comprise two-thirds of the 13,000,000,000 cu.ft. of large timber used annually and more than three-fourths of the sawed lumber. Of the paper consumed in the United States, nine-tenths is made of softwoods. To meet its 1929 requirements, the United States cut about four times as much as grows each year. *Alaska* has great reserves of virgin timber in her coast forests and will contribute largely to the world trade. *Mexico* has about 20,500,000,000 cu.ft. of pine in mountainous forests at an elevation between 7,000 and 10,000 feet.

Europe is barely capable of meeting its softwood timber needs. Just before the World War Great Britain imported 97% of the timber she consumed; France, Germany, Italy, Belgium and the Netherlands imported approximately 30, 47, 65, 77 and 82% respectively. The only European countries that have any prospect of increasing their output of softwood timber for any considerable period or even of continuing to export at the present rate are Sweden, Finland, Russia and possibly Czechoslovakia and Yugoslavia.

In *Asia* the only country exporting on a large scale at present is Japan. In Asia only western and eastern Siberia are reputed to have enormous supplies of virgin softwood timber. Siberian forests, however, are largely unexplored, and little is known of their actual condition. Of the vast forest area of *South America* only 5% is composed of conifers. The bulk is in southern Brazil and adjacent portions of Argentina and Paraguay. The entire region produces only from one-third to one-half as much softwood timber as Argentina alone buys from the United States and Canada. The other South American countries depend upon the Northern Hemisphere for much of their construction timber.

Africa, although it possesses extensive equatorial forests, does not contain enough softwood timber to furnish even the small amounts required locally for construction purposes. In *Australia,* the softwood supply is inadequate for local needs. Much pine, fir and spruce lumber is imported from North America, Europe and north-eastern Asia. The small area of softwood forest in New Guinea and the other islands of the Pacific is insignificant.

Lord Lovat, after a survey of the softwood forests of the world, arrives at the conclusion that, except in Russia, the main softwood virgin timber reserves will be exhausted before very long, and Europe will have to depend more and more on timber raised by the agency of man; that the United States shortage is likely to come more quickly than that in Europe; that the more the American supply becomes centred in the Pacific coast States, the greater is the probability of the industrial States of north-eastern America coming into the European markets for saw-timber in the same way that they do now for pulpwood; and, finally, that as the United States consumes over 13,000,000,000 cu.ft. of softwoods, as opposed to a total European consumption of 9,000,000,000 cu.ft., the United States advent into European markets will have an important bearing upon European prices.

Temperate Hardwoods Supplies.—Like the conifers the temperate hardwoods are confined chiefly to the Northern Hemisphere and are located fairly close to consuming centres. They as a rule occupy the better soils of the more favourably situated lands and, therefore, have been progressively destroyed to make room for cultivation. The large old timber has been depleted even to a greater extent than that of the softwoods. *Europe* has still extensive areas of hardwood forests and even exports special kinds, such as the oak of Poland and Yugoslavia. On the whole, however, the consumption of hardwoods in Europe greatly exceeds the production. In *Asia,* Japan exports small quantities of oak. Walnut and other hardwoods are exported from Asiatic Turkey and the Caspian region. Siberia has about 30% by area of the temperate broad-leaved forests of the world. Except in the Far East, however, they consist of fairly light stands of aspen and birch, much of it valuable chiefly for firewood or pulp and not to be compared with the hardwoods of the United States and Europe. In *North America* the United States now has the largest supply of temperate hardwoods. The other North American regions have no surplus over their own needs. The original stand of approximately 250,000,000,000 cu.ft. of merchantable hardwoods has dwindled to about one-fourth of that amount and is being further depleted at the rate of over 2,000,000,000 cu.ft.

a year. The United States uses nearly 4,000,000,000 cu.ft. of hardwood timber a year, exclusive of firewood, or almost two-thirds of the entire world consumption of temperate hardwood timber. In the temperate region of the Southern Hemisphere including *southern Chile* and *Argentina, portions of New Zealand* and *Tasmania* and the *high mountains of South America* and *Africa*, there are relatively small quantities of valuable hardwood timber, and little or none for export. The outlook for future supplies of hardwoods, however, is probably better than for softwoods, because woods adapted to the same uses can be got from the tropical forests, though they may cost much more. (R. Z.)

VII. NATURAL GAS

The occurrence of natural gas is widespread, both geographically and geologically. Geographically, natural gas is produced in (1) United States: Alaska, Arkansas, California, Colorado, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Missouri, Montana, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, Utah, West Virginia and Wyoming; and (2) Canada: Alberta, New Brunswick, Ontario and Saskatchewan. It is found beneath the earth's surface, compressed in small cavities or in porous rock strata. The "gas sand" is a porous rock formation containing millions of small cavities which gas, oil, water or all three together may occupy.

There is a considerable difference of opinion among geologists and chemists as to the origin of natural gas. There are two theories—the organic and the inorganic. In the former, natural gas is considered as having been formed as the result of a tremendous distillation process of decayed vegetable and animal matter millions of years ago. The inorganic theory places the origin of natural gas at a still greater age back into the beginnings of the world, and regards it as a product of heat and volcanic action on carbon possibly deposited when the first crust of the earth was formed. The organic theory is the one more generally accepted. It is a well-established belief, however, that regardless of the process by which natural gas came into existence, the new gas now being generated underground is negligible, so that when the present supplies are exhausted, natural gas will fail.

The by-products of natural gas are natural gasolene, helium, chloroform, formaldehyde, formic and other acids. An important use of natural gas is in the manufacture of carbon black, produced for the manufacture of printer's ink and automobile tyres.

More than 1,000,000,000 gal. of gasolene were (1929) being recovered as a by-product, thus adding to the total supply of motor fuel. Also many millions of cubic feet of liquefied petroleum gases were produced and marketed as raw materials; many thousand pounds of medicinal synthetic and pharmaceutical preparations were made. It has been estimated that 100,000,000 cu.ft. of helium could be produced annually.

The natural gas industry is of most importance in the United States where its magnitude is indicated by the fact that between 15 and 16 million persons living in some 2,500 cities and towns in 24 States represent the domestic consumers of natural gas. In addition possibly 17,000 industrial concerns utilize this fuel. The supply of gas is drawn from more than 45,000 wells covering an area of over 15,000,000 acres. The expansion of natural gas service by means of long high pressure transmission lines to distant towns is one of the outstanding features of the public utility situation in many parts of the United States, natural gas replacing manufactured gas at many important centres.

As in the petroleum industry, pessimistic opinions prevalent a few years ago regarding dwindling supplies of natural gas have been forgotten as a result of the enormous developments of 1929.

Drilling for gas, even with the modern and improved methods, is generally quite uncertain. Expensive drilling is the only means of definitely determining whether gas exists in paying quantities. Thus out of a total area of 3,000,000 sq.m. in the United States, less than 12,000 sq.m. have been productive of natural gas. Geologists are able to indicate probable productive or non-productive lands with a reasonable degree of accuracy, but not with sufficient accuracy to establish a safe estimate of the probable reserve.

In recent years much attention has been given to the conservation of this fuel. Since natural gas is so often incidental to the recovery of oil, it is in many cases largely wasted—acting merely as the vehicle which propels the oil out of the oil sand. (F. W. PA.)

VIII. COAL

Since the estimate of the coal resources of the world was made in 1913 by the 12th International Geological Congress, the World War and the Versailles treaty have changed many boundaries and consequently the resources of many nations. The best revision of these figures for Europe is that by Sir Richard Redmayne, and it is used for European figures in the accompanying table. It does not show the quantities of various kinds of coal in European countries, a task that must be left to some future congress. Neither Sir Richard Redmayne nor the International Geological Survey gives consideration to the exhausted minerals, except that the United States figures are corrected to 1910. Because of the impossibility of correcting all the figures, owing to the changes in boundaries and to inadequate data as to kinds of coal extracted and even as to total extraction in some countries, no attempt has been made, as it should have been, to correct for consumption and waste in mining. The figures for Ireland have been energetically debated. Those given by the congress may be too low, especially in view of some recent discoveries. Nevertheless, the figures of the congress have been taken without change, including those of England, though, there also, extensions of fields have been indicated without definite estimates of their importance. Some changes were made in the figures for Panama, Pennsylvania, Rhodesia, Victoria and British Columbia, the last because the report of J. D. MacKenzie has shown the resources of Vancouver island to be probably overestimated.

Using the figures in the table on p. 865 and the figures for production of coal in the 1925 publication of the Bureau of Mines (Department of Commerce, United States) *Mineral Resources of the United States*, it is found that the 1925 production of coal in the United States was about 582 million tons while the coal reserve in the United States is estimated at 4,231,076 million tons. This shows a supply of over 7,000 years on the basis of the 1925 production. Similarly for the world, with a coal reserve estimated at 7,867,600 million tons and a 1925 production of about 1,498 million tons, a supply of over 5,000 years is shown based on the 1925 production. These figures indicate that, even with large increases in coal consumption it will take many years to exhaust the known world resources, as estimated in 1925.

In the table, A represents anthracite; B is coal with volatile matter between 12 and 35%; C is coal lying between B and a coal D, the moisture in which exceeds 20%.

IX. PETROLEUM

In discussing the petroleum resources of the world the best that can be offered is a scientific guess carefully formulated on the basis of the data now available. Probably the best available study is that by Eugene Stebinger, chief of the Foreign Mineral Section, in the U.S. Geological Survey (made in 1919) on a map upon which he indicated by circles the relative importance of the estimated oil reserves of the different regions. Stebinger's estimates follow, the table on p. 866 expressing first, the relative values of these groups as compared with unit value for the United States, and second, the corresponding quantities when unit value for the United States is 7,000,000,000 barrels.

Since the Stebinger estimates, there have been several careful investigations and reports on the oil reserves of the United States. Petroleum recovered by present methods of flowing and pumping from existing wells and acreage thus proven in the United States amounts to 5,300,000,000 bbl., according to an estimate made by the Committee of Eleven of the American Petroleum Institute in 1925. The report estimates "that after pumping and flowing there will remain in the area now producing and proved 26,000,000,000 barrels of crude oil, a considerable portion of which can be recovered by improved and known processes such as flooding with water, the introduction of air and gas pressure and mining, when price justifies. Improved methods of deep drilling below oil sands now producing will disclose in many areas deposits not hitherto available, which will be tantamount to the discovery of new fields."

The Federal Oil Conservation Board in its report issued in Sept. 1926, said "from the most recent estimates it would appear that the reserves of oil available by flowing and pumping wells from present production and proven fields amount to about 4,500,000,000 barrels." The board points out that there is a wide variation in estimates of the amount of oil left underground in the sands after production ceases with ordinary methods of flowing and pumping which have been hitherto employed.

Dr. David White, of the U.S. Geological Survey, commenting on the Stebinger estimates pointed out that oil indications are

Estimate of Coal Reserves of the World. Tons of 2,000 lb.

	Actual reserve Millions of tons Class of coal			Probable reserve Millions of tons Class of coal			Total
	A	B and C	D	A	B and C	D	
North and Central America							
United States	..	..	.	21,380	2,155,592	2,054,104	4,231,076
Canada	744	30,905	424,354	1,634	275,743	621,132	1,354,512
Honduras			..	..	1	4	5
Panama	..	.	.	300	350		650
Total estimate for North and Central America	744	30,905	424,354	23,314	B 2,431,686	2,675,240	5,586,243
South America							
Colombia	.	.	..		B 29,762	.	29,762
Venezuela		.			6	.	6
Peru			..	772	B 1,476	..	2,248
Argentina		6	..		.	.	6
Chile	.	2,295	.		C 1,065	.	3,360
Total estimate for South America		2,301	.	772	32,309	.	35,382
Europe							
United Kingdom	12,504	143,471	..	14	B 35,017	..	182,308
Germany	..	.	..	.	..	..	163,415
Poland		..	..	..	..	..	75,871
Ukraine		..	..	..	..	..	61,351
Czechoslovakia	..	..	..	..	.	..	26,999
France	..	..	..	.		..	20,478
Belgium	.	..	..	..	.	..	12,125
Norway including Spitzbergen	..	..	..	..	B 9,645	..	9,645
Spain	.		..	..	..	..	6,104
Yugoslavia	.	.	..	..	..	..	4,905
Russia	..	..	.	..	..	.	2,191
Netherlands	..	.	..	.	.	..	1,887
Rumania	..	..	..	.	.	..	800
Hungary	..	.	..	..	..	..	673
Austria	..	.	.	.	..	.	428
Bulgaria	..	.	..	..	C 33	395	428
Italy	..		.	..	..	.	272
Sweden	..	B 117	..	.	B 9	.	126
Denmark	..		..	.	.	55	55
Greece	.	..	11	..	.	33	44
Total estimate for Europe	.		.				570,105
Asia							
Korea	8	1	6	36	14	24	89
China	9,792	10,784		417,314	658,895	661	1,097,446
Japan	5	C 987	74	63	6,872	784	8,785
Manchuria		B 34		75	B 246		..
	..	C 417		.	C 560		1,332
Siberia				1	72,790	118,878	191,669
Indo-China	..	.	.	22,048		.	22,048
India	.	244	248		83,972	2,620	87,084
Persia	.				B 2,048	.	2,048
Total estimate for Asia	9,805	12,467	328	439,537	825,397	122,967	1,410,501
Africa							
Belgian Congo		..	..	.	99	992	1,091
Southern Nigeria	..	..	88	.	.	.	88
Rhodesia	2	378	82	..	B 7,027	.	
					C 143	.	7,632
South Africa	.	.	.	12,853	49,097	.	61,950
Total estimate for Africa	2	378	170	12,853	56,366	992	70,761
Oceania							
Australia	109	2,173	241	617	143,608	42,536	189,284
New Zealand	..	B 29	675	..	B 109	2,053	3,732
		C 400		..	C 466	.	..
British North Borneo	.	C 6	.	.	C 77	.	83
Netherlands India		44	809		C 220	372	1,445
Philippines	.	.	4		B 6	63	73
Total estimate for Oceania	109	2,652	1,729	617	144,486	45,024	194,617
Total estimate for world	..						7,867,609

(R. D. H.)

Estimated Oil Reserves	Relative value	Millions of bbl.
United States and Alaska	1·00	7,000
Canada	·14	995
Mexico	·65	4,525
Northern South America, including Peru	·82	5,739
Southern South America, including Bolivia	·51	3,550
Algeria and Egypt, Persia and Mesopotamia	·83	5,820
S.E. Russia, S.W. Siberia and the region of the Caucasus	·83	5,830
Rumania, Galicia and western Europe	·16	1,135
Northern Russia and Saghalien	·13	925
Japan and Formosa	·18	1,235
China	·20	1,375
India	·14	995
East Indies	·43	3,015
Total	6·15	43,055
Total Eastern Hemisphere	3·03	21,255
Total Western Hemisphere	3·12	21,800
Total north of Equator	5·20	36,400
Total south of Equator	·95	6,655

known in regions not indicated on the Stebinger map although in most such instances the geological conditions seem to preclude reserves of great importance, and that there are in other countries many untested regions in which the geological conditions appear to be favourable for the occurrence of oil fields though surfaee indications of oil have not yet been reported, possibly due in part to insufficient exploration. It is highly probable, he said, that oil in considerable amounts will eventually be discovered in areas of north-west Canada. Other regions outside of the United States in North America which seem likely to make contributions, possibly of minor importance, include Central America, Santo Domingo and lower California. In South America, important new centres of production seem probable along a very extensive strip of territory bordering the east surface of the Andes, and in addition areas of north-eastern Brazil are possibly oil bearing.

Madagascar offers much promise, and conditions favourable for developing oil fields appear to be present not only in Angola and other regions of west Africa but possibly in east Africa also. Australia, Tasmania and New Zealand may yet disclose producing areas of value and it seems reasonable to expect new discoveries of importance in parts of India not on the Stebinger map. Arabia, Palestine, Armenia and Anatolia all offer thoroughly circumstantial indications.

Also it seems rather probable that oil will be produced in portions of Spain, Austria and other countries of western Europe. Considerable extension of the known Russian oil areas may be expected, and Siberia, about which geological information is so greatly desired, and which is said to carry indications of oil deposits in Transcaspia, Turkistan, Kamchatka and notably in northern Saghalien, may reasonably be expected to contain oil-bearing areas. China has oil indications in at least four of her provinces. It appears probable that oil is present, scattered from Persia and Transcaspia, eastward as far at least as Gobi. There are possibilities of oil in the Philippine Islands.

"Evidence as to the probable presence of additional oil reserves in the areas just reviewed," leads White to conclude "that there are probably 20,000,000,000 barrels of oil available in the world in addition to the 43,000,000,000 barrels contained in the regions covered by Stebinger's estimates quoted above, or as much, in round numbers as 60,000,000,000 barrels in all."

Petroleum Substitutes.—The chief substitutes for petroleum now available is oil obtained by distillation from oil shale and from coal. Though oil shale is now utilized in only a few countries, it is widely distributed throughout the world, and the oil shale resources of the United States are so extensive as to furnish a guarantee for the future. In North America oil shale occurs in both Canada and the United States but is commercially undeveloped.

Large areas in the eastern United States and eastern Canada are underlain by dark shales of the Primary or Palaeozoic age that are in many places as rich in organic matter from which oil can be distilled as those mined commercially in Scotland and France. Comparatively little is known about oil shale in South America, though it is said to occur in Argentina, at several localities in Brazil, and in Chile. Unprofitable attempts have been made to distill oil from oil shale in eastern Brazil. In Africa thin beds of unmined shale capable of yielding oil when distilled are reported from Angola, the Belgian Congo, Natal and the Transvaal. Perhaps the largest area of oil shale is in the Belgian Congo.

In Europe the commercial development of the oil-shale industry began early in the 19th century, before the rise of the modern petroleum industry. About 91% of the world's oil shale output is produced in Scotland, 8% in the Autan and Aumance districts in Estonia and France and the remainder in Australia, Germany and Italy. In Scotland the oil-shale industry has been able to compete successfully with the petroleum industry because of the output of valuable by-products made in connection with the oil and because of the remoteness of Scotland from the principal sources of petroleum—southern Russia and the United States. Large deposits of oil shale are reported to occur in northern Russia. Oil shale in Asia is not mentioned in any report that has been seen, but valuable deposits may nevertheless exist there.

Formerly oil shale was mined and distilled in Oceania, at several places in Australia (most of them in New South Wales) and in New Zealand. But the total shale oil produced in all these places has amounted to less than 1% of the world's output.

The U.S. Federal Conservation Board estimates a supply which can be recovered from domestic oil shale, if and when the price warrants its extraction, of 92,000,000,000 bbl., nearly ten times the total quantity of oil that has been produced in the United States from 1859 to 1929. At the present rate of production from wells, this quantity would suffice for roundly 100 years. The estimate is made that the two and one-half trillion tons of bituminous, sub-bituminous and semi-bituminous coal in the United States, within 3,000 ft. of the surface, is capable of yielding about 92,000,000,000 bbl. of motor fuel, more than 300 times the motor fuel production in 1927. It is also estimated that another 12,000,000,000 bbl. of motor fuel may be obtained from the 940,000,000,000 tons of lignite deposits in this country. This would make available an estimated total quantity of 104,000,000,000 bbl. or 4,264,000,000,000 gal. of fuel for motors in addition to the numerous billion barrels of crude oil from wells and oil shales.

(L. M. F.)

METALLIC AND NON-METALLIC GROUPS

Under this heading are discussed the most important metallic and non-metallic substances including Iron, Lead and Zinc, Copper, Aluminium, Nickel, Manganese, Tin, Tungsten, Vanadium, Sulphur, Mercury, Silicon and Mica.

I. IRON

Broad allowances for incomplete information must be made when considering iron ore resources. While no new immense iron ore fields remain to be discovered in either Europe or North America the remaining four continents are still largely unsurveyed. Of known iron ore reserves 15,000,000,000 tons occur in North America, 12,000,000,000 in Europe and 7,000,000,000 in South America. If it be assumed that the remaining three continents are proportionately as well supplied—and against this assumption there is no geological argument—the conclusion is reached that the world iron ore reserve is a total of 90,000,000,000 tons.

The world was in 1929 using annually some 150 million tons of iron ore. This was supplied by many mines, but a few great ore fields were responsible for the bulk of the tonnage. The Lake Superior iron ore region in the United States ships some 60 million tons annually, and the Lorraine field of France and Luxembourg about 40 millions. The fields of Great Britain rank third with around 13 million tons, and the Alabama region of the United States fourth with some 6 millions. After that, ranging from 5 million down to 1 million annually, come Spain, Sweden, Manchuria, western France, Newfoundland, Cuba and North Africa.

The localization of demand may cause more concern than excessive total consumption, for a few ore fields are being drawn upon in exceptional tonnages while other large fields are practically unused. For example, if the present-day drafts continue,

our current estimates of known ore reserves in the different great fields suggest that ore of present day grade will be exhausted in the Lake Superior region within 50 years, in Spain and Great Britain within the century, and in Lorraine in less than 150 years. As against this far-off threat, it may be seen that on the basis of present drafts the Alabama fields should last 300 years or more, while the vast reserves of Brazil, Cuba and Newfoundland have not yet been drawn upon seriously. It is safe to say that the United States can retain its present leadership in iron and steel manufacture for several decades more. It is probable, however, that soon the old primacy of Great Britain and the present American leadership will, in these heavy manufacturing lines, be challenged by a new European competition based on the Lorraine and Norman ore fields, and upon west European coals and cokes.

With regard to the four continents which are less well known and less developed industrially, existing knowledge of relative ore and fuel supplies permits certain deductions of considerable validity. It may be safely assumed, for example, that the known coal supplies of Asia, particularly in China and India, will justify and encourage a large iron and steel industry as local consumption increases; and that under certain conditions the excess product may be exported so as to become a serious factor in European and North American trade and industry. With regard to South America, Africa and Australia, present knowledge of raw material resources suggests that while Australia may easily become self-supporting in the way of steel and iron products, the other two are likely to become important as exporters of iron ore to coal-rich areas, but not as serious producers of iron and its products. Older conclusions as to iron ore exhaustion have been modified seriously by the fact that, within the past two decades, their bases of deduction have been strikingly changed. For 150 years the world iron industry had increased at the rate of 50% each decade; and most earlier estimates prolonged this past rate of increase into the indefinite future. Now, for the first time in the history of modern industrialism, there has been experienced a period of 15 years in which the world iron industry has not progressed; and there is no reason to assume that, whenever this dead point is finally passed over, the old rate of increase will be resumed. It is indeed far more likely that in the future the iron industry of the world will increase at a far slower rate, possibly not above that of the rate of increase of world population. If so the known ore reserves will last for very many generations (E. C. E.)

II. LEAD AND ZINC

Lead.—No quantitative estimate of the copper, lead and zinc resources of the world has been made and it is doubtful whether a reasonable approximation can be made. Looking backward through 50 years there have been periods when it was thought that the supply of these ores was superabundant and other periods when they have seemed to be scarce and opinion has swung from one extreme to another. Especially has this been true in the instance of zinc. However, as to each of these metals, new discoveries, both geographical and technological, may develop valuable resources out of what was previously unknown or worthless. The only conditions under which the world's resources of minerals can be reasonably forecast are when we may say that at least we have so much, as in the instances of coal and iron. Between these extremes it is always a matter of the equilibrium among production, consumption and price. So far as we can see ahead we shall have a sufficient supply of these metals, but we can not see clearly what price we shall have to pay for them, even through the next 10 years.

The production of lead comes principally from the following districts, their percentages being given. South-eastern Missouri, 11·7; Utah, 8·6; Coeur d'Alene (Idaho), 7·5; Tri-State, covering the contiguous parts of Oklahoma, Kansas and Missouri, 5·9; Mexico, 12·6; Spain, 9·2; Broken Hill, N.S.W., 9·5; Sullivan mine, Kimberley, B.C., 7·5; Bawdwin mine, Burma, 3·5. These places account for about 76% of the world's production. Except in south-eastern Missouri, the mines produce a mixed ore which is milled so as to give an enriched galena product for the lead smelter and a blende product for the zinc smelter. Many of the great lead-producing districts of the past were exploited for lead alone, such as Eureka, Nev., and Leadville, Colo., and exhausted Lead-producing districts have waxed and waned more generally and more rapidly than either copper or zinc. Because of this and the failure to make any new important discoveries since 1900, together with the greatly increased demand for lead, experts have taken a pessimistic view and predict a steadily rising price in order to develop poorer ores and remoter mines. About 1925 the new process of selective flotation enabled the profitable mining of large supplies of previously unworkable zinc-lead ores. Lead and zinc production became increasingly interlocked. In 1929 the mines that produce straight lead or zinc ore are few. What will be said hereinafter under "zinc" will therefore apply equally to lead

Zinc.—The world's greatest resources of zinc ore, mentioned substantially in the chronological order of their exploitation, have heretofore been the mines of Upper Silesia; Franklin, N.J.; the Tri-State district of Missouri, Kansas and Oklahoma; Iglesias in Sardinia; Broken Hill in New South Wales; Butte, Mont.; Kimberley in British Columbia; and Bingham and Park City, Utah In 1926 these districts produced about 70% of the world's total of 1,250,000 tons of spelter. The remainder was mined in Bolivia, Algeria, Burma, China, Czechoslovakia, France, Germany, Great Britain, Indo-China, Japan, Mexico, Peru, Spain, Scandinavia, Tunis and the United States. Some great mining districts have lived and died, the most noteworthy of these having been Vieille Montagne (now of Belgium) and Leadville, Colo., but many new districts are being exploited. A maintenance of the output of the present large producing districts—Broken Hill, Franklin and Kimberley—at the current rate for another 20 years at least may reasonably be forecast Upper Silesia, Tri-State, Iglesias and Butte can not be expected so to do, except as to the Blei Scharley mine in Upper Silesia, and the Orphan Girl at Butte.

On the other hand new sources of production are being developed as the results of exploration of new territory, the extension of transportation and improvement of metallurgic processes, which not only make it possible to use profitably ores that formerly were considered refractory but also to give an increased yield from all ores. Among the new districts that are making or are promising a yield are Flin Flon, Sudbury, Buchan (N.F.), Broken Hill (N. Rhod.), Roseberry (Tas.), Mount Isa, Cerro de Pasco (Peru). By 1932 most of these will be producing A general upward trend of price was expected in 1925 as a consequence of the increasing scarcity of zinc ore, but the advent of selective flotation changed that outlook almost immediately Portions of the world, as yet unexplored scientifically, may have great zinc ore possibilities as, northern Canada, wherein important deposits are now being opened; Labrador, Newfoundland, the Andes; Siberia, where there are some great known deposits; Africa, especially in the north and in the Congo region and in Rhodesia; the interior of Australia, and in New Guinea

The production of ores up to the present time has been from deposits whereof there have been surface indications Much of the world's surface is covered by alluvial material which probably hides mineral deposits We are on the eve of advances in geophysical science and methods that are opening the way to the discovery of such hidden deposits. On the side of requirements, the need for all of these metals steadily increases Immediately previous to the World War the annual per caput consumption of the United States was about 8 lb. of copper, 9 of lead and 6·5 of zinc. In the principal countries of Europe the average was a little less, especially of copper. In 1929 the American per caput consumption was about 15 lb. of copper, 12 of lead and 10 of zinc European consumption was, however, still below the pre-war rate A continuing increase may be expected in America, and in Europe a regaining of pre-war rate and then advances. These prospects as to requirements follow from the intimate association of copper and lead with electrification and with storage batteries. For lead there is no general substitute, although aluminium is employed occasionally for electrical transmission. Though hardly to be rated with copper and lead, zinc is used to an important extent in brass, and in paints it replaces lead when the latter becomes scarce. (X.)

III. COPPER

The recent history of the copper industry is closely related to the tremendous development of the electrical industries in the past 30 years. In 1929 nearly 70% of the total annual output of the metal was consumed by those industries. World production for the ten years ending Dec. 31, 1900, was 4,158,513 tons; for the ten years ending Dec. 31, 1927, approximately 13,157,500 tons. In the earlier period the United States furnished 52·3% and in the later 53·9%. South America's proportion rose from 8·4% to 16·2% and Africa's from about 2% to about 5½%. The total recorded output of the world since 1800 has been about 39,600,000 tons, one-half of which has been supplied by the mines of the United States. Indications are that South America, Africa and Canada will increase their proportion in the next ten years. Prior to the exploitation of the large bodies of the "porphyry" or low grade copper ore, it was not customary for the copper producing companies to publish statements of reserves of ore in the ground. The porphyry companies report reserves because in general the exploration of such deposits can be done very cheaply by drilling many years in advance of mining operations.

The so-called "deer level" or "vein" mines still adhere to the practice of not publishing reserves because of the large amounts of money required to explore such deposits much in advance of actual mining, and the probability that if such a policy were pursued, the work would largely have to be done over again when mining operations overtook exploration. The general practice of these companies is to keep exploration four or five years ahead of mining, gauging against past performances the amount to be done by the relative rate of discovery per foot of development. Published estimates of reserves in porphyry mines have included only such material as could be treated profitably at the time of the estimate. Lower cost per ton of ore, increased recovery of metal per ton of ore and higher price of metal all tend to lower the minimum grade of ore that can be treated profitably.

Several important companies are now making money by the extraction of ores which do not contain over 15 lb. of the metal to the ton, while 25 years ago the minimum grade which could be profitably handled was more than double this amount. The Rio Tinto district in Spain has been producing copper since the days of Caesar and in 1924 had an output in the neighbourhood of 70,000,000 pounds. The last official statement of ore reserves by the principal company in this district was made in 1905, at which time the reserves were estimated at 60 years' supply. Since then, highly important discoveries have been made.

The Mansfeld Copper Company mines in Germany have been exploited for several centuries and are now producing between 30,000,000 and 40,000,000 lb. annually. The first recorded production from this district was about A.D. 1200. Attention has been recently attracted to developments in Chile and Peru. One hundred years ago Chile was one of the chief copper producers of the world, and the copper deposits of Peru with associated high-grade silver ores were known to Pizarro. With cheaper sources of supply in the United States, importance waned in these deposits, only to be revived in the present century with the recognition of the availability of large deposits of copper ore containing 40 to 50 lb. per ton, which could be profitably exploited on a large scale.

The latest official estimate of the reserves of the Chile Copper Company shows about 700,000,000 lb. of 2·12% copper, from which about 24,000,000,000 lb. of the metal are recoverable by present known methods. This is equal to 100 years' life at the present rate of output—with, possibilities of additional hundreds of millions, if not billions of tons, which may become available, if costs can be reduced to the present level of those of the Utah Copper Company now operating profitably on 1% ore. This ore body, together with certain others, constitutes a very large reserve of copper. These occurrences do not include all the deposits of copper amenable to even the present methods of exploitation, to say nothing of the known deposits certain to be developed through future economies. Similar considerations apply to the still more recent developments in Africa, where one company already estimates its reserves at approximately 85,000,000 tons of ore averaging 6·87% copper. The existence of ore of this grade in this area is the best evidence of the presence of greater amounts of copper contained in ore carrying only 2% or less, which, upon the development of adequate transportation and labour supply, will eventually become commercially available.

To summarize the situation as to the world reserves of copper in the so-called "porphyry" deposits, which, although known, were unavailable at the beginning of this century, these deposits are now supplying one-half the world's needs and have resources sufficient to last 50 years at the present rate of production with present methods. The "vein" mines in the United States have in the past supplied over 65% of the output and may long maintain this proportion. At least we might estimate that their present resources are as great as those of the porphyry group. The American Bureau of Metal Statistics has published consumption figures showing clearly the relatively slow recovery of the European industry since the World War compared to the marked progress in the United States. At the same time the figures point definitely to an increasing European demand for the metal. Great Britain, France and Germany have an aggregate population of 150,000,000 people. If their per caput requirements eventually reach the present level of those in the United States (15·54 for 1926) they will require an additional one and one-quarter billion pounds of the metal per annum. On the other hand, the existing facilities for production, plus those in process of development and projected, are sufficient to meet these requirements within the next ten years if they are needed. There is nothing to indicate any present failure of the supply of copper. Copper is practically indestructible and as the total supply of metal above ground increases, the amount of second-hand metal or scrap available for consumption increases and the need for virgin copper from the ground decreases.

(A. NOT.)

IV. ALUMINIUM

The aluminium content of the earth appears to be concentrated near the earth's surface. F. W. Clarke and H. S. Washington estimate that the earth as a whole contains only 1·79% of aluminium, but that the outer crust, to a depth of 10 m., contains 8·05%. This is equivalent to an aluminium oxide content of 15 to 16%. The ores of aluminium are employed for the production of aluminium, alumina, aluminous abrasives, cement, aluminium chloride, alum, etc. From economic considerations those ores are employed which yield the maximum number of units of alumina per unit of cost. For this reason the pre-eminent ore is bauxite, which contains 50 to 60% of alumina. The bulk of the world's aluminium is produced from alumina extracted from bauxite by digestion with caustic soda—the well known Bayer process. In 1929 about four tons of bauxite would produce a ton of aluminium. Bauxite of commercial grade is available in extensive deposits in Europe, North and South America, Asia and Africa, but the bulk of the production comes from the first three of these continents. E. C. Eckel, upon the assumption that the available bauxite per square mile of area is the same in other continents as in Europe, has estimated the world's bauxite reserves as about 2,500 millions of tons. In 1928 the world's consumption of bauxite was only about 1,500,000 tons. Allowing for substantial annual increases in consumption, therefore, the world's supply will last a long time.

The aluminium industry was in 1928 using the purest bauxite, particularly with respect to silica, and much of the world's supply of bauxite is less desirable for the Bayer process. However, there are other processes being developed which can handle lower grades. Among these are the electric furnace process of C. M. Hall as recently developed by Aluminum Company of America, as well as the processes of Pedersen and Haglund. Other ores of aluminium, particularly certain of the silicates, are proving susceptible to treatment by processes now under development, so that when they become economically important they can be utilized. This will still further extend the available supplies of aluminium ores. The consumption index of aluminium is increasing more rapidly than some of the older, commonly used metals. Up to 1929 aluminium has competed principally with copper and other non-ferrous metals on a price per volume basis. With the greater realization, however, of the economic value of the lightness and strength of aluminium and the development of strong, light alloys, aluminium

competition with steel will increase in the future. This will be accompanied by improved production and fabrication methods. Uses of the compounds of aluminium, as in the abrasive, cement and chemical industries should expand rapidly. For all these demands, the supply of aluminium appears ample for hundreds of years. (J. D. E.)

V. NICKEL

While nickel is one of the elements of most common occurrence in the earth's crust, the commercially important ore deposits are confined to two localities, Canada and New Caledonia. Of these Canada is by far the more important, producing (1929) approximately 90% of the world's nickel. While there are numerous other known nickel deposits, it is improbable that this percentage will be much affected for many years. The ore deposits are of two kinds: *sulphide deposits*, where the nickel occurs in conjunction with copper and sulphur; and *silicate deposits*, where the ore occurs as nickel silicate (generally as a double silicate of nickel and magnesium). The Canadian deposits are typical of the first type, those of New Caledonia of the second type The known Canadian nickel deposits are located in Sudbury district, Ont., within an area 40 m long by 30 m. wide. While some 35 deposits of varying size and richness have been located since the original discovery in 1883, only a few of these mines are worked. Thus in 1929 The International Nickel Company was operating only the Creighton mine, and was at work developing the Frood mine for future production. The Mond Nickel Company was developing the Frood extension and operating the Garson and Levack mines On the basis of diamond drilling and other exploratory work it is estimated that there is proven ore in sight of approximately 175,000,000 tons, containing between three and four million tons of nickel. With a world consumption of approximately 40,000 tons of nickel per annum, this is equivalent to 100 years of proven ore

The New Caledonia deposits, originally discovered in 1865, rapidly assumed primary importance, and from 1875 to 1880 were the chief producers of the world's nickel. In 1905 the New Caledonia deposits were surpassed in production by the Canadian mines, which since that time have maintained their pre-eminence. The peak of New Caledonia production was reached in 1911 It is now a steady producer of about 10% of the world supply Owing to the character of the New Caledonia deposits it is impossible to give any figures on ore resources, or potential production It is known that there is still a large amount of ore on the island, and it is believed that New Caledonia will continue to produce nickel for many years Besides these two localities deposits of nickel ore are known to exist at a number of places. In general these conform in type to one of the two classes mentioned above, but the size and character of the deposits render them non-commercial under present economic conditions The best known of these are deposits of the sulphide type ores, in Norway, Finland, Sweden, Germany and South Africa, and the silicate type ores in Madagascar, Germany and Greece Nickel ores in the United States are comparatively unimportant (J F TH)

VI. MANGANESE

World resources of manganese may be divided into two classes: manganese ore containing more than 35% manganese; and manganiferous ores containing less than 35% manganese In countries where manganese ore production is large and consumption small the second class is of small interest, whereas if the opposite conditions prevail manganiferous ores may be of considerable importance. In modern steel-making practice the trend is toward a greater use of high manganese pig iron (*see* MANGANESE STEEL) and manganiferous ores are extensively used in blast furnaces. This practice is particularly useful where the production of ferro-manganese grade ores is small, as the high manganese in the pig iron results in a higher manganese content of the steel during refining and thus in a saving of expensive ferro-manganese The use of high-manganese iron is common in Germany and is becoming so in the United States.

The largest resources of manganese ore are in Russia, India, Brazil and the Gold Coast of Africa. The largest developed deposit is the Tchiaturi deposit in the Republic of Georgia (Caucasus). This has been estimated to contain from 40,000,000 to 200,000,000 tons. The Nikopol deposit in south-eastern Russia has been estimated to contain upwards of 10,000,000 tons. The deposits in India are numerous and it has been estimated that an annual production of 600,000 tons could be maintained for at least 40 years. The main deposits are in the Central Provinces. The Gold Coast resources are estimated at 10,000,000 to 20,000,000 tons and the Brazilian resources at 15,000,000 tons. Large deposits of high-grade ore are also known to exist in Dutch East Indies, Chile, China, Cuba, Czechoslovakia, Spain and Bechuanaland Protectorate of South Africa. The reserves of manganese ore in the United States of America are estimated at about 1,500,000 tons Of manganiferous ores there are some 40,000,000 tons. The world's present demands have been estimated at 2,500,000 tons (C H. HE)

VII. TIN

Tin resources of the world are generally—and probably correctly—considered to be smaller than those of any of the other major industrial metals and nearer exhaustion. Necessarily in making this statement price is a factor to be considered. If the market price soars, deposits of progressively lower grade will become profitable Likewise, economies to be effected in mining, and higher recoveries resulting from improved methods of ore dressing and smelting will tend to expand the resources of the world. Still another factor is the possibility of discovering new fields of substantial importance, the most likely area being interior Africa, with French Indo-China, Siam and China offering excellent opportunity. In 1926 some authorities forecast a fairly uniform rate of production for ten years to be followed by a gradual decline, because of the exhaustion of the producing fields To-day even the more apprehensive foresee supplies to assure any reasonable demand for a substantially longer period

For a number of years the Federated Malay States have contributed about one-third of the world's output of about 150,000 tons almost entirely from placer operations. In 1928 as a consequence of the putting into operation a large number of new modern dredges the percentage was increased to about 40, the world total at the same time passing 170,000 tons. Still further increases in the Malay States are to be expected, and with the introduction of bigger and better dredges, the reserves of exploitable grade are steadily expanding Bolivia was the next largest producer in 1928 with 25% of the world's total compared with about 22% in recent years Production comes from lode mines mostly in one district The largest individual producer is planning a substantial expansion in production. Placers are being developed that may augment the output Improvements in ore dressing and metallurgy are likely to make practicable the winning of lower grade lode ores, of which there are good supplies. The Dutch East Indies, third largest contributor, account for about a quarter of the world's supply The mines are placers and, being controlled by the Government, no expansion in output took place in 1928. Nigeria, Siam and China, each with about 5% of the world's total output, have fields possessing possibilities of expansion and a reasonably long life. (A B. P.)

VIII. TUNGSTEN

The metal tungsten has played a very important part within the last quarter of a century in the progress of the electrical and mechanical arts Recent developments indicate that its importance will be still greater in the coming years It is a chief component of tool steels and enters into the manufacture of heat-resisting and non-corrosive steels. Recently tools have been invented consisting of pure tungsten carbide imbedded in a metallic matrix which promise to revolutionize the art of cutting and shaping not only metals but also such unworkable materials as porcelain, glass, bakelite, etc. In 1929 tungsten formed the light filaments, contact points and X-ray targets of the electrical industry besides entering as a component into magnet steels With the rapid strides made in radio and television its expansion into the electric industry may grow to huge proportions

Nature has fortunately provided a very wide-spread mineralogical occurrence of tungsten, both in the primary and secondary formations of the earth The primary deposits are invariably

associated with granitoid rocks and are most important. The secondary deposits form the lesser resources of tungsten minerals. Oceania and the Continents of Asia, Australia, North and South America, Europe and Africa have all, one time or another, been commercial producers of tungsten minerals. Tungsten has been a comparatively cheap metal and it has been the endeavour of producers to obtain their ore supplies as cheap as possible. The supremacy of tungsten production has floated from country to country as the surface ore was exhausted and more expensive deeper mining made necessary. Burma and the Federated Malay States held the bulk of the tungsten market until the World War. Then North and South America began to produce ores. China in 1917 produced only about 5% of the total output of the world, whereas in 1927 it produced over 68%. From indications in 1929 the United States bid fair to become a large factor in tungsten mining, as they are the largest consumer. Owing to its great importance in warfare it is the endeavour of the principal Governments of the world to keep their indigenous tungsten resources under development in spite of the lower cost of foreign minerals.

The important commercial minerals of tungsten fall under two main groups, the first group being tungstates of the metals iron and manganese, and the second group being the tungstate of calcium. The pure iron tungstate mineral is known as ferberite, and the manganese tungstate as hubnerite. The mixed iron manganese tungstates are called wolframite. The only important mineral in the second group is the calcium tungstate, known as scheelite. Until recently scheelite was the more coveted mineral for metallurgical purposes owing to its greater purity, but progress in smelting and reduction practice has offset this advantage.

IX. VANADIUM

The tremendous advances made within the last few years in the transportation industry, be it railroad, automobile or aeroplane, have very markedly brought forth the importance of the metal vanadium. It is always used in the metallurgical industry as an alloy. It is added to metals in very small quantities, yet produces in the finished metal very marked changes in physical properties. The present day mass production in the automotive industry or the developments in the aeroplane motor would not have been possible had it not been for the development of vanadium metallurgy. Vanadium has also played an important part in armaments.

Vanadium is one of the most widely distributed elements in the earth's crust, being present in almost all igneous rocks. However, occurrences of the metal in concentrated mineral deposits are scarce. The one dominating occurrence of vanadium is at Minas Ragra in Peru, South America, being the source of 85% to 90% of the total vanadium produced in the world. The other workable deposits of vanadium have up to now also been confined to the Western Hemisphere, in Mexico and the western parts of the United States, especially the States of Colorado and Utah. Very recently, however, deposits containing vanadium have been developed on the African continent, in Rhodesia and in the territory formerly known as German South-west Africa and now under British mandate. There are other less important occurrences of vanadium known on the European continent, in the iron ores of Sweden and Norway, and also in those of Luxembourg. However, these have no commercial significance. The mineral found in the most important deposit in Peru is patronite, a vanadium sulphide. In Colorado and Utah the occurring minerals are roscoelite, a vanadium silicate, and carnotite, a radium-bearing uranium vanadate. The ores of Mexico and Africa are descloizite and mottramite, complex vanadates of lead, zinc and copper.

The already known resources of vanadium minerals in the world fully assure an adequate supply for approximately the next 35 years. At the same time considerable effort is directed towards finding new deposits or further exploiting the known ones. The consumption of vanadium is augmenting yearly. Vanadium is an essential constituent of high-speed tool steel, the demand for which has increased tremendously with the expansion of mechanical production. It is also used in heat-resisting and non-corrosive steels. Very recently developments in the chemical industry will tend to make large demands on vanadium resources. Vanadium is beginning to be used in the textile, varnish, linoleum and rubber industries, and a particularly important application seems to be the use of its oxide as a catalyzer in the manufacture of sulphuric acid replacing platinum. Vanadium may also be applied in the agricultural and pharmaceutical industries. Marked strides have been made in the metallurgical treatment of vanadium minerals so that materials previously considered low grade or useless have been made available to the industry, thus augmenting the sources of raw materials and thus adding to vanadium reserves. (B. D. S.)

X. SULPHUR

Native sulphur, or brimstone, occurs in many places throughout the world, generally either in beds of gypsum, limestone and associated rocks or in the vicinity of active and extinct volcanoes. The principal extensive deposits are found along the Gulf coastal plain of the United States, in two places in Sicily, at several points on the mainland of Italy, in Japan, Spain, Austria, in the Aleutian islands, Alaska, in the Chilean Andes, South America, in China, India, Russia and in several of the South Sea islands. Until 1905, Sicily controlled the sulphur industry, approximately 85% of the total world's supply being produced in Sicily and Italy.

It was discovered many years ago when drilling for oil that sulphur existed in large quantities in the saline dome formations of the Gulf coastal plain of the U.S. No successful method was devised for winning this sulphur until the development of the Frasch process about 1900. (*See* SULPHUR.)

With sulphur obtained at low cost by this process, the deposits of Louisiana and Texas became the principal sources for the world, the Sicilian production taking second place. Since 1923 about 85% of the world's supply has been from the Texas field, 12% from Sicily and 3% from Japan, Spain and other countries.

It is estimated that the Texas known reserves are at least 50,000,000 tons. That more discoveries will be made is almost assured. The world's consumption of native sulphur since 1923 has averaged yearly about 2,300,000 metric tons. No recent data have been published regarding the reserves in Sicily. It is therefore to be seen that the supply will apparently be adequate for many years. Other deposits in the United States are of considerable extent, but are not of present day commercial value. Pyrite ores, gypsum and waste smelter gases may be considered sources of sulphur, competing with native sulphur.

The chief use for native sulphur is to burn it to sulphur dioxide gas for the manufacture of sulphuric acid or for the production of sulphite liquors for paper pulp manufacture. For certain chemical purposes, especially for the production of agricultural insecticide sprays, and in the manufacture of rubber and sulphuretted products, native sulphur has a distinct field of use. (A. E. W.)

XI. MERCURY

Although free mercury is found in the form of amalgams, and approximately 25 ores containing mercury are known, cinnabar is the only ore found in sufficient quantity to be of commercial importance. It is rarely found in a high degree of purity, but is always mixed with large quantities of rock. Italy and Spain (1929) furnish over 80% of the world's mercury. Nearly all of Italy's production comes from the Idria and Monte Amiata districts. In Idria, the ore is rapidly approaching exhaustion, but in Monte Amiata the quantity of reserves now under development is estimated at 20,000 metric tons, indicating a life of ten years at the 1929 rate of production, and is supplemented by large undeveloped areas in the same region, which insure a supply for a much longer time. In the Almaden district, which furnishes the bulk of the Spanish supply, the reserve is estimated at 40,000 metric tons or more, assuring a supply for 25 years. The United States holds third place in production, but the richest fields are fully or nearly exhausted, and a thorough survey has revealed no important possibilities. Production in Czechoslovakia and Russia has increased, each reaching 2% of the total. Mexico supplies about 1% of the total, and the rest of the world less than 1%.

Production in the principal fields of Italy and Spain is regulated by agreement. The principal uses for mercury are: (1)

drugs and chemicals; (2) fulminates in explosives; (3) pigments for paints, including marine anti-fouling points; (4) electrical apparatus, including radio supplies; (5) treatment of felt for hats; (6) mercury vapour engines. In the mirror industry, the use of mercury has been almost entirely replaced by deposition of silver, and the amalgamation process for the extraction of gold and silver, once important, has been largely supplanted by the cyanide and flotation processes. The use of mercury vapour engines is increasing. (F. F. R.)

XII. SILICON

While the element silicon does not occur free in nature, its compounds make up approximately 88% of the earth's crust. Silicon is found in the form of silicon dioxide, either as quartz or as silicates, generally in combination with alumina (clay, shale, feldspar, etc.). Industrially useful and commercially important, silicious resources are consequently generally available in all countries. Of primary importance are hydrous aluminium silicates, broadly termed clays, varying in purity of chemical composition and in physical properties from kaolin, which approaches the pure aluminium silicate, kaolinite, to the shales which contain enough kaolinite to render them workable in ceramic processes The uses which clays find in industry may be summarized as follows: *kaolins* (white burning clays of high purity) for making paper, porcelain and chinaware, electrical porcelain, wall tile and rubber; *fire clays* (high fusing clays generally with some free silica and 1 or 2% of iron, lime and alkalies) for fire-brick and other metallurgical refractories, glass-house refractories, gas retorts and retorts for zinc smelting and in general for use to withstand high temperatures, sewer pipes, chimney tiles, clay and graphite crucibles and in the manufacture of aluminium sulphate; *common clays* and *shales* (miscellaneous rocks which become plastic on grinding in water) for common brick, sewer pipes, building tiles, portland cement, electrical conduit tiles, chemical stoneware.

Silica (silicon dioxide) occurs chiefly as quartz, in the form of sand, sandstone, quartzite rock, vein quartz and rock crystal and also as infusorial earth. Quartz sand and crushed quartzite rocks find uses in abrasives, glass, glazes and enamels, silica refractories, electric furnace products (silicon carbide and many metal-silicon alloys), porcelains, sand lime brick and other ceramic products. Vein quartz or rock crystal is necessary for the production of transparent fused silica, but the translucent material may be made from quartz sand. Rock crystal in large sizes is important as a gem. Gannister, a form of quartzite, is employed in manufacturing silica refractories. *Infusorial earth,* or diatomaceous earth, is employed for thermal insulation and for filtering and clarifying in chemical manufacture, and "fullers' earth" which is properly a "clay," is similarly used for bleaching and clarifying oils and fats. Among the useful silicate minerals is feldspar, of primary importance in porcelain, whiteware and other ceramic products, glazes, enamels and glass. The minerals sillimanite, andalusite and kyanite are important raw materials for electrical insulators and also for greatly improved metallurgical refractories. *Asbestos*, a hydrous magnesium silicate (chrysotile) is woven into fire-resisting fabrics and for brake linings, and the shorter fibres are used in shingles and roofing sheets, coverings for the insulation of steam pipes and for parts of electrical equipment. *Talc* and *mica* are also important. (E. W. T.)

XIII. MICA

The commercial importance of mica is due to its highly developed cleavage, which permits the manufacture of dimensioned parts with great accuracy; its transparency; flexibility; stability at high temperatures; and insulating qualities. No satisfactory substitute is known nor has any medium developed which can replace mica in modern electrical equipment. Mica is an essential constituent in the ignition system of the internal combustion motor and therefore of great importance in the automobile and aeroplane industries. The rapid development of wireless communication has also been dependent upon abundant supply of high grade mica. Mica production is restricted to the ancient, stable, land masses such as the peninsula of India, central and southern Africa, Madagascar, the Appalachian area in North America and the eastern areas in South America.

The micas of economic importance are of two varieties: *muscovite,* found in many localities; and *phlogopite* found in Madagascar and Canada. India, the United States, Canada and Madagascar produce over 90% of the world's mica. In none of these countries is there any immediate indication of exhaustion of the deposits. Production at the 1928 level may be maintained for an indefinite period. Continued search for new deposits may be depended upon to add to known resources. Mica of good quality is produced in minor quantities in Central and South America, Africa, Australia and Siberia. (W. M. My.)

PRECIOUS METALS GROUP

This classification includes the Platinum group of metals (Platinum, Palladium, Iridium and others) and Gold and Silver.

PLATINUM METALS

Prior to the World War 95% of the world's supply of platinum metals came from placer mines in the Ural mountains, Russia. The platinum-producing placers of the San Juan river in the Choco district of Colombia, South America, became the largest source of supply during the World War and have continued important. Nickel-copper ores became an important source of platinum metals when electrolytic refining was started on a large scale in 1907 by the International Nickel Company and the Mond Nickel Company, both of which operated mines in the Sudbury district of Ontario, Canada. The platinum metals have been produced in various provinces of Australia, and Tasmania was for many years the largest producer of osmiridium. In 1921 Osmiridium was first recovered as a by-product from the treatment of gold ore and tailings in South Africa, still the only reliable source

Various other countries have yielded small quantities of the platinum metals, but are not important sources of supply. In 1925 a discovery of platinum group metals was made in certain basic igneous rocks in the Rand district of South Africa. Development of these deposits over the last two years has demonstrated the importance of this field. A small production of the metal was made during experimental work on the complex metallurgical problem, which must yet be satisfactorily solved if these relatively low-grade platinum metals-bearing copper-nickel ores are to compete successfully with the placer fields of Russia and Colombia. Remelted or refined scrap platinum metals form a very important part of the yearly supply of the noble metals; the total recovered in 1927 in the United States alone was 53,072 troy ounces.

Africa.—So long as the mines of the Transvaal continue their system of treating the "banket" gold ores on corduroy or similar tables, there should continue to be produced at least 5,000 oz. of osmiridium a year. In 1924, there was discovered in the Transvaal what appears to be one of the largest and most important sources of platinum metals in the world The deposits are in lodes and pipe form. The development so far accomplished has shown very large reserves of ore carrying 4 to 6 dwt. of platinum metals a ton. The metallurgy is complex and, up to 1928, had not been satisfactorily solved There is an immense reserve of platinum metals in the South African deposits, which will eventually be available for consumption. It is reported that platinum has been discovered in alluvial deposits covering an area of at least 40 sq m. in Sierra Leone, north of the Gulf of Guinea.

Australasia.—Platinum occurs with gold, tin and monazite in beach sands on the north-eastern coast of New South Wales, at the mouths of Clarence and Richmond rivers. Apparently the production from this source has been small. Platinum has also been found in some masses of ironstone at Darling creek and Mulga springs, near Broken Hill. Most of the platinum produced in New South Wales has come from alluvial washings at Fifield and Platina Of late years the production from this district has been greatly diminished. Some quantities of platinum are known to occur with tin, monazite and gold in the beach sands at the south-eastern border of Queensland. So far as can be learned, little platinum has been saved from these deposits. There are osmiridium fields, 20 m. west of Waratah, Tasmania, on Nineteen Mile creek, a tributary of Savage river. The Adams River field in west-central Tasmania was discovered in 1925, but was largely worked out by 1927. Papua, the south-eastern part of New Guinea, has

produced a little osmiridium from placer deposits in the Waria, Gira and Arkora rivers on the south side of the Stanley range.

Japan.—Osmiridium and platinum associated with magnetite, chromite and cinnabar occur in the placers of Yubari-gawa, Pechan and Usotannai rivers, in the central and northern parts of Hokushu island. A small yearly production has been made.

Europe.—About 95% of the platinum in the world has come from five districts on the European and on the Asiatic side of the Ural mountains of Russia. The platinum is washed from creek and river gravels from localities eroded from masses of peridotite and pyroxenite. To a considerable extent the production is still obtained from small hand-workings, but recently large electric dredges have been installed, which are able to handle poorer grades of materials. The average yield is said to be about 0·07 oz. of platinum per metric ton of gravel. Professor Lipovsky estimates that there are reserves of 7,000,000 oz. of platinum in Russia.

North America.—Several creeks, including Dime creek on Seward peninsula, and some tributaries of Copper river in south-central Alaska, have yielded a little placer platinum, but cannot be considered as sources of regular supplies. The chief source of platinum metals in Canada is in the nickel-copper ores of the Sudbury district of Ontario. These deposits are extremely large, are in strong hands and should continue as regular producers of platinum metals for many years to come. The Tulameen river in southern British Columbia has been the source of a small yearly production of crude placer platinum. Most of the gravels have been worked several times and the district holds little promise for the future. In the United States the principal production of crude platinum has come as a by-product of gold dredging on the east side of the Sacramento and San Joaquin river valleys in California, though a minor quantity of metal has been saved on Cottonwood creek, in Shasta county, Hayfork creek, in Trinity county, Calif., the Illinois river, in Josephine county, Ore., and from the beach sands at various places from Eureka, Calif., north to the mouth of the Columbia river, Ore. The production in recent years has been declining, and, with the exhaustion of known dredging ground by about 1938, the output will be very small. A small quantity of palladium-nickel-copper ore has been produced from mines on Prince of Wales island, south-east Alaska, near Goodsprings, Nevada, and Albany, Wyoming.

South America.—Platinum was first discovered and described in material from Colombia, and in 1788 the metal was being largely used in jewellery and in the manufacture of crucibles. At the end of 1788 there had been collected from Choco 3,820 Spanish pounds of the metal. In 1824 the annual production from Choco is said to have amounted to about 1,000 pounds. The gold-platinum alluvial deposits of Colombia cover an area of more than 5,000 sq.m., which lies west of the central ridge of the Colombian Andes, in the Atratro and San Juan drainage basins, and extends south of the mouth of San Juan river along the coast to Mira river. The richest deposits and those most worked are near the headwater of San Juan river, principally on Condoto river. In the gravels of the San Juan drainage there are about equal quantities of gold and platinum, but in the Atrato basin platinum constitutes approximately 15% of the value, the remainder being gold. The most productive area is held by American companies. What appears to be a conservative estimate gives a total of 336,000,000 cu.yd. of gravel that can be considered as reserves, with 68,000,000 cu.yd. as proved ground capable of producing at a profit under present working conditions. This estimate of reserves may be increased in the light of future work.

Uses of Platinum Metals.—The essential uses of these metals are in the chemical, electrical and dental industries. Pure platinum is required in the chemical industry for catalyzers in the manufacture of sulphuric acid by the contact process and in the manufacture of nitric acid from ammonia. Pure platinum utensils of various kinds, including crucibles, dishes, tongs and triangles, are required in every chemical laboratory. Platinum-iridium alloys containing from 15 to 50% iridium have been used very extensively by the electrical industry, but several satisfactory substitutes have been developed. Tungsten, molybdenum and nickel-chromium alloys are the principal substitutes, but their use has not done away with the need for platinum in the industry. The principal use of platinum-iridium alloys in electrical work is in contact points, and the proportion of iridium necessary in the alloys is directly dependent on the intensity of the current passing through the contacts and the speed at which the contacts move.

The chemical industry in the United States since 1918 has used between 5 and 7% of the platinum metals consumed and it uses relatively little except platinum. The dental industry uses approximately 14% of the yearly consumption of platinum metals and uses nearly equal quantities of platinum and palladium with relatively little iridium. Its use of platinum has decreased and of palladium has increased since 1925. The electrical industry normally consumes from 13 to 19% of the United States total of platinum metals, using 12 times as much platinum as palladium and eight to ten times as much platinum as iridium. There is an increasing demand for iridium with the development of aeronautic internal combustion engines. The jewellery industry is the largest market for platinum group metals, absorbing from 57 to 65% of the yearly turnover. It normally uses about 40 oz. of platinum to one oz. of iridium, but since 1925 has been consuming more palladium and the minor metals of the platinum group, including rhodium and osmium. The miscellaneous uses of platinum include the photographic-chemical industry as the largest consumer, and the gold pen industry, which uses either the natural osmiridium or in recent years a synthetic osmium-iridium alloy, which is said to be a satisfactory substitute for the native "point metal."

The metals of the platinum group are essential to three important industries, yet these three take only about one-third of the yearly total. The jewellers take approximately the remaining two-thirds and are the stable market for the noble metals. Stated in another way, the platinum metals are essentially "luxury metals" and their continued demand on a large scale depends more on style in jewellery than on any other factor. Platinum jewellery can be made in more intricate design with equal strength than in other metals, according to the makers, and sets off gems and the costume as no other metal can. It would appear that the known reserves of platinum-group metals in Russia, Colombia and South Africa are sufficiently large to supply world demand for many years to come, with the possible exception of a supply of iridium. Iridium is an essential constituent of all "hard platinum." Its chief source is from the natural alloy osmiridium and this alloy is extremely rare. Had it not been for a change in practice in South Africa for the treatment of the gold ores of the Rand in 1921 there would have been a serious world shortage of iridium.

(J. M. Hi.)

GOLD

Since the rise of the Spanish empire in the New World, £4,245,000,000 of gold has been produced. Only 15% of this amount was produced between 1493 and the Californian alluvial discoveries of 1848, and over half in the first 27 years of the present century.

Of the total gold produced since 1493 the Transvaal has contributed 22%, the United States 21½% and Australasia 17%. The following table shows the value of the production in different areas:—

Locality	Total amount.	Amount produced in 1912–27.
	£	£
United States (practically since 1849)	911,000,000	220,000,000
Transvaal (since 1884)	929,000,000	604,000,000
Australasia (since 1851)	715,000,000	98,000,000
Russia and Siberia (since 1814)	378,000,000	48,000,000
Mexico (since 1521)	146,000,000	46,000,000
Canada (since 1858)	132,000,000	74,000,000
India (since 1880)	70,000,000	32,000,000
Rhodesia (since 1898)	66,000,000	46,000,000
West Africa (since 1880)	28,000,000	19,000,000
	3,750,000,000	1,187,000,000
South America, etc. (since 1493)	869,000,000	128,000,000
Total 435 years	4,245,000,000	1,315,000,000

Eduard Suess has calculated that during the period 1848–75 the annual yield of £22,000,000 was obtained as to £19,300,000 or 88% from alluvial and as to £2,700,000 or 12% from lodes. By 1890 the output of £24,500,000 was derived as to £11,000,000 or 45% from alluvial, as to £11,500,000 or 47% from lodes, and as to £2,000,000 or 8% from the stratified banket of the Transvaal. So productive has the last source of the metal become, that of the world's gold production of £82,000,000 in 1927, £43,-000,000 or 52% came from banket, while lode mining yielded £34,000,000 or 42%, and alluvial had probably fallen to £5,000,-000 or 6%.

Though production has advanced so rapidly in the course of the present generation, there are indications that, apart from any new discoveries which may yet be made, the output reached its zenith in 1915. Thereafter, partly as a result of restriction of production due to the increased costs resulting from the World War, but partly also as a result of exhaustion of mines, the annual total fell from £96,400,000 to £65,500,000 in 1922 (a year exceptionally affected by a white miners' strike in the Transvaal), recovering to £82,000,000 in 1926 and 1927.

The commanding position of the British empire regarding gold production is indicated by the fact that it was responsible in 1927 for 71% of the total production. The Transvaal alone yields three-fourths of the empire's and over half of the world's total. Such countries as Australia and the United States are declining.

The destination of the gold taken out of the earth since 1493 has been estimated as follows: industrial arts (Europe and America), 31%; India, 14%; China and Egypt, 3%; available as money, 52%.

Gold Consumption.—The industrial arts and India have the first call on gold production They largely increased their demands after the outpourings of gold by California and Australia after 1848 and 1851, thereby serving to moderate the great increase of prices of commodities which took place, and largely maintained their rate of absorption for some time after the gold output had commenced to decline. Again, after production in the 'nineties started its great climb to the height of 1915, they increased their demands exceptionally until for the 20 years to 1924 industry absorbed £20,000,000 and India £15,000,000 per annum. On the whole they have taken 45% of the aggregate gold production, and all of this has been effectively withdrawn from the amount available as money, for India's imports and its own production have been wholly turned into jewellery, possessions and hoards.

The distribution and redistribution of the aggregate output between the end of 1913 and the end of 1926 is as follows.—

Distribution of World's Aggregate Gold Production in 1913 and 1926

	Dec. 31, 1913.		Dec. 31, 1926.	
	£	%	£	%
State banks and treasuries				
Other banks	1,044,000,000	33½	1,918,000,000	46
In circulation	59,000,000	2	13,000,000	½
Not traceable (including private holdings)	483,000,000	15½	107,000,000	2½
			147,000,000	3½
World's stock of gold money	1,586,000,000	51	2,185,000,000	52½
Absorbed by industrial arts (Europe and America)	1,042,000,000	33½	1,274,000,000	30½
Absorbed by India	392,000,000	12½	597,000,000	14½
Absorbed by China and Egypt	100,000,000	3	107,000,000	2½
World's gold output (from 1493)	3,120,000,000	100	4,163,000,000	100

The figures set down for money in circulation are guesswork and may be too high, but the table serves to show that while about £400,000,000 has been taken out of the pockets of the public, through monetary changes produced by the World War, about twice that amount has been added to the stocks in central banks.

World's Resources.—In the early days of the Rand, *i.e.*, from 1893 to 1901, experts like Hamilton Smith, Bergrath Schmeisser, Messrs. Hatch & Chalmers, Dr. George F. Becker and John Hays Hammond estimated that the total production of the field down to a vertical depth of 3,060 to 6,000 feet would be from £325,000,-000 to £800,000,000 (the estimates growing with time), while to the end of 1927 the production had already reached £895,000,000 and the Rand had not passed its zenith. The further yield to be obtained from the existing mines was in 1925 put by Sir Robert N. Kotze (until lately the Government mining engineer of the Union of South Africa) as at least 310,000,000 tons from the end of 1924, which would be equal if one takes the yield at 28s per ton to £430,000,000. In 1927 Dr. H. Pirow, the present Government mining engineer, with £81,000,000 more taken out of the ground, put it at 327,000,000 tons (say £450,000,000) or more Unofficial estimates which allow for three new producers would put it much higher at £600,000,000 from the end of 1926, and this figure would give a total Rand output from the commencement of £1,450,000,000 Needless to say the actual output depends not merely on extensions of areas at present known to be payably auriferous, but upon conditions of work as depth is attained and especially upon working costs

It is more important to attempt to forecast the annual rate of gold production and this is especially difficult. As regards the Rand the average yield for the seven years to 1917 was 27s. 5d per ton and for the nine years following (omitting the exceptional year 1922) it averaged 28s. 3d, varying no more than between 27s. 10d and 28s 9d. annually, taking gold at its standard value Most estimates of the future rate of production refer to tonnage only, but this may be taken to yield 28s. per ton, the figure interpolated above. Sir Robert N. Kotze as far back as 1914 expected that for the then existing producers the yield would be £25,800,-000 per annum at the end of 1924 (while it was actually £39,-700,000 including some new producers), £17,600,000 at end—1929, £15,300,000 at end—1934, £11,700,000 at end—1939 and £7,900,-000 at end—1944 Writing on Sept. 30, 1925, he expected the yield from the then existing producers to be (if we take the yield at 28s, per ton) £31,000,000 in 1931, £21,000,000 in 1936 and £7,000,000 in 1941. Dr Pirow, writing on May 27, 1927, expected the yield (again translating his tons at 28s. apiece) to be £36,000,000 per annum at the end of 1934 and £20,000,000 at the end of 1939. A probable estimate, allowing for three probable new producers, would put it at £40,000,000 in 1930, £35,000,000 in 1935, £25,-000,000 in 1940 and £15,000,000 in 1945 Most of these estimates are based on the mines existing at the time they were made, and contain no allowance for additional areas taken up by those mines or for any increase in their rate of crushing—apart altogether from ignoring new producers. There are considerable areas on the Rand which may in course of time be worked, but except for the possible three new mines just mentioned they cannot at present be assessed Sufficient has been said to indicate that as time goes on the estimates increase, and this may be repeated. It is, however, clear that the West, Central and Middle-East Rand reached its zenith in 1912 with £32,700,000, while it at present contributes £20,500,000 and will probably continue to decline. On the other hand the Far East Rand—which is a vigorous growth of more recent date, taking its rise about 1904—has steadily advanced until it has reached over £21,000,000 and is likely to maintain this rate for many years to come. The Rand may shortly reach its zenith, though until quite recent years it seemed to have attained that point in 1916, when the world's output also was at its height.

It is not easy to assess the possibilities of the rest of the world, but on the whole its output is likely to decline. There are no outstanding goldfields outside the Rand The production of the United States, Australia and India is declining and that of Rhodesia and West Africa is stationary, while most hope of an increase is to be looked for especially in Canada, and possibly in Russia and Mexico. The world's output apart from that of the Rand was £63,000,000 in 1910, £59,100,000 in 1915, £35,200,000 in 1920, £41,300,000 in 1925, and £39,500,000 in 1927, the chief contributors to the decline being Australia and the United States, which together in 1910 yielded £33,200,000 and in 1927 only £12,-000,000. The present outlook is that the world's total may reach

£85,000,000 in 1930 and then decline to about £75,000,000 by 1940, unless some outstanding discovery is made. (J. Ki.)

SILVER

Any attempt to evaluate the world's resources in silver is complicated by the fact that so much of it is produced in connection with other metals, notably lead, copper and gold; almost every gold mine produces some silver and every silver mine some gold. The three largest silver-producing States of the United States are Utah, Montana and Idaho; in the first two silver is produced chiefly in connection with copper, and in the latter in connection with lead ores. About one-third of the silver in the United States is derived from what are primarily copper ores, one-third from lead ores and the remainder from all other kinds, including those which are simply silver ores. The silver content of many of these ores is so low that they could not possibly be worked for silver alone, so that an evaluation of silver resources becomes an estimation of the resources of copper, lead, zinc or other deposits which are important producers of silver.

Silver occurs in rocks of all geologic ages from the oldest to the most recent. It also occurs in nearly all countries of the world, so that nearly all of them are able to produce at least some part of their requirements. China, however, which is one of the principal silver-consuming countries of the world, produces very little silver, and it is not understood where its silver supply was obtained during its long isolation from the rest of the world. The available evidence as to the silver production of the countries with which it maintained contact does not indicate probable sources of supply. The Comstock lode in Nevada was discovered in 1858; by 1877 its annual production had reached $22,000,000 in silver, and for a long period this deposit furnished half the silver output of the United States, its total output of silver to 1900 being estimated at $220,000,000. Its output since 1886, when most of the deep mines in the lode were abandoned, has been relatively small. With the decline of the Comstock district the Leadville district in Colorado took its place as the greatest silver district of the world. Silver production there reached its peak (over $11,000,000) in 1881, followed by a gradual decline until 1907, since when it has remained at about $2,000,000 annually. The silver production of Canada was about 5,000,000 oz. per year until 1905, when the Cobalt district was discovered; in 1910–13 the output was over 32,000,000 oz. per year. Eight years later it was about 13,000,000 oz.; now it is over 20,000,000 annually. The average yearly production of the world for the period 1901–22 was 188,000,000 oz., ranging from 163,000,000 to 226,000,000. Mexico produces about one-third of the total; the United States about one-fourth, and Canada and South America each contribute about one-tenth of the total production.

The principal use of silver is in coinage, and the industrial arts. Photographic and chemical uses (which are the only ones in which silver may be said to be consumed) require an annual amount estimated at from 10,000,000 to 20,000,000 ounces. It is evident therefore that there are two reserves of silver, unmined ore and the accumulated stock of metal. It seems certain that the world can produce for a long period enough silver for the uses by which it is actually consumed. How long it can produce enough to supply needs for coinage and industrial arts depends not only on the discovery of new silver-producing districts, and the production of metals with which it is associated, but also to the extent to which silver coins may be replaced with token coins made of other more abundant metals. It is quite possible also that other metals may be substituted for silver in its uses in the industrial arts, since recent developments in the art of chromium plating and in the production of non-corrosive alloy steels make it possible to produce at a reasonable price metal articles that will not tarnish. It is possibly safe to imply that a silver-producing district like Cobalt will not be discovered anywhere except perhaps in northern Canada or parts of Africa and Siberia that have not been sufficiently explored. Consequently the principal additional supplies of silver for future use are likely to be copper, lead, zinc and other metal deposits where the large tonnage involved may yield considerable quantities even though the amount per ton is small. However, the copper deposits of Africa, which constitute the largest additions to the reserves of that metal which have recently been developed, contain no important silver reserves. (T. T. R.)

RARER ELEMENTS

Cobalt, molybdenum, titanium, tantalum, uranium and radium are treated here as representative of important classes of rare minerals, and nickel, vanadium and tungsten, properly termed rare minerals, are discussed separately above.

Cobalt.—Cobalt is found in small quantities in many places, and in large quantities in few. Its chief ores are smaltite ($CoAs_2$), and cobaltite ($CoAsS$). It is closely associated with nickel in occurrence, and has been found in meteorites and in a number of rare minerals, but these sources naturally play no very important rôle. The chief supply (1924–26) has been as follows: Queensland, Australia, furnishing about 100 tons of cobalt content in cobaltite concentrates; the Belgian Congo, about 825 tons of cobalt content in copper-iron-cobalt alloy; and Ontario, Canada, about 750 tons of cobalt content in alloys and chemicals. Arseno-sulphide ore from Chili, and cobalt-bismuth-nickel ores from Saxony, Germany, have added a few tons more of cobalt content, making a total of about 1,600–1,700 tons. During 1927 prospecting failed to reveal any new commercially important supplies, though some few prospects were located in Queensland, at Pola de Lena (Asturias), and in the Province of Leon. Shipments of ore from Cobalt, Ontario, in that year were reported as 7,309 tons, and of oxide metal and salts from the Union Minière du Haut Katanga as 350 tons. During the first nine months of 1928 the production from Ontario amounted to 460,995 lbs. of oxides, salts and unseparated oxides. The principal source in Ontario is high-grade silver ores and concentrates, averaging 5%–10% cobalt. These deposits and those of Africa seem to give an assurance of adequate supply. Some cobalt ores have been found in Norway, Sweden, the Caucasus, New Caledonia and at Lancaster Gap, Pennsylvania, U.S.A. During the last few years no cobalt has been produced in the United States. Other minerals containing cobalt are the sulphides linnaeite and jaipurite, the arsenides safflorite and skutterudite and the cobalt-copper sulphide carrollite.

Molybdenum.—The chief sources of molybdenum are molybdenite (MoS_2) and wulfenite ($PbMoO_4$). Molybdite ($Fe_2O_3 \cdot 3MoO_3 \cdot 7\frac{1}{2}H_2O$) and pateraite ($CoMoO_4$) are important sources. Molybdenum is rather widely distributed, having been found in Norway, Sweden, Finland, Saxony, France, Italy, Belgium, Spain, South Africa, Australia, New Zealand, Japan and Peru, but in recent years Canada and the United States have led in production. Early supplies, up to 1910, came chiefly from Queensland. By 1917 Canada was the largest producer, but of late the United States has been well in the lead. The ore at Climax, Colorado, carrying molybdenite and molybdite was said, in 1923, to be capable of producing 1,000 tons per day for 30 years, and this ore contains 11 lbs. of molybdenite per ton. In 1927 the United States was practically the only producer of molybdenum. Concentrates averaging 75%–88% MoS_2 amounted approximately to 2,150,000 lbs. This came principally from Climax, Colorado, and Sulphur Gulch, New Mexico. Although the consumption of molybdenum is increasing, the supply keeps well ahead of the demand, and a very recent statement shows that the area developed at Climax contains over 4,000,000 tons of ore. The present (1929) production is 3,000,000 lbs. of metallic molybdenum per annum. The recent considerable increase in the use of molybdenum has been due to its growing employment in machine and other steels, where great toughness is desired.

Tantalum.—Tantalum is closely associated with columbium or niobium and is found widely distributed in many rare-earth minerals, of which samarskite and euxenite are perhaps best known. The chief sources, however, are the minerals columbite and tantalite, two minerals which are identical except for the relative amounts of tantalum and columbium present. The general symbol representing their composition is $Fe,Mn(Cb,Ta)_2O_6$, and in various samples the ratio between the iron and manganese and the tantalum and columbium differs. In general, tantalite is high in tantalum and columbite in columbium. Some ores from Australia run as high as 50% to 70% Ta_2O_5. In the Black Hills of South Dakota and in Connecticut, U.S.A., ores have been

found ranging from 10% to 40% Ta_2O_5. Tantalum ores have also been reported from Maine, Massachusetts, New York, Pennsylvania, Virginia, North Carolina, Colorado and California in the United States, and from Norway, Sweden, Finland, Russia, Bavaria, Italy and the Malay States Between the years 1918 and 1926, about 17,500 lbs. of columbite were mined in the United States. Comparatively new uses of tantalum are in the manufacture of pen points and of radio tubes.

Titanium.—Titanium is very widely distributed. Its most important mineral sources are ilmenite ($FeTiO_3$) and rutile (TiO_2). F. W. Clarke, of the U.S. Geological Survey, stated some years ago that 784 out of 800 igneous rocks analyzed in the Survey laboratory contained titanium. During the years 1925–6 the production of ilmenite in metric tons was as follows: United States, 9,400; Norway, 4,150; Brazil, 3,000; Canada, 3,800; and India, 330; and the production of rutile from Norway and the United States was about 120 metric tons. The deposits of ilmenite ore at Lake Sanford, New York, and Iron Mountain, Wyoming, are estimated to contain many millions of tons, averaging 35% ilmenite The Titan Co of Norway owns one of the richest and largest known deposits of ilmenite. The Norwegian deposits of titanium in the islands of Lofoten and Vesterael, and near Rodsand and Solnordal, are very extensive. They are estimated still to contain about 500,000 tons, varying from 4%–40% TiO_2 Norway is estimated to have a total of 20–25 million tons of titanium minerals. In recent years the use of titanium oxide in pigments has been greatly developed and is now the chief use of titanium products. Its high covering-power and its non-poisonous and chemically inert properties are much in its favor.

Uranium and Radium.—It is best to discuss these elements together because of their close association. Practically all uranium minerals carry radium, and the world's supply of radium is produced from uranium minerals Uraninite or pitchblende, the chief uranium mineral, contains from 79% to 90% of the oxide U_3O_8 The composition of the mineral is very complex Carnotite is next in importance It is essentially a potassium-uranium vanadate ($K_2O \cdot 2UO_3 \cdot V_2O_5 \cdot 3H_2O$) carrying about 60% UO_3 There are many other uranium minerals, such as autunite, a calcium-uranyl phosphate, gummite, a lead-calcium-uranium silicate; tyuyamunite, a lime carnotite; uranocircite, a barium carnotite; betafite, a complex titano-columbo-tantalate of uranium, thorium and the rare earths, samarskite and euxenite, etc These uranium-radium ores are quite widely distributed, and the following figures, giving the world's estimated total production of radium up to and including the year 1926, in grams, give also an indication of the sources and production of uranium, since large quantities of its salts result as by-products of radium extraction. United States, 250; Belgian Congo, 180; Czechoslovakia, 42; Portugal, 15; Madagascar, 8; Russia (Ferghana), 6; Cornwall, 4, and South Africa, 1 In all, about 500 grams, valued at $70,000 per gram, have been produced The Belgian Congo in 1929 dominated the world market for radium The Union Minière du Haut Katanga sold 26 grams during the year ending June, 1928 The production obtained by the Soviet Government during the year was 6 grams, extracted from a Ferghana radium ore The Czechoslovakian Government is working ores mined at Jachymov, Joachimstal No radium was isolated in the United States during 1928, and only a small amount of radium ore was mined Katanga also furnishes the greater part of the uranium salts for the market. In general, it may be stated that the deposits in the Belgian Congo, together with those in Colorado, Utah, Arizona and New Mexico, U S A, will furnish an adequate supply of radium and uranium for years to come. At present about 28,000 lbs. of uranium pigments for glass are made annually

Zirconium.—The chief mineral sources of zirconium are zircon ($ZrSiO_4$), baddeleyite and brazilite, both essentially ZrO_2. Zircite is a commercial name given to the oxide or to a mixture of the silicate and the oxide. Zircon is found chiefly in Ceylon, the Ural Mountains, Greenland and Australia; and in the United States, in commercial quantities, in western North Carolina, at Ashland in Virginia and at Pablo Beach in Florida It occurs in small quantities associated with many minerals, notably with monazite sands. Baddeleyite, brazilite, zirkelite and zircite (the partially purified ore) come chiefly from Ceylon and Brazil. Exports from Brazil reached 1,119 tons in 1913, but fell off later. Recent information with regard to the amount of zirconium minerals used is lacking; in 1927, however, 4,488 lbs of zirconium was imported into the United States to supplement its supply Brazil is the world's main producer of zirconium ores. Zirconium ores are playing an important rôle in the manufacture of ceramics and refractories (P. E. B)

SUBSTITUTES FOR NATURAL RESOURCES

Any discussion of substitutes for natural resources must be prefaced by a discussion of the meaning of the term substitute. When whale oil was an important illuminant there was much concern as to its future supply and some search was made for possible substitutes The development of the petroleum industry arose principally from a desire to find a use, in order to provide a market, for an available material and not in response to a search for a whale oil substitute. The electric light, which has so largely displaced the oil lamp, was developed as a demand for something better, not as a demand for a petroleum substitute, for the market has been almost continuously over-supplied with petroleum during the whole period of electric lighting development It is therefore possible to think of chinaware and porcelain as substitutes for the vessels of wood, horn and metal that preceded them, of glass as a substitute for the oiled paper with which window openings were once closed, of wooden houses as a substitute for skin tents; and of brick houses as a substitute for wooden ones It is evident that these things are substitutes only in the sense that they replaced something that preceded them, and this because they better served some human need.

The term substitute has come to have a derived sense of something inferior used because that for which it is substituted either is not available in sufficient supply or, because of scarcity, is unduly high in price The idea of the inferiority of the substitute is one that would be cultivated by those engaged in the production and marketing of the original In the case of butter substitutes, for example, their production and sale are hampered by legislation which, it is alleged, represents the relative political strength of the interests involved rather than the scientific aspect of the matter The converse of this situation is presented by various devices which are sold to provide an artificial substitute for the therapeutic effect of sunlight; the producers of devices which give out infra-red rays are not required to furnish any evidence that the devices will produce the effects claimed for them It will therefore be clear that the economic and social problems involved in the use of substitutes are many and varied How difficult some of them are of solution can be illustrated by some examples. Suppose a necklace of artificial pearls so skilfully made that only a few of the most expert persons in the world would be able to detect that they were not real pearls, which would cost 10 or 100 times as much as the substitutes Has the belief in the inferiority of the substitute any other than a sentimental basis?

With inert natural resources the question is more easily determined because the purposes which natural resources serve can usually be set forth in exact chemical and physical specifications There can be no doubt whether one metal will conduct electricity as well as another, or whether one substance produces the same chemical effect as another for the kind and degree of difference can be measured, the cost can be ascertained, and the relation between the difference in the cost and the service studied But even in the case of these substances it is sometimes difficult to make a just evaluation A single substance may be used for a great many purposes, and thus is developed a tendency to carry over its known superiority for one use into another field where it may or may not be also superior The general considerations involved in this tendency are illustrated with specific examples Tin is mostly produced in south-eastern Asia and Bolivia, where there is little local use for it, while the United States, which uses over half the world's total output, produces none. About one-third of the metal imported into the United States is used for making tin-plate, and about two-thirds of the tin-plate is used for

making tin cans for packing various commodities. The principal use of tin cans is for preserved foods. It is easily possible to preserve food in ceramic ware jars, and many foods are sold in glass jars, but these jars are heavier and can easily be broken. For most purposes the glass jar is not, therefore, a satisfactory substitute for the tin can, but for specially selected fruits, which are to be sold at a high price, the glass jar is better, because the more attractive appearance of the jar is part of the consideration which enables it to be sold at a higher price. Thus glass is or is not a satisfactory substitute for tin in connection with food preservation, according to the special conditions attending its use

Tin-plate, in addition to being used for cans, is utilized for roofing purposes; obviously glass could not be so used. Terne plate (an alloy of lead and tin) is, however, used for roofing, but could not be used for food containers as the lead in the alloy produces toxic effects. Collapsible tubes made of tin are extensively used as containers for tooth-paste, shaving cream and various other commodities of a creamy consistence; no satisfactory substitute for tin has been devised for this purpose. Tin foil is used as a wrapping for candy and chewing gum, as a lining for boxes and cartons of cigarettes and for a variety of other purposes. Aluminium foil and lead foil are, to a growing extent, substitutes for this use, but neither has the bright lustre of tin foil. Except for appearance, paraffined paper would serve this use equally well. A variety of attractive transparent, moisture-proof and dust-proof wrapping materials have been placed on the market recently and, for some purposes, they are much better than tin foil, while for other uses they are inferior. Tin when alloyed with copper produces bronze, which has a variety of uses that it best serves. For some of these uses silicon or manganese can be used as the addition agent to the copper, but for others they are not satisfactory. When manufactured for transmission wire, cadmium can be used, with better results than other substances from the transmission standpoint, although not from other considerations. Tin is also used in the alloys employed for bearings in machinery. These alloys are of great variety, depending on the service required of them, and a discussion of possible substitutes would be exceedingly complex. Tin has a variety of chemical uses, two of the most important being for making enamels and weighing silk. In both cases the use of substitutes is possible

For tin, therefore, various things may be used as substitutes in its various uses, with variable degrees of effectiveness, according to the circumstances of each case No one can safely prophesy that research will not reveal some substitute that will give equally good service at equal or even less cost and, on the other hand, no one can safely prophesy that it will. The whole subject of substitutes is charged with uncertainty from its very nature In the search for substitutes several general considerations must be maintained as objectives. The first is that the substitute should be more abundant than that which it replaces; little advantage is gained if a sufficient supply of the substitute material is not available. A second is that the substitution should be real, not fictitious; large quantities of power or of other materials should not be generally involved in making the substitution. Substitutes should, if possible, be locally available, to avoid the burden of transportation cost, and also to avoid the possibility of being dependent on foreign countries for a source of supply. Finally, the substitute should not impose too heavy a task in changing the habits of consumers, or the usual processes of plant operations.

The principal use of manganese is in connection with steel manufacture and for this purpose an alloy containing 80% manganese is usually employed. In America manganese ore of the desired quality has to be imported; domestic ores can be used to make a 20% alloy but less conveniently, as the 20% alloy has to be added while molten, although solid lumps of the 80% alloy that can be employed are commonly used. Substitution of the lower grade alloy is made difficult by this consideration.

Substitutes for gasolene have been much discussed and alcohol is one of the various materials that have been proposed It has the great advantage that it can be made from vegetable materials that are reproducible Alcohol cannot, however, be used effectively in an engine built to use gasolene; it needs one specially designed for it. Its general use as a substitute would therefore involve not only the organizing of industry to produce and distribute the alcohol, but also the replacement of over 20,000,000 gasolene engines. Another possible substitute is gasolene made from oil shale. To mine the shale required to produce any considerable part of the gasolene now used would require the setting up of a mining industry of approximately the same size as our present coal-mining industry, and this industry would have to be in regions that are now very sparsely inhabited because they are arid Thus not only a shifting of population would be required, but also the provision for water and food supply, housing and other facilities. The task is thus much more complex than the working out of a process whereby gasolene can be made from oil shale.

Substitution of one product for another not only involves the various considerations outlined above, but often requires the finding of adequate markets for by-products. Much has been said about the wastefulness of buying coal in its raw state, and one of the principal subjects for research is the processing of coal to yield coke, gas and a great variety of by-products. The proportions of these various things that can be made are definitely fixed by chemical and engineering considerations, but the markets for them are quite variable, not only from day to day, but over longer periods. The demand for gas may be greater than the demand for the coke produced, or it may be less, and these relations may shift from day to day or week to week. For a time it was difficult to find adequate outlet for the benzol made as a by-product, and it was chiefly used as a substitute for gasolene. However, development of the nitro-cellulose lacquers provided a large demand for benzol at an increased price, and the present supply was in 1929 practically all used for this purpose.

The problems involved in considering substitutes for things which are the result of life processes are even more complex. Citing clothing as an example, changes in human habits and considerations of style are extremely important. Only a few years ago wool and cotton were the principal materials from which articles of clothing were made, but in recent years demands have been transferred so largely to silk and fur that the woollen and cotton textile industries have been seriously affected Straw, ribbon and other materials were formerly used extensively in making women's hats, but now felt hats are almost universal. To what extent demands for materials may be affected by a change in styles which may be brought about by skilful advertising and merchandising is exceedingly difficult to prophesy. Such changes have some limits imposed by physical conditions; thus wool is used for men's outer garments, because they keep their shape better.

In food products the tendency has been steadily to increase the number, variety and quality over a long period of years, with the result that people are now better nourished than at any previous period in human history. Fruit, for example, instead of being available to only the wealthier class outside the growing season is now a regular article of diet in almost every home all the year round; its greater consumption, it is believed, has led to a decline in the per capita consumption of meat. Sugar and chocolate are also used much more extensively than formerly; these, like most other food products, seem capable of being produced in any amounts that are required. Chewing gum, though not a food, is, however, an example of an organic product for which it may be necessary to find a substitute, as its increasing use bids fair to outstrip the present supply of chicle gum (the principal ingredient), which is the only gum that at the temperature of the mouth is neither too soft nor too hard, and is also free from any objectionable flavour. Rubber illustrates the manner in which public concern over supply of raw materials varies. The demand for rubber was easily met, until the introduction of the automobile forecast a great increase. This caused much concern for future supply and many chemists have worked to discover substitutes. The great increase in rubber production in Malaya shifted attention to schemes to maintain the price of the raw material in the face of production that had increased faster than consumption. If anything equally serviceable can be produced and sold at less cost it will be adopted, but the world

can produce what is needed without necessity for any substitutes.

Raw material for paper manufacture has long been a source of concern. Different materials are used to produce the various grades of paper, but newsprint, which is the largest in demand, is made from wood pulp. For the purpose soft woods are required, and these woods are also the principal kind needed for lumber purposes. Neither newsprint nor lumber has much salvage value and they are largely destroyed by their first use. Some progress has been made in decreasing the demands on lumber for packages, and it has also been found possible to remove the ink from newspapers, though not sufficiently to permit the re-use of the stock for the same purpose It seems probable that wood and all the other raw materials that are produced as a result of growth can, with care, always be produced in sufficient amounts to meet human needs, so that the problem is really one of producing them at a cost which will not produce some economic shift that disturbs the complex equilibrium in modern industry. Shifts of this sort result from so many other causes in addition to shortage of essential raw materials and human ingenuity has been so successful in meeting them thus far that while the study of substitutes is proper for the engineer and chemist, it does not at present need to be a matter of great public concern.

(T. T R)

PHYSICAL UNITS. In order that our acquaintance with any part of nature may become exact we must have not merely a qualitative but a quantitative knowledge of facts Hence the moment that any branch of science begins to develop to any extent, attempts are made to measure and evaluate the quantities and effects found to exist To do this we have to select for each measurable magnitude a *unit* or standard of reference, by comparison with which amounts of other like quantities may be numerically defined There is nothing to prevent us from selecting these fundamental quantities, in terms of which other like quantities are to be expressed, in a perfectly arbitrary and independent manner, and, as a matter of fact, this is what is generally done in the early stages of every science. We may, for instance, choose a certain length, a certain volume, a certain mass, a certain force or power as our units of length, volume, mass, force or power, which have no simple or direct relation to each other. Similarly we may select for more special measurements any arbitrary electric current, electromotive force, or resistance, and call them our units The progress of knowledge, however, is greatly assisted if all the measurable quantities are brought into relation with each other by so selecting the units that they are related in the most simple manner, each to the other and to one common set of measurable magnitudes called the *fundamental quantities*

The progress of this co-ordination of units has been greatly aided by the discovery that forms of physical energy can be converted into one another, and that the conversion is by definite rule and amount (*See* ENERGY) Thus the mechanical energy associated with moving masses can be converted into heat, hence heat can be measured in mechanical energy units The amount of heat required to raise one gramme of water through 1° C in the neighbourhood of 10° C is equal to about 42 million *ergs*, the *erg* being the kinetic energy or energy of motion associated with a mass of 2 grammes when moving uniformly, without rotation, with a velocity of 1 cm per second This number is commonly called the "mechanical equivalent of heat," but would be more exactly described as the "mechanical equivalent of the specific heat of water at 10° C." Again, the fact that the maintenance of an electric current requires energy, and that when produced its energy can be wholly utilized in heating a mass of water, enables us to make a similar statement about the energy required to maintain a current of one ampere through a resistance of one ohm for one second, and to define it by its equivalent in the energy of a moving mass. Physical units have therefore been selected with the object of establishing simple relations between each of them and the fundamental mechanical units. Measurements based on such relations are called *absolute measurements.* The science of dynamics, as far as that part of it is concerned which deals with the motion and energy of material substances, starts from certain primary definitions concerning the measurable quantities involved In constructing a system of physical units, the first thing to consider is the manner in which we shall connect the various items. What, for instance, shall be the unit of force, and how shall it be determined by simple reference to the units of mass, length and time?

The modern absolute system of physical measurement is founded upon dynamical notions, and originated with C. F. Gauss. The postulate which lies at the base of the study of physics is that in the ultimate issue we can describe all phenomena in terms of mechanical data Our fundamental scientific notions are those of *length, time,* and *mass* Hence, in selecting units for physical measurements, we have first to choose units for the above three quantities.

Fundamental Units.—Two systems of fundamental units are in common use. the British system, having the yard and pound as the standard units of length and mass, frequently termed the "foot-pound-second" (F P S) system; and the "centimetre-gramme-second" system (C G S.), having the centimetre and gramme as standard units of length and mass, termed the "metric" system The fundamental unit of time is the same in both systems, namely, the "mean solar second," 86,400 of which make one solar day (*See* TIME.) Since these systems and the corresponding standards, together with their factors of conversion, are treated in detail in the article WEIGHTS AND MEASURES, we need only deal here with such units as receive special scientific use, *i e.*, other than in ordinary commercial practice Various secondary units are chosen for special purposes. In astronomy, where immense distances have to be very frequently expressed, a common unit is the mean radius of the earth's orbit, the "astronomical unit" of length, *i e.*, 92,900,000 miles For stellar distances astronomers have adopted a unit of length termed the "light year," which is the distance traversed by light in a year; this unit is 63,000 times the mean radius of the earth's orbit. Another unit employed is the par-sec, that is, the distance at which the value of the parallax is one second of arc. For very small lengths, such as the wave lengths of light, the unit selected is a ten-thousand-millionth of a metre, termed an Ångström unit or a "tenth-metre," since it is 10^{-10} metres. Sometimes the thousand-millionth of a metre, the "micromillimetre," denoted by $\mu\mu$, or again the "micron," denoted by μ and equal to one-millionth of a metre is employed. The latter is much used by bacteriologists.

Units in Mechanics.—The quantities to be measured in mechanics (*q v.*) are velocity and acceleration (dependent on the units of length and time only), momentum, force, energy or work and power, dependent on the three fundamental units The unit of velocity in the British system is 1 foot. Similarly, the unit on the metric system is 1 centimetre per second Momentum is defined as the product of mass into velocity; unit momentum is therefore the momentum of unit mass into unit velocity; in the British system the unit of mass is the pound, and in the metric system, the gramme is the unit of mass

Force, being measured by the change of momentum in unit time, is expressed in terms of the same units in which unit momentum is defined The natural British unit is the "poundal," the force which in one second accelerates the velocity of a mass of one pound by one foot per second; but it has not come into general use The metric (and scientific) unit, named the "dyne," is derived in the same way from the centimetre, gramme, and second. The poundal and dyne are related as follows:—1 poundal = 13,825·5 dynes.

A common unit of force among engineers is the "weight of one pound," by which is meant the force equivalent to the gravitational attraction of the earth on a mass of one pound. This unit obviously depends on gravity; and since this varies with the latitude and height of the place of observation (*see* EARTH, FIGURE OF), the "force of one pound" of the engineer is not constant. Roughly, it equals 32·17 poundals A pressure is a force per unit area and can be measured in terms of the above units; for example, as lb. wt per square foot. The standard atmosphere (corresponding to a barometric height of 760 cm.) is often taken as a secondary unit; it is equal to 1,013,600 dynes per centimetre.

Energy or work is measured by force acting over a distance. The scientific unit is the "erg," which is the energy expended when a force of one dyne acts over 1 centimetre. (*See* ENERGY.) This unit is too small for measuring the quantity of energy associated, for instance, with engines; for such purposes a unit ten million times as great, termed the "joule," is used. As we noticed in the case of units of force, common-life experience has led to the introduction of units dependent on gravitation, and therefore not invariable; the common British practical unit of this class is the "foot-pound"; in the metric system its congener is the "kilogramme-metre."

Power is the rate at which force does work; it is therefore expressed by "units of energy per second." The metric unit in use is the "watt," being the rate equal to 1 joule per second. Larger units in practical use are: "kilowatt," equal to 1,000 watts; the corresponding energy unit being the kilowatt-second, and 3,600 kilowatt-seconds or 1 kilowatt-hour called a "Board of Trade unit" (B.T.U.). This last is a unit of energy, not power. In British engineering practice the common unit of power is the "horse-power" (HP), which equals 550 foot-pounds performed per second, or 33,000 foot-pounds per minute; its equivalent in the metric system is taken as 746 watts.

Units of Heat.—In studying the phenomena of heat, two measurable quantities immediately present themselves:—(1) temperature and (2) quantity of heat. Three arbitrary scales are in use for measuring temperature (*see* THERMOMETRY), and each of these scales affords units suitable for the expression of temperature. On the Centigrade scale the unit, termed a "Centigrade degree," is one-hundredth of the interval between the temperature of water boiling under normal barometric pressure (760 mm. of mercury) and that of melting ice; the "Fahrenheit degree" is one-hundred-and-eightieth, and the "Réaumur degree" is one-eightieth of the same difference.

Empirical units of "quantity of heat" readily suggest themselves as the amount of heat necessary to heat a unit mass of any substance through unit temperature. In the metric system the unit, termed a "calorie," is the quantity of heat required to raise a gramme of water through one degree Centigrade. This quantity, however, is not constant, since the specific heat of water varies with temperature. (*See* CALORIMETRY.) In defining the calorie, therefore, the particular temperatures must be specified; consequently there are several calories particularized by special designations:—(1) gramme-calorie, the heat required to raise 1 gramme of water between 15° C and 17° C through 1° C; (2) "mean or average gramme calorie," one-hundredth of the total heat required to raise the temperature of 1 gramme of water from 0° C to 100° C; These units are thus related:—1 common calorie = 0·987 mean calories = 0·992 zero calories. A unit in common use in thermo-chemistry is the *greater calorie,* which refers to one kilogramme of water and 1° C. In the British system the common unit, termed the "British Thermal Unit" (B.Th.U.), is the amount of heat required to raise one pound of water through one degree Fahrenheit; a centigrade unit (C.H.U.) has also been introduced and is rapidly being adopted.

Electrical Units.—We are principally concerned in electrical work with three quantities called respectively, electric current, electromotive force, and resistance. These are related to one another by Ohm's law, which states that the electric current in a circuit is directly as the electromotive force and inversely as the resistance, when the current is unvarying and the temperature of the circuit constant. Hence, if we choose units for two of these quantities, the above law defines the unit for the third. Much discussion has taken place over this question. From the scientific standpoint the current and voltage are most readily defined in terms of forces. The ampere is defined as one-tenth of that current which, flowing in a circle of 1 cm. radius, exerts a force of 2π dynes upon a unit magnetic pole placed at its centre. This unit pole is itself defined in terms of the mechanical force between two such poles; so the ampere is made to depend on mechanical units. Again, voltage × current × time is mechanical work and is expressed in terms of ergs or joules. Resistance is voltage divided by current, and thus the corresponding unit of resistance is defined. But for electric engineering (power and light) the choice is decided by the nature of the quantities themselves. Since resistance is a permanent quality of a substance, it is possible to select a certain piece of wire or tube full of mercury, and declare that its resistance shall be the unit of resistance and if the substance is permanent we shall possess an unalterable standard or unit of resistance. For these reasons the practical unit of resistance, now called the international ohm, has been selected as one of the above three practical electrical units.

It is known that there are two available methods for creating a standard or unit electric current. If an unvarying current is passed through a neutral solution of silver nitrate it decomposes or electrolyses it and deposits silver upon the negative pole or cathode of the electrolytic cell. According to Faraday's law and all subsequent experience, the same current deposits in the same time the same mass of silver. Hence we may define the unit current by the mass of silver it can liberate per second. Again, there is the method already described. Thirdly, the unit of electromotive force may be defined as equal to the difference of potential between the ends of the unit of resistance when the unit of current flows in it.

Apart, however, from the relation of these electrical units to each other, it has been found to be of great importance to establish a simple relation between the latter and the absolute mechanical units. Thus an electric current which is passed through a conductor dissipates its energy as heat, and hence creates a certain quantity of heat per unit of time. Having chosen our units of energy and related unit of quantity of heat, we must so choose the unit of current that when passed through the unit of resistance it shall dissipate 1 unit of energy in 1 unit of time.

British Association Units.—The founders of the modern system of practical electrical units were a committee appointed by the British Association in 1861, at the suggestion of Lord Kelvin, which made its first report in 1862 at Cambridge. (See *B. A. Report.*) The five subsequent reports containing the results of the committee's work, together with a large amount of most valuable matter on the subject of electric units, were collected in a volume edited by Prof. Fleeming Jenkin in 1873, entitled *Reports of the Committee on Electrical Standards.* This committee continued to sit and report annually to the British Association since that date until 1912; the whole of the reports have since been reprinted in book form. It is to the labours of this committee, acting in friendly correspondence with international committees, that the present system of electrical measurements is due.

Electrostatic and Electromagnetic Units.—It has throughout been recognized that a second consistent system of electrical units is possible. The unit electrical charge (or quantity of electricity) can be based upon the force between two electric charges. Accordingly, on the *electrostatic* system the unit of electric quantity is such that $f = q^2/(Kd^2)$ where q is the quantity of each of two equal charges, d is the distance between them and K is the dielectric constant (or specific inductive capacity) of the intervening medium, that of air being taken as unity. (*See* ELECTROSTATICS.) The current is then defined as the amount that flows in unit time, and the energy is specified in terms of ergs or joules; thence the unit of resistance is defined by means of the equation Energy $= RC^2t$. The relation between the electromagnetic and electrostatic system of units is that the absolute EMU unit of current (*i.e.,* 10 amperes) is equal to 3×10^{10} electrostatic units. (*See* the various articles on ELECTRICITY.)

Practical Electric Units.—The committee of the British Association charged with the duty of arranging a system of absolute and magnetic units settled also on a system of practical units of convenient magnitude, and gave names to them as follows:—

10^9 absolute	electromagnetic		units of resistance	= 1 ohm
10^8	„	„	units of electromotive force	= 1 volt
$\frac{1}{10}$th of an	„	„	unit of current	= 1 ampere
$\frac{1}{10}$th of an	„	„	unit of quantity	= 1 coulomb
10^{-9}	„	„	units of capacity	= 1 farad
10^{-15}	„	„	units of capacity	= 1 microfarad

Since the date when the preceding terms were adopted, other multiples of absolute C.G.S. units have received practical names, thus:—

10^7 ergs or absolute C.G.S. units of energy	= 1 joule
10^7 ergs per second or C.G.S. units of power	= 1 watt
10^9 absolute units of inductance	= 1 henry
10^8 absolute units of magnetic flux	= 1 weber
1 absolute unit of magnetomotive force	= 1 gauss

(Neither the weber nor the gauss has received very general adoption, although recommended by the committee of the British Association on Electrical Units. Many different suggestions have been made as to the meaning to be applied to the word "gauss." The practical electrical engineer, up to the present, prefers to use *one ampere-turn* as his unit of magnetomotive force, and *one line of force* as the unit of magnetic flux, equal respectively to $10/4\pi$ times and 1 times the C.G.S. absolute units. Very frequently the "kiloline," equal to 1,000 lines of force, is now used as a unit of magnetic flux.)

An Electrical Congress was held in Chicago, U.S.A., in Aug. 1893, to consider the subject of international practical electrical units, and the result of a conference between scientific representatives of Great Britain, the United States, France, Germany, Italy, Mexico, Austria, Switzerland, Sweden and British North America, after deliberating for six days, was a unanimous agreement to recommend the following resolutions as the definition of practical international units. These resolutions and definitions were confirmed at other conferences, and at the last one held in London in Oct. 1908 were finally adopted. It was agreed to take:—

"As a unit of resistance, the *International Ohm*, which is based upon the ohm equal to 10^9 units of resistance of the C.G.S. system of electromagnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice 14·4521 grammes in mass, of a constant cross-sectional area and of the length of 106·3 cm.

"As a unit of current, the *International Ampere*, which is one-tenth of the unit of current of the C.G.S. system of electromagnetic units, and which is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, deposits silver at the rate of 0·00111800 of a gramme per second.

"As a unit of electromotive force, the *International Volt*, which is the electromotive force that, steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere. It is represented sufficiently well for practical purposes by $\frac{10,000}{10,184}$ of the E.M.F. of a normal or saturated cadmium Weston cell at 20° C, prepared in the manner described in a certain specification.

"As a unit of quantity, the *International Coulomb*, which is the quantity of electricity transferred by a current of one international ampere in one second.

"As the unit of capacity, the *International Farad*, which is the capacity of a condenser charged to a potential of one international volt by one international coulomb of electricity. (This unit is far too large for most purposes; one millionth of it is called a microfarad; even a millionth of this is more practical in certain modern applications—it might be called a micro-microfarad or a dimicrofarad, on the analogy of the use of di- in chemical nomenclature.)

"As a unit of work, the *Joule*, which is equal to 10^7 units of work in the C.G.S. System, and which is represented sufficiently well for practical use by the energy expended in one second by an international ampere in an international ohm.

"As a unit of power, the *Watt*, which is equal to 10^7 units of power in the C.G.S. System, and which is represented sufficiently well for practical use by the work done at the rate of one joule per second.

"As the unit of inductance, the *Henry*, which is the induction in a circuit when an electromotive force induced in this circuit is one international volt, while the inducing current varies at the rate of one ampere per second."

Rational System of Electrical Units.—The above-described practical system based on the C.G.S. double system of theoretical units labours under several very great disadvantages. The practical system is derived from and connected with an abnormally large unit of length (the earth quadrant) and an absurdly small unit of mass. Also in consequence of the manner in which the unit electric quantity and magnetic pole strength are defined, a coefficient, 4π, makes its appearance in many practical equations. For example, on the present system the magnetic force H in the interior of a long spiral wire of N turns per centimetre of length when a current of A amperes circulates in the wire is $4\pi AN/10$. Again, the electric displacement or induction D through a unit of area is connected with the electric force E and the dielectric constant K by the equation $D=KE/4\pi$. In numerous electric and magnetic equations the constant 4π makes it appearance where it is apparently meaningless. A system of units in which this constant is put into its right place by appropriate definitions is called a rational system of electric units. Several physicists have proposed such systems.

Heaviside's Rational System.—One remedy for the difficulty has been suggested by Heaviside. He proposes to restate the definition of a unit magnetic pole in such a manner as to remove this constant 4π from the most frequently employed equations. His starting-point is a new definition according to which a unit magnetic pole is said to have a strength of m units if it attracts or repels another equal pole placed at a distance of d centimetres with a force of $m^2/4\pi d^2$ dynes. It follows from this definition that a rational unit magnetic pole is weaker or smaller than the irrational or British Association unit pole in the ratio of $1/\sqrt{4\pi}$ to 1, or ·28205 to 1. The magnetic force due to a rational pole of strength m at a distance of d centimetres being $m/4\pi d^2$ units, if we suppose a magnetic filament having a pole of strength m in rational units to have a smaller sphere of radius r described round its pole, the magnetic force on the surface of this sphere is $m/4\pi r^2$ units, and this is therefore also the numerical value of the flux density. Hence the total magnetic flux through the surface of the sphere is

$$4\pi r^2 \times m/4\pi r^2 \text{ units} = m \text{ units};$$

and therefore the number which denotes the total magnetic flux coming out of the pole of strength m in rational units is also m.

It follows, therefore, that if the intensity of magnetization of the magnetic filament is I and the section is s, the total flux traversing the centre of the magnet is Is units; and that if the filament is an endless or poleless iron filament magnetized uniformly by a resultant external magnetic force H, the flux density will be expressed in rational units by the equation $B=I+H$. The physical meaning of this equation is that the flux per square centimetre in the iron is simply obtained by adding together the flux per square centimetre, if the iron is supposed to be removed, and the magnetization of the iron at that place.

A final question suggests itself: Do the systems of units founded directly upon mechanical quantities constitute finality, or can we proceed to make a further reduction in the number of primary quantities?

There are certain constants of nature which are fundamental, invariable, and, as far as we know, of the same magnitude in all parts of the universe. One of these is the *mass* of the atom, say of hydrogen. Another is the *length* of a wave of light of particular refrangibility emitted by some atom, say one of the two yellow lines in the spectrum of sodium or one of the hydrogen lines. Also a *time* is fixed by the velocity of light in space which is according to the best measurement very close to 3×10^{10} cms. per sec. Another natural unit is the so-called *constant of gravitation*, or the force in dynes due to the attraction of two spherical masses each of 1 gramme with centres at a distance of 1 cm. Very approximately this is equal to 648×10^{-10} dynes. Another natural electrical unit of great importance is the electric charge represented by 1 electron. (*See* ELECTRICITY.) This, according to the latest determination, is nearly $3{\cdot}4\times10^{-10}$ electrostatic units of quantity on the C.G.S. system. Hence, 2,930 million electrons are equal to 1 E.S. unit of quantity on the C.G.S system, and the quantity called 1 coulomb is equal to 879×10^{16} electrons. In round numbers 9×10^{-18} electrons make 1 coulomb. The electron is nature's unit of electricity and is the charge carried by 1 hydrogen ion in electrolysis. (*See* CONDUCTION, ELECTRIC, sec. *Liquids*.) Accordingly a truly natural system of physical units

would be one which was based upon the electron, or a multiple of it, as a unit of electric quantity, the velocity of light or fraction of it as a unit of velocity, and the mass of an atom of hydrogen or multiple of it as a unit of mass. An approximation to such a natural system of electric units will be found discussed in chap. 17 of a book on *The Electron Theory*, by E. E. Fournier d'Albe (London, 1906), to which the reader is referred. In addition, in more recent times, a new universal constant has been determined. It is generally known as Planck's constant because it first appeared in Planck's theory of full radiation.

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PHYSICS. The old term "natural philosophy" signified an attempt to frame a theory of that part of the material universe which could be explored by observation and experiment, and of which the underlying laws were sufficiently understood to be amenable to mathematical calculation. The science of biology was excluded from its purview, for life was not sufficiently understood to be amenable to treatment of that thorough kind, and similarly the mental sciences were excluded, although an observable material organism was a sensible instrument and mode of manifestation; but even so the subject was a huge one and had to be subdivided. The branch of biological science nearest to inclusion was physiology, being a study of the mechanism involved in the functions of living organisms.

The branch of natural philosophy that advanced most rapidly towards perfection was the mechanics of the heavenly bodies, where the things treated of were comparatively few and far apart, and could readily be dealt with as individuals, so that the laws governing their movements could be formulated with some satisfaction. This branch, under Sir Isaac Newton, became so highly elaborated as to dominate and set an example to the rest; but, after all, astronomy was only a special case of the motion of material bodies, and Galileo had begun the study of ordinary motions on the earth's surface, developing into a complete treatment of their velocities, accelerations and distortions, and partly accounting for them by the fundamental inertia of matter influenced by forces of different kinds, and by the subsidiary properties of elasticity, friction, cohesion and the like.

Matter was always known to exist in three states, solid, liquid and gaseous, each having peculiar properties of its own; and the fluids formed resisting media through which the solids could move. Moreover all these bodies were subject, not only to locomotion in bulk, but to internal vibrations, and for the apprehension of these vibrations we had special sense organs, which enabled them to be examined with special facility, and thereby taught us much concerning the things themselves. Some of these vibrations are known as sound, others as heat, and there was yet a third kind of vibration, appealing to the eye, the effect of which could travel across space empty of matter, which therefore had to be filled with a hypothetical substance called "the ether" (or aether), whose properties are still in doubt.

Apart from these vibrations, which could be originated and absorbed by matter, it was found that matter consisted of particles called atoms, of a definite size and weight, which could enter into combination with each other, and so form the various compounds with which humanity had always been acquainted. A study of this branch of natural philosophy blossomed into the great science of chemistry, while geology took over a study of the history and conditions of the earth's crust. The remaining portions of natural philosophy were grouped in comparatively modern times under the head *physics*, which, by derivation from φύσις, signifies a study of nature so far as it can be reduced by calculation and experiment to a few simple or at least fundamental laws. Those laws, first studied by Galileo, were formulated with masterly precision by Isaac Newton, and throughout the 19th century dominated the field. It was hoped at one time that they would be all-inclusive; the expressed ambition of Newton was that ultimately all observable phenomena might be brought under their sway. A long continued effort was made throughout the 19th century to apply them, not only to matter, but to the ether also—an attempt which failed, and has now, for a time at any rate, been abandoned. Hypothetical attempts were also made to include the phenomena of life and mind under the same fundamental laws of mechanism, without necessarily postulating anything outside and beyond such treatment; these efforts, the basis of a materialistic philosophy, were perfectly legitimate, though they have proved unsuccessful. No one claims that the ordinary laws of physics and chemistry are disobeyed by live things, but it is now fairly admitted that they have to be supplemented, while, with regard to the ether, it is still a question as to how far the simple laws are applicable at all. The very terms inertia, velocity, acceleration, force, are of only doubtful validity except when applied to definite material particles, and even then these properties themselves require elucidation. It may be that no fundamental explanation of even the simplest phenomenon can be satisfactorily and safely given until the laws of the fundamental substance, of which probably matter itself is composed, are better understood and formulated.

The Sub-divisions of Physics.—Meanwhile the science of physics has made gigantic strides, throwing off such branches as sound, light, heat, elasticity, hydrodynamics and the kinetic theory of gases. It was found that, although the atoms of matter were too small to be dealt with individually, the results of their combined action could be formulated statistically, in accordance with the laws of probability; and that, although the atoms of a gas were flying about in all directions at random, yet their number was so great that the pressure on any surface exposed to their random bombardment could be treated as perfectly uniform, except indeed when the exposed surface was extremely small. In the latter case individual atoms might exert a noticeable effect, giving occasionally a one-sided bombardment, and exerting an otherwise inexplicable propelling action on the body exposed to it. Thus originated a discrimination, now universally recognized, between the peculiar activities displayed by very small things and the customary behaviour of things on so large a scale that we can handle and directly apprehend them by our senses.

So far as matter was concerned there seemed little difference between physics and chemistry, except that physics sought to probe into the deeper-seated motions underlying molecular combination, and to investigate not only the anatomical groupings but the actual working of the agencies which rendered those groupings possible. It sought to understand the hidden meaning of chemical affinity and the nature of cohesion generally, and indeed of gravitation too. It was not satisfied with the idea of forces acting at a distance, or of the mere clinging together of polarized particles; it sought to dive down into the hidden meaning of attraction, and to explain if possible the very atoms themselves.

In all this it was mightily helped by the development—since Newton's time, in fact mainly in the 19th century—of two great and important new branches, the sciences of electricity and magnetism. These are agents which, like light, operate through what we call empty space or vacuum, and therefore seem primarily associated not with matter as such, but with the more fundamental ether. The fact that mankind has no sense organ for their direct appreciation involved the consequence that, unlike sound, light and heat, they had to be discovered as well as critically examined and studied. Nevertheless in our own time these new powers have become dominant; they have been taken up by engineers, and applied on an extensive and beneficent scale, so that they are now more or less familiar to everybody. The applications of electricity and magnetism are of great and growing importance, but that is not what constitutes their vivid interest to a physicist. Their importance is that they give a clue and greatly extend our

knowledge of the properties of the ether, which had only very partially been displayed in the familiar form of light. Indeed, Clerk Maxwell, perhaps the greatest man of science in the 19th century, made the far reaching discovery that light itself was an electromagnetic vibration, a fact which has now blossomed into the engineering application of radio telegraphy.

The phenomenon called radiation, of which visible light is one small portion, contains the key to the interaction between ether and matter, and is the link between the physics of the 19th and that of the 20th century. All matter is always radiating, and if it does not cool or otherwise lose energy it is only because it absorbs exactly the quantity and quality which it emits. Stagnation of any kind is non-existent in the material universe. Every particle quivers, and the ether quivers in sympathetic unison. The problem of their interaction is being attacked and partially solved by the mathematical physicists of the 20th century.

It may be asked, indeed it often is asked, how discoveries can be made by means of calculation. The answer is quite definite. The mathematical physicist probes down into the fundamental activities, so as to be able to formulate in his mind what is really going on, and to express the actions which can be observed in a definite and quantitative form called an equation, especially in that form called a differential equation, which expresses interactions among the smallest parts. The discovery of the relation between electricity and magnetism on the one hand, and light on the other, will serve as an illustration of the process. Clerk Maxwell took the known phenomena of electricity and the known phenomena of magnetism, together with their interaction so brilliantly discovered and examined by the early physicists of all countries at the beginning of the 19th century culminating in the work of Faraday, and threw them into the form of equations. These, when combined and manipulated in accordance with the laws of pure mathematics, resulted in a differential equation in time and space, containing nothing but electric and magnetic quantities, which nevertheless corresponded with the known equation for waves, such as those of sound or of light or on the surface of water. He perceived therefore that electromagnetic experiments could in the future probably give rise to such waves, and that they would travel at a speed which could be calculated in terms of the electric and magnetic constants of a vacuum, *i.e.*, of the ether. He inaugurated a set of experiments which would determine, not indeed those constants separately, for they are still unknown, but their product, viz., the product which appeared in his differential equation as determining the speed of the waves. He found that the velocity with which his waves ought to travel was identical with that of light, and thus came to the conclusion, and was ultimately held to prove for all time, that light was an electromagnetic phenomenon. On this basis a whole new development began, and continues to this day.

Applications of Differential Equations.—It is worth while illustrating the bearing of a differential equation, and the way in which it embodies a whole series of phenomena which can be dissected from it by the arts of pure mathematics in a purely mechanical though recondite manner, and then handed back to the physicist for interpretation. Naturally the physicist and the mathematician may be combined in the same individual in exceptional cases, and as has recently been said (*Nature*, May 26, 1928): "It is interesting to speculate whether the intellectual gulf separating the great physical scientists from the rest of their fellows is not greater now than at any previous period in the world's history—whether they have not usurped the place of the metaphysicians." That was true in Newton's day, and is true now; though no one claims that any single individual possesses the exceptional power displayed by Newton.

A differential equation which may serve as an illustration is the following:

$$A\frac{d^2H}{dt^2} + B\frac{dH}{dt} = C\left(\frac{d^2H}{dx^2} + \frac{d^2H}{dy^2} + \frac{d^2H}{dz^2}\right).$$

H is any quantity, no matter what, representing some salient feature in the kind of subject dealt with; it is allowed to have a slope of variable gradient in any of the three directions in space, and to have a rate of variation and indeed an accelerated or variable rate of variation in time. The equation expresses the relation between these extremely abstract possibilities as affecting the (perhaps unknown) quantity *H*, while *A*, *B*, *C* are physical constants characteristic of the special conditions appropriate to some particular problem, each being capable of a physical interpretation in any definite case.

When the conditions are such that *A* is zero, the equation can be made to represent the whole theory of the conduction of heat; and it was thus worked out by the great mathematician Fourier into a complete analysis of diffusion by a series of harmonics. It gives primarily the flow of heat through a conductor of any shape, and it was applied by Lord Kelvin, after Fourier, to the cooling of the earth, and to diffusion in gases and liquids, and to many other phenomena. In fact the same differential equation represents his theory of signalling through an Atlantic cable. The working out of the consequences of any equation may be treated as a mathematical exercise; the interpretation of those consequences in any particular case belongs to the physicist. When the conditions are such that only *B* is zero, the equation represents the phenomenon of waves, or at least of such waves as travel with a definite velocity independent of wave-length, like air waves and ether waves.

When *C* is zero the equation represents the settling down of a disturbance, whether electrical or material, after the forces which originated the disturbance have ceased to act. The neutralization of the *C* term avoids reference to space-considerations and makes it an equation in time alone, like a law of cooling or of leakage, which last is so simple a case as not even to involve *A*; while if the right-hand side be changed to *C H* the equation represents all the laws of electrical oscillations as worked out by Lord Kelvin in 1853 and now applied in wireless wave meters. The *A* term then represents inertia, or the magnetic property called self-induction; the *B* term signifies resistance, especially the kind of electrical resistance involved in Ohm's law. When the conditions are such that *A* and *B* are both zero, things have become stationary, and the equation reduces to the one so extensively applied by Laplace to solve static gravitational problems. It embodies the conditions which gravitational fields must satisfy, and develops into part of the theory of astronomy.

When none of the coefficients is zero, and all three terms have to be taken into account (especially if a term involving *H* is added in some cases), the equation represents waves or diffusions travelling through a more complicated medium, at speeds varying with or at least dependent on the wave-length. Waves such as these can occur in the ether when it is interfered with or loaded by electrified particles, or when a medium is a polarizable insulator or a conductor. It can be made to represent the reflection of light by metals, as well as the transmission of waves through the Heaviside layer of ionized air, now becoming familiar to wireless amateurs. It also gives the Heaviside theory of cable signalling, which is more complete than Lord Kelvin's was, and which, applied in practice in America and elsewhere, has much improved long-distance telephony. Needless to say the equation in full form can do much more than that. It, or rather an interlacing set of such equations, represents the most general kind of wave; and the kingdom dominated by waves is now rapidly expanding.

The solution of such equations taxes the powers of all but high mathematicians and may lead to new functions of vast interest and importance. Skilled manipulation of the symbols by a pure mathematician is neither aided nor hindered by information about the particular things they may be intended to represent. The laws are just as valid and self-consistent even if the symbols represent imaginary quantities, as they sometimes do. In the interpretation of the integrated solution however there must be a return to reality.

The vast multitude of facts and phenomena which can thus be treated by a differential equation, so that previously unsuspected consequences can be deduced, is surely of high interest even to those whose education does not enable them to follow the details. The reason why they are so powerful in enabling latent facts to be brought to light is plain enough. It is because the actual proc-

esses at work are compactly, precisely and completely formulated, in all their interactions, by these equations, so that they embody the essence of the phenomenon; their solution and consequences can subsequently be worked out by the few who possess sufficient skill and insight. This method of procedure—from formulation, through solution, to interpretation—is indeed the highest example of the advantage possessed, and the power gained, by those who have successfully attained the aim of all science, *"rerum cognoscere causas."*

MODERN PHYSICS

So long as we are dealing with massive bodies or with great groups of particles, the laws of dynamics, based upon Newton's laws of motion and applied without any breach of continuity, were sufficient and reigned supreme. This kind of dynamics dominated the 19th century, but just at the end, as a fitting prelude to the 20th century, a number of discontinuities began to be discovered. The first discontinuity was indeed old, viz., the atomic theory of matter, and was only evaded by the fact that we inevitably dealt with great numbers of atoms. In the years 1897 to 1900 however Sir J. J. Thomson, elaborating some 1879 experiments of Sir William Crookes in a partial vacuum, discovered and finally clinched the discontinuity of electricity; in other words he realized the electron, which had previously been only surmised rather vaguely by a few. Zeeman and Lorentz had just showed that electric charges were the agents really responsible for the generation of radiation, a fact further illustrated and enforced by Röntgen's discovery of X-rays. After their isolation electrons were weighed and measured by Thomson, and found to possess the fundamental properties of matter. The nature of radiation as emitted by electrons was analysed and examined in precise detail by the spectroscope. Then another discontinuity was discovered by Max Planck, for, as soon as single atoms and their constituent particles were attended to, a new discontinuity appeared, apparently in radiation, but rather in what turned out to be a quantity connected with the orbital revolutions of an electron, akin to the sweeping out of equal areas which Kepler long ago had formulated for the planets; and Bohr formulated his astronomical theory of the structure of the atom. So through various channels it was found that these fundamental electric units, which were presumably structures in the ether, lay at the root of matter itself, and that matter was actually an electrical phenomenon. Discontinuities are natural and inevitable when dealing with individual minute particles; they were only masked in previous days because this minute treatment had not been attempted, though a hint had been given in that direction by the failure of the kinetic theory of gases, as ordinarily applied, to explain the irregular movements of very small bodies exposed to molecular bombardment.

The Theory of Relativity.—Then came the theory of relativity, which adopted, generalized, and boldly formulated a number of vague but growing suspicions. In particular it postulated a universal and unalterable constitutional velocity in the ether, now known as c, which had been recognized in Clerk Maxwell's theory as of an electromagnetic nature, but the nature of which is still unknown. This, like Planck's constant h, is found to enter into every department of physics, not only conspicuously when minute bodies are dealt with, but secretively throughout. All matter is moving through the ether, so that the constitutional velocity c of that medium enters into and modifies even the Newtonian laws of motion, thus giving a complexity which sometimes seems strange to ordinary or evolutionary experience, and with a little ingenuity can be made to appear paradoxical. Many other results of high interest follow, and the gravitational function of the medium shows signs of yielding to mathematical treatment.

The revolutionary outcome of all this is that the ether in its various forms of energy dominates modern physics, though many prefer to avoid the term "ether" because of its 19th century associations, and use the term "space." The term used does not much matter. Faraday began the discovery that it is in space that the real phenomena occur. Every differential equation is an expression in space with its three dimensions and the other abstraction called time; and some attempt has been made to unify these two great abstractions by aid of the velocity c. This however is rather verging on metaphysics, unless it is merely regarded as a legitimate convenience in calculation to deal with four similar variables instead of three and an odd one.

One definite outcome of the bold generalisations or challenges of relativity is that energy, which since its conservation was established has always been recognised as protean in form, now includes not electric charges alone but matter itself as one of its forms, so that atoms of matter might be turned into other forms of energy, if only we knew how. The idea already has some cosmological significance, for it is believed by Jeans to be the cause or mechanism of the radiation of the sun and other stars. The atom of matter is electrically constituted; it is composed of equal amounts of positive and negative electricity in its normal condition. High temperature signifies great activity or immense speeds among the atoms. They can be dissociated or broken up by collision, and their opposite ingredients may occasionally clash, lose their identity, or at least their locality, and pass quickly away as a quantum of radiation. The interior of stars is known to be at an exceedingly high temperature, and accordingly their mass is believed to be gradually decreasing, their matter dying and passing away as radiation into the depths of space. Whether there is ever or anywhere a recuperative action is at present unknown. When, if ever, such action is discovered—as is not unlikely—it will have a cosmological and philosophical bearing

It is interesting, as illustrating Newton's exceptional foresight and speculative skill, that at the end of a disquisition on the changes and interchanges of known forms of energy (though the term "energy" as a dominating physical term was not adopted till long afterwards), he should conclude thus: "And among such various and strange transmutations, why may not Nature change bodies into light, and light into bodies?"

Interaction of Matter and Radiation.—Meanwhile strange reactions have been discovered between matter and radiation Radiation is generated by electrons, and accordingly itself suffers discontinuity. Maxwell calculated that it must exert pressure: it is now found to exert pressure after the same bombarding fashion as the molecules of a gas exert it Radiation is generated and absorbed not continuously but in quanta, and these quanta exert a bombarding action as if they were particles or corpuscles; yet they must be waves, because they exhibit interference and diffraction phenomena—a study of which, in optics, began with Newton himself. Wave quanta with extra high frequency of vibration are more efficient projectiles, and eject such suitable electrons as they encounter with more energy than do those with a more ordinary rate of vibration This connection between energy and frequency is a development of Planck's quantum, which, like much else, is due to Einstein's bold and forcible conceptions The outcome of all this is that the old barrier between the corpuscular theory and the wave theory is being removed There is truth in both. High speed particles are accompanied by waves, somewhat akin to the waves at the bows of a steamer, and the apparently sharp distinction between a wave and a corpuscle is subject to a compromise which includes both.

We have long studied matter by means or by the aid of radiation or waves; we are now beginning to see that momentum, which seemed a property of matter, is possessed by waves, and that the familiar thing which we call matter is after all a manifestation or localization of ether-energy, in a form not as yet completely known or understood Ether energy—the one fundamental existence—seems to manifest itself alternatively, or even as it would seem indiscriminately, sometimes as what we might call a particle and sometimes as a wave. De Broglie seems to have initiated this idea, which has been taken up and elaborated by Schrödinger and others The result is that, whereas we once thought that we knew a great deal about an electron, its size and its speed, we are now confronted with some uncertainty. It is all very well to speculate and theorize, but all theories must be verified and brought to the test of experiment; and experiment—even indirect observation—on this minute scale is barely possible.

The difficulty can easily be rendered intelligible. We have to use some physical means to examine the behaviour of anything. We

cannot see a thing unless it is illuminated, or unless it emits light itself; and, if we are examining something very minute, the illumination itself, which consists of quanta with a definite momentum, may be altering the conditions of the very thing we want to observe. How then can we determine the position and speed of an electron? Heisenberg has shown that we cannot do both. If one determination is accurate, the other is vague. We are not even sure now of the size of an electron, for if it carries waves with it, those waves must occupy a certain region, which, though perhaps small compared with an atom, is far greater than anything we can call the electric nucleus. Indeed a highly accelerated electron, like one of those in Bohr's inner atomic orbits, seems to spread like a sinuous disturbance over the whole orbit, so that only in the outer and larger orbits is there any close correspondence between ordinary dynamics and actual fact. That there is a correspondence at all is satisfactory, but there is much detail in the ultimate minutiae which at present escapes us.

The difficulty of examining very small things by reason of the perturbations introduced by our measuring instruments can be illustrated in a simple manner. To take the temperature of a hot bath is easy enough, but a thimbleful would be chilled or otherwise altered by the thermometer employed. It is in fact difficult to observe any very small quantity without introducing perturbations. Heisenberg has actually formulated a law of uncertainty, in a singularly definite manner, showing that Planck's quantum is involved. There is an uncertainty in the position of an electron, and an uncertainty about its speed or momentum. The product of the two uncertainties is, strange to say, equal to Planck's constant h.

There are still more recent developments. Speculation is active, the revolution is in progress and fresh discoveries are constantly being made. The whole constitutes an elaborate network of interlockings and coincidences, which must have a deep-seated meaning when we can unravel the tangled skein. All we can do now is to hint at the stages that are being reached, to realize that nothing like the last word has been spoken, to wonder at the genius which has so greatly illuminated and yet partly confused us and to have faith in the advent of a great generalization. (O. J. L.)

PHYSICS, ARTICLES ON. The Physics programme is one of the most comprehensive and authoritative of the different divisions of the *Encyclopædia*. From the nature of the science close interrelation between the different branches of theory and research is possible and the various authors have combined to produce an interactive whole. In drafting the original programme it was found advisable to survey the field of physics by sub-divisions or departments, such as Heat, Light, Sound, Electricity and Magnetism (this having also a special section, Wireless Division), Electricity, Magnetism, Atomics and Radiation, and General.

Among the general articles those most important for the purpose of introducing the reader to the more specialised discussions are those dealing with SCIENCE; BAROMETER; DENSITY; ENERGY, CONSERVATION OF; GRAVITATION; HYDROMETER; DYNAMO-ELECTRIC MACHINE; DYNAMOMETER; KINETIC THEORY; PERPETUAL MOTION (which deals with the numerous attempts to construct a machine which, without outside power, will forever keep moving in a normal manner), exposing the fallacies which have underlain all such efforts; UNITS, DIMENSIONS OF; PHYSICAL UNITS; PHYSICAL CHEMISTRY; MEASUREMENTS; METROLOGY; RELATIVITY; SPACE AND TIME, and SOLID STATE, THEORY OF.

The general article *Science*, starting with a definition, proceeds to survey the whole world of scientific achievement. The first sub-section deals with the origin of science, beginning "in the slow and unconscious observation by primitive races of men of natural occurrences, such as the apparent movements of the heavenly bodies and in the gradually acquired mastery over the rude implements by the aid of which such men strove to increase the security and comfort of their lives." The origin of modern science in the explanation of the phenomena of nature by anthropomorphic or mythological interpretation is the beginning from which one is led gradually to a study of early astronomy.

From early astronomy we proceed to a discussion of the problem of matter and the theory of Atoms. The theories of the old Ionian nature philosophers are stated and their division of the elements examined. From this point we proceed gradually to a study of early biology; the belief of primitive man that disease was due to the action of some malignant demon or to the spells of some human enemy, developed into a more rational understanding of the real origin of life and disease. From the half-understood spell-binding stage of magic and witchcraft, man came to feel that his body and its growth was part of the general principle of development and was not subject to magical formulas and tabus.

Then comes a discussion of Geometry, born of the desire of man to know the measure of the world in which he lived. It was not long before man realized another aspect of scientific activity which resulted in the origin of mechanics. This is followed by an historical account of the dark ages and the mediaeval period, "the ancient knowledge only survived fragmentarily in compendiums written just before the dark ages." The Renaissance follows and we are then brought to the true method in physics with Galileo Galilei (1564–1642) and the foundation of the science of dynamics. In the 19th century came the application of similar principles in the study of geology. The development of physiology and biology from the 17th century onwards is traced, and the remainder of the article concerns itself with modern physics, finishing with sections on the methods and meaning of science, the classification of the sciences, and the philosophical basis of science.

In addition to the main article PHYSICS, where the history and development of the science are discussed, all main subdivisions of the subject have separate headings. PHYSICAL OPTICS includes a discussion of Polarization, Absorption, Dispersion, Reflexion and Refraction. Other important articles connected with LIGHT are OPTICS; BINOCULAR INSTRUMENT; DIFFRACTION; INTERFEROMETER; MICROSCOPE; MIRROR; LENSES; PHOTOGRAPHY; PHOTOMETRY; SKY; PERISCOPE; LIGHT and VELOCITY.

Sound is treated thoroughly as to general principles and allied studies such as Acoustics in the article SOUND, THEORY OF. The articles on TALKING-MACHINE include gramophone and phonograph and deal with the general mechanical reproduction of sound.

In the general article ELECTRICITY are included discussions of Electrostatics and Electrokinetics as well as a detailed history of the development of electrical theory. Further important articles in this subsection are ACCUMULATOR; ELECTRICAL INSTRUMENTS; ELECTROLYSIS; ELECTRON; ELECTROMAGNET; CONDENSER; TELEPHONE; PHOTOMETRY AND TELEVISION, and THERMOELECTRICITY. In the wireless subdivision of the electrical division there are many important articles including ATMOSPHERIC ELECTRICITY; ELECTRIC WAVES; TELEGRAPHY; BROADCASTING and RADIO RECEIVER.

MAGNETISM is an historical study of the development of magnetic theory up to modern times. There are many important subdivisions and small definition articles such as COMPASS; DIAMAGNETISM; FERRO-MAGNETISM, and HYSTERESIS refer the reader to the proper subdivision of the main article where further information is to be found. The article MAGNETO HIGH TENSION, besides surveying the general field includes studies of Inclinometer, Magnetograph and Magnetometer.

In the section of Atomics and Radiation the most important articles are ATOM, STRUCTURE OF; MATTER; CONDUCTIVITY, dealing with this principle in Solids, in Liquids, and in Gases; POSITIVE RAYS; QUANTUM THEORY; NUCLEUS; RADIATION, ELECTROMAGNETIC; SPECTROSCOPY; X-RAYS; PHOTOELECTRICITY, etc. The various movements and effects are treated under their own headings as in PHOTOELECTRICITY; ZEEMAN EFFECT; STARK EFFECT and COMPTON EFFECT and what may be called the key article is a lengthy exposition of RADIOACTIVITY. Special attention has been paid to the bibliographies of the physics articles and a comprehensive system of cross-references is designed to give the reader a complete survey of the subject.

PHYSICS IN MEDICINE. The science of physics concerns itself with energy in its various manifestations and the properties of matter, and in consequence plays a part in medicine whose value and importance are ever increasing. It furnishes means of investigating the structure of the animal body and the functions of its members; it assists in the detection of abnormality

and disease, and in the preparation, control and administration of therapeutic remedies; finally, it enables man to acquire a measure of control of his environment by scientific heating, lighting, ventilation and drainage, and the development of means of transport for himself and his necessities.

In particular, such processes of the living body as muscular contraction, the circulation of the blood, the respiratory intake and output of the lungs, the nervous impulse and its journeyings and the maintenance of the energy balance by food intake are in a measure explicable in terms of physics and physical chemistry.

Source of Bodily Energy.—To consider some of these in detail, first the question of the energy value of food may be cited. According to the principle of conservation of energy—if this is valid for transformations of energy occurring in the living animal—the same amount of energy should be evolved from the utilisation of food inside the body as outside, provided the resulting chemical end-products are the same in the two cases and have the same physical state. This has been shown to be the case by the direct measurement over a sufficiently long period, of the heat given out by resting man or animal when placed in a suitable calorimeter, and by also separately measuring the heat evolved in the oxidation of a quantity of food equal to that which was consumed in this period. When due allowance is made for substances which are excreted unchanged or only partially oxidized, and for the work of evaporation, it is found that the agreement is beyond doubt. This is of considerable importance, for if it were not the case, then it would be quite uncertain whether or not man received energy from unknown sources and physics would be of little use in medicine. As it is, the fact that the oxidation of food is the only source of bodily energy of man, makes possible the prescription of diets adequate to a variety of conditions, whether of health or disease.

Not only does the principle of conservation of energy apply to the body as a whole, it is also applicable to the units which go to form it, *i.e.* to all those energy changes and oxidations necessary for life which occur in the cell. Now the living cell consists of a watery solution containing colloids, crystalloids and substances in suspension, enclosed in a cell wall or membrane. Therefore the study of the physical properties of solutions, colloids and membranes in the laboratory should, and does, afford much information concerning its behaviour. Below some of these properties are examined with this object.

Hydrogen Ion Concentration.—It is well known that solutions which conduct electricity (electrolytes) do so in virtue of the electrically charged "ions," positive and negative, derived from the dissociation of the molecules of the dissolved substances. Pure water is only slightly ionized, yielding hydrogen ions carrying a positive electrical charge and an equal number of hydroxyl ions with a negative charge, the product of the concentration of hydrogen ions and hydroxyl ions being constant for a given temperature. When a substance is dissolved in water it, in general, produces a change in its chemical neutrality, owing to the disturbance in the balance existing between the concentration of hydrogen and hydroxyl ions. Thus an acid dissolved in water yields hydrogen ions as a direct result of solution, and leads to an increase in hydrogen ion concentration and a decrease in the concentration of hydroxyl ions. Similarly the solution of a base produces hydroxyl ions and leads to a decrease in hydrogen ion concentration and an increase in the concentration of hydroxyl ions.

Acidity then is due to the preponderance of hydrogen ions over hydroxyl ions, and alkalinity is due to the converse. Neutrality is an equilibrium of hydrogen and hydroxyl ions. Certain substances—called amphoteric electrolytes—produce both hydrogen ions and hydroxyl ions on dissociation, and may therefore combine as acids with bases, or as bases with acids. Proteins are of this class, and so of course, is water.

An alteration in acidity is the causative factor in the regulation of respiration, the activity of muscle, and the excitability of nerve and plays an important part in regulating excretion and secretion.

The powerful effects of variation in hydrogen ion concentration on physiological processes require the existence of mechanism for the prevention of considerable changes of this kind. One of the main functions of blood is to provide this. It can itself withstand the addition of relatively considerable amounts of free acid or free alkali without much change in its reaction, largely owing to the presence of carbonates and phosphates. The electrolytic dissociation theory provides the only satisfactory explanation of this.

Colloids and Membranes.—The colloidal state is recognised as a permanent suspension of solid particles or liquid globules in a continuous medium of a different kind. In contrast to true solutions, colloids are heterogeneous systems in which the suspended particles are large enough to possess the special properties peculiar to surfaces. It is easily seen that, since molecules at the surface of separation of two phases are attracted more powerfully in the direction of the phase to which they belong than in the opposite direction, the interface will be in a state of tension. Consequently any change in the area of a surface film will result in a loss or gain of surface energy. Again, particles of colloid solutions usually possess an electrical charge, which is localized on its surface. Such particles are to a large extent prevented from aggregating together and falling as precipitates by the mutual repulsion of their electrical charges.

The deposition of charged ions on a colloidal particle or any surface would confer on the surface a charge of corresponding sign. This process is called *adsorption* and it may or may not be accompanied by chemical action between the constituents of the surface and the adsorbed material. The neutralization of electrical charges by adsorption of oppositely charged ions from added neutral salts results in precipitation. A similar effect may be produced by oppositely charged colloids.

An important case of adsorption is that occurring at the semipermeable membrane which covers cells. Physical principles show that any material which lowers surface energy will be accumulated in the surface. Certain substances, such as proteins, may form solid deposits in the surface films owing to their concentration brought about in this way. These deposits are capable in some cases of being redissolved if carried into the interior of the cell. Hence the cell membrane must have a variable structure in equilibrium with its contents.

Osmotic Pressure.—Semi-permeable membranes, *i.e.*, membranes which allow water to pass freely, but hold back dissolved substances exhibit another important property. Water will tend to diffuse more rapidly through the membrane towards that side on which the concentration of dissolved substance is greater, than in the reverse direction. This would cause a difference in hydrostatic pressure on the two sides if an increase in volume of the more concentrated solution is prevented by a non-yielding envelope. This pressure is called *osmotic pressure* and the unilateral passage of fluid *osmosis* (*q.v.*). Solutions which exert the same osmotic pressure are said to be *isotonic*.

It is easy to see that the solutions which bathe a cell not enclosed in a rigid envelope must, for equilibrium, possess the same osmotic pressure as the cell contents. Otherwise the cell will contract through loss or expand through gain of water, and will be destroyed unless the osmotic pressures can be equalized in this way. In any case if any change of concentration occurs, the functional activity of the cell will be affected. The membrane covering individual cells and blood corpuscles is impermeable to salts, glucose, etc.; that forming the walls of the capillary blood vessels is permeable to these but not to colloids.

The osmotic pressure of colloids although it is very small compared with that of solutions of electrolytes, has been shown by Starling to play an important part in the formation of urine. Oedema also, according to some authors, is a phenomenon of osmosis.

The chemical behaviour of colloidal particles is very inert compared with the same amount of material in true solution. This permits of the use in medicine of colloidal preparations of metals and other powerful drugs to secure a slow and prolonged action of continuous minute doses of the active ionized form into which they break down.

The reference already made to the properties of colloids and electrolytes and to some of the parts they play in the animal body, are properties and phenomena which demanded for their elucidation the use of the microscope, ultra-microscope, polarimeter, electrometer, etc.

Physics of Muscle and Nerve.—The study of the action of muscles and nerves illustrates perhaps in a still more definite manner, the dependence of medical on physical science. This dependence is twofold, in that the investigation and rational explanation of physiological phenomena has had to await, not only the development of physical theory for the realm of inanimate matter, but also the invention and technical perfection of detecting and recording instruments of the greatest sensitivity and highest precision.

In order to maintain living muscles and nerves outside the animal for long periods they are bathed in an artificial saline solution, which, as we have seen, must be isotonic with them and have the same hydrogen ion concentration Now much of the difficulty in investigating vital processes is due to the microscopic size of the living cell, which results in changes which are also small Largely owing to the development of sensitive galvanometers and also to the modern thermionic amplifier and cinematograph camera, it is possible to detect extremely small variations of energy if they occur in the form of electrical changes or can be converted into that form. Minute changes of temperature—and therefore the production of small quantities of heat—can be measured by the electrical currents generated in thermocouples or by changes in electrical resistance of metallic conductors.

Methods of Investigation.—In studying the activity of an isolated nerve or muscle preparation, it is usual to employ a brief electric current as stimulus, since it is possible to repeat it without producing permanent damage and the duration and intensity can be so readily and accurately controlled By these means, it has been possible to measure with some accuracy the heat produced in a muscle by a single stimulus, and also that liberated over long intervals at rest, or in recovery after prolonged stimulation. The results prove that oxidation is necessary to maintain the normal life and structure of an animal cell in a living but completely resting condition. Further it has been shown that muscular contraction is a surface phenomenon, since the energy developed is proportional to the *length* of the fibres and not their volume.

Similarly it has been shown that the nervous impulse is excited by a stimulus which in all probability consists in an accumulation of ions in certain parts of the nerve fibre. The arrival of the impulse at any point on the nerve is indicated by the active region developing a negative electrical potential with regard to the neighbouring inactive regions. If then, electrodes are placed in contact with the active and inactive regions and connected through a galvanometer, a current will pass through the circuit towards the active region. It is found that the energy involved in the transmission of the impulse is derived from that stored in the fibre itself, and not from the stimulus: the latter only acts as a trigger.

Radiation.—Not the least service rendered by physics to medicine is the demonstration and exploitation of the fact that, in addition to those radiations—light and radiant heat—which are directly perceived through the senses, there exist others which have a profound influence on the animal body. The spectrum of electromagnetic radiation is now known to comprise, in descending order of wave lengths, the Hertzian waves of wireless communication, infra-red rays, the visible spectrum, ultra-violet rays, X-rays and the gamma rays of radio-active substances The shorter wave lengths of the visible spectrum and the still shorter ones mentioned above, all possess the power of either stimulating or destroying the animal cell, according as the quantity of energy absorbed is small or excessive. The action of the rays is *selective* in that different cells exhibit different degrees of response to a given quality and intensity of radiation.

Some radiations, notably those from certain parts of the ultra-violet spectrum, have a *specific* action on biological material, *i.e.*, the absorption of a given amount of radiant energy of this wave length will provoke a much greater response in a given cell or organism than the absorption of an equal amount of energy of another wave length.

These two effects—the specific and the selective effects of different radiations—are of great importance in radiation therapy

The mechanism of the action of radiation on the cell has not been traced in all its stages Ultimately, however, it is attributable either to the heat produced by the energy absorbed, or to the ionizing (photo-electric) effect on the atoms of the cells involved. The principal methods of physical dosage measurement in radiation therapy also depend on these two last mentioned properties. Exact dosage measurements have shown that the biological reactions produced by different kinds of radiation obey similar laws in that they all require a minimum duration and have a threshold value of intensity below which no effect is produced.

For other applications of physics to medicine the reader should consult the following articles —PHYSIOLOGY; HYGIENE; ELECTRO-THERAPY; X-RAYS, RADIUM. (F. HD)

PHYSIOCRATIC SCHOOL, the name of a group of French economists and philosophers. The heads of the school were François Quesnay (*q.v.*) and Jean Claude Marie Vincent, sieur de Gournay (1712–1759). The principles of the school had been put forward in 1755 by R Cantillon, a French merchant of Irish extraction (*Essai sur la nature du commerce en général*), but it was Quesnay and Gournay who gave them a systematic form, and made them the creed of a united group of thinkers and practical men, bent on carrying them into action. The members of the group called themselves *les économistes*, but it is more convenient, because unambiguous, to designate them by the name *physiocrates* (Gr. φύσις nature, and κρατεῖν to rule), invented by P. S. Dupont de Nemours (1739–1817)

The general political doctrine is as follows: Society is composed of a number of individuals, all having the same natural rights If all do not possess (as some members of the negative school maintained) equal capacities, each can at least best understand his own interest, and is led by nature to follow it The social union is really a contract between these individuals, the object of which is the limitation of the natural freedom of each just so far as it is inconsistent with the rights of the others. Government though necessary, is a necessary evil; and the governing power appointed by consent should be limited to the amount of interference absolutely required to secure the fulfilment of the contract. In the economic sphere this implies the right of the individual to such natural enjoyments as he can acquire by his labour That labour, therefore, should be undisturbed and unfettered, and its fruits should be guaranteed to the possessor; in other words, property should be sacred. Each citizen must be allowed to make the most of his labour; and therefore freedom of exchange should be ensured, and competition in the market should be unrestricted, no monopolies or privileges being permitted to exist.

The Single Tax on Land.—The physiocrats then proceed with the economic analysis thus: Only those labours are truly "productive" which add to the quantity of raw materials available for the purposes of man, and the real annual addition to the wealth of the community consists of the excess of the mass of agricultural products (including, of course, metals) over their cost of production On the amount of this *produit net* depends the well-being of the community and the possibility of its advance in civilization The manufacturer merely gives a new form to the materials extracted from the earth; the higher value of the object, after it has passed through his hands, only represents the quantity of provisions and other materials used and consumed in its elaboration. Commerce does nothing more than transfer the wealth already existing from one hand to another; what the trading classes gain thereby is acquired at the cost of the nation, and it is desirable that its amount should be as small as possible. The occupations of the manufacturer and merchant, as well as the liberal professions, and every kind of personal service, are "useful" indeed, but they are "sterile," drawing their income, not

from any fund which they themselves create, but from the superfluous earnings of the agriculturist. The revenue of the state, which must be derived altogether from this net product, ought to be raised in the most direct and simplest way—namely, by a single impost of the nature of a land tax.

The special doctrine relating to the exclusive productiveness of agriculture arose out of a confusion between "value" on the one hand and "matter and energy" on the other. A. Smith and others have shown that the attempt to fix the character of "sterility" on manufactures and commerce was founded in error. And the proposal of a single *impôt territorial* falls to the ground with the doctrine on which it was based. But such influence as the school exerted depended little, if at all, on these peculiar tenets, which indeed some of its members did not hold. The effective result of its teaching was mainly destructive. It continued in a more systematic form the efforts in favour of the freedom of industry already begun in England and France.

The Rule of Nature.—These conclusions as to the revolutionary tendencies of the school are not at all affected by the fact that the form of government preferred by Quesnay and some of his chief followers was what they called a legal despotism, which should embrace within itself both the legislative and the executive function. The reason for this preference was that an enlightened central power could more promptly and efficaciously introduce the policy they advocated than an assembly representing divergent opinions and fettered by constitutional checks and limitations. Turgot used the absolute power of the Crown to carry into effect some of his measures for the liberation of industry, though he ultimately failed because unsustained by the requisite force of character in Louis XVI. But what the physiocratic idea with respect to the normal method of government was appears from Quesnay's advice to the dauphin, that when he became king he should "do nothing, but let the laws rule," the laws having been, of course, first brought into conformity with the *ius naturae*. The partiality of the school for agriculture was in harmony with the sentiment in favour of "nature" and primitive simplicity which then showed itself in so many forms in France, especially in combination with the revolutionary spirit, and of which Rousseau was the most eloquent exponent. The members of the physiocratic group were undoubtedly men of thorough uprightness, and inspired with a sincere desire for the public good, especially for the material and moral elevation of the working classes. Quesnay was physician to Louis XV., and resided in the palace at Versailles; but in the midst of that corrupt court he maintained his integrity, and spoke with manly frankness what he believed to be the truth. And never did any statesman devote himself with greater singleness of purpose or more earnest endeavour to the service of his country than Turgot, who was the principal practical representative of the school.

The physiocratic school never obtained much direct popular influence, even in its native country, though it strongly attracted many of the more gifted and earnest minds. Its members, writing on dry subjects in an austere and often heavy style, did not find acceptance with a public which demanded before all things charm of manner in those who addressed it. The physiocratic tenets, which were in fact partly erroneous, were regarded by many as chimerical, and were ridiculed in the contemporary literature; as, for example, the *impôt unique* by Voltaire in his *L'Homme aux quarante écus,* which was directed in particular against P. P. Mercier-Larivière (1720–1794). It was justly objected to the group that they were too absolute in their view of things; they supposed, as Smith remarks in speaking of Quesnay, that the body politic could thrive only under one precise régime—that, namely, which they recommended—and thought their doctrines universally and immediately applicable in practice. They did not, as theorists, sufficiently take into account national diversities or different stages in social development; nor did they, as politicians, adequately estimate the impediments which ignorance, prejudice and interested opposition present to enlightened statesmanship.

The physiocratic system, after guiding in some degree the policy of the Constituent assembly, soon ceased to exist as a living power; but its good elements were incorporated into the more complete construction of Adam Smith.

See the articles on Quesnay (with bibliography), Mirabeau and Turgot; also Tocqueville, *L'Ancien régime et la révolution,* ch. iii.; Taine, *Les Origines de la France contemporaine,* vol. i.; R. Stourm, *Les Finances de l'ancien régime et de la révolution* (1885); J. F. X. Droz, *Histoire du règne de Louis XVI.*; L. de Lavergne, *Économistes français du XVIII.e siècle* (1876); H. Higgs, *The Physiocrats* (1897); C. Landauer, *Die Theorien der Merkantilisten und der Physiokraten über die ökonomische Bedeutung des Luxus* (Munich, 1915); R. Savatier, *La Théorie du commerce chez les physiocrates* (1918); R. Gonnard, *Hist. des doctrines economique* (3 vols., 1921–22).

PHYSIOGNOMY, a term which denotes a supposed science for the "discovery of the disposition of the mind by the lineaments of the body" (Bacon); is also used colloquially as a synonym for the face or outward appearance, being variously spelled by the old writers.

Physiognomy was regarded by those who cultivated it as a two-fold science: (1) a mode of discriminating character by the outward appearance, and (2) a method of divination from form and feature. On account of the abuses of the latter aspect of the subject its practice was forbidden by the English law. By the act of parliament 17 George II. c. 5 (1743) all persons pretending to have skill in physiognomy were deemed rogues and vagabonds, and were liable to be publicly whipped, or sent to the house of correction until next sessions. The pursuit thus stigmatized as unlawful is one of great antiquity: in ancient times physiognomy was a profession.

The first systematic treatise which has come down to us is that attributed to Aristotle, in which he devotes six chapters to the consideration of the method of study, the general signs of character, the particular appearances characteristic of the dispositions, of strength and weakness, of genius and stupidity, of timidity, impudence, anger and their opposites, etc. Then he studies the physiognomy of the sexes, and the characters derived from the different features, and from colour, hair, body, limbs, gait and voice. He compares the varieties of mankind to animals, the male to the lion, the female to the leopard. The general character of the work may be gathered from the following specimen. While discussing noses, he says that those with thick bulbous ends belong to persons who are insensitive, swinish; sharp-tipped belong to the irascible, those easily provoked, like dogs; rounded, large, obtuse noses to the magnanimous, the lion-like; slender hooked noses to the eagle-like, the noble but grasping; round-tipped retroussé noses to the luxurious, like barndoor fowl; noses with a very slight notch at the root belong to the impudent, the crow-like; while snub noses belong to persons of luxurious habits, whom he compares to deer; open nostrils are signs of passion, etc.

While the earlier classical physiognomy was chiefly descriptive, the later mediaeval authors particularly developed the predictive and astrological side, their treatises often digressing into chiromancy, onychomancy, clidomancy, podoscopy, spasmatomancy and other branches of prophetic folk-lore and magic.

Along with the medical science of the period the Arabians contributed to the literature of physiognomy; notably 'Ali b. Ragel, Rhazes and Averroes. Avicenna also makes some acute physiognomical remarks in his *De animalibus,* which was translated by Michael Scot about 1270. Among mediaeval writers Albertus Magnus (born 1205) devotes much of the second section of his *De animalibus* to physiognomy. The famous sage of Balwearie, Michael Scot, while court astrologer to the emperor Frederick II., wrote his treatise *De hominis phisiognomia,* much of which is physiological and of curious interest. It was probably composed about 1272, but not printed until 1477. This was the first printed work on the subject.

The 16th century was rich in publications on physiognomy. Treatises were published, among others, by John de Indagine, Cocles, Andreas Corvus, Michael Blondus, Janus Cornaro, Anselm Douxciel, Pompeius Ronnseus, Gratarolus, Lucas Gauricus, Tricassus, Cardanus, Taisnierus, Magnus Hund, Rothman, Johannes Padovanus, and, greatest of all, Giambattista della Porta. The earliest English works were anonymous: *On the Art of Foretelling Future Events by Inspection of the Hand* (1504), and *A Pleasant*

Introduction to the Art of Chiromancie and Physiognomie (1588). Dr. Thomas Hill's work, *The Contemplation of Mankynde, contayning a singular Discourse after the Art of Physiognomie*, published in 1571, is a quaintly written adaptation from the Italian authors of the day.

The development of a more accurate anatomy in the 17th century seems to have diminished the interest in physiognomy by substituting fact for fiction; and consequently the literature, though as great in quantity, became less valuable in quality. The principal writers of this age were T. Campanella, R. Coclenius, Clement, Timpler, J. E. Gallimard, Moldenarius, Septalius, Saunders, C. Lebrun (a precursor of Charles Bell), Elsholz, de la Bellière, J. Evelyn (in the appendix to *Numismata*), Baldus, Bulwer (in his *Pathomyotomia*), Fuchs, Spontoni, Ghiradelli, Chiaramonti, A. Ingegneri, Finella, De la Chambre, Zanardus, R. Fludd and others of less importance.

The 18th century shows a still greater decline of interest; the only name worthy of note is that of J. K. Lavater (*q.v.*) The popular style, good illustrations and pious spirit of his works gave them a popularity they little deserved, as there is no system in his work, which chiefly consists of rhapsodical comments upon the several portraits.

The physiological school of physiognomy was foreshadowed by Parsons and founded by Sir Charles Bell, whose *Essay on the Anatomy of the Expression*, published in 1806, was the first scientific study of the physical manifestation of emotions in the terms of the muscles which produce these manifestations. In the later editions of this essay the thesis is elaborated with greater detail. Moreau's edition of Lavater, in 1807, was somewhat along the same lines. In 1817 Dr. Cross of Glasgow wrote his defence of a scientific physiognomy based on general physiological principles. The experiments of G. B. A. Duchenne (*Mécanisme de la physiognomie humaine, Paris*, 1862) showed that by the use of electricity the action of the separate muscles could be studied and by the aid of photography accurately represented. These observations confirmed by experimental demonstration the hypothetical conclusions of Bell. The machinery of expression having thus been indicated, the connection of the physical actions and the psychical state was made the subject of speculation by Herbert Spencer (*Psychology*, 1855). These speculations were reduced to a system by Darwin (*Expression of Emotions*, 1872), who formulated the following as fundamental physiognomical principles:—

(1) Certain complex acts are of direct or indirect service, under certain conditions of the mind, in order to relieve or gratify certain sensations or desires; and whenever the same states of mind are induced the same sets of actions tend to be performed, even when they have ceased to be of use. (2) When a directly opposite state of mind is induced to one with which a definite action is correlated, there is a strong and involuntary tendency to perform a reverse action. (3) When the sensorium is strongly excited nerve-force is generated in excess, and is transmitted in definite directions, depending on the connections of nerve-cells and on habit.

The last of these propositions is adversely criticized by P. Mantegazza as a truism, but it may be allowed to stand with the qualification that we are ignorant concerning the nature of the influence called "nerve-force" It follows from these propositions that the expression of emotion is, for the most part, not under control of the will, and that those striped muscles are the most expressive which are the least voluntary. To the foregoing may be added the following three additional propositions, so as to form a more complete expression of a physiognomical philosophy:—

(4) Certain muscles concerned in producing these skin-folds become strengthened by habitual action, and when the skin diminishes in elasticity and fulness with advancing age, the wrinkles at right angles to the course of the muscular fibres become permanent. (5) To some extent habitual muscular action of this kind may, by affecting local nutrition, alter the contour of such bones and cartilages as are related to the muscles of expression. (6) If the mental disposition and proneness to action are inherited by children from their parents, it may be that the facility in, and disposition towards, certain forms of expression are in like manner matters of heredity.

Illustrations of these theoretic propositions are to be found in the works of Bell, Duchenne and Darwin, and in the later publications of Theodor Piderit, *Mimike und Physiognomik* (1886) and Mantegazza, *Physiognomy and Expression* (1890), to which the student may be referred for further information.

For information on artistic anatomy as applied to physiognomy *see* the catalogue of sixty-two authors by Ludwig Choulant, *Geschichte und Bibliographie der anatomischen Abbildung*, etc. (Leipzig, 1852), and the works of the authors enumerated above, especially those of Aristotle, Franz, Porta, Cardan, Corvus and Bulwer. For physiognomy of disease, besides the usual medical handbooks, *see* Cabuchet, *Essai sur l'expression de la face dans les maladies* (Paris, 1801); Mantegazza, *Physiology of Pain* (1893), and Polli, *Saggio di fisiognomonia e potognomonia* (1837). For ethnological physiognomy, *see* amongst older authors Gratarolus, and amongst moderns the writers cited in the various textbooks on anthropology, especially Schadow, *Physionomies nationales* (1835) and Park Harrison, *Journ. Anthrop. Inst.* (1883). For the physical characteristics of criminals *see* Lombroso, *L'Uomo delinquente* (1897); Ferri, *L'Omicidio* (1895); von Baer, *Der Verbrecher* (1893); Laurent, *Les Habitués des prisons* (1890); Havelock Ellis, *The Criminal* (1901); A. Lenz, *Grundriss der Kriminalbiologie* (Vienna, 1927); L. Grinberg, *Emotion and Delinquency* (1928).

PHYSIOLOGICAL ARTICLES. The special articles in Physiology form natural complements to those of the medical programme. DIGESTION; HEART AND CIRCULATION; NUTRITION; EQUILIBRIUM; MUSCLE AND MUSCULAR EXERCISE; PAIN, SIGNIFICANCE OF; BIOCHEMISTRY; TASTE AND SMELL; ENZYMES and REPRODUCTION and SEX, are among the most important articles in this section. *See* also MEDICAL ARTICLES.

PHYSIOLOGY is the science which treats of the functional working of the body in health, as opposed on the one hand to anatomy which treats of the structure of the body and pathology which treats of its function as distorted by disease. In all forms of animal life except the lowest, the body is made up of organs. With regard to the functions of all the more important organs special articles will be found under their respective names (*see* HEART; INTESTINE, LIVER; LUNG; etc).

The activities of these organs are co-ordinated by the nervous system (*see* BRAIN; NERVE; SPINAL CORD; SYMPATHETIC SYSTEM) and the hormones (*see* HORMONES) Nevertheless the body is in a sense more than a number of co-ordinated units. The body has an architecture which has been evolved along well defined lines and which it is the business of the present article to trace as far as may be possible.

The phrase "well defined lines" rather than "well defined principles" has been used advisedly; for it may often be a matter of speculation, whether, even when a frequent repetition of the same sort of architectural conceit occurs, any principle is really involved; or whether merely the same sort of accident has taken place in the same sort of way. To the most reflective type of mind physiology presents no more fascinating problem, than that of the extent to which the structure of the body is the result of some well ordered plan either of "evolution" or "design." In the strict sense of the word "principle" would imply such a plan, but in what follows the word will be used more loosely to include phenomena that recur with sufficient frequency to simulate an orderly sequence, even though the recurrence may in reality be little more than accidental.

Constancy of Internal Environment.—This principle is associated particularly with the name of the great French physiologist Claude Bernard. Innumerable examples might be given in illustration of it but a few must suffice Moreover the examples might be either in the realm of the physical or of the chemical properties of the environment The first to be discussed, namely constancy of internal temperature, is physical and is chosen not because it is more important than others, but because the constancy has crept into the animal kingdom very slowly and its implications are to some extent traceable A unicellular organism, such as the amoeba, exists at a temperature indistinguishable from that of the water in which it lives. Every accident which affects the temperature of the water affects that of the amoeba; the only defence which the creature can put up against a too rigorous environment, whether of heat or cold, is to flee if it can to more genial surroundings. Within those limits all the processes of its body, of digestion, of respiration, of movement, must take place at the temperature of the water in which the unicellular organism finds itself. Compare the condition of affairs in man, the most

highly organized creature; the temperature of the body is within very narrow limits (1) constant from one time to another; (2) the same over the whole body; and (3) maintained at a level quite different from—and independent of—that of the surrounding medium.

In the development of man, this constancy has been brought about by stages. The root of the matter lies in the fact that the organism itself produces heat; the amoeba is so small and its cooling surface relatively so great, that the heat produced by the organism itself is a negligible factor in determining its temperature; but if enough amoebae were packed together the heat which they produced would have less opportunity of escape and so the centre of the mass would attain a higher temperature just as the heat produced in a hay rick raises the temperature of the interior of the rick. Therefore a high body temperature argues a certain considerable *size* as one of the properties of the body. That the body temperature should be uniform over the whole body is accomplished by the circulation of the blood. The maintenance of the constancy of environment inside the body by the device of circulating the same fluid throughout all its interstices appears very early in the development of animal life and maintains the constancy in many other respects besides that of temperature.

The constancy of the body temperature with regard to time is on the other hand something which has been attained at a late stage in the development of the animal kingdom. The so called "warm blooded animal," in reality the animal whose temperature remains at an even level, did not appear until long after the vertebrate level had been reached. Yet this device was developed apparently independently both in birds and mammals.

So manifest are the advantages of a constant temperature that its late development seems almost surprising. The body from one point of view consists of innumerable and ceaseless chemical reactions. These reactions take place at given velocities, the velocity of each reaction depending upon the reaction itself and the temperature at which it is taking place. Imagine the whole machine adjusted perfectly to work at 30° Cent., each reaction progressing at a velocity which (a) is most suitable for its own purpose, and (b) fits into the general scheme so nicely that the whole multitude of reactions take place harmoniously. Now alter the temperature from 30° to 10°; some of the reactions are affected much by the alteration, some little; chaos must result and the whole machine be thrown out of gear. Therefore a third condition (c) is necessary, namely, that the effect of temperature on the velocities of the reactions must be such that when the temperature is altered the reactions alter in speed harmoniously with one another. This fresh condition naturally limits the number and nature of the chemical processes, which are available. Some chemical operation might be most desirable and could take place at 37° C, but its insertion into the body would be merely vicious if, by refusing to keep pace with its fellows, it brought the mechanism to a standstill at 10° C. By maintaining a uniform temperature condition (c) is dispensed with and the body is free to select what chemical reactions are most suitable under the constant condition without reference to the extent to which they may be affected by alteration of the temperature.

The constancy of the body temperature is maintained by a nice adjustment of the heat loss of the body to the heat formation; for the mechanism of this adjustment *see* the article on ANIMAL HEAT; here it need only be said that the adjustment is controlled entirely by the nervous system.

Alkalinity of the Blood.—The second property of the internal medium, which is maintained at an approximately constant level, is the alkalinity of the blood. Great prominence has been given to the study of the hydrogen ion concentration of the blood within the last decade. So far as is known the limits within which the alkalinity of the blood may vary are between pH 8·00 and pH 7·00. The work of L. J. Henderson and of Hasselbalch has gone to show that the hydrogen ion concentration depends not upon the actual quantity of acid or alkali present but upon the balance between the two. In a system consisting of carbonic acid and sodium bicarbonate in solution the hydrogen ion concentration,

$$cH = K \times \frac{(CO_2)}{(NaHCO_3)}$$

where K is a constant and (CO_2) and ($NaHCO_3$) the molecular concentrations respectively of carbonic acid and sodium bicarbonate, from which it follows that addition of water to the system will not alter the hydrogen ion concentration.

Every action of the body tends to upset this equilibrium usually in the sense of putting more acid into the blood; muscular exercise for instance adds carbonic and sometimes lactic acid to the circulating medium. How then is the constancy maintained? First by the action of the respiratory system. Increase of the hydrogen ion concentration of the blood leads to increased activity of the respiratory centre, and greater consequent loss of carbonic acid by the body in the breath. Secondly the kidney comes into play and if the concentration of acid in the blood falls alkali is secreted in correspondingly excessive amounts in the urine. Whether the central nervous system controls the output of alkali by the kidney is not known. The actual secreting cells of the kidney are not regarded as being operated by nerves; if therefore the nervous system plays a part it probably does so by controlling the blood supply.

Two examples have been taken for consideration but the reader can from any book on physiology learn of many more, such as the constancy of sugar, of protein, of the calcium-phosphorus ratio of oxygen, of haemoglobin and so forth. Yet these are not absolutely constant in the blood but their variation is within small limits—any considerable deflection from which is in health soon redressed.

The Principle of Maximal Activity.—The most elementary consideration of the architecture of any structure demands some discussion of the sizes of the various components. This question has received little attention from the physiological point of view. The anatomist has tabulated the average dimensions of the various organs but the physiologist has little to say about the reasons which determine these sizes. What little there is on this subject in the literature of physiology is not always to the point. The human body at rest may be compared to a battleship with her fires lit, her ammunition on board and her guns ready for action. Any description of such a ship is, however, given in terms of the energy she puts forth, not when at rest, but when in the fullest possible activity; she has a speed of so many knots, her hitting power is so and so. Only expressed in those terms the dimensions of her various parts become intelligible. So it is with the body, but the difficulties of studying it, or any of its parts, when the maximum of energy is being developed is very great. Some decision must be come to as to the units in which the energy is to be expressed. In the case of a motor car it is expressed in terms of fuel consumed—so many miles to the gallon or to the litre. In the case of man it may also be expressed in litres—litres of oxygen used in consuming the fuel. A man may use as much as four litres of oxygen per minute. This oxygen is of course used in the tissues themselves and therefore must be carried to them. To carry four litres of oxygen efficiently requires probably about 30 litres of blood, therefore 30 litres of blood must pass out of the heart per minute. That fact fixes the size of the aorta and presumably the dimensions of the heart itself. Moreover the blood has to be oxygenated and therefore the dimensions of the lungs are also fixed. Thus the limiting factor in deciding the size of any organ has nothing to do with the events taking place in the resting body but with the maximum activity with which the organ is concerned.

A striking instance is furnished by the splenic vein. Many observers have noted that the splenic vein is large out of proportion to the quantity of blood which usually passes along it. Only recently has it been appreciated that the spleen may hold at a time perhaps one-fifth of the total quantity of blood in the body and that it may contract suddenly expelling possibly $\frac{1}{4}$ of a litre of blood in a few seconds.

What is true of the body as a whole is true of the individual organs.

The following table gives the quantity of oxygen which they are capable of using in the dog or cat:—

Voluntary muscle	Nerves cut	0·003	Tone at rest	0·006
			Gentle contraction	0·020
			Active contraction	0·080
Unstriped muscle	Rest	0·004	Contracting	0·007
Heart	Slow and feeble contraction	0·007	Normal contractions	0·05
			Very active	0·08
Submaxillary gland	Nerves cut	0·03	Chorda stimulation	0·10
Pancreas	Not secreting	0·03	Secreting after injection of secretia	0·10
Intestines	Not absorbing	0·02	Absorbing peptone	0·03
Liver	Fasting animal	0·01 0·02	Fed animal	0·03 0·05
Suprarenal	Normal	0·045		

Thirty years ago physiologists were exercised with the study of the extent to which organs could be cut away without fatal results. Bradford found that the whole of one kidney and the half of the second could be removed in animals without fatal results; it was observed also that the removal of one lung did not appear to be very serious. Men marvelled at the fact that the organs were so unnecessarily large; the standard which they applied was that of rest and not the conditions under which the kidney or the lung was required to function on the greatest scale of which it is capable.

Again it is well known that but a small portion of many of the endocrine organs, if left in the body, will apparently prevent the obvious sequelae of removal of the whole. Why then should the body contain so much more of the organ than appears necessary and why in many cases will the part left grow perhaps to the original size? Presumably because there are moments when the whole organ is required. It is in relation to such that its size is regulated.

The Principle of Mobilized Units.—When an organ becomes active it may be conceived of as doing so in one of two ways (of course the two may be combined). The first is that each unit of which the organ is composed may become heightened in activity; the second is that a single unit is capable of only two states, the active and the resting and that the degree of activity of the organ depends simply on the relative number of active and of resting units which it contains.

For many years the view has been held with regard to the heart, that that organ cannot give a partial contraction; if it contracts at all it gives the full contraction of which it is capable in the condition in which it may be at the moment. This was known as the "all or none" principle. It seemed to indicate that not only did each fibre of the heart muscle contract to its full extent but that when contraction took place, all the fibres in the heart contracted. These are two separate points. For the moment the applicability of the "all or none" principle to the cell will be considered. More recently the principle has been applied both to striated muscle and to nerve. As now conceived each fibre of which a skeletal muscle is composed, contracts to its full extent if it contracts at all, but, unlike the heart, not all the fibres need necessarily contract. Thus the degree of shortening of the muscle will depend upon the number of fibres which are thrown into contraction and not upon the degree of contraction of each.

Very beautiful records have recently been obtained of the impulses which pass up sensory nerve fibres; the same principle holds good. There is a standard impulse which can pass up, that is a property of the nerve. The gradation of the sensation depends upon the number of such which pass along the nerve in a given time, and on the number of nerve fibres which are stimulated simultaneously.

With regard to the applicability of the "all or none" law to secreting cells there is nothing known.

Passing from the consideration of cells to that of organs, one finds that there is frequently a unit between the cell and the organ; the lung consists of alveoli, the same is true of the salivary gland, the kidney consists of tubules, and so forth. Till recently it was assumed that in any one organ all the units are at work all the time, the activity of each unit being graded in the same degree as that of its fellow. With regard to the kidney Richards and Wearn have shown it to be otherwise, the degree of activity of the organ being the expression of the number of tubules which are in action at any time; for the tubules appear to work in shifts. Haldane has found reasons for suspecting the same principle to operate in the case of the lung. In normal quiet breathing he regards only a portion of the lung as being involved, while when the respiration is more laboured a larger number of alveoli become ventilated. The application of the principle of mobilized units to the lung rests, however, on a less sure basis than its application to the kidney. In the latter case the glomeruli have been seen to go in and out of action, the blood flow through them being at times suspended; in the lung it is a matter of inference.

The most striking instance of the mobilization of units is that of the capillaries as observed by Krogh. In a muscle for instance the capillaries run parallel to the muscle fibres. When the muscle is at rest the majority of these capillaries are entirely closed, no blood whatever running along them. As the muscle becomes more and more active, a correspondingly greater number of capillaries open till the maximum may be many times the number at rest.

Principle of Substantial Reserves.—The principal materials (gross) which the body requires are carbohydrate, fat, protein, water and oxygen. In the case of each the body carries some sort of store beyond that placed at the immediate seat of metabolism.

Carbohydrate.—The blood contains about 7 grams of sugar; that is a little more than half an hour's supply for the whole body. The remaining carbohydrate is stored as glycogen. Of this about half is distributed throughout the tissues generally and may therefore be regarded more or less as being at the seat of its metabolism. The remaining half, amounting to 75 grams or half a day's supply, is to be found in the liver which acts as a store for the body as a whole. Thus the body has a store of about one half day's supply of carbohydrate,—250–300 grams being the figure put down in the standard dietaries for daily consumption. That is not to say that after 12 hours' abstinence there is no carbohydrate left in the body, but it means that the organism is gradually falling back on something else.

Fat is stored on a much greater scale than carbohydrate. The amount of fat stored in the body naturally differs in different individuals within very wide limits, but it has been established as the result of numerous experiments that a portion of the fat laid down in the body is directly derived from what is eaten. Thus if some oil of low melting point be taken in the food it may at once be recognised as entering into the store of fat reserved in the body.

Whilst it is quite clear that carbohydrate eaten may be stored as carbohydrate and used as such, and while it is equally clear that fat eaten may be stored as fat, the more arresting question arises—Is not much of the fat of the body essentially a store of carbohydrate? In order to establish this thesis it would be necessary to prove (1) that carbohydrate taken may be laid on as fat; and (2) that when carbohydrate is needed fat may be reconverted into carbohydrate or at all events used as carbohydrate is used. That carbohydrate taken in the food may be laid on as fat was proved by the classical experiment of Lawes and Gilbert. In this two young pigs were chosen from the same litter and while one was killed and analysed, the other was fed on "grains," a diet which is practically free from fat, consisting of protein and carbohydrate. The amount of fat put on by the growing pig was greater than could be accounted for on the assumption that it was formed from protein. Indeed since the days of Lawes and Gilbert it has become increasingly doubtful whether fat can be formed from protein on any considerable scale in the mammal.

To pass to the possible reconversion of fat into carbohydrate,—that is at the moment a subject on which the highest authorities are in controversy. It may be that when muscle is in want of carbohydrate and cannot get any from the usual sources fat is reconverted, but it may not be so. If it is not, however, there appears to be but one possibility, namely, that the muscle can

derive energy from fat without its passing through the carbohydrate stage. In either case the muscle would be availing itself of fat entering the body as carbohydrate. Therefore the fat would be a potential, if not an actual reserve of carbohydrate.

Oxygen.—Oxygen is stored to some extent in the body. At one time the conception was held that oxygen was stored actually in the tissues as so-called "intra-molecular" oxygen. That conception was founded on two others—(1) that a frog's muscle could contract in an atmosphere free from oxygen; and (2) that the contraction was essentially an oxidation. Now the idea of "intra-molecular oxygen" has been given up and we must look for no further store of oxygen than is to be found in the haemoglobin of the body. What is to be found there and in the lungs suffices to preserve consciousness for a few, perhaps two or three, minutes, and life for a somewhat longer time. The blood on the average is circulated round the body (at rest) rather more than once per minute and not so much as twice; on that circuit about one third of its oxygen is taken out. If therefore one assumes that all the blood goes round the body in 45 seconds and that there is enough oxygen in the blood for three circuits that would give oxygen enough for 135 seconds. In addition in such a case as that of drowning there is reserved oxygen in the lungs to the extent of what would supply the body for about two to three minutes. But if the body has no great store of oxygen on which to fall back, it has a considerable store of the material which transports oxygen and that is probably much more important. So far as is known about 80 per cent of the haemoglobin of the body is in circulation; the rest is stored, some in the spleen, some probably in the red marrow and the rest in situations as yet not fully explored.

The Principle of Specific Chemical Response.—There are a number of relatively simple chemical substances, any of which if injected into the body cause the body to produce some other substance which unites with and in a sense neutralises it. To give three examples:—If a fatty acid be administered to the alimentary canal, the acid will be absorbed by the villi, the cells of which will produce glycerine and the result will be a neutral fat. If on the other hand benzoic acid be administered it will get so far as the kidney and there the kidney cells will produce glycine, turning it into hippuric acid. Lactic acid similarly if thrust into the general circulation will be excreted as ammonium lactate, the ammonia being produced not by the cells of the body generally but by those, or certain of those, in the kidney. We have now arrived at the confines of the great subject of immunity —and perhaps outside the region of the present article.

The Principle of Dual Control.—The body has two ways of doing a great many things. Examples of this principle are so numerous as to be found in almost any system of the body. To take the point at which two of the most important systems of the body—the nervous and the respiratory systems—touch, let us consider the nervous control of respiration.

The essence of respiration is a rhythmic outflow of alternate inspiratory and expiratory impulses from the brain to the muscles concerned. That rhythm is probably, but not certainly, inherent in the brain itself, but it is regulated by influences which play upon the brain. These influences fall into two general categories—those which arrive along the nervous paths from the lungs and elsewhere and those which are borne to the brain in the blood stream.

An increase of total respiration may then take place in either of two ways—(a) many forms of irritation in the lung produce an increased total ventilation which is abolished by cutting the vagi and which may therefore be regarded as being due to special stimuli passing up along these nerves, (b) increase of carbonic acid in the blood even in the absence of nervous stimulation will so act upon the respiratory centre as to increase the total ventilation. During muscular exercise both the nervous and the chemical factors come into play; the nervous is the first to be initiated and therefore it may be regarded as the most sensitive; but even were it not involved a sufficient regulation could probably be carried out by the carbonic acid in the blood.

The respiratory centre furnishes another example. This time it is a combination of a nervous with a physical regulation. The facts are principally based on the observations of Professor Richet. If a dog lies down in the sun he will very shortly commence to pant in rapid, shallow respirations passing air over his tongue and through his respiratory passages. According to Professor Richet this tachypnoea is associated with an actual lowering of the body temperature and is due to stimuli from the warm skin reaching the respiratory centre via the sensory nerves. But even did not this nervous regulation of the body temperature take place another would supervene of perhaps a cruder character, for as soon as the body temperature began to rise, the warmer blood reaching the respiratory centre would itself produce an increased ventilation. Here again the nervous effect is the first to be invoked and presumably the more delicate.

The digestive system abounds with examples of duality. Of the three principal forms of food which are digested, carbohydrates, proteins and fats, the organs for the secretion of the digestive ferments are in all cases reduplicated. Starch is turned into sugar both by the saliva and by the pancreas, protein is broken down to the peptone stage both by the pepsin of the stomach and the trypsin of the pancreas, while to quote Leathes "two fat splitting enzymes are present in the intestinal contents, one being provided by the pancreatic juice and the other by the intestinal juice. . . . The action of the intestinal juice is however overshadowed by that of the pancreatic juice."

Not only are the ferments which effect digestion duplicated but there is a measure of duplication about the mechanisms responsible for their secretion. The processes of the alimentary canal are actuated, some by nervous stimuli, some by chemical, but in large measure by both. The secretion of saliva is entirely actuated by nervous stimuli; gastric juice is secreted largely as a result of nervous stimuli, but its flow is maintained by chemical bodies. In the secretion of pancreatic juice chemical stimuli play the more prominent part, nervous stimuli not however being entirely absent; whilst the secretion of the intestine is—so far as is known—due entirely to hormones. If the whole process from end to end be reviewed, some of the statements made about the respiratory centre are applicable. The process of digestion is initiated by nervous and maintained by chemical stimuli. As Dr. Anrep has pointed out, the further the food gets from the surface of the body, the less is it under the influence of the nervous, the more is it under the influence of the hormonal system.

The vascular system no less than the alimentary is subject to both hormones and to nervous stimuli, inasmuch as nearly all its parts are innervated by the sympathetic system (for adrenaline acts on the nerve endings of that system). Thus Florey has shown in the intestine of the dog, that a sudden sound will cause the mucous membrane to pale in a matter of a few seconds. If the nerves to this piece of intestine be severed the noise will still cause the intestine to pale, but after a much longer time—in about a quarter of a minute. The paling is in each case due to constriction of the small vessels. In the first case the constriction is initiated by nervous stimuli reaching the mucosa along the branches of the splanchic supply; in the second the blanching is due presumably to adrenaline secretion. The case is not however entirely parallel to that of the nervous and chemical government of the pancreas inasmuch as the adrenaline secretion is itself due to nervous stimulation, so that the reduplication is merely a reduplication of the paths by which the nervous system can control the calibre of the vessels.

What applies to the blood vessels applies, so far as the relative rôles of the nervous and the endocrine systems are concerned, to many other structures in the body which will at once occur to the reader. Many organs have not only a chemical and a nervous mechanism but also a double nervous supply. That however will be treated under the heading of ANTAGONISTIC NERVES.

Two organs in the mammals stand out as having no substitutes, the lungs and the generative organs, and in each case the fact is a little interesting because lower down in the animal kingdom that simplicity does not exist. Apart from the existence of gills, in the frog there is a cutaneous respiration so that it, even

in air, has two alternatives. As regards reproduction of course the most primitive form is simply by fission. Reproduction by fission exists in many forms of life collaterally with sexual reproduction, but in all the higher types of the animal kingdom it has been given up.

The Principle of Antagonistic Nerves.—There are numerous places in the body in which the actual condition of the organ at any moment is obtained by the balancing of antagonistic influences upon it. Four examples may be given.

(1) The rate of the heart beat is regulated by two nerves, one of which, the vagus, when stimulated, makes the heart go slower, while the other, the sympathetic, drives it faster. Normally its pace is neither so fast nor so slow as that of which it is capable, a fact to be accounted for by the balance of influences passing down the two nerves; if this balance alters the rate changes. (2) The diameter of the pupil of the eye is under the control of two nerves, one of which if stimulated dilates the pupil while the other constricts it; the actual size depends upon the relative influence of the two at any one moment. (3) The movements of the joints (say of the thigh joint) in walking are obtained by the balancing of the muscles which move the joint. It is not merely that alternately one set of muscles comes into action whilst the antagonistic set goes out of action: but each set is the whole time in a greater or less degree of tone. The whole action of the thigh depends upon the relative degree of the various muscles which exert an antagonistic action. (4) In the highest animals delicate manual movements have been secured by the antagonism of the thumb to the fingers, especially to the first finger.

The four examples cited, if examined, show little similarity in the mechanism by which the antagonism is produced. In the first the nerves act presumably in the same structure in the heart tissue. In the pupil the two sets of nerves act on different muscles. These do not pull directly against one another like men in a tug of war; the muscle which tends to close the pupil is a ring, that which tends to open it is radial. In the thigh you have definite groups of muscles pitted against one another and pulling the bone in opposite directions, while in the finger and thumb there are actually different organs.

Thirty years ago thought was focussed on antagonistic nerves because they were supposed to initiate opposite phases of protoplasmic activity in the organs which they supplied. All living matter was conceived as capable of anabolism (building up) and katabolism (breaking down); the slowing of the heart due to vagus stimulation was supposedly the expression of accentuated anabolic activity, the quickening of the heart due to sympathetic stimulation was held to indicate increased katabolism. Of the known cases of antagonistic nerves there are so few in which the two sets of fibres end in the same tissue that their connection with anabolic and katabolic activity has passed out of the picture.

It seems likely that their principal interest lies in the fact that by use of such antagonisms nature has built up a body capable of potentialities which it (the body) would not otherwise possess. By the balancing of the finger against the thumb more accurate and more delicate movements can be made than those of which either finger or thumb separately is capable. By the balancing of the thigh muscles against one another an accuracy of poise is secured which would not otherwise exist. The same is clearly true of the pupil, and had we the necessary discernment we could probably see the application of the general principle involved to the heart and blood vessels.

The Principle of Integrative Adaptation.—When the body is subjected to such adverse conditions that constancy of the composition of the blood cannot be maintained, the lack or excess of some one constituent may be of considerable gravity. In such circumstances some form of adaptation frequently takes place. This adaptation consists in an alteration in quite a number of factors each of which changes only a little though when the whole series of changes are integrated the net result is a very large degree of adaptation to the new environment. In such cases the body is not restored to its original degree of efficiency, but it has moved a considerable distance in that direction.

Examples may be drawn from the response of the body to exercise, to high altitudes, to anaemia and so forth, for which the articles on ANOXAEMIA, MUSCULAR EXERCISE, VASCULAR SYSTEM and ANAEMIA may be consulted. (J. BAR.)

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PIACENZA (Lat. *Placentia*), a town and episcopal see of Emilia, Italy, the capital of the province of Piacenza, 42½ m. S.E. of Milan and 91 m. N.W. of Bologna by rail. Pop. (1921) 47,917 (town), 58,190 (commune). It lies on the Lombard plain, 217 ft. above sea-level, near the Po, which here is crossed by road and railway bridges each about 600 yd. long, just below the confluence of the Trebia. It is still surrounded by walls with bastions and fosse in a circuit of 4 miles. The cathedral was erected between 1122 and 1233, in the Lombard Romanesque style. The campanile is 223 ft. high. The entire edifice has been restored since 1898, and the frescoes by Guercino, Lodovico Caracci and Procaccini seem inappropriate to its severe style. In Sant' Antonino the deputies of the Lombard League swore to the conditions of peace ratified in 1183 at Constance. San Francesco is a Gothic edifice begun by the Franciscans in 1278. S. Savino, a Romanesque building of A.D. 903 (rebuilt in 1107 and restored in 1903) contains a mosaic pavement with curious representations, including one of a game of chess. S. Sisto (1499) once contained Raphael's Sistine Madonna, now in Dresden, sold in 1754 to Frederick Augustus III. Its place is occupied by a copy by Avanzini, and there are also several good intarsias by Bartolomeo da Busseto. Of the secular buildings the most interesting is the Palazzo Comunale, begun in 1281, built in marble and brick, with beautiful windows, one of the finest buildings of its kind in Italy. The Palazzo dei Tribunali and the Palazzo degli Scoti are early Renaissance brick buildings with terra-cotta decorations. The huge Farnese palace was begun after Vignola's designs by Margaret of Austria in 1558, but it was never completed, and since 1800 it has been used as barracks. The town has a motor car factory. It is an important agricultural centre. Petroleum wells have been bored hereabouts.

Piacenza was made a Roman colony in 218 B.C., in which year it afforded protection to the remains of the Roman army after the battle of the Trebia (*q.v.*). In 205 it withstood a siege by Hasdrubal. Five years later the Gauls burned it; and in 190 it was recruited with 3,000 families. In 187 it was connected with Ariminum and the south by the construction of the Via Aemilia. Later on it became a very important road centre; the continuation northwards of the Via Aemilia towards Milan, with a branch to Ticinum, crossed the Po there, and the Via Postumia from Cremona to Dertona and Genoa passed through it. Later still Augustus reconstructed the road from Dertona to Vada, and into Gallia Narbonensis, and gave it the name of Julia Augusta from Placentia onwards. The rectangular arrangement of the streets in the centre of the town, through which passes the Via Aemilia, is a survival from Roman times. Placentia is mentioned frequently as an important military point in Roman times. It was one of the leading members of the Lombard League. In 1447 the city was captured and sacked by Francesco Sforza. Having been occupied by the papal forces in 1512, it was in 1545 united with Parma (*q.v.*) to form an hereditary duchy for Pierluigi Farnese, nephew of Paul III. In 1796 it was occupied by the French. In 1848 Piacenza was the first town of Lombardy to join Piedmont, but was reoccupied by the Austrians till 1859.

PIANOFORTE. The group of keyed stringed musical instruments, among which the pianoforte is latest in order of time, has been invented and step by step developed with the modern art of music. During the 10th century the "organum" arose, an elemen-

tary system of accompaniment to the voice, consisting of fourths and octaves below the melody and moving with it, and the organ (*q.v.*), the earliest keyed instrument, was, in the first instance, the rude embodiment of this idea and convenient means for its expression. About the same time arose a large stringed instrument, the organistrum, the parent of the now obsolete hurdy-gurdy; as the organ needed a blower as well as an organist, so the player of the organistrum required a handle-turner, by whose aid the three strings of the instrument were made to sound simultaneously upon a wheel, and, according to the well-known sculptured relief of St. George de Boscherville, one of the strings was manipulated by means of a row of stoppers or tangents pressed inwards to produce the notes. The other strings were drones, analogous to the drones of the bagpipes, but originally the three strings followed the changing organum.

FIG. 1.—PRIMITIVE CLAVICHORD (BEFORE 1460): EARLIEST EXISTING REPRESENTATION OF A KEYED STRINGED INSTRUMENT, FROM ST. MARY'S, SHREWSBURY

In the 11th century (the epoch of Guido of Arezzo [*q.v.*], to whom the beginning of musical notation is attributed), the Pythagorean monochord, with its shifting bridge, was used in the singing schools to teach the intervals of the plain-song of the church. The practical necessity, not merely of demonstrating the proportionate relations of the intervals, but also of initiating pupils into the different gradations of the church tones, had soon after Guido's time brought into use quadruplex monochords, which were constructed with scales so that four lines indicated authentic and the four plagal tones. This arrangement found great acceptance, for Aribo, writing about fifty years after Guido, says that few monochords were to be found without it. Aribo strenuously endeavoured to improve it, and "by the grace of God" invented a monochord measure which, on account of the rapidity of the leaps he could make with it, he named a *caprea* (wild goat). Jean de Muris (*Musica speculativa,* 1323) describes the musical instruments known in his time, but does not mention the clavichord or monochord with keys, which could not have been then invented. Perhaps one of the earliest forms of such an instrument, in which stoppers or tangents had been adopted from the organistrum, is shown in fig. 1, from a wood carving of a vicar choral or organist, preserved in St. Mary's church, Shrewsbury. The latest date to which this figure may be attributed is 1460.

In the Weimar *Wunderbuch,* a MS. dated 1440 with pen and ink miniatures is given a "clavichordium" having 8 short and apparently 16 long keys. The artist has drawn 12 strings in a rectangular case, but no tangents are visible. A keyboard of balanced keys existed in the little portable organ known as the regal, so often represented in old carvings, paintings and stained windows. Vitruvius, *De architectura,* lib. x. cap. xi., translated by Newton, describes a balanced keyboard; but the key apparatus is more particularly shown in *The Pneumatics of Hero of Alexandria,* translated by Bennet Woodcroft (London, 1851).

The name of regal was derived from the rule (*regula*) or graduated scale of keys, and its use was to give the singers in religious processions the note or pitch. The only instrument of this kind known to exist in the United Kingdom is at Blair Atholl, and it bears the very late date of 1630. The Brussels regal may be as modern. (*See* Victor C. Mahillon, *Catalogue Descriptif* [1880], I. p. 320, p. 454.) We attribute the adaptation of the narrow regal keyboard to what was still called the monochord, but was now a complex of monochords over one resonance board, to the latter half of the 14th century; it was accomplished by the substitution of tangents (fixed in the ends of the balanced keys) for the movable bridges of the monochord or such stoppers as are shown in the Shrewsbury carving. Thus the monochordium or "payre of monochordis" became the clavichordium or "payre of clavichordis"—pair being applied, in the old sense of a "pair of steps," to a series of degrees. Ed. van der Straeten (*La Musique aux Pays Bas,* i. 278) reproduces a so-called clavichord of the 15th century from a MS. in the public library at Ghent. The treatise is anonymous, but other treatises in the same MS. bear dates 1503 and 1504. In the Weimar *Wunderbuch* is a pen-and-ink sketch of the "clavicimbalum" placed upon a table, in which we recognize the outline of the harpsichord, but on a smaller scale.

The earliest known record of the clavichord occurs in some rules of the minnesingers, dated 1404, preserved at Vienna. (*See* Ambros, *Geschichte der Musik* [1892], ii. 226.) The monochord is named with it, showing a differentiation of these instruments, and of them from the clavicimbalum—the keyed cymbal, cembalo (Italian), or psaltery. From this we learn that a keyboard had been thus early adapted to that favourite mediaeval stringed instrument, the "cembalo" of Boccaccio, the "sautrie" of Chaucer.

There were two forms of the psaltery: (1) the trapeze, one of the oldest representations of which is to be found in Orcagna's famous Trionfo della Morte in the Campo Santo at Pisa, and another by the same painter in the National Gallery, London; and (2) the contemporary "testa di porco," the pig's head, which was of triangular shape as the name suggests. The trapeze psaltery was strung horizontally, the "istromento di porco" either horizontally or vertically—the notes, as in the common dulcimer, being in groups of three or four unisons. In these differences of form and stringing we see the cause of the ultimate differentiation of the spinet and harpsichord. The compass of the psalteries was nearly that of Guido's scale; but according to Mersenne (*L'Harmonie universelle* [Paris, 1636], livre iii., p. 107), the lowest interval was a fourth, G to C, which is worthy of notice as anticipating the later "short measure" of the spinet and organ.

The simplicity of the clavichord inclines us to place it, in order of time, before the clavicimbalum or clavicembalo; but we do not know how the sounds of the latter were at first excited. There is an indication as to its early form to be seen in the church of the Certosa near Pavia. In 1472, chromatic keyboards, which imply a considerable advance, were already in use. There is an authentic representation of a chromatic keyboard, painted not later than 1426, in the St. Cecilia panel (now at Berlin) of the famous Adoration of the Lamb by the Van Eycks. The instrument depicted is a positive organ, and it is interesting to notice in this realistic painting that the keys are evidently boxwood, as in the Italian spinets of later date, and that the angel plays a common chord—A with the right hand, F and C with the left. But diatonic

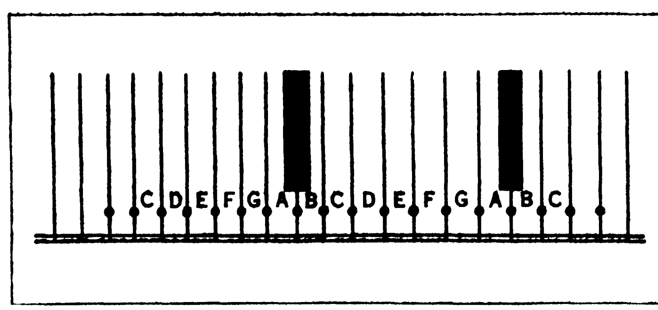

FIG. 2.—DIATONIC CLAVICHORD KEYBOARD (GUIDO'S SCALE) FROM VIRDUNG, BEFORE 1511, SHOWING THE SHORT KEYS B FLAT

organs with eight steps or keys in the octave, which included the B flat and the B natural, as in Guido's scale, were long preserved, for Praetorius speaks of them as still existing nearly two hundred years later. This diatonic keyboard, we learn from Sebastian Virdung (*Musica getutscht und auszgezogen,* Basel, 1511), was the keyboard of the early clavichord. We reproduce his diagram as the only authority we have for the disposition of the one short key.

Virdung's diagram of the chromatic is the same as our own familiar keyboard, and comprises three octaves and a note, from F below the bass stave to G above the treble. But Virdung tells

us that even then clavichords were made longer than four octaves by repetition of the same order of keys. The introduction of the chromatic order he attributes to the study of Boetius, and the consequent endeavour to restore the three musical *genera* of the Greeks—the diatonic, chromatic and enharmonic. But the last-named was not attained until equal temperament tuning was developed by J. S. Bach. Virdung gives woodcuts of the clavichordium, the virginal, the clavicimbalum and the clavicytherium. We reproduce three of them (figs. 3, 6 and 8), omitting the virginal as obviously incorrect. Writers on musical instruments have continually repeated these drawings without discerning that in the printing they are reversed, which puts the keyboards entirely wrong, and that in Luscinius's Latin translation of Virdung (*Musurgia, sive praxis musicae,* Strasbourg, 1536), which has been hitherto chiefly followed, two of the engravings, the clavicimbalum and the clavicytherium, are transposed, another cause of error.

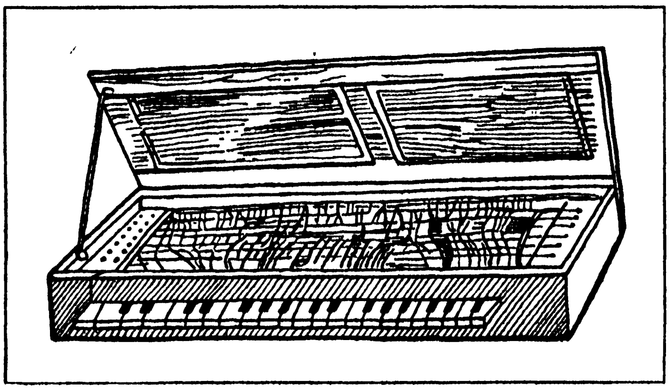

FIG. 3.—VIRDUNG'S CLAVICHORDIUM (1511): FACSIMILE WOODCUT, REVERSED TO CORRECT THE KEYBOARD

Still commonly known as monochord, Virdung's clavichord was really a box of monochords, all the strings being of the same length. We observe in this drawing (fig. 3) the short sound-board, which always remained a peculiarity of the clavichord, and the straight sound-board bridge—necessarily so when all the strings were of one length. To gain an angle of incidence for the tangents against the strings the keys were splayed, an expedient further rendered necessary by the "fretting"—three tangents being placed to give three different notes from each single group of strings tuned in unison. In the drawing the strings are merely indicated. The German for fret is *Bund,* and such a clavichord, in that language, is known as a "gebundenes Clavichord" both fret (to rub) and *Bund* (from *binden,* to bind) having been taken over from the lute or viol. The French and Italians employ "touche" and "tasto" (touch). Praetorius who wrote a hundred years later than Virdung, says two, three and four tangents were thus employed in stopping.

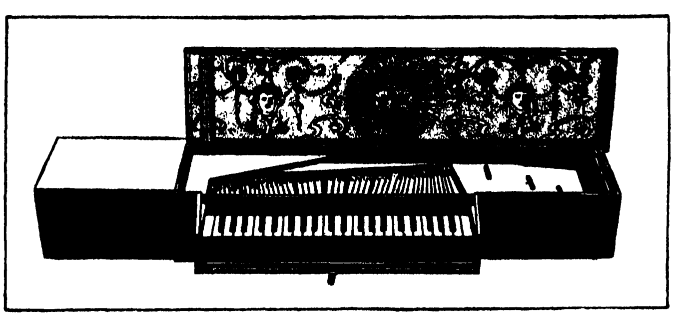

FIG. 4.—MANICORDO (CLAVICHORD) D'ELEONORA DI MONTALVO (1659); KRAUS MUSEUM, FLORENCE

Clavichords were made with double fretting up to about the year 1700—that is to say, to the epoch of J. S. Bach, who, taking advantage of its abolition and the consequent use of independent pairs of strings for each note, was enabled to tune in all keys equally, which had been impossible so long as the fretting was maintained. The modern scales having become established, Bach was now able to produce, in 1722, *Das wohltemperirte Clavier,* his famous collection of preludes and fugues in all the twenty-four major and minor scales for a clavichord which was tuned to what is now known as "equal temperament."

The oldest clavichord, here called manicordo (as French *manicorde,* from monochord), known to exist is that shown in fig. 4. The lowest octave is here already "bundfrei" or fret-free. The strings are no longer of equal length, and there are three bridges, divisions of the one bridge, in different positions on the sound-board. Mersenne's "manicorde" (*Harmonie Universelle,* Paris, 1636, p. 115), shown in an engraving in that work, has the strings still nearly of equal length, but the sound-board bridge is divided into five. The fretted clavichords made in Germany in the last years of the 17th century have the curved sound-board bridge, like a spinet. In the clavichord the tangents always formed the second bridge, deciding the pitch, besides acting as the sound exciters (fig. 5). The common damper to all the strings was a "list" of cloth, interwoven behind the tangents. As the tangents quitted the strings the cloth immediately stopped all vibration. As regards compass Handel's clavichord now in the museum at Maidstone (an Italian instrument dated 1726, and not fretted), has a compass of 3½ octaves (F to A).

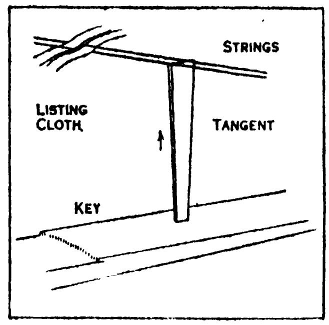

FIG. 5.—CLAVICHORD TANGENT
Showing position when front of keyboard is depressed; the tangent rises into contact with the strings and forms the end-point of the speaking length. The back string is kept from vibrating by means of the "Listing" cloth

The clavichord must have gone out of favour in Great Britain and the Netherlands early in the 16th century—the more brilliant and elegant spinet being preferred to it. Like the other keyboard instruments it had no German name, and can hardly have been of German origin, but it remained longest in use in Germany—until even the beginning of the 19th century.

The next instrument described by Virdung is the virginal (*virginalis,* proper for a girl), a parallelogram in shape, having the same projecting keyboard and compass of keys as the clavichordium. Here we trace derivation from the psaltery, in that the sound-board covers the entire inner surface of the instrument and the disposition of the strings is triangular. The virginal in Virdung's drawing has an impossible position with reference to the keyboard, which renders its reproduction as an illustration useless. But in the next drawing, the clavicimbalum, this is rectified, and the drawing, reversed on account of the keyboard, can be accepted as roughly representing the instrument so called (fig. 6). There would be no difference between the clavicimbalum and the virginal were it not for a peculiarity of keyboard compass, which emphatically refers itself to the Italian "spinetta," a name

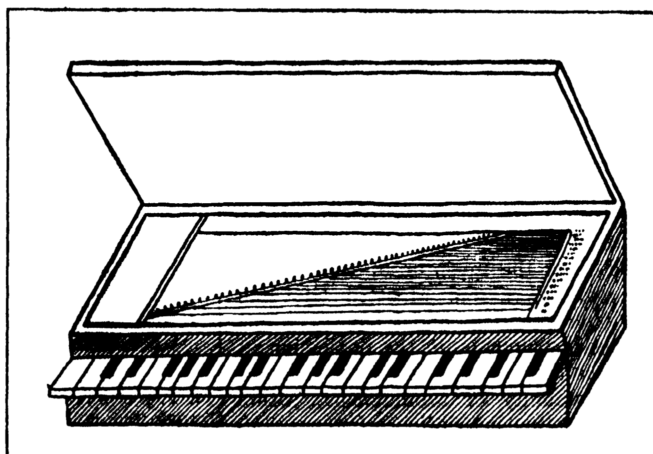

FIG. 6.—VIRDUNG'S CLAVICIMBALUM (SPINET), 1511; REVERSED FACSIMILE WOODCUT

unnoticed by Virdung or by his countryman Arnold Schlick, who, in the same year 1511, published his *Spiegel der Orgelmacher* (Organ-builders' Mirror), and named the clavichordium and clavicimbalum as familiar instruments. In the first place, the keyboard, beginning apparently with B natural, instead of F, makes the clavicimbalum smaller than the virginal, the strings in this arrangement being shorter; in the next place it is almost certain that the Italian spinet compass, beginning apparently upon a semitone, is identical with a "short measure" or "short octave" organ compass, a very old keyboard arrangement, by which the first three notes while appearing to be B, C and C sharp were tuned to G, C and A. The origin of this may be deduced from the psaltery and many representations of the regal, and its object appears to have been to obtain dominant basses for cadences, harmonious closes having early been sought for as giving pleasure to the ear.

Authority for this practice is to be found in Mersenne, who, in 1636, expressly describes it as occurring in his own spinet (*espinette*). We read (*Harmonie Universelle*, Paris, 1636, liv. 3, p. 107)—"Its longest string is little more than a foot in length between the two bridges. It has only thirty-one keys [*marches*] in its keyboard, and as many strings over its sound-board, so that there are five keys hidden [he now refers to the illustration] on account of the perspective—that is to say, three diatonic and two chromatic, of which the first is cut into two; but these sharps serve to go down to the third and fourth below the first step, C *sol* [tenor clef C], in order to go as far as the third octave, for the eighteen principal steps make but an eighteenth, that is to say, a fourth more than two octaves." Mersenne's statement sufficiently proves, first, the use in spinets as well as in organs of what we now call "short measure," and, secondly, the object of divided sharps at the lower end of the keyboard to gain lower notes.

As regards the kind of plectra earliest used we have no evidence. The little crow-quill points project from centred tongues in uprights of wood known as "jacks" (fig. 7), which also carry the dampers, and rising by the depression of the keys in front, the quills set the strings vibrating as they pluck them in passing. J. C. Scaliger in *Poetices libri septem* (1561, p. 51. c. 1.) states that the clavicimbalum and harpichordum of his boyhood were called spinets on account of those quill points (*ab illis mucronibus*), and attributes the introduction of the name "spinetta" to them from *spina*, a thorn, the meaning being extended to any small pointed object such as a quill. We will leave "harpichordum" for the present, but the early identity of "clavicimbalum" and "spinetta" is certainly proved. Scaliger's etymology remained unquestioned until Signor Ponsicchi of Florence discovered another, but less acceptable derivation. He found in a rare book entitled *Conclusione nel suono dell' organo, di D. Adriano Banchieri* (Bologna, 1608), the following passage, which translated reads: "Spinetta was thus named from the inventor of that oblong form, who was one Maestro Giovanni Spinetti, a Venetian; and I have seen one of those instruments, in the possession of Francesco Stivori, organist of the magnificent community of Montagnana, within which was this inscription—*Joannes Spinetvs Venetvs fecit, A.D. 1503.*" Scaliger's and Banchieri's statements may be combined, as there is no discrepancy of dates, or we may rely upon whichever seems to us to have the greater authority, always bearing in mind that neither invalidates the other. In France the word "épinette" still stands for both "spinet" and "chicken-house" which seems to strengthen the first-named theory. A spinet dated 1490 was shown at Bologna in 1888; another old spinet in the Conservatoire, Paris, is a pentagonal instrument made by Francesco di Portalupis at Verona, 1523.

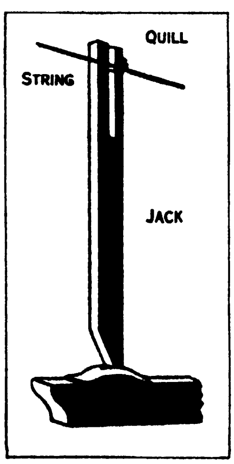

FIG. 7.—SPINET "JACK" Showing the quill which twangs the string on its upward journey, but, being hinged, slides quietly past on its return

The Milanese Rossi were famous spinet-makers, and have been accredited (*La Nobilità di Milano,* 1595) with the recessing of the keyboard, which had previously entirely projected; by this recessing a greater width was obtained for the sound-board. The spinets by Annibale Rosso at South Kensington, dated respectively 1555 and 1577, show this alteration, and may be compared with the older and purer form of one, dated 1568, by Marco Jadra (also known as Marco "dalle spinette," or "dai cembali"). The apparent compass of the keyboard in Italy generally exceeded four octaves by a semitone, E to F; but we may regard the lowest natural key as usually C, and the lowest sharp key as usually D, in these instruments, according to "short measure."

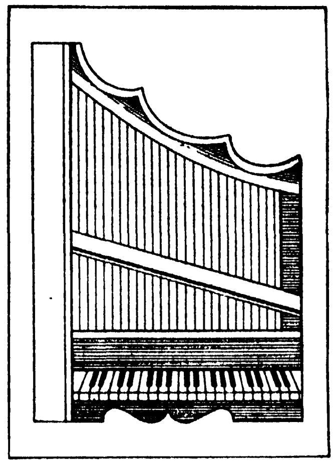

FIG. 8.—VIRDUNG'S CLAVICYTHERIUM (UPRIGHT HARPSICHORD), 1511; REVERSED FACSIMILE WOODCUT

The rectangular spinet, or "virginal," early assumed in Italy the fashion of the large "cassoni" or wedding chests. The oldest we know of in this style, and dated, is the fine specimen belonging to M. Terme which figures in *L'Art decoratif*. Virginal is not an Italian name; the rectangular instrument in Italy is "spinetta tavola." In England, from Henry VII. to Charles II., all quilled instruments (*stromenti di penna*), without distinction as to form, were known as virginals. It was a common name, equivalent to the contemporary Italian *clavicordo* and Flemish *clavisingel*. From the latter we arrive at the French *clavecin* the spinet being simply a "petit clavecin."

Mersenne (*op. cit.*, liv. iii., p. 158) gives three sizes for spinets —one $2\frac{1}{2}$ ft. wide, tuned to the octave of the "ton de chapelle" (a half tone above the present English medium pitch), one of $3\frac{1}{2}$ ft. tuned to the fourth below, and one of 5 ft. tuned to the octave below the first, the last being therefore tuned in unison to the chapel pitch. The octave spinet, of trapeze form, was known in Italy as "ottavina" or "spinetta di serenata." It had a less compass of keys than the larger instrument, being apparently three and two-third octaves, E to C—which by the "short measure" would be four octaves, C to C. These little spinets were placed upon the larger ones in performance and used to heighten the brilliant effect. In the double rectangular clavisingel of the Netherlands, in which there was a movable octave instrument, we recognize a similar intention. There is a fine spinet of this kind at Nuremberg. Praetorius illustrates the Italian spinet by a form known as the "spinetta traversa," an approach towards the harpsichord, the tuning pins being immediately over the keyboard. This transposed spinet, more powerful than the old trapeze one, became fashionable in England after the Restoration, when Haward, Keene, Slade, Player, Baudin, the Hitchcocks, Mahoon, Haxby, the Harrir family, and others made such "spinets" during a period for which we have dates from 1664 to 1784. Pepys

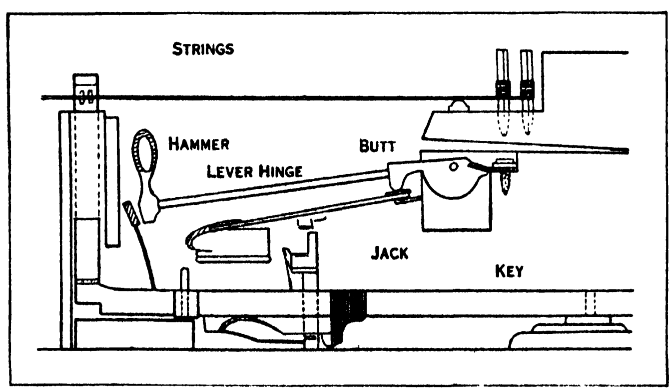

FIG. 9.—CRISTOFORI'S ESCAPEMENT ACTION (1720)
The hinged lever, when struck by the jack, transmits the blow to the butt, thus having the effect of throwing the hammer towards the strings

bought his "Espinette" from Charles Haward for £5, July 13, 1664. Thomas Hitchcock (for whom there are dates 1664 and 1703 written on keys and jacks of spinets bearing Edward Blunt's name and having divided bass sharps) made a great advance in constructing spinets, giving them the wide compass of five octaves, from G to G, with very fine keyboards in which the sharps were inlaid with a slip of the ivory or ebony, as the case might be, of the naturals.

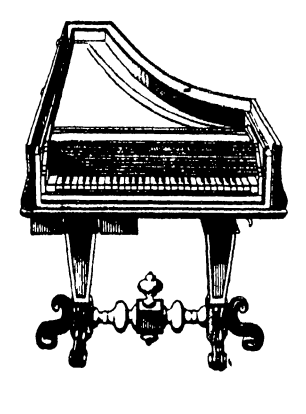

FIG 10—CRISTOFORI'S PIANO E FORTE (1726), KRAUS MUSEUM, FLORENCE

We have now to ask what was the difference between Scaliger's harpichordum and his clavicymbal. Galilei, the father of the astronomer of that name (*Dialogo della musica antica e moderna,* Florence, 1581), says that the harpichord was so named from having resembled an "arpa giacente," a prostrate or "couched" harp, proving that the clavicymbal was at first the trapeze-shaped spinet; and we should therefore differentiate harpichord and clavicymbal as derived from the harp and psaltery respectively

The Latin name "clavicimbalum," having early been replaced by spinet and virginal, was in Italy and France bestowed upon the long harpichord, and was continued as clavicembalo and clavecin Much later, after the restoration of the Stuarts, "harpichord" was accepted and naturalized in England as harpsichord, which we will define as the long instrument with quills, shaped like a modern grand piano. We can point out no long instrument of this kind so old as the Roman cembalo at South Kensington. The outer case is of finely tooled leather. It has a compass of nearly four octaves, E to D, and the natural keys are of boxwood.

The startling "piano e forte" of 1598, brought to light from the records of the house of D'Este by Count Valdrighi of Modena (*see* Van der Straeten, vi., 122), we are disposed to regard, not as an anticipation of Cristofori's subsequent invention of the pianoforte, but as an ordinary cembalo with power to shift by a stop, from two unisons (forte) to one string (piano), at that time a Flemish practice, and most likely brought to Italy by one of the Flemish musicians who founded the Italian school of composition.

About the year 1600, when accompaniment was invented for monody, large cembalos were made for the orchestras to bring out the bass part, the performer standing to play. Such an instrument was called "archicembalo," a name also applied to a large cembalo, made by Vito Trasuntino, a Venetian, in 1606, intended by thirty-one keys in each of its four octaves, to restore the three genera of the ancient Greeks.

Double keyboards and stops in the long cembalo or harpsichord came into use in the Netherlands early in the 16th century We find them imported into England The following citations, quoted by Rimbault in his *History of the Pianoforte,* are from the privy purse expenses of King Henry VIII.

"1530 (April). Item the vj daye paied to William Lewes for ii payer of virginalls in one coffer with iiii stoppes brought to Grenewiche iii. li. And for ii payer of virginalls in one coffer brought to the More other iii. li."

Now the second instrument may be explained ("virginals" meaning any quilled instrument) as a double spinet, like that at Nuremberg by Martin van der Beest, the octave division being movable. But the first cannot be so explained; the four stops can only belong to a harpsichord, and the two pair instrument to a double-manual Again from the inventory after the king's death (*see* Brit. Mus. Harl. MS. 1419) fol. 247—

"Two fair pair of new long Virginalls made harp-fashion of Cipres, with keys of ivory, having the King's Arms crowned and supported by his Grace's beastes within a garter gilt, standing over the keys."

This is probably another double keyboard harpsichord. We read in an inventory of the furniture of Warwick Castle, 1584, "a faire paire of double virginalls," and in the Hengrave inventory, 1603, "one great payre of double virginalls." Hans Ruckers, the great clavisingel maker of Antwerp, lived too late to have invented the double keyboard and stops, evident adaptations from the organ, and the octave string was already in use when he began his work. Until the last harpsichord was made by Joseph Kirkman, in 1798, scarcely an instrument of the kind was constructed, except in Italy, without the octaves. The harpsichord as known throughout the 18th century, with "piano" upper and "forte" lower keyboard, was the invention of Hans Ruckers's grandson, Jean Ruckers's nephew, Jan Couchet, about 1640 Before that time the double keyboards in Flemish harpsichords were merely a transposing expedient, to change the pitch a fourth, from plagal to authentic and vice versa, while using the same groups of keys.

After the Antwerp make declined, London became pre-eminent for harpsichords—the representative makers being Jacob Kirckmann and Burckhard Tschudi, pupils of a Flemish master, one Tabel, who had settled in London, and whose business Kirckmann continued through marriage with Tabel's widow. Tschudi was of a noble Swiss family belonging to the canton of Glarus. According to the custom with foreign names obtaining at that time, by which Haendel became Handel, and Schmidt Smith, Kirckmann dropped his final *n* and Tschudi became Shudi, but he resumed the full spelling in the facies of the splendid harpsichords he made in 1766 for Frederick the Great, which are still preserved at Potsdam By these great makers the harpsichord became a larger, heavier-strung and more powerful instrument, and fancy stops were added to vary the tone effects To the three shifting registers of jacks were added the "lute," the charm of which was due to the favouring of high harmonics by plucking the strings close to the bridge, and the "harp," a muting effect produced by impeding the vibration of the strings by contact of small pieces of buff leather. Two pedals were also used, the left-hand one a combination of a unison and lute.

The right-hand pedal was to raise a hinged portion of the top or cover and thus gain some power of "swell" or crescendo, an invention of Roger Plenius, to whom also the harp stop may be rightly attributed The first idea of pedals for the harpsichord to act as stops appears to have been John Hayward's (?Haward) as early as 1676, as we learn from Mace's *Musick's Monument,* p. 235. The French makers preferred a kind of knee-pedal arrangement, known as the "genouillère," and sometimes a more complete muting by one long strip of buff leather, the "sourdine" As an improvement upon Plenius's clumsy swell, Shudi in 1769 patented the Venetian swell, a framing of louvres, like a Venetian blind, which opened by the movement of the pedal, and becoming in England a favourite addition to harpsichords, was early transferred to the organ, replacing the rude "nag's-head" swell.

To keep his collection of musical instruments in playing order Prince Ferdinand dei Medici engaged a Paduan harpsichord maker, Bartolommeo Cristofori, the man of genius who invented and produced the pianoforte We fortunately possess the record of this invention in a literary form from a well-known writer, the Marchese Scipione Maffei; his description appeared in the *Giornale dei letterati d'Italia,* a publication conducted by Apostolo Zeno. The date of Maffei's paper was 1711. Rimbault reproduced it, with a technically imperfect translation, in his *History of the Pianoforte* We learn from it that in 1709 Cristofori had completed four "gravecembali col piano e forte"—keyed-psalteries with soft and loud—three of them being of the long or usual harpsichord form. The sketch of his action in Maffei's essay shows an incomplete stage in the invention, although the kernel of it—the principle of escapement or the controlled rebound of the hammer—is already there He obtains it by a centred lever (*linguetta mobile*) or hopper, working, when the key is depressed by the touch, in a small projection from the centred hammer-butt The return, governed by a spring, must have been uncertain and incapable of further regulating than could be obtained by modifying the strength of the spring Moreover, the hammer had each time to be raised the entire distance of its fall There are, however, two pianofortes by Cristofori, dated respectively 1720 and

1726, which show a much improved construction, for the whole of an essential piano movement is there. The earlier instrument (now in the Metropolitan Museum, New York) has undergone considerable restoration, but the 1726 one, which is in the Kraus Museum at Florence, retains the original leather hammer-heads. Both instruments possess alike a contrivance for determining the radius of the hopper, and both have been unexpectedly found to have

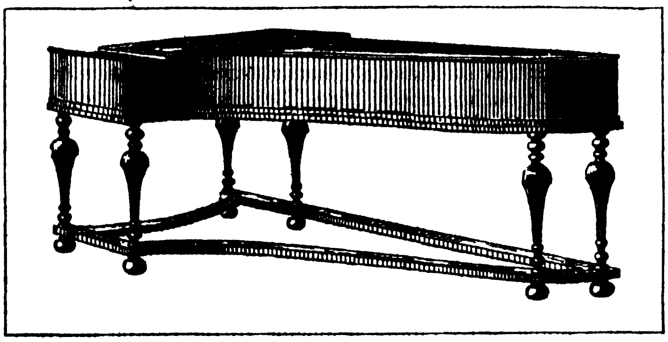

FIG. 11.—SILBERMANN FORTE PIANO (1746), STADTSCHLOSS, POTSDAM

the "check" (Ital. *paramartello*), which regulates the fall of the hammer according to the strength of the blow which has impelled it to the strings.

Thicker stringing, to withstand even Cristofori's light hammers, demanded in its turn a stronger framing than the harpsichord had needed. Accordingly to make his structure firm Cristofori considerably increased the strength of the block which holds the tuning-pins, and as he could not do so without materially adding to its thickness, he adopted the bold expedient of inverting it; driving his wrest-pins, harp-fashion, through it, so that tuning was affected at their upper, while the wires were attached to their lower, ends. Then, to guarantee the security of the case, he ran an independent string-block round it of stouter wood than had been used in harpsichords, in which block the hitch-pins were driven to hold the farther ends of the strings, which were spaced at equal distances (unlike the harpsichord), the dampers lying between the pairs of unisons.

Cristofori died in 1731. He had pupils, but did not found a school of Italian pianoforte-making. The 1711 essay of Scipione Maffei was translated into German, in 1725, by König, the court poet at Dresden, and friend of Gottfried Silbermann, the renowned organ builder and harpsichord and clavichord maker (*see* Dr. Oscar Paul's *Geschichte des Claviers*, Leipzig, 1868). Incited by this publication, and perhaps by having seen in Dresden one of Cristofori's pianofortes, Silbermann appears to have taken up the new instrument, and in 1726 to have manufactured two, which J. S. Bach, according to his pupil Agricola, pronounced failures. The trebles were too weak; the touch was too heavy. There has long been another version to this story, viz., that Silbermann borrowed the idea of his action from a very simple model contrived by a young musician named Schroeter, who had left it at the electoral court in 1721, and, quitting Saxony to travel, had not afterwards claimed it.

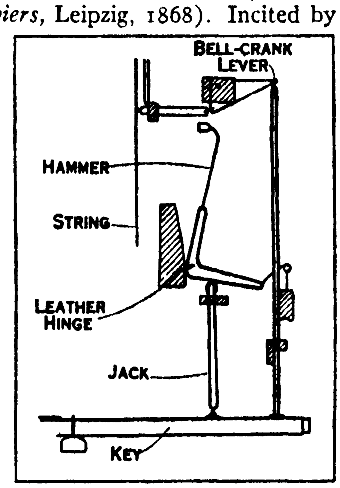

FIG. 12.—FREDERICI'S UPRIGHT GRAND PIANO ACTION (1745)
In the museum of the Brussels Conservatoire. The leather hinge allows the bellcrank lever to convert the upward throw of the jack into a forward motion of the hammer towards the string

Whatever Silbermann's first experiments were based upon, he ultimately adopted Cristofori's pianoforte without further alteration than the compass and colour of the keys and the style of joinery of the case. In the Silbermann grand pianofortes at Potsdam, known to have been Frederick the Great's, and to have been acquired by that monarch prior to J. S. Bach's visit to him in 1747, we find the Cristofori framing, stringing, inverted wrest-plank and action complete. Fig. 11 represents the instrument on which J. S. Bach played in the Stadtschloss, Potsdam.

It has been repeatedly stated in Germany that Frederici, of Gera in Saxony, an organ builder and musical instrument maker, invented the square or table-shaped piano, the "fort bien," as he is said to have called it, about 1758–60. No square piano by this maker is forthcoming, though an "upright grand" piano, made by Domenico del Mela in 1739, with an action adapted from Cristofori's has been discovered by Signor Ponsicchi of Florence. Victor

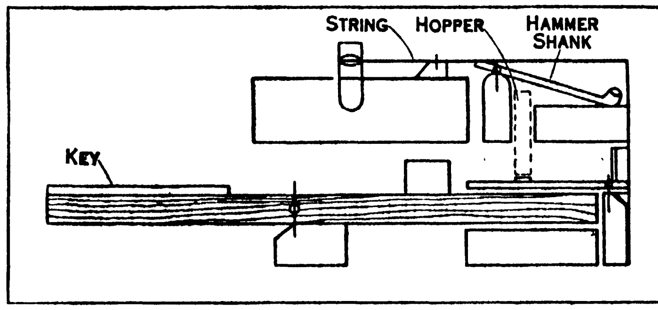

FIG. 13.—SCHROETER'S MODEL FOR AN ACTION (1721): SHOWING THE KEY READY TO LIFT THE HOPPER, AND MAKE IT STRIKE THE HAMMER SHANK

Mahillon of Brussels, however, acquired a Frederici "upright grand" piano, dated 1745. In Frederici's upright grand action (fig. 12) we have not to do with the ideas of either Cristofori or Schroeter; the movement is practically identical with the hammer action of a German clock, and has its counterpart in a piano at Nuremberg; a fact which needs further elucidation. We note here the earliest example of the leather hinge, afterwards so common in piano actions. An attempted combination of harpsichord and pianoforte appears very early. The English poet Mason, the friend of Gray, bought such an instrument at Hamburg in 1755, with "the cleverest mechanism imaginable."

It was only under date of 1763 that Schroeter published for the first time a diagram of his proposed invention, designed more than forty years before. It appeared in Marpurg's *Kritische Briefe* (Berlin, 1764). Now, immediately after, Johann Zumpe, a German in London, who had been one of Shudi's workmen introduced (there is some tradition that Mason had to do with the invention of it) a "square" piano, which was destined to become the most popular domestic instrument. Zumpe was in fact not the inventor of the square piano, which appears to have been well known in Germany before his date, a discovery made by Mr. George Rose. In Paul de Wit's Musical Instrument Museum—formerly in Leipzig, afterwards transferred to Cologne—there is a small square piano by Hildebrandt 27 in. long 10 in. wide and $4\frac{1}{2}$ in high, having a contracted keyboard of 3 octaves and 2 notes. The action of this small instrument is practically identical in every

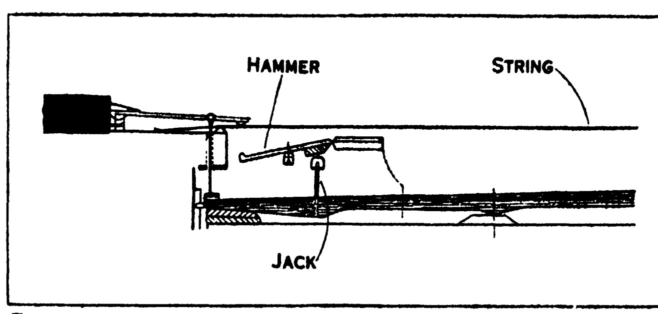

FIG. 14.—ZUMPE'S SQUARE PIANO ACTION (1765): GIVING A DIRECT BLOW WITH THE JACK NEAR THE BUTT END OF THE HAMMER

detail with that of the square pianofortes made much later by Zumpe (Paul de Wit, *Katalog des musikhistorischen Museums*, Leipzig, 1903. No. 55, illustration, p. 38). Inside is inscribed: "Friedrich Hildebrandt, Instrumentenmacher in Leipzig, Quergasse," with four figures almost illegible. Paul de Wit refers the instrument to the middle of the 18th century. It has all the

appearance of being a reduced copy of a well-established type, differing very little from the later models.

Burney tells us all about Zumpe; and his instruments still existing would fix the date of the first at about 1765. Fétis narrates, however, that he began the study of the piano on a square piano made by Zumpe in 1762. In this simple action (fig. 14) we have the nearest approach to a realization of Schroeter's idea. It will be noted that Schroeter's damper (fig. 13) would stop all vibration at once. This defect is met by Zumpe's "mopstick" damper.

Another piano action had, however, come into use about that time or even earlier in Germany The discovery of it in the

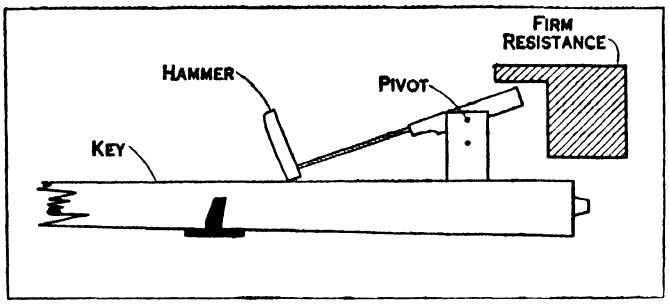

FIG. 15—EARLIEST KNOWN PIANO ACTION ON THE GERMAN PRINCIPLE OF ESCAPEMENT, WHEREBY THE PIVOT RISES WITH THE KEY AND THROWS THE BUTT AGAINST A FIRM RESISTANCE

simplest form is to be attributed to V. C. Mahillon, who found it in a square piano belonging to Henri Gosselin, painter of Brussels (fig. 19). The principle of this action is that which was later perfected by the addition of a good escapement by Stein of Augsburg, and was again later experimented upon by Sebastian Erard Its origin is perhaps due to the contrivance of a piano action that should suit the shallow clavichord and permit of its transformation into a square piano It will be observed that the hammer is, as compared with other actions, reversed, and its pivot rises with the key, necessitating a fixed rail against which the hammer butt strikes. It was Stein's merit to graft the hopper principle upon this simple action; and Mozart's approbation of the invention, when he met with it at Augsburg in 1777, is expressed in a well-known letter addressed to his mother. No more "blocking" of the hammer, destroying all vibration, was henceforth to vex his mind. He had found the instrument that for the rest of his short life replaced the harpsichord. V. C. Mahillon secured for his museum the only Johann Andreas Stein piano which is known to remain. It is from Augsburg, dated 1780, and has Stein's escapement action (fig. 16), two unisons, and the knee pedal.

Mozart's own grand piano, preserved at Salzburg, and the two grand pianos (the latest dated 1790) by Huhn of Berlin, preserved

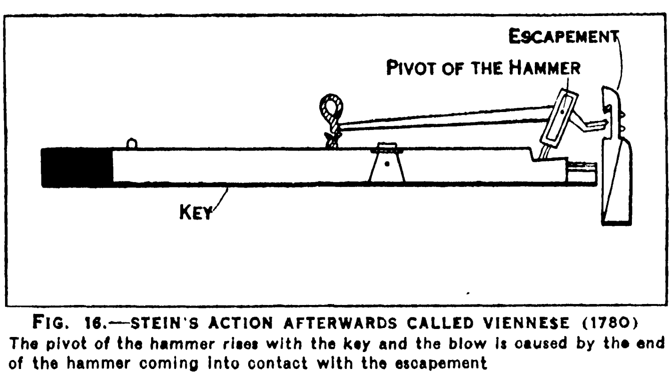

FIG. 16.—STEIN'S ACTION AFTERWARDS CALLED VIENNESE (1780)
The pivot of the hammer rises with the key and the blow is caused by the end of the hammer coming into contact with the escapement

at Berlin and Charlottenburg, follow Stein in all particulars. These instruments have three unisons upwards, and the muting movement known as *celeste*, which no doubt Stein had also. The wrest-plank is not inverted; nor is there any imitation of Cristofori. Stein's instrument was accepted as a model in Berlin as well as Vienna, to which city his business was transferred in 1794 by his daughter Nanette, known as an accomplished pianist and friend of Beethoven, who at that time used Stein's pianos. Streicher, a pianist, who married Nanette, further improved the Viennese instrument, famous for its lightness of touch.

We will quit the early German piano with an illustration (fig. 17) of a square piano action in an instrument made by Johann Gottlob Wagner of Dresden in 1783, and embodying the Cristofori principle rather than the Viennese.

Burney, who lived through the period of the displacement of the harpsichord by the pianoforte, is the only authority to whom

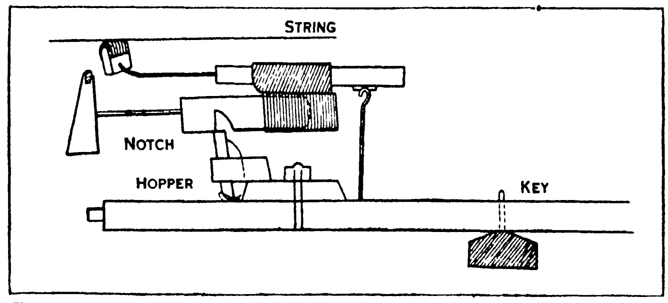

FIG 17.—GERMAN SQUARE ACTION (1783): ESCAPEMENT IS EFFECTED AT THE POINT WHERE THE HOPPER FALLS INTO THE NOTCH PIANO BY WAGNER, DRESDEN

we can refer as to the introduction of the latter instrument into England He tells us without giving the exact date that the first hammer harpsichord that came to England was made by an English monk at Rome, a Father Wood, for an English gentleman, Samuel Crisp of Chesington; the tone of this instrument was superior to that produced by quills, with the advantage of *piano* and *forte* expression so that, although the touch and mechanism were imperfect, yet in a slow movement like the "Dead March" in *Saul* it excited wonder and delight Fulke Greville afterwards bought this instrument for 100 guineas, and it remained unique in England for several years, until Plenius, the inventor of the lyrichord, made a pianoforte in imitation of it In this instrument the touch was better, but the tone was inferior Plenius produced his lyrichord, a *sostenente* harpsichord, in 1745, and Mason imported a pianoforte ten years later Burney further tells us that the arrival in London of J. C. Bach in 1759 was the motive for several of the second-rate harpsichord makers trying to make pianofortes, but with no particular success Of these Americus Backers (d. 1776), said to be a Dutchman, appears to have gained the first place. He was afterwards the inventor of the so-called English action, based upon Cristofori's, and may have made the instrument referred to in an old play-bill of Covent Garden in Messrs Broadwoods' possession, dated May 16, 1767, which has the following announcement —

"End of Act I Miss Brickler will sing a favourite song from *Judith*, accompanied by Mr Dibdin on a new instrument call'd Piano Forte"

Backers's "Original Forte Piano" was played at the Thatched House in St. James's Street, London, in 1773 Ponsicchi has found a Backers grand piano at Pistoria, dated that year.

The escapement lever is suggested by Cristofori's first action, to which Backers added a contrivance for regulating it by means of a button and screw (*see* fig. 18). The check is from Cristofori's second action John Broadwood and Robert Stodart were friends, Stodart having been Broadwood's pupil; and they were the assistants of Backers in the installation of his invention On his deathbed he commended it to Broadwood's care, but Stodart appears to have been the first to advance it—Broadwood being probably held back by his partnership with his brother-in-law, the son of Shudi, in the harpsichord business (The elder Shudi had died in 1773.) Stodart soon made a considerable reputation with his "grand" pianofortes, a designation he was the first to give them. In Stodart's grand piano we first find an adaptation from the lyrichord of Plenius, of steel arches between the wrest-plank and belly-rail, bridging the gap up which the hammers rise These are not found in any contemporary German instruments, but may have been part of Backers's. Zumpe's small square piano had met with great success, he was soon enabled to retire, and his imitators, who were legion, continued his model with its hand stops for the dampers and sourdine, with little change but that

which straightened the keys from the divergences inherited from the clavichord.

John Broadwood took this domestic instrument in hand to improve it, and in the year 1780 succeeded in entirely reconstructing it. He transferred the wrest-plank and pins from the right-hand side, as in the clavichord, to the back of the case, an

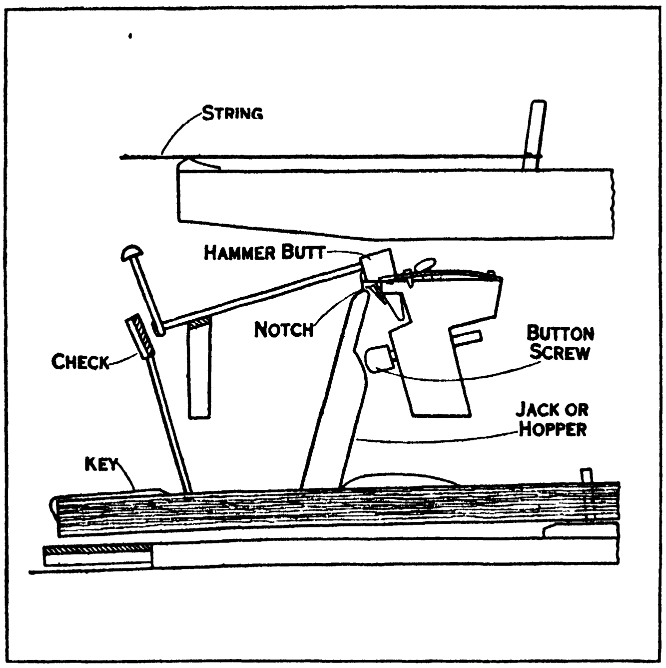

FIG. 18.—GRAND PIANO ACTION (1776). THE "ENGLISH" ACTION OF AMERICUS BACKERS
The button screw throws the jack out of the notch in the butt after making the blow; improved by Messrs. Collard (1835), who reversed the lever and hammer butt

improvement universally adopted after his patent, No. 1379 of 1783, expired. In this patent we first find the soft and sustaining pedals, since universally accepted, but at first in grand pianofortes only. John Geib patented (No. 1571 of 1786) the hopper with two separate escapements, one of which was soon adopted in the "grasshopper" of the square piano, it is believed by Geib himself;

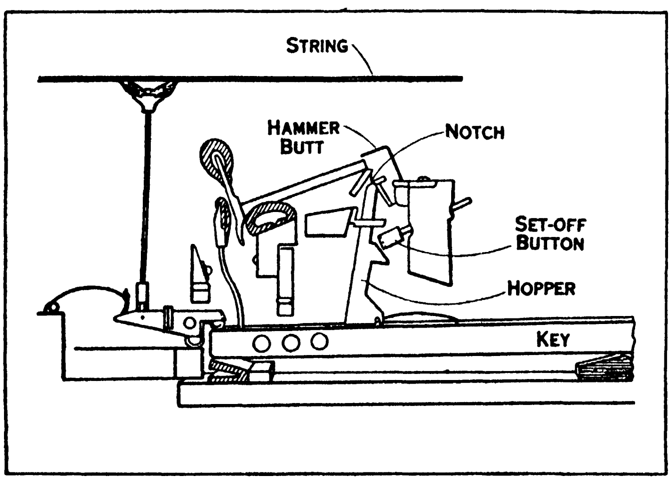

FIG. 19.—BROADWOOD'S GRAND PIANO ACTION (1884). ENGLISH DIRECT MECHANISM
The hopper is thrown from the notch in the butt, by the slanting blow given by the set-off button when the hopper rises

and Petzold, a Paris maker, appears to have taken later to the escapement effected upon the key.

To return to John Broadwood—having launched his reconstructed square piano, he next turned his attention to the grand piano to continue the improvement of it from the point where Backers had left it. He called in the aid of professed men of science—Tiberius Cavallo, who in 1788 published his calculations of the tension, and Dr. Gray, of the British Museum. The problem was solved by dividing the sound-board bridge, the lower half of which was advanced to carry the bass strings, which were still of brass. Even the first attempts to equalize the tension and improve the striking-place were successful in improving the tone greatly. To please Dussek, Broadwood in 1791 carried his five-octave, F to F, keyboard, by adding keys upwards, to five and a half octaves, F to C. In 1794 the additional bass half octave to C, which Shudi had first introduced in his double harpsichords, was given to the piano.

The first square piano made in France is said to have been constructed in 1776 by Sebastian Erard, a young Alsatian. In 1786 he came to England and founded the London manufactory of harps and pianofortes bearing his name. Erard took out his first patent for a "repetition" action in 1808. He did not, however, succeed in producing his famous repetition or double escapement action until 1821; it was then patented by his nephew Pierre Er-

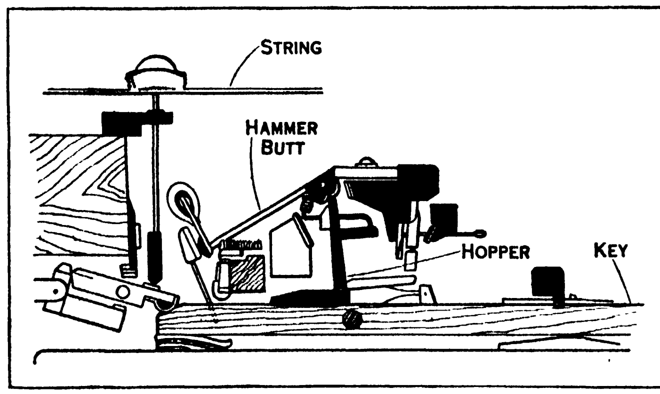

FIG. 20.—COLLARD'S GRAND PIANO ACTION (1884); ENGLISH ACTION, WITH REVERSED HOPPER AND CONTRIVANCE FOR REPETITION ADDED, OPERATING UNDER THE BUTT

ard. When the patent expired in England in 1835 it had proved a loss from the difficulties of carrying out the invention. This induced the House of Lords to grant an extension of the patent.

Erard invented in 1808 an upward bearing to the wrest-plank bridge, by means of agraffes or studs of metal, through holes in which the strings are made to pass, bearing against the upper side. A long brass bridge on this principle was introduced by William Stodart in 1822. A pressure-bar bearing of later introduction is claimed for the French maker, Bord.

The first to see the importance of iron combined with wood (ultimately almost supplanting it) in pianoforte framing was a native of England and a civil engineer by profession, John Isaac Hawkins, known as the inventor of the ever-pointed pencil. He was living at Philadelphia, U.S.A., when he invented and first produced the familiar upright pianoforte—"portable grand" as he then called it. He patented it in America, his father, Isaac Hawkins, taking out the patent for him in England in the same year, 1800.

There had been upright grand pianos as well as upright harpsichords, the horizontal instrument being turned up upon its wider end and a keyboard and action adapted to it. William Southwell, an Irish piano-maker, had in 1798 tried a similar experiment with a square piano, to be repeated in later years by W. F. Collard of London; but Hawkins was the first to make a piano with the strings descending to the floor, the keyboard being raised, and this, although at the moment the chief, was not his only merit. He anticipated nearly every discovery that has since been introduced as novel. His instrument is in a complete iron frame, independent of the case; and in this frame, strengthened by a system of iron resistance rods combined with an iron upper bridge, his sound-board is entirely suspended. An apparatus for tuning by mechanical screws regulates the tension of the strings, which are of equal length throughout. The action, in metal supports, anticipates Wornum's in the checking, and still later ideas in a contrivance for repetition. Southwell appears to have been one of the first to profit by Hawkins's ideas by bringing out the tall cabinet pianoforte, with hinged sticker action, in 1807. All that he could, however, patent in it was the simple damper action, turning on a pivot to relieve the dampers from the strings. The next

steps for producing the short or cottage upright piano were taken by Robert Wornum, who in 1811 produced a diagonally, and in 1813 a vertically, strung instrument. Wornum's improved crank action (fig. 23) was not complete until 1826, when it was patented for a cabinet piano; but it was not really introduced until three years later, when Wornum applied it to his little "piccolo" The principle of this centred lever check action was introduced

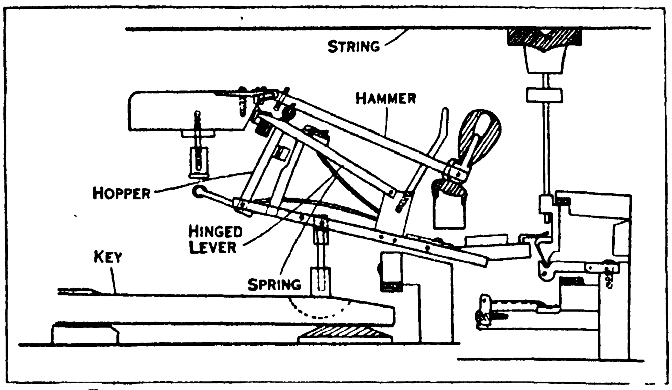

FIG 21—ERARD'S DOUBLE ESCAPEMENT ACTION (1821)
The escapement of repetition is effected by a spring pressing the hinged lever upwards, to allow the hopper which delivers the blow to return into position, before the key has risen again

into Paris by Pleyel and Pape, and thence into Germany and America (Pleyel exhibited a small upright piano in Paris in 1827, but Pierre Erard did not turn his attention to upright pianos until 1831.)

Early in the 19th century William Allen, a young tuner in the employ of the Stodarts, devised a metal system of framing intended primarily for compensation, but soon to become, in other hands, a framing for resistance. His idea was to meet the divergence in tuning caused in brass and iron strings by atmospheric changes by compensating tubes and plates of the same metals, guaranteeing their stability by a cross batoning of stout wooden bars and a metal bar across the wrest-plank Allen consulted Stodart's foreman, Thom; and Allen and Thom patented the invention in January 1820 The firm of Stodart at once acquired the patent

We now arrive at an important epoch in pianoforte construction—the abolition of the wooden construction in favour of a combined construction of iron and wood, the former material gradually asserting pre-eminence. Allen's design is shown in fig 24. The long bars are really tubes fixed at one end only; those

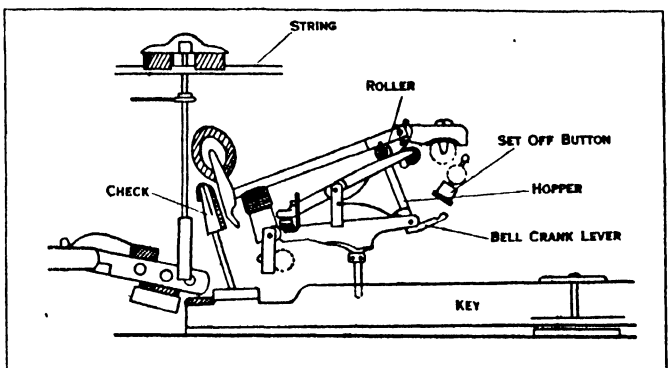

FIG 22.—STEINWAY'S GRAND PIANO ACTION (1884)
The double escapement as in Erard's (fig. 21) but with shortened balance and usual check. The hopper escapes from under the roller owing to the bell-crank lever coming into contact with the set-off button

of iron lie over the iron or steel wire, while those of brass lie over the brass wire, the metal plates to which they are attached being in the same correspondence. At once a great advance was made in the possibility of using heavier strings without danger to the durability of the case and frame In 1821, a fixed iron string-plate, the invention of one of Broadwood's workmen, Samuel Hervé, was applied to one of the square pianos of that firm. The great advantage in the fixed plate was a more even resistance to the tension of the strings and the reduction of their length behind the bridge. Long iron resistance bars were experimented on as substitutes for the wooden bracing by Joseph Smith in 1798; but to James Broadwood belongs the credit of trying them first above the sound-board in the treble part of the scale in 1808, and again in 1818; he did not succeed, however, in fixing them properly. Sebastian and Pierre Erard seem to have been first in the field in 1823 with a complete system of nine resistance bars from treble to bass; with a simple mode of fastening them through the sound-board to the wooden beams beneath James Broadwood, by his patent of 1827, claimed the combination of string-plate and resistance bars, which was clearly the completion of the wood and metal instrument, differing from Allen's in the resistance being fixed Broadwood left the bass bars out, but added a fourth bar in the middle to the three in the treble he had previously used But the weight of the stringing was always increasing, and a heavy close copper covering of the bass strings had become general. The resistance bars were increased to five, six, seven, eight and, as we have seen, even nine, according to the ideas of the different English and French makers who used them in their pursuit of stability.

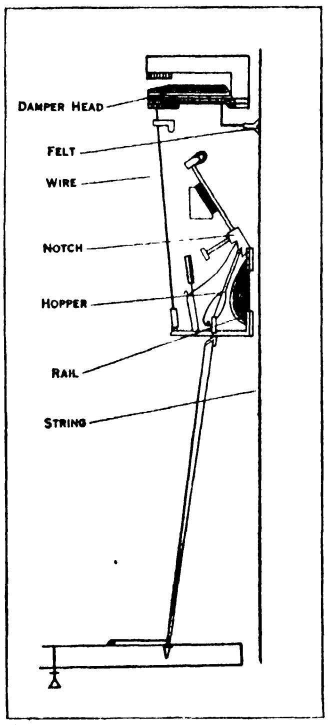

FIG 23—WORNUM'S UPRIGHT ACTION (1826), ORIGINAL OF THE NOW UNIVERSAL ACTION IN UPRIGHT PIANOS
The Hopper in its ascent drove the hammer forward at the same time contacting the rail which threw the upper end of the hopper out of the notch forming what is known as the escapement. Meanwhile the damper-head is raised by the wire, and the felt is taken from the string

A method of fastening the strings on the string-plate depending upon friction, and thus dispensing with "eyes," was a contribution of the Collards, who had retained James Stewart, a man of considerable inventive power, who had been in America with Chickering This invention was introduced in 1827 Between 1847 and 1849 Mr Henry Fowler Broadwood, grandson of John Broadwood, invented a grand pianoforte to depend practically upon iron, in which, to avoid the conspicuous inequalities caused by the breaking of the scale with resistance bars, there should be no bar parallel to the strings except a bass bar, while another flanged resistance bar, as an entirely novel feature, crossed over the strings from the bass corner of the wrest-plank to a point upon the string-plate where the greatest accumulation of tension strain was found After the Great Exhibition of 1851 he employed an ordinary straight bar in the middle of his concert grand scale, his smaller grands having frequently two such as well as the long bass bar After 1862 he covered his wrest-plank with a thick plate of iron into which the tuning pins screw as well as into the wood beneath, thus avoiding the crushing of the wood by the constant pressure of the pin across the pull of the string.

The introduction of iron into pianoforte structure was differently and independently effected in America, the fundamental idea there being to use a single casting for the metal plate and bars, instead of forging or casting them in separate pieces. Alphaeus Babcock was the pioneer of this kind of metal construction. He also cast an iron ring for a square piano in 1825, which, although not a success, gave the clue to a single casting resistance framing, successfully accomplished by Conrad Meyer, in Philadelphia, in 1833, in a square piano which still exists, and was shown in the Paris Exhibition of 1878 Meyer's idea was improved upon by Jonas Chickering (1797–1853) of Boston, who applied it to the grand piano as well as to the square, since which time this prin-

ciple has been universally adopted.

We have now to consider over- or cross-stringing, by which the bass division of the strings is made to cross over the tenor part of the scale—the object being in the first instance to get longer bass strings than are attainable in a parallel scale, and in the next to open out the scale and extend the area of bridge pressure on the sound-board. In the 18th century clavichords were sometimes overstrung in the lowest octave to get a clearer tone in that very indistinct part of the instrument (strings tuned an octave higher being employed). The first suggestion for the overstringing in the piano was made by the celebrated flute-player and inventor Theobald Boehm, who carried it beyond theory in London, in 1831, by employing a small firm located in Cheapside, Gerock & Wolf, to make some overstrung pianos for him. Boehm expected to gain in tone; Pape, an ingenious mechanician in Paris, tried a like experiment to gain economy in dimensions, his notion being to supply the best piano possible with the least outlay of means. Tomkinson in London continued Pape's model, but neither Boehm's nor Pape's took permanent root. The Great Exhibition of 1851 contained a grand piano, made by Lichtenthal of St. Petersburg, overstrung in order to gain symmetry by two angle sides to the case. It was regarded as a curiosity only. Later, in 1855, Henry Engelhard Steinway (originally Steinweg; 1797–1871), who had emigrated from Brunswick to New York in 1849, and had established the firm of Steinway & Sons in 1853 in that city, effected the combination of an overstrung scale with the American iron frame, which exhibited in grand and square instruments shown in London in the International Exhibition of 1862, excited the attention of European pianoforte makers, leading to important results.

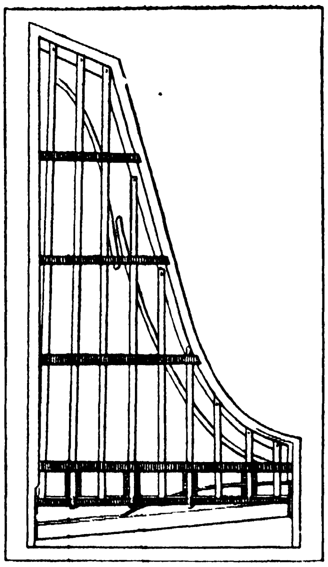

FIG. 24.—ALLEN'S COMPENSATING GRAND PIANO (1820)' THE FIRST COMPLETE METAL FRAMING SYSTEM APPLIED OVER THE STRINGS

It would be inaccurate to say that no outstanding developments have taken place in pianoforte construction during the last fifty years, but few new principles have been discovered, and improvement has taken place almost entirely in the direction of applying in greater and greater measure scientific knowledge to methods and practices previously empirical (*see* PIANOFORTE MANUFACTURE) thus resulting in improvement in tonal volume and purity.

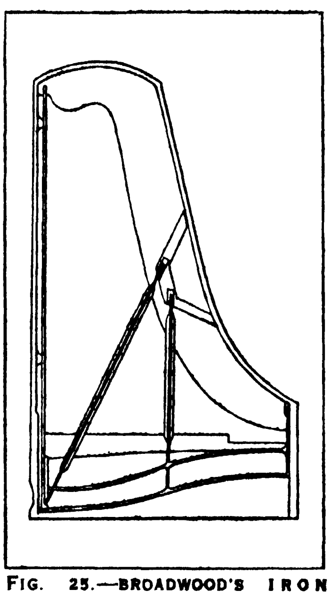

FIG. 25.—BROADWOOD'S IRON GRAND PIANO (1884), HAVING COMPLETE IRON FRAME WITH DIAGONAL RESISTANCE BAR

Summing up matters it may be said that the modern pianoforte retains six important characteristics of the clavichord, in that it has an independent sound-board (*i.e.*, the ends of the strings are not fastened to it), dampers to prevent vibration of the strings not in use, "listing" cloth to deaden the vibration from the ends of the strings beyond the bridges, groups of three strings tuned in unison and a tone production which depends upon a blow instead of a plucking (as in the spinet and harpsichord).

Five of the ideas developed in the harpsichord have also survived or have been revived from time to time, namely, the sustaining pedal, the celeste felt for soft playing, the transposing keyboard, the soft stop for practising very quietly, and the double manual (viz., as recently introduced by Emanuel Moór).

As regards the sustaining pedal the importance of this cannot be over-estimated, for not only does it allow of harmonies being maintained when necessary without holding the keys down, but it also modifies the tone quality by allowing all strings to take part simultaneously by means of their resonance. Moreover the sound-board is encouraged to increase its amplitude of vibration, thus increasing the tonal volume, which in skilful hands can be made to reach a maximum intensity of over twenty times that of the most powerful harpsichord. Contrariwise, the tone can be attenuated and diminished by means of the soft pedal, which brings the hammers nearer the strings, or (as in the case of grand pianos) shifts the hammers so that they strike two instead of three strings. The "celeste" pedal and "soft stop" devices both involve the introduction of a strip of felt between the strings and the hammers at the point of contact, thus reducing the force of the blow. For school pianos, used for practising almost continuously throughout the day, the soft stop is a most useful adjunct and when properly designed need not interfere unduly with the touch of the instrument.

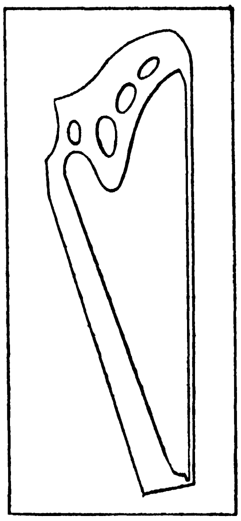

FIG. 26.—MEYER'S METAL FRAME FOR A SQUARE PIANO (1833)

The transposing device, in turn, is now becoming popular on player pianos, which are being increasingly used for accompaniment purposes. It is obviously a great advantage to be able to suit the requirements of any particular voice in this way and the means of doing so are easily provided. In the ordinary instrument on the other hand it is difficult to keep transposing devices in perfect order owing to the necessity for shifting the keys relative to the action, a movement which upsets the delicate regulation of the repetition, and renders the device unsatisfactory.

Finally, the double keyboard, as invented by Emanuel Moór, represents a really important development, extending the resources of both performer and composer to an astonishing degree. Such a revolutionary departure will doubtless take time to become commercially possible, but the most weighty musical opinion is entirely in its favour. Briefly stated, the second keyboard lies just behind and above the normal standard notes, and operates those strings which are an octave higher. Consequently it is possible to play extended chords, arpeggios and double octaves with great facility. There is also an octave coupler which further increases the possibilities of the instrument from the point of view of volume. To what extent the principle will ever secure general adoption it would be rash to prophesy, but as to its ingenuity and musical value there is no room for doubt.

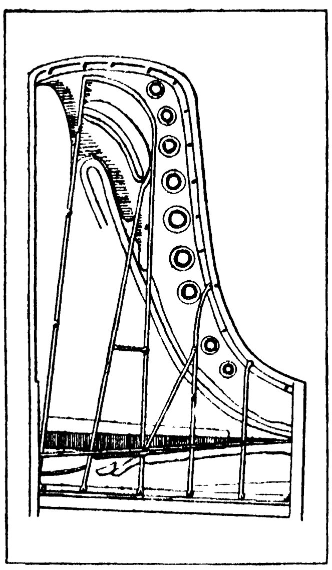

FIG. 27.—STEINWAY'S GRAND PIANO (1884), A METAL FRAMING IN A SINGLE CASTING AND OVERSTRUNG

The principles discovered in the early actions (Erard 1821 and Robert Wornum 1826) still stand firm, and all subsequent improvements have been built thereon. The separate parts of the modern action are produced by automatic machinery, and assembled by hand with great skill and accuracy. The pianoforte

manufacturer has long recognized the advisability of allowing this important component to be made for him by specialists, the hammers and hammer shanks being fitted after the action has been installed.

Present-day development is towards a greater tonal volume without altering the weight or depth of touch, any increase in which is a serious handicap to the virtuoso. The sound-board is made as sensitive as possible, supported in a rigid frame-work which absorbs little or no energy from the board at its edges. The modern sound-board sustains a continual down-pressure from the strings of nearly half a ton, whereas the early grand pianos had scarcely a hundred-weight pressure thereon. The string tension has tripled (from 60 to 180 lb. per string in some instances) with the ability of the wire drawers to supply stronger and stronger wire, and the iron founder has had to devise castings which stand a total stress of 16 tons and upwards without occupying too much room, or covering too large a portion of the surface of the sound-board. Some early makers had the mistaken idea that an iron structure entailed the production of a "metallic" tone in the instrument; but those who adhered to the use of the wooden frame were soon left behind, mainly owing to the extreme susceptibility of the pitch of such pianos to temperature and humidity changes, which rendered the tuning very unstable.

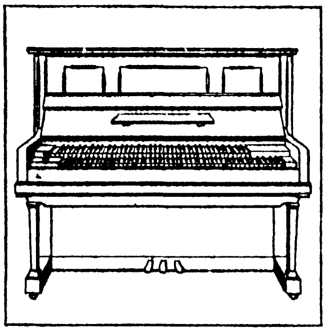

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FIG. 28.—A WEBER PIANO SHOWING THE EMANUEL MOÓR DUPLEX COUPLER KEYBOARD

As regards the future, one of the most interesting of the possible further developments which have been mooted is the electrical agitation of the strings so as to secure a sustained tone instead of one which rapidly diminishes after the moment of impact. In Germany experiments are being made with quarter-tone scales, which may or may not develop a new technique for composers and performers, but the standard key-board of to-day has such a wide range of frequencies (from 27 to 4,176 vibrations per second) that it is unlikely that it will be superseded for many years to come. (A. J. H.; K. S.; S. A. H.)

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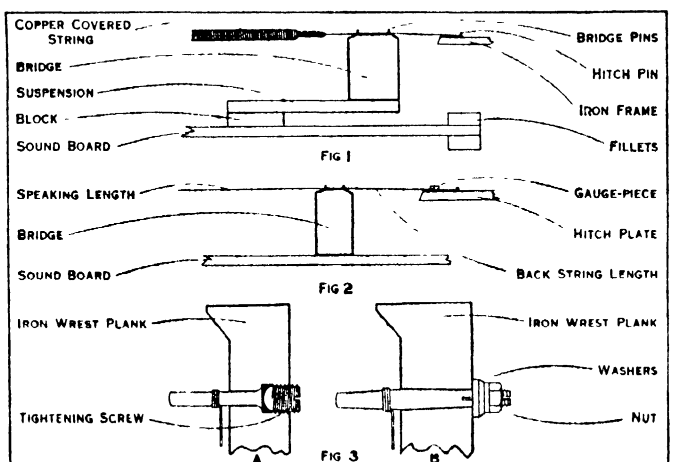
PIANOFORTE MANUFACTURE. There are eighty-eight notes in the full compass keyboard of the pianoforte, which gives a range of 7¼ octaves. The fifty-second note from the bass end of the scale is called "Pitch C," and serves as the standard from which all the others are tuned. Since each note has to vibrate twice as fast as the note of the same name an octave below, and there are twelve semitones to the octave, it follows that the semitone ratio from note to note must be the twelfth root of 2, namely 1·05946, which is a geometrical progression giving the now generally adopted "equal temperament" tuning. Purely mathematical considerations make it essential that the string lengths should also proceed in geometrical progression, but in a slightly smaller octave ratio than 2:1. In Germany the ratio most favoured is 1·875:1, and in Great Britain 1·89:1. Both of these ratios approximately allow of half-size increases in the gauge of wire used,



FIGS. 1, 2 & 3.—METHODS OF CONNECTING STRINGS TO SOUNDBOARD
1. Connecting of bass bridge to a sensitive part of the soundboard, 2. Slight dip of string after leaving bridge on its way to hitch-plate, 3. Two methods of avoiding the use of wooden-plank in extreme climates. (A) the screw pushes wrest-pin forward and holds it friction-tight, (B) the pin is held in a tapered hole by a nut

twice per octave, without departing far from the uniform tension initially decided upon. The English Music Wire Gauge advances one-thousandth of an inch in diameter per half size, while the New Westphalian Gauge advances 0·025 millimetre per half size, but there are irregularities in the English Gauge at various places, for reasons apparently unknown.

In small instruments, whether grands or uprights, it is impossible to carry theoretical string lengths throughout the piano, and compromises have to be made by shortening and thickening them in order to maintain the necessary high tension. Since short

and thick strings give a different and inferior tone quality it must not be expected that small instruments will give a pure and balanced "timbre" throughout the scale.

Cold drawn steel wire of the highest quality is specially made for the pianoforte industry, with a breaking strength of about 150 tons per square inch. Three types are now in favour, the polished, the plated and the rust-resisting. The last has been successfully developed, and is especially useful for export models.

Length of Strings.—In practice the strings of the 88th note are always between 5·0 and 5·5 centimetres in length, the shorter length being used for small instruments. From this starting point the succeeding lengths are calculated mathematically until it becomes necessary to employ heavier strings weighted by means of one or two layers of copper wire closely and tightly spun upon them. In order to gain in length and to fix the bridge to a sensitive part of the sound-board, well away from its edges, about fifty of the bass strings (12 singles and 19 bichords) are planned to cross over the others, reaching to a separate and higher bridge. This method of "overstringing" is now general in all but the cheapest pianos. The lengths of the copper-covered strings are not calculated mathematically but are made so that the lowest note is as long as possible. Additional length is often secured by means of a "suspended" bridge, as shown in fig. 1, which transmits the vibrations of the bridge to a point which should be at least six inches from the edge of the sound-board.

It has been found that a tension of about 160 lb. is advisable for the uncovered strings, and the diameter of wire is calculated from the formula $\frac{\sqrt{18,600\,T}}{nl}$, after which the nearest gauge to this diameter is selected, it being impracticable to manufacture a different diameter for each note. In the formula, "n" is the number of vibrations per second, "T" the tension in lb., and "l" the length of the vibrating portion of the string, in centimetres.

For the copper-covered strings some makers employ the formula $\frac{\sqrt{20,000\,T}}{nl}$, which gives the all-over diameter of the required string. Others calculate the weight per centimetre instead of the diameter, using the formula $\frac{111,250\,T}{n^2l^2}$, afterwards spinning strings of the required weight, as found by experimental determinations. For bichord bass strings a considerable increase of tension is provided, varying from 10 to 15%, and for the single bass strings a further increase of 15% and upwards, according to the size of the instrument.

The Sound-board.—As the strings vibrate they transmit pressure differences to the bridge attached to the sound-board (the bridge at the other end being as rigid as possible). The large area of the sound-board is thus set in motion, and this in turn agitates the air in its immediate vicinity, the aim being to provide a sensitive and extremely elastic board, capable of reproducing the most complicated wave-forms, with as little loss of energy as possible. In addition, the board must be made of material of low density and of uniform texture. The timber of the spruce family (*Picea excelsa*), where cut "on the quarter," answers all these requirements, the best qualities transmitting sound-waves along the grain at the rate of 16,000 feet per second and upwards. The transmission across the grain is about one-fourth of this speed, a difficulty which is surmounted by gluing bars of the same material across the back of the board at right angles to the grain. The Grotrian-Steinweg sound-boards are called "homogeneous," which means that the material selected has as far as possible the same closeness of grain all over its surface. This timber became known as "Swiss Pine," but is not botanically a pine. In America sound-boards are made of another timber of the same family, *Picea alba,* and a darker coloured wood of similar texture, *Abies pectinata,* is also used.

Most sound-boards are made with the grain running diagonally so that the long bridge runs almost parallel to the grain. The thickness is usually about $\frac{3}{8}''$ all over, some manufacturers insisting, however, that the treble end should be thicker. There is some theoretical evidence in favour of this, but in practice it is difficult to discover any difference. Sound-boards are always fitted so that they are slightly "bucked" or high in the middle, as though part of the surface of a sphere of about sixty feet radius. This shape is secured in several ways, perhaps the best being to subject the board to a dry temperature of 110 degrees Fahrenheit for some hours, and then to glue on the bars which have been planed to a slight curve. The subsequent expansion as the board takes up its usual ten per cent of moisture from the air produces the desired curvature. Since the board is always under pressure from the strings it follows that it behaves as an arch, which shape is retained through the rigidity of the rim to which it is fixed.

The "Down-bearing."—Good contact is maintained between strings and bridge by leaving the bridge a little higher than the general level of the two extremities. The resulting pressure of the strings on the sound-board is known as the "down-bearing," the regulation of which is one of the most critical processes in pianoforte manufacture. It is agreed that about one-fortieth of the tension is a suitable amount for each string to press upon the bridge. Translated into degrees this means that the bridge must stand high enough to allow the string to dip one and a half degrees after it passes over the bridge on its way to the hitch-pin on the iron frame. Allowance has to be made for the fact that as the tension is applied the whole board is pressed down somewhat, and the amount of such sinking depends upon its dimensions, barring and support round the edge. The extra height is not measured at the bridge, but by means of a straightedge laid across where the string will pass, the amount of clearance at the hitch-pin is allowed for. (*See* fig. 2.) It does not matter so much what the exact pressure is, but inequalities of pressure cause very serious results, affecting those strings which lie between places of excessive pressure, and robbing them of their adequate contact with the bridge. Good contact between strings and bridge is also maintained by means of bridge-pins which lie in the line of the strings and are inserted at an angle of 70 degrees with the plane of the bridge. By passing the string to the left of the front pin and to the right of the back pin a frictional grip is secured. This practice is almost universal, the only outstanding departure being Messrs. Broadwood's method of screwing studs to the bridge and passing the strings through these. Previous efforts to provide a studded bridge have been discarded owing to the studs working loose and causing falseness of tone, but Messrs. Broadwood claim to have overcome this difficulty.

Tone and Overtones.—Pianoforte tone is compound, each note consisting of a fundamental tone and its overtones, which, sounding together, form the "harmonic series," with their vibration rates in the ratio of 1:2:3:4, etc. For instance, the tone of "middle C" has for harmonics the following notes, the frequencies of which are inserted in brackets: C (261), C (522), G (783), C (1,024), E (1,305), G (1,566), B♭ (1,827), C (2,088), D (2,349) and so on. If these notes be played together as a chord it will be at once detected that the harmonics blend together pleasingly, with the exception of the seventh and ninth which are dissonant. By striking the strings at one-eighth of their length from the fixed end, it is believed that the best tone quality is produced, whether by discouraging the 7th and 9th harmonics or by encouraging the 4th is not yet scientifically proved. This strike proportion is used for all notes from the bass up to "pitch C," after which other considerations make it necessary to strike the string gradually nearer the end, the fraction at the extreme treble being empirically decided upon at about $\frac{1}{16}$. Since the discordant harmonics of these notes are very weak and even beyond the limits of human audition it does not matter if they are produced, the striking point being arranged to allow of a quicker recoil of the hammer from the string.

Toning the Hammers.—The process known as "toning" the hammers is an attempt to control the time of contact between hammer and string, a soft hammer staying long enough to damp out some of the partial tones, while a hard-nosed hammer accentuates them. If a string vibrates a thousand times per second, its "periodic time" is one-thousandth of a second, and experimental evidence proves that the best tone is emitted if the hammer is toned so that contact is maintained for about half this

period. English felt is used wherever the highest quality is required, its resiliency being second to none. Great pressure is used in modern hammer-making and the density at the treble end where the hammer dimensions are small, is more than double that of the bass hammers. The toner, by means of pricking the felt, lessens the hardness beneath the nose of the hammer, without disturbing it at the actual point of contact. In this he is entirely guided by his ear, the aim being to eliminate undesirable tone components and secure an evenly graded scale, with no audible break between the treble and bass strings.

The Action.—The hammers are actuated by a system of levers known as the "action," which is now made by firms specialising in this unit alone, rather than by the piano manufacturer himself. The noses of the hammers rest at a distance of two inches from the strings, but if a note is held down after having been played, the hammer is "checked" when it has rebounded five-eighths of an inch, so that the blow can be repeated rapidly. When the key is half-way down, the felt "damper" is lifted from the strings and remains lifted until the key is released

Pedals.—The tone is modified by means of two pedals, the left-hand pedal taking the hammers nearer to the strings and thus decreasing the force of the blow Sometimes the whole action is shifted to the right, so that the hammer only strikes two strings instead of three The right-hand pedal lifts all the dampers from the strings so as to sustain harmonies as long as required, and not merely for increased power. In America a central pedal is often added, called the "Sostenuto," which, instead of lifting all the dampers, affects only those which happen to be already lifted, keeping them so until the pedal is released Thus one is able to sustain a chord, leaving the hand free for other notes

The ideal point of contact for the dampers is at the same place as the striking point, and in grand pianos this is approximately arranged, the dampers lying along the strike line above the strings, and operated by gravity only In upright pianos a position just under the strike line is favoured, such actions being known as "under-damper," and the pressure obtained by springs The cheaper piano is sometimes provided with an older type wherein the damper is operated by gravity at a point just above the hammers This is known as the "over-damper" action, and although the vibrations of the strings are of less amplitude above the hammer-line than below it, a well-made over-damper action is still in favour by certain Continental makers of repute, owing to its more effective silencing of the harmonics

Touch.—The depth of touch for the keys has been standardised in all countries at 9 millimetres, with an additional millimetre to allow of the locking of the check and the free escapement of the "Jack" lever The pivoting of the key has to be so placed as to give the correct amount of lift at the other end, usually about 6 millimetres, but varying a little with the different makes of action The best "touch" is secured if the keys slope backwards a little when at rest, becoming exactly level when half depressed At this point begins the extra load due to the lifting of the dampers, but the momentum already gained is sufficient to render it unnoticeable A "touch weight" is used during the regulating of the action, so that when it is placed upon the end of the key, and suddenly released, the force exerted is just sufficient to make the note sound faintly. This "dead weight" of touch is not standardised, but averages 90 grammes in the bass, down to 60 grammes in the treble.

Frame.—The iron frame, which takes most of the load exerted by the pull of the 220 strings, is cast in one piece at the foundry, from an iron pattern which has been made 1 per cent larger than the finished frame, in order to allow for the contraction of the casting during cooling

Tuning Pins.—The tuning pins of mild steel, about 7 millimetres in diameter, are driven into a wrest-plank of quartered beech or maple, sometimes of ply construction to prevent splitting. The holes are bored slightly smaller than the pins, a ratio of 15:17 giving the correct amount of tightness. Since the plank is bolted to the iron frame and glued to the wooden back it follows that the load is shared between the frame and the back, the tendency in modern construction being to eliminate the wooden back altogether. The wrest-plank is often covered with a web of iron into which maple plugs have been driven, the tuning pins passing through these plugs into the plank. This method has proved very efficient and is being increasingly adopted in both upright and grand pianos. Patent methods of securing the tuning-pins have been introduced from time to time, but the method above described remains, and would seem likely to survive, being both efficient and free from complications

For tropical climates, an all-metal wrest-plank has proved its worth, the wrest-pins being held "friction tight" from the back of the plank Fig 3 shows an Australian and a German method of providing sufficient hold for the pin, at the same time allowing it to be adjusted finely by the tuner. In order to prevent the two surfaces from rusting together, a very fine grade of graphite is used as a lubricant The washers have a projection which fits into a slot running down the threaded portion of the pin, which ensures that they move with it during all adjustments.

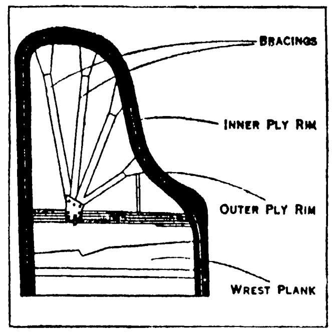


FIG 4—STEINWAY GRAND CASE-WORK, SHOWING PARTS

Standardisation.—The similarity in methods and design of the leading manufactures in all countries is accounted for by the necessity for standardisation of the keyboard, its height from the floor, the provision of room for the knees, the situation of the pedals, and the natural laws controlling the vibration of stretched strings In the upright piano the wooden back forms a convenient base to which the ends of the case are glued, besides being the means for securing rigidity for the edges of the sound-board and a support for both iron frame and wrest-plank

The peculiar form of the grand piano enables an immensely strong inner rim to be built up in one continuous bend, into which bracings are dove-tailed, and to which the key-bottom (supporting the key-board) is secured This inner rim, on which the sound-board and iron frame are fastened, may be six inches deep, and from $1\frac{1}{4}''$ to $1\frac{1}{2}''$ thick Additional rigidity is further provided by gluing this unit to an outer rim, also of ply formation, about a foot deep and from $1''$ to $1\frac{1}{4}''$ thick. The skeleton formation of the case-work of a large Steinway grand is shown in fig. 4, but it must be remembered that the lateral stiffness of such a structure varies inversely as the cube of its length, and therefore small grands do not need such elaborate re-inforcement, the very smallest (4 ft 3 in to 4 ft 6 in in length) often having no bracings at all. (S A. H)

See the BIBLIOGRAPHY under PIANOFORTE, also *Grove's Dictionary of Music and Musicians* (1927–28)

PIANOLA: *see* PLAYER-PIANO

PIANOSA (anc *Planasia*), an island of Italy, belonging to the province of Leghorn, and forming part of the commune of Campo nele 'Elba, from which it is 11 m S W Pop. (1921) 908 As its name indicates, it is quite flat, and the highest point is only 95 ft. above sea-level. Its area is 6 sq m The discovery of numerous fossilized bones of animals show that it was still united to the mainland in the quaternary period. Traces of human habitation in the neolithic period have been found. Augustus banished to it his grandson, Agrippa Postumus, and some ruins of baths near the harbour still bear his name It was depopulated in 1553 by the Turkish fleet, and only resettled in 1835.

PIARISTS, the popular name of a Catholic educational order, the "clerici regulares scholarum *piarum*," the Pauline Congregation of the Mother of God, founded by Joseph of Calasanza at Rome in the beginning of the 17th century Here he organized, in 1607, a brotherhood which ultimately, in 1617, became an independent Congregation, numbering at that time fifteen priests, under Calasanza as their head To the three usual vows they added a fourth, that of devotion to the gratuitous instruction of youth In 1622 the Congregation received a new constitution from Gregory XV., and had all the privileges of the mendicant

orders conferred upon it. The Piarists, who are not numerous, are found chiefly in Italy, Spain, the West Indies, Germany and Austria.

BIBLIOGRAPHY.—*See* M. Heimbucher, *Orden und Kongregationen* (1897) ii. 271; articles by O. Zöckler in Herzog-Hauck's *Realencyklopädie für protestantische Theologie* (1904), vol. xv.; C. Kniel in Wetzer und Welte's *Kirchenlexikon* (1895), vol. ix. and art. "Piarists" in the *Catholic Encyclopaedia.*

PIAROAN, an independent linguistic stock of South American Indians, named from the Piaroas, one of its most important tribes. The Piaroan tribes live in the region of the Venezuelan-Colombian border, along the Orinoco river between the Sipapo and the Matabeni, and on the course of the latter river, the Zama and lower Vichada. The Piaroas are described as a forest rather than a river people, using bark canoes constructed for temporary purposes only. Their houses are communal, and are circular and conical in shape, built of thatch. They are agricultural, using manioc as their main food and but little maize.

See J. Chaffanjon, *L'Orenoque et le Caura* (Paris, 1889); A. von Humboldt, *Personal Narrative of Travels to the Equinoctial Regions,* etc. (London, 1818).

PIASTRE, a monetary unit of Turkey, and also of Egypt, 100 piastres making one Turkish or Egyptian pound. The piastre itself is a silver coin containing 1·203 grammes of silver, 830 fine, in Turkey, and 1·4 grammes, 833 fine, in Egypt.

PIATRA (Neamtu), the capital of the department of Neamtu, Rumania, situated on the left bank of the river Bistrita, where it cuts a way through the Carpathian foothills. Pop. (1921) 26,000. A branch railway passes through the town, and at Bacau meets the main Czernowitz-Galatz line. The church of St. John's (or the Prince's) monastery was founded in 1497 by Stephen the Great. There are saw-mills and textile factories in Piatra, which has a considerable trade in wine and timber, and is also a popular summer resort. Neamtu is one of the most densely forested regions in Moldavia.

PIATTI, CARLO ALFREDO (1822–1901), Italian violoncellist, was born at Bergamo on Jan. 8, 1822. He was the son of a violinist, and became a pupil at the conservatorio of Milan. From 1838 onwards he journeyed over Europe, playing with extraordinary success in all the important cities of the Continent. In 1894 the fiftieth anniversary of his first appearance in London was celebrated by a reception given in honour of him and his lifelong friend Joachim. He retired from public life, owing to a severe illness, in 1897, and until his death at Bergamo on the 19th of July 1901 divided his time between his native town and Cadenabbia.

PIAUHY or **PIAUHI,** a north-eastern State of Brazil, bounded north and west by Maranhão, east by Ceará, Pernambuco and Bahia, and south by Bahia. It has a few miles of Atlantic coast-line on the north, and the Rio Parnahyba forms the boundary line with Maranhão throughout its entire length. Area, 94,795 sq.m.; pop. (1920) 609,003. Part of the State on the Atlantic coast and along the lower Parnahyba is low, swampy and malarial. South of this the country rises gradually to a high plateau with open *campos.* This plateau region is drained by numerous tributaries of the Parnahyba, chief of which are the Urussuhy, the Canindé and its tributary the Piauhy, the Gurgueia and its tributary the Parahim, which drains the large inland lake of Parnaguá, the Longa, and the Poty, which has its source in the State of Ceará. The Parnahyba is navigable for boats of 3 ft. draught up to Nova York, a few miles above the mouth of the Gurgueia. The climate is hot and humid in the lowlands and along the lower Parnahyba, but in the uplands it is dry with high sun temperatures and cool nights. The principal industry is stock-raising, which dates from the first settlement in 1674 by Domingos Affonso Mafrense, who established here a large number of cattle ranges. A secondary industry is the raising of goats. The agricultural products are cotton, sugar and tobacco. Much cotton is grown, and some of it manufactured. Forest products include rubber, carnauba wax and dye-woods. The exports include hides, skins, rubber, wax, tobacco and cotton. The capital is Therezina, on the right bank of the Parnahyba, 250 m. above Parnahyba (town), with which it is connected by a line of light-draught river boats. The town dates from 1852, is attractively situated, and is regularly laid out with broad, straight streets crossing each other at right angles. The population of the *Municipio* in 1920 was 57,500 which includes a large rural district. Other *municipios* with their populations in 1920, are Oeiras (24,563), founded in 1718 under the name of Moxa; Amarante (15,844); Valença (34,742); and Campo Maior (17,992).

PIAVE, a river in Italy, which played an important part in the latter period of the World War on the Italian front. It rises under the Paralba pass in the Carnic Alps and flows in a south-westerly direction past Belluno as far as Feltre and then turns to the south-east, flowing into the sea at Cortellazzo to the north-east of Venice, with another, older mouth nearer to Venice. Its course is 220 km. in length. Its depth and width vary very considerably according to the seasons of the year, a fact which had an important bearing on the operations along its banks. In its lower reaches its bed is a vast extent of gravel only filled in times of heavy rains or at the melting of the snows. After the Austro-German break-through at Caporetto in October 1917, the remains of the Italian II. army and all the III. fell back on the Piave between Pederobba and the sea and were reconstituted behind that river. The Austrians made repeated attempts to cross the river in the Nov. and Dec. battles, but were eventually driven back on to the left bank. For a time some British troops held a sector of the Piave front, but they were afterwards transferred to the Asiago plateau. On June 15, 1918 the Austrians delivered a general attack along the greater part of the Italian front, known as the battle of the Piave, their object being to break through into the rich agricultural area of the Veneto. They concentrated their attacks on the sector between Falzè di Piave and Nervesa (opposite the Montello hill, rising along the right bank), and on that between the Grave di Papadopoli, a gravel covered island in the river, and Musile. Two Austrian forces succeeded in getting across and occupied half of the Montello and some other points, but were forced by Italian counter-attacks to recross the Piave, after suffering heavy losses. Later an Italian local attack resulted in the conquest of the area between the old and the new Piave near the estuary. In Oct. 1918 an Italian offensive on a large scale was effected. The battle, which takes its name from Vittorio Veneto, east of the Piave, began on October 23, but did not extend to the Piave until the 27th. On that day a small mixed Italian force crossed the river near Valdobbiadene and a part of the X. army also crossed the Piave at the Grave di Papadopoli (this army, commanded by the earl of Cavan, comprised two British divisions). The bridges of the VIII. army were swept away by the current and the regiments which had got across were isolated, and as the British forces which had crossed were not strong enough to outflank the Austrians on the dominant position of San Salvatore, Gen. Caviglia, commander of the VIII. army, sent his XVIII. corps across on the British bridges; while that corps advanced up the river the British pushed east towards the Monticano; thus by the 29th the Austrian forces on the Piave were cut in half. On the 30th the bulk of the Italian attacking forces were across the river and the Austrians in full retreat.

PIAZZA ARMERINA, a city of Sicily, in the province of Caltanisetta, 43 m. W. of Catania; 2,360 ft. above sea-level. Pop. (1921) 27,479 (town), 38,406 (commune). It has a 16th-century cathedral, with a fine Norman campanile, and some of the houses and churches show Norman or Gothic architecture. The town was founded in the 12th century, and the inhabitants are of Lombard origin, and still speak a dialect of their own.

PIAZZI, GIUSEPPE (1746–1826), Italian astronomer, was born at Ponte, in the Valtellina, on July 16, 1746. He discovered, on Jan. 1, 1801, the first asteroid or minor planet, to which he gave the name of Ceres. He died at Naples on July 22, 1826.

See B. E. Maineri, *L'Astronomo Giuseppe Piazzi* (Milan, 1871); R. Wolf, *Biographien,* Bd. iv. p. 275; *Monatliche Correspondenz* (1810; portrait), xxi. 46; *Astr. Jahrbuch,* liv. 218; *Bulletin des sciences* (1826), vi. 339; *Edin. Journal of Science* (1827), vi. 193; *Memoirs Roy. Astr. Soc.* iii. 119; R. Grant, *Hist. Phys. Astronomy,* pp. 238, 510, 549.

PIBRAC, GUY DU FAUR, SEIGNEUR DE (1529–1584), French jurist and poet, was born at Toulouse. He studied law there with Jacques Cujas, and afterwards at Padua. In 1548 he

was admitted to the bar at Toulouse, and rose to be *juge-mage,* an office in Languedocian cities about equal to that of *prévôt.* He was selected in 1562 as one of the three representatives of the king of France at the council of Trent. In 1565 he became general advocate to the parlement of Paris, and extended the renaissance in jurisprudence which was transforming French justice. In 1573 he was sent by Charles IX. to accompany, as chancellor, his brother Henry (afterwards Henry III.) to Poland, of which Henry had been elected king. He was employed in negotiations with the so-called *politiques,* whom he managed to keep quiet for a while. In 1578 he became the chancellor of Marguerite of France, queen of Navarre. He died in 1584 He was the friend of Ronsard, de Thou and L'Hôpital, and left, among other literary remains, elegant and sententious *quatraines.*

PICA, the European representative of a group of diminutive rodent mammals, also known as tailless hares, mouse-hares, or piping hares, constituting the family *Ochotonidae* with the single genus *Ochotona.* From the more typical hares and rabbits they differ by the short and rounded ears, the absence of a tail, the shorter hind-limbs, and by complete collar-bones. The soles of the feet are hairy, and the fur is soft and thick. Picas are inhabitants of cold and desert regions. They dwell in the chinks between rocks, or in burrows, although one Himalayan species frequents pine-forests. They are very active, and most of the species utter a piping or whistling cry They store up a supply of grass for winter use. The Himalayan *roylei* may be seen in the daytime, but most kinds are nocturnal. The Siberian species, *O. alpina,* ranges into eastern Europe, but Central Asia is the headquarters, although a few species range into Arctic America and the Rocky Mountains. In size picas may be compared to guinea-pigs. There are several extinct genera.

See Rodentia, also J. L. Bouhote, "The Mouse-hares of the genus *Ochotona,*" *Proc Zool. Soc.* (London, 1905).

In printing pica is a type in size smaller than "English" and bigger than "Small pica." It is also known as 12 point The following passage is printed in pica:

Types are of various sizes, and the sizes are classified according to the dimensions of their "ems" or bodies.

"Pica" is the common standard of measurement in printing offices. The unit is a single letter of pica type called an "em."

PICARD, JEAN (1620–1682), French astronomer, was born on July 21, 1620, at La Flèche, Anjou. After acting as prior of Rillé, Anjou, for some years, he went to Paris and was admitted to the Academy of Sciences as an astronomer in 1666. In 1671 he went to examine Tycho Brahe's observatory, Uraniborg, in Denmark, and returned with some of the originals of Tycho's work Picard's measurement between Mahoisine and Amiens provided the first accurate measure of a degree of a meridian, and was used by Newton to verify his theory of gravitation. Picard founded *La Connaissance des Temps* in 1679, and edited it until his death on July 12, 1682.

His works are published in the 6th and 7th vols of the *Memoires* of the Academy of Sciences.

PICARD, LOUIS JOSEPH ERNEST (1821–1877), French politician, was born in Paris on Dec. 26, 1821, and joined the Parisian bar. In 1871 he accompanied Jules Favre to Versailles to arrange the capitulation of Paris, and in February he became minister of the interior in Thiers's cabinet. Attacked both by the Monarchist and the Republican press, he resigned in May. Later in the year he was sent as ambassador to Brussels On his return to Paris in 1873 he resumed his seat in the Left centre, and in 1875 became life senator. He died in Paris on May 13, 1877

PICARDY, an old province of France, bounded north by Hainaut and Artois, on the east by Champagne, on the south by the Île de France, and on the west by Normandy and the English channel. Its maritime frontier ran from the mouth of the Aa to the cliffs of Caux, and it included the whole of the basin of the Somme and part of that of the Oise. The chief towns of Picardy were Amiens, Boulogne, Abbeville, Laon, Soissons, Montreuil, Péronne, Beauvais, Montdidier, St. Quentin and Noyon. Its principal rivers were the Somme and the Oise. Picardy formed part of the archdiocese of Reims. Its bishoprics were Amiens, Beauvais, Senlis, Soissons, Noyon and Laon, and it contained the ancient abbeys of Corbie, St. Valéry and St. Riquier. In 1789 the province of Picardy was covered by the three bishoprics of Amiens, Noyon and Boulogne It was one of the provinces of the five great *fermes.* Its area now forms the department of the Somme and parts of the departments of Pas de Calais, Aisne and Oise.

The name of Picardy does not appear until the 13th century. At that time the province was divided into the two bailliages of Amiens and Vermandois, but its regular organization as part of the kingdom of France only dates from the beginning of the 16th century, when it was divided into north and south Picardy. North Picardy, or Picardy proper, formed one of the great military governorships of the kingdom, while south Picardy was included in the Île de France.

Under the Romans, Picardy was part of *Belgica secunda;* it was inhabited by the Morini, the Ambiani, the Veromandui, the Bellovaci and the Suessiones, whose names still appear in Amiens, Vermandois, Beauvais and Soissons. In the 5th century Picardy became the centre of Merovingian France Clovis had his first capital at Soissons; Charlemagne had his at Noyon, and Laon was the capital and the refuge of the later Carolingian sovereigns

During the later feudal period Picardy was the home of the counts of Vermandois, of Clermont and of Ponthieu, the sire of Coucy, and others The dukes of Burgundy were anxious to annex Picardy, in 1435, by the famous treaty of Arras, the royal towns and lands in the valley of the Somme were ceded by King Charles VII. to Burgundy. However, after the death of Charles the Bold in 1477 Picardy was finally united with the crown of France. The province was early an industrial district. Flemish immigrants brought with them the lucrative trade of weaving cloth, and the Somme towns were soon competing with those of Flanders. The Picard towns were noted for their love of independence, which often brought them into collision with the kings of France during the 13th century. At a later time the province received a number of Spanish immigrants. In the middle ages the Picards formed one of the four "nations" recognized in the organization of the University of Paris.

See A Labourt, *Essai sur l'origine des villes de Picardie* (Amiens 1840), P. N Grenier, *Introduction à l'histoire générale de la province de Picardie* (Amiens, 1856), and H. Carnoy, *Littérature orale de la Picardie* (1883).

PICARESQUE NOVEL, THE. This special form of the *roman d'aventures* may be defined as the prose autobiography of a real or fictitious personage who describes his experiences as a social parasite, and who satirizes the society which he has exploited The picaroon, or rogue type, is represented by Encolpios Ascyltos and Giton in the *Satyricon,* which tradition ascribes to Petronius; it persists in Lucian, in the *Roman de Renart,* in the *fabliaux* and in other works popular during the middle ages But in its final form the picaresque novel may be regarded as a Spanish invention The word *picaro* is first used, apparently, in a letter written by Eugenio de Salazar at Toledo on April 15, 1560; the etymology which derives *picaro* from *picar* (to pick up) is unsatisfactory to philologists, but it suggests the picaroon's chief business in life. A connection with French *picoreur* (*praedator*) is possible The earliest application of the expression *picaro* to a character in fiction occurs in Mateo Alemán's *Guzmán de Alfarache* (1599) But a genuine *novela picaresca* existed in Spain before the word *picaro* became generally current

Spanish Examples.—The earliest specimen of the kind is *La Vida de Lazarillo de Tormes y de sus fortunas y adversidades* an anonymous tale long attributed, on insufficient grounds, to Diego Hurtado de Mendoza (*q v*) The authorship of this brilliant book and the circumstances of its publication are obscure however, it was certainly issued not later than 1554 (in three editions), and was thrice reprinted before 1559, when it was placed on the Index. Imitations of so successful a story were inevitable, and as early as 1555 there appeared at Antwerp *La segunda parte de Lazarillo de Tormes,* an anonymous seque

which completely misinterpreted the irreverent wit of the original. The first part had been prohibited because of its attacks on the clergy; in the second part the hero is presented as a devout youth transformed into a tunny. Another sequel, by Juan de Luna, was published at Paris in 1620. Meanwhile, many surreptitious copies of the first part were introduced into Spain; the Inquisition finally gave up the attempt to suppress it, and in 1573 an expurgated edition was authorized. In 1599 Mateo Alemán (*q.v.*) published the *Primera parte de Guzmán de Alfarache.* It is modelled upon *Lazarillo de Tormes,* being the autobiography of the son of a ruined Genoese money-lender; but the writer indulges in a tedious series of moralizings This contrasts sharply with the laconic cynicism of *Lazarillo de Tormes;* but *Guzmán de Alfarache* is richer in invention, in variety of episode and in the presentation of character Its extraordinary popularity tempted a Valencian lawyer named Juan José Martí to publish a *Segunda parte de la vida del pícaro Guzmán de Alfarache* (1602) under the pseudonym of Mateo Luján de Sayavedra; but in 1604 Alemán brought out the true continuation A third part, written in Spanish by the Portuguese Felix Machado de Silva, Marques de Montebilo, was first printed in 1927. The *Viaje entretenido* (1603) of Agustín de Rojas is a realistic account of the writer's experiences as a strolling actor and playwright, and, apart from its considerable literary merits, it is an invaluable contribution to the history of the Spanish stage as well as a graphic record of contemporary low life.

The next in chronological order of the Spanish picaresque tales is *La Pícara Justina* (1605), the history of a woman picaroon, which it has long been customary to ascribe to Andrés Pérez, a Dominican monk; there is, however, no good reason to suppose that the name of Francisco López de Ubeda on the title-page is a pseudonym. The *Pícara Justina* has wrongly acquired a reputation for indecency; its real defects are an affected diction and a want of originality. The *Pícara Justina* is now read solely by philologists in quest of verbal eccentricities. Gines de Pasamonte, one of the secondary figures in *Don Quixote* (1605–15), is a singularly vivid sketch of the Spanish rogue, and in the comedy entitled *Pedro de Urdemalas* Cervantes again presents a brilliant panorama of picaresque existence He returns to the subject in *Rinconete y Cortadillo* and in the *Coloquio de los perros,* two of the best stories in the *Novelas ejemplares* (1613). In the *Viaje del mundo* (1614) the zealous missionary Pedro de Cevallos interpolates amusing tales of what befell him in the slums of Andalusia before he fled from justice to America In *El Pasajero* (1617) Cristóbal Suárez de Figueroa fills in the sketch of the knavish innkeeper already outlined by Cervantes in *Don Quixote* Evidence of the widely diffused taste for picaresque literature is found in *Enríquez de Castro* (1617), a story in Spanish by the Frenchman François Loubayssin de Lamarca

The roving instinct of Vicente Martínez Espinel (*q v*) had led him into strange and dangerous company before and after his ordination as a priest, and his *Relaciones de la vida del escudero Marcos de Obregón* (1618) is remarkable for a baffling compound of fact with fiction written in the lucid style of which Espinel was a master; it was largely utilized by Le Sage in *Gil Blas.* Within five months of its publication at Madrid a fragmentary French version by the Sieur d'Audiguier was issued at Paris, and at Paris also there appeared a Spanish picaresque story entitled *La desordenada codicia de los bienes ajenos* (1619), ascribed conjecturally to a certain Dr. Carlos García, who reports his conversation with a garrulous gaol-bird, and appends a glossary of slang terms used by the confraternity of thieves Every kind of picaroon is portrayed with intelligent sympathy by Alonso Jerónimo de Salas Barbadillo, who is always described as a picaresque novelist; yet he so constantly neglects the recognized conventions of the Spanish school that his right to the title is disputable. Thus in *La Hija de Celestina* (1612) he abandons the autobiographical form, in *El subtil cordobés Pedro de Urdemalas* (1620) he alternates between dialogue and verse, and in *El Necio bien afortunado* (1621) the chief character is rather a cunning dolt than a successful scoundrel. The pretence of warning newcomers against the innumerable occasions of sin in the capital is solemnly kept up by Antonio Liñan y Verdugo in his *Guía y avisos de forasteros que vienen a la corte* (1620), but in most of his tales there is more entertainment than decorum.

An unusual gravity of intention is visible in Jerónimo de Alcalá Yañez y Ribera's *Alonso, mozo de muchos amos* (1624–26), in which the repentant *pícaro* Alonso, now a lay brother, tells the story of his past life to the superior of the monastery in which he has taken refuge.

At about this time there lived in Spain an ex-nun named Catalina de Erauso, who fled from her convent, dressed herself in men's clothes, enlisted, was promoted ensign and saw more of life than any other nun in history. Her adventures arrested the attention of De Quincey, who would seem to have read them in a Spanish original which has been admirably translated since then by the French poet José Maria de Heredia. The Spanish original, in its existing form, was issued no earlier than 1829 by Joaquín María de Ferrer, whose character is not a satisfactory guarantee of the work's authenticity, but its interest is unquestionable. No such suspicion attaches to the *Vida* of Alonso de Contreras, first published in 1899, in which every convention of the picaresque novel is faithfully observed, and the incidents are no doubt substantially true, though this ex-captain, like most converts, judges his own past with unnecessary harshness This subtle form of vanity also pervades the *Comentarios de el desengañado de sí mismo* of Diego Duque de Estrada, a rakish soldier and inferior dramatist whose autobiography (begun in 1614 and continued at intervals during many years) was not printed till 1860. A far higher order of talent distinguishes the *Capitulaciones de la vida de la corte y oficios entretenidos en ella,* a bitterly unsparing review of picaresque life written by the great satirist Francisco Gómez de Quevedo y Villegas (*q v*). These thumbnail sketches were the preparatory studies worked up into the more elaborate *Vida del buscón Don Pablos* (1626), the cleverest and most revolting book of its class

The *Varia fortuna del soldado Píndaro* (1626) added nothing to the established reputation of Gonzalo de Céspedes y Meneses Alonso de Castillo Solórzano (*q v*) tempted the public with three picaresque stories published in quick succession: *La Niña de los embustes, Teresa de Manzanares* (1634), the *Aventuras del Bachiller Trapaza* (1637) and a sequel to the latter entitled *La Garduña de Sevilla* (1642). But the style was no longer welcomed with the old enthusiasm in Spain The *Bachiller Trapaza* was destined to be continued by Mateo da Silva Cabral in Portugal and to be exploited by Le Sage who likewise utilized in *Gil Blas* episodes taken from *El Siglo pitagórico* (1644), the work of Antonio Enríquez Gómez (*q v*). The primitive rogue returns to the scene in *La Vida y hechos de Estebanillo González* (1646) Le Sage drew upon him in the *Histoire d'Estevanille González.*

Outside Spain.—Meanwhile, the rogue had forced his way into other European literatures. The Antwerp continuation (1555) of *Lazarillo de Tormes* brought the original to the notice of northern readers, and this first part was translated into French by Jean Saugrain in 1560, a new edition being called for in the following year. A Dutch version was issued anonymously in 1579, and it seems extremely likely that the book had been translated into English before this date.

The first known edition of David Rowland's version of *Lazarillo de Tormes* is dated 1586, but as a licence to print a translation of this tale was granted on July 22, 1568–69, it is probable that a 1576 edition which appears in the Harleian catalogue really existed. Numerous reprints (1599, 1639, 1669–70, 1672, 1677) go to prove that *Lazarillo de Tormes* was very popular, and that Shakespeare had read it seems to follow from an allusion in *Much Ado about Nothing* (Act. II, sc. i.): "Now you strike like the blind man; 'twas the boy that stole your meat, and you will beat the post." To Thomas Nash belongs the credit, such as it is, of being the first to write a picaresque novel in English: *The Unfortunate Traveller; or the Life of Jack Wilton* (1594). Nash led the way, and a reference to "Spanish pickaroes" in Middleton's *Spanish Gipsie* indicates that the picaroon type had speedily become familiar enough for London playgoers to understand the reference. Interest in picaresque literature was kept alive in

England by James Mabbe's admirable version (1622) of *Guzmán de Alfarache;* by *The Son of the Rogue or the Politic Thief* (1638), an anonymous translation, done through the French, of *La desordenada codicia;* and by another anonymous translation (1657), likewise done through the French, of Quevedo's *Buscón.* The result of this campaign was *The English Rogue described in the Life of Meriton Latroon, a witty Extravagant* (1665), by Richard Head and Francis Kirkman.

It is not till Defoe's time that the English picaresque novel acquires any real importance. There is a female picaroon in *Moll Flanders,* and, as Defoe read Spanish, it is conceivable that Moll Flanders was suggested by the *Pícara Justina;* but this resemblance does not make a picaresque novel of *Moll Flanders.* The satirical spirit which is lacking in *Moll Flanders* is abundantly present in *Colonel Jack,* which bravely aims at exhibiting "vice and all kinds of wickedness attended with misery." Henceforward the picaroon is naturalized in English literature, and is gloriously reincarnated in Fielding's *Jonathan Wild* and in Smollett's *Ferdinand, Count Fathom.*

The Dutch translation of *Lazarillo de Tormes* (1579) did not enable the picaresque novel to strike root in Holland, yet from it is derived one of the best Dutch comedies, *De Spaensche Brabander Jerolimo* (1616) of Gerbrand Bredero. A German translation of *Guzmán de Alfarache* was published by Aegidius Albertinus in 1615; both *Lazarillo* and *Rinconete y Cortadillo* were translated by Niclas Ulenhart in 1716, and in 1627 there appeared an anonymous version of the *Pícara Justina* The Spanish tradition was followed by Martin Frewden in a continuation (1626) of *Guzmán de Alfarache,* but the only original picaresque novel of real value in German is Grimmelhausen's *Simplicissimus.* The attempt to acclimatize the picaresque novel in Italy failed completely.

The first translation of the *Novelas ejemplares* was published at Paris in 1618 by Rosset and d'Audiguier; and French translations of *Guzmán de Alfarache,* of *Marcos de Obregón,* of *La Desordenada codicia,* of the *Buscón* and of the *Pícara Justina* were printed in 1600, 1618, 1621, 1633 and 1635 respectively. Scarron frankly mentions Castillo Solórzano's *Garduña de Sevilla* in the *Roman Comique* (1651), and his *Précaution inutile* and *Les Hypocrites* are convincing proofs of close study of Spanish picaresque stories. the *Précaution inutile* is taken from *Guzmán de Alfarache,* and *Les Hypocrites* is merely a translation of Salas Barbadillo's *Hija de Celestina.* The *Roman bourgeois* (1666) of Antoine Furetière is generally described as a picaresque novel, but it is concerned with the foibles of the middle class rather than with the sly devices of common vagabonds.

The Spanish picaroon lives again in *Gil Blas,* where, with a dexterity almost rarer than original genius, a master of literary manipulation fuses materials unearthed from forgotten and seemingly worthless Spanish quarries. Gil Blas is a creation of the gentler, sunnier French spirit, like Beaumarchais's Figaro he is a Spaniard born, reared and humanized in Paris, and these two are the only picaroons whose relative refinement has not been gained at the cost of verisimilitude. But the old original scoundrel was not yet extinct. in the interval between the appearance of the *Barbier de Séville* and the *Mariage de Figaro* Restif de la Bretonne produced a sequel (1776) to the *Buscón*—a sequel so dull as to be wellnigh unreadable. The untamed Spanish rogue had become impossible towards the end of the 18th century: in the 19th he was deliberately rejected when Théophile Gautier wrote his *Capitaine Fracasse.* Yet Gautier conscientiously provides a Spanish atmosphere. *Capitaine Fracasse* is the last important book which continues the picaresque tradition But picaresque fiction can never be exhausted while human nature is unchanged. Pereda (*q.v.*) in *Pedro Sánchez* (1884) touches the old theme with the accent of modernity; and the *pícaro* flourishes afresh in the novels of Baroja.

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(J. F.-K ; X)

PICASSO, PABLO (1881–). The initiator of Cubism in modern painting He was born on Oct. 23, 1881, at Malaga, in Spain. His father was an artist and professor at the Academy at Barcelona, and under him Pablo received his first lessons in art. After many visits to Paris, he settled there in 1903 Though a Catalan by birth, he developed his art in France, where he became one of the leaders of the Post-Impressionist school

His early work displays a clear contour, a carefully planned space arrangement, and plastic modelling in cool, greenish-grey tones, almost monochrome One might trace therein the influence of Daumier and of Toulouse-Lautrec Like the latter, he chose the subject matter of his pictures from the life of the circus, and from the morbid side of life in a big city, and he rendered with intense sincerity of feeling the strained and sad look of young soubrettes of Montmartre, of acrobats and harlequins He thus, from the beginning, followed a line distinct from that of Matisse and his Fauvist following, who took pleasure in colour and flat patterns, as such, and who never entirely broke with the traditions of Impressionism. To this early period are. "La Famille Soler" (1903), a rhythmically composed family group; "l'Aveugle" (1903), archaic in the delineation of form; "La Boule" (1905), a composition with two acrobats

The Cubistic formula was gradually evolved by Picasso and Georges Braque, between 1906 and 1910, while studying the composition of still life groups consisting mainly of bowls with fruit, bottles, glasses, and musical instruments It was Braque who first introduced into his designs nails and bits of printed paper, delighting in the harmonious distribution of certain black letterpress on white paper Picasso then added pieces of wood and other tangible objects, which led to a form of art where sculpture and painting were combined.

During Picasso's earlier Cubist period, the surfaces of his canvases were delicately toned in brown or grey by dots in pointillist fashion displaying some constructive design—mainly abstract, though here and there realistic fragments of recognizable objects were introduced. The gradations of light and dark suggested shading and space. At a later period this three dimensional element disappeared; colour notes were introduced and the design formed a purely two dimensional pattern

The artist did not seek to imitate form, but to create form As opposed to the Impressionist pre-occupation with the rendering of ever-changing and superficial appearances, he wished to make images, which, by the clearness of their structure, should convey an idea of life and reality Carrying his convictions to the logical extreme, he discarded all resemblance to natural form, and endeavoured to create a purely abstract language of form—a visual music Thus, though these pictures may seem to most of us theoretic abstractions, the artist tried to convey a deep reality. "For reality alone, even when concealed has power to arouse emotion." In these realistic and mystical conceptions he shows himself a true son of Spain

After 1918, Picasso again based his pictures on natural form His paintings became magnificently plastic and monumental His clear, incisive outline drawings are executed with forcible directness and with rigid economy of means

Picasso's inventive gift, which led him from one experiment to another, inspired many followers. Painters such as Metzinger, Gleizes, Leger, Villon, and sculptors such as Archipenko and Lipschitz, to name only a few, followed in his wake. He was one of the first to appreciate the weird expressiveness of negro sculpture; his style led to an appreciation of "significant form" and of con-

structive design in all branches of art. He became the paramount influence in modern art, besides Cézanne, who is sometimes claimed as the initiator of the Cubist movement; though the great artist of Aix, with his intense feeling for nature, would probably have disowned this offspring.

Picasso's influence was also felt on the stage. He himself produced a series of designs for curtains, scenery and costumes for certain Russian ballets. The history of his collaboration with Jean Cocteau and Erik Satie in the ballet *Parade* (1917) is told by Cocteau in *Le coq et L'Arlequin* (English trans. 1921). Other ballets for which he produced designs were *Tricorne* (1920), *Cuadro Flamenco*, an Andalusian dance (1921), and *Pulcinella* (1926). In the creation of these artistic ensembles his great qualities as a designer, the unlooked for beauty of his harmonies, his astonishing audacities, stand him in good stead.

The most representative collection of his later work is in the possession of G. F. Reber, Lausanne. The best early works are with Lotte von Mendelssohn Bartholdy in Berlin. Other important works are with Paul Rosenberg, Paris; A. Flechtheim, Düsseldorf, and with the Barnes Foundation, Philadelphia.

Picasso illustrated several books, notably André Salmon, *Le Manuscrit trouvé dans un chapeau*. He executed portrait drawings of contemporary writers and musicians such as Stravinsky, J. Cocteau, M. Jacob, Apollinaire, A. Salmon, etc. He also etched several plates.

See Guillaume Apollinaire, *Les Peintres Cubistes* (1912); Max Raphael, *Von Monet zu Picasso* (Munich, 1922); Leone Rosenberg, *Cubisme et Tradition* (1920); Maurice Raynal, *Picasso* (1921); André Salmon, *L'Art Vivant* and *Picasso* (1920). (I. A. R.)

PICAYUNE, the name in Florida and Louisiana of the Spanish half-real = $\frac{1}{16}$ of a dollar, $6\frac{1}{4}$ cents, and hence used of the United States 5 cent piece; from the French *picaillon*, an old copper coin of Piedmont, and possibly related to the Italian *piccolo*, little, small. In America the word is used of anything trifling or contemptible.

PICCININO, NICCOLO (1386–1444), Italian *condottiere*, born at Perugia. He served under the Visconti of Milan in campaigns against Francesco Sforza from 1425 to 1444.

PICCINNI, NICCOLA (1728–1800), Italian composer, was born at Bari, Naples, on Jan. 16, 1728. He was educated under Leo and Durante, at the Conservatorio di Sant' Onofrio in Naples. His first opera, *Le Donne dispettose*, was produced in 1755, and in 1760 he composed, at Rome, *La Cecchina, ossia la buona Figliuola*, an *opera buffa* which attained a European success. It was followed by many others, one of which, also an opera buffa, *Il Viaggiatori* (Naples 1774), had nearly as great a success as *La Cecchina*. In 1776 Marie Antoinette invited him to Paris. He had married in 1756 his pupil Vincenza Sibilla, a singer, whom he never allowed after her marriage to appear on the stage. All his next works were successful; but, unhappily, the directors of the Grand Opéra conceived the mad idea of deliberately opposing him, apparently against his will, to Gluck, by persuading the two composers to treat the same subject—*Iphigénie en Tauride*—simultaneously. The Parisian public now divided itself into two rival parties, which, under the names of Gluckists and Piccinnists, carried on an unworthy and disgraceful war. Gluck's *Iphigénie* was first produced on May 18, 1779. Piccinni's *Iphigénie* followed on Jan. 23, 1781, and, though performed seventeen times, was soon forgotten. Of the works of Piccinni's Paris period the best is *Didon* (1783), which kept the stage for half a century. In 1789, after the outbreak of the French Revolution, Piccinni returned to Naples, where he was at first well received by King Ferdinand IV.; but the marriage of his daughter to a French democrat brought him into irretrievable disgrace. For nine years after this he maintained a precarious existence in Venice, Naples and Rome; but he returned in 1798 to Paris, where a small place was found for him at the Conservatoire. He died at Passy, Paris, on May 7, 1800.

See P. L. Ginguené, *Notice sur la vie et les ouvrages de Niccola Piccinni* (Paris, 1801); E. Demoiresterres, *La Musique française au 18e siècle, Gluck et Piccinni, 1774–1800* (Paris, 1872); E. Blom, *Stepchildren of Music* (1926). For a list of his operas, which number over 80, see *Rivista musicale italiana*, viii. 75.

PICCOLO, a small flute of less than half the dimensions of the large concert flute and pitched an octave higher. The principles of construction and the acoustic properties are the same for the piccolo as for the flute, with the exception that the piccolo does not contain the additional tail-piece with the extra low keys, which give the flute its extended compass.

PICCOLOMINI, the name of an Italian noble family, prominent in Siena (*q.v.*) from the beginning of the 13th century onwards. In 1220 Enghelberto d'Ugo Piccolomini received the fief of Montertari in Val d'Orcia from the emperor Frederick II. as a reward for services rendered. They obtained great wealth through trade, and established counting-houses in Genoa, Venice, Aquileia, Trieste and in various cities of France and Germany. Supporters of the Guelph cause in the civil broils by which Siena was torn, they were driven from the city in the time of Manfred, restored after the Angevin victories, expelled again during the brief reign of Conradin and again restored with the help of Charles of Anjou. Their commercial influence passed to the Florentines. Many members of the house were distinguished ecclesiastics, generals and statesmen in Siena and elsewhere; two of them were popes, viz., Aeneas Silvius Piccolomini (Pius II., *q.v.*) and Francesco Piccolomini (Pius III., *q.v.*).

See Richter, *Die Piccolomini* (Berlin, 1874); A. Lisini and A. Liberati, *Albero della famiglia Piccolomini* (Siena, 1899); and articles by A. Lisini in the *Miscellanea storica senese*, 3rd series 12, and 4th series, 17 and 189.

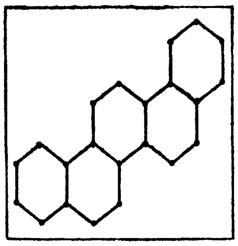
PICCOLOMINI, OCTAVIO, Prince (1599–1656), duke of Amalfi, Austrian general, was born on Nov. 11, 1599 in Florence, and carried a pike in the Spanish service at the age of sixteen. On the outbreak of the Thirty Years' War he served in Bohemia and Hungary, then in Spain and Italy. In 1627 he reentered the Imperial service as colonel and captain of Wallenstein's lifeguard. He was disgraced for practising extortion at Stargard in Pomerania, but his adroitness soon secured him the rank of "colonel of horse and foot." In the Mantuan War Piccolomini acted both as subtle diplomatist and as plundering soldier of fortune when Gustavus Adolphus invaded Germany.

Piccolomini was interned at Ferrara as a hostage for the ratification of a treaty, but joined in urging Wallenstein's reappointment as commander-in-chief. He was not immediately promoted on the duke's reappearance, and served under General Holk, an officer brought in from the Danish service, in the preliminary operations and in the battle of Lützen. After Lützen, the Emperor made Piccolomini a *general-feldwachtmeister*. At the same time, however, Holk was created a field marshal at Wallenstein's instance, much to his rival's chagrin. In 1633 Piccolomini commanded an important detachment posted at Königgrätz to bar the enemy's advance from Silesia into Bohemia. In May he accompanied Wallenstein on his advance into Silesia, but disapproving of the duke's policy, joined in a military conspiracy, which ended in the murder of Wallenstein (Feb. 29, 1634). Piccolomini's own part in the tragedy is commemorated in Schiller's *Wallenstein*. His material rewards for his activities in connection with the downfall of Wallenstein were his marshal's bâton, 100,000 gulden and the beautiful estate of Nachod in the Riesengebirge.

In 1638 Piccolomini was made a count of the empire, and in 1639, won a great victory over the French (relief of Thionville, July 7, 1639), was rewarded with the office of privy councillor from the emperor and with the dukedom of Amalfi from the king of Spain. But instead of being appointed, as he hoped, Gallas's successor, he was called in to act as *ad latus* to the Archduke Leopold Wilhelm, with whom he was defeated in the second battle of Breitenfeld in 1642. After this he spent some years in the Spanish service, being granted the title of grandee and the order of the Golden Fleece. Having re-entered the Imperial army, he was again disappointed of the chief command by the selection of the brave veteran Peter Melander, Count Holzapfel; but in 1648 he was at last appointed lieutenant-general of the emperor, and thus conducted as generalissimo the final campaign of the Thirty Years' War at the end of which he was made prince. He died on Aug. 11, 1656. He left no children (his only son Josef Silvio, the "Max" of Schiller's *Wallenstein*, was murdered

by the Swedes after the battle of Jankau in 1645), and his titles and estates passed to his brother's son.

PICENE, $C_{22}H_{14}$, an aromatic hydrocarbon found in the products of the destructive distillation of lignite and peat tars and in the residues from the rectification of Californian petroleum. Picene crystallises in colourless leaflets with a blue fluorescence; it melts at 364° C and boils above 500° C. A study of its oxidation by E. Bamberger and F. D. Chattaway (1893) gave picene-quinone (an *ortho*-diketone) and picenic acid. The latter when distilled with lime yielded ββ-dinaphthyl. These facts support the above constitutional formula, $C_{22}H_{14}$.



MOLECULAR ARCHITECTURE OF PICENE (CLOSED RING)

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PICENES. The Picenes do not figure at all prominently in the writings of ancient historians. They played a considerable rôle, however, in the confederacy of Italian states which challenged the hegemony of the growing Roman republic, and were punished at the end of the Social War by the complete suppression of their independence. The Picene capital was Ascoli, a little south of Ancona, on the eastern foothills of the Abruzzi.

The territory of the Picenes extended, to judge from the uniform character of the archaeological remains, all along the Adriatic coast from Rimini to the river Sangro; south of which again the Samnite mountaineers of Aufidena exhibited a civilization of identical character, though far less opulent. Inland, the Picene influence, and very probably the same population, extended as far as the midrib of the Apennines. A very ancient settlement at Terni, made long before 1000 B.C., may plausibly be attributed to them, and some writers think that they had a certain number of stations even in Latium. This would be perfectly natural if the Picenes were the principal survivors of a fairly homogeneous Neolithic population which once extended over the whole north and centre of Italy. According to this theory the Neolithic people were conquered and overwhelmed first by the invaders of the Bronze Age and then by the Villanovans (*see* VILLANOVANS). Neither of these incursions, however, penetrated further down the east coast than Rimini, at which point they were checked and diverted by the fighting forces of the Picenes.

This people retained its independence down to the third century B.C. when it finally succumbed to the Romans. It represents a phase of culture in the Early Iron Age diametrically opposed to that of the Villanovans, derived from a different source and developed under different inspiration. The first contrast between Villanovans and Picenes is in respect of their burial customs. The Villanovans cremated their dead, and the small percentage of inhumations occurring here and there within their territory may be ascribed to the survival of some few of the original Neolithic inhabitants. The Picenes on the other hand used no rite except inhumation; they buried their dead in the earth, generally in the contracted position customary among the aborigines, and cremation was entirely unknown in their part of the country.

The beginning of archaeological research in Picenum dates from the discovery by E. Brizio, in 1892, of two large and important cemeteries at Novilara, near Pesaro. Two remarkable stelae had been found in this neighbourhood 30 years earlier, with lines written in a script resembling the Etruscan in it's general character, but expressing a wholly different language which is inferred to be Sabellic (*q.v.*). Several more of these stelae were found at Novilara itself, and at neighbouring places including Fano, but they still await translation. Two of them are engraved with rude but very interesting pictures of native life, representing naval battles and scenes of hunting and fighting. They are further ornamented with spiral designs, which misled earlier investigators, who saw only their superficial resemblance to sub-Mycenaean patterns. It is now established that the stelae are at any rate not older than 700 B.C.

In the Novilara cemeteries were found, besides stelae, numerous other objects and ornaments which make it possible to reconstruct some outlines of the economic history of the Adriatic coast. About a dozen tombs at Novilara are as early as the 10th and 9th centuries B.C., while a few sporadic finds at Ancona and neighbouring points are no less ancient. From the contents of these it can be seen that the east coast of Italy was participating as early as the 10th century in the important trade in Baltic amber, which came down a main trunk route to the head of the Gulf of Venice. It can be seen also that Pesaro and Ancona were in no way dependent upon Bologna, inasmuch as many of the fibulae are of types quite unknown to the Villanovans though perfectly familiar in Greece and Sicily.

It is to commercial relations, rather than to any movement of immigration, that the composite character of Picene civilization should be attributed. In spite of the numerous details of their life which suggest analogies with the Balkans, or with Greece of the Dipylon period, there is no evidence that the population was derived, or substantially recruited, from either of these sources. The general stock of the inhabitants remained as it always had been, predominantly composed of the Mediterranean race originally derived from North Africa.

The essential characteristic of the Picenes is that they were primarily and above everything else fighting men. It has been pointed out that even before the dawn of the Iron Age they were obliged to defend their borders. They succeeded in maintaining their independence for many centuries. It is not surprising, therefore, that many tombs at Novilara contained weapons. The favourite arm was the spear, and the next in frequency was the dagger, of which there were several patterns. Swords seem to have been rather the weapons of the élite, and were extremely handsome. Helmets are fairly frequent, shields very rare, in the graves.

From graves of the 8th and 7th centuries B.C. at Novilara a complete picture may be recovered of the arms and equipment of a Picene foot soldier. His favourite sword was a broad and short weapon of iron, intended, like a sabre or a tulwar, for the heaviest cutting. Its edge was on the inside, and the hilt curved back at an angle like that of an ancient Bosnian hewing-knife. In fact there can be no doubt that swords of this kind were originally imported from the Balkans where the general type has always been well known. The curiously shaped sheath was made of wood, covered with sheets of bronze finely engraved with geometric patterns. Other swords found at Novilara are definitely Greek in origin, being of shapes familiar from the paintings on Dipylon vases. Similarly the helmets and shields are of Greek patterns, but the daggers, except when they seem to be original Italian products, follow the stock forms derived from the Hallstatt series prevalent all over Europe. The entire outfit is thus curiously hybrid in character, and quite unlike that of any other Italians. Not less characteristic than the armament of the men were the ornaments and apparel of the women. A certain number of objects were imported from the factories of Etruria or Bologna. Such are the bronze manicuring sets hung upon chatelaines attached to the waist, and the bronze ear-cleaners terminating in the figure of a monkey or of Aphrodite surrounded by doves. But the narrow girdles made of chain mail in links, the huge and elaborate pendants terminating in imitation sea-shells, the handsome torques and pectorals make an ensemble quite unlike anything found among Villanovans or Etruscans.

The rich cemeteries discovered along the coast in the neighbourhood of Ancona have been little studied, and no full publication of them is yet available. All the material obtained from them may be seen in the Ancona museum, in the large buildings of a disused monastery in the city. The richest cemetery was that of Belmonte, but the collections from Cupra-marittima, Grottamare and several smaller sites are also very important. Belmonte, in particular, which dates to the 6th and 5th centuries B.C., has yielded some very fine examples of Ionic Greek work in the minor arts. There are bronze bowls decorated with figurines of cast bronze, a favourite representation being that of Herakles as the tamer of lions and horses; jugs and vessels of hammered bronze and many superb carvings in amber, of which there was a prodigal abundance at this period. At Rapagnano were found two

shield-bosses of bronze, ornamented with scenes of combat between mounted men and foot soldiers in the best Ionic style. Greek influence was entirely predominant in Picene art from the 6th century onwards, but it is important to observe that it found its way, not through Etruria, but quite directly from the Greek colonies of southern Italy. This is proved by the simultaneous presence in these tombs of the very distinctive and peculiar Apulian geometric pottery, which is unknown in Etruria.

Indeed, so far as present evidence avails, and allowing that it is dangerous to prophesy in regard to a region only partially explored, Etruscan influence on the Adriatic coast was very slight and unimportant. A tumulus of the 7th century found at Fabriano is almost entirely Etruscan in its contents, but as yet this is an isolated example. A certain amount of trade was undoubtedly carried on across the Apennines, but there is little in the general complex of Picene life which suggests a strong Etruscan impress. On the contrary, it remains a curiously individual and virile civilization, in spite of its many borrowings. The backbone of Picene commerce was constituted by a lively trade with Istria, which may be clearly traced by means of a comparative study of the objects found in the graves. Nothing, except the existence of a trade-system which centred at the head of the Gulf of Venice, could explain the remarkable circumstance that, in places as far apart as the Italian lakes, Istria, Picenum and Bosnia, there have been found torques, pendants and amulets so precisely similar that they must have been distributed by the same firm of agents.

See E. Brizio in *Monumenti Antichi,* vol. v.; D. Randall-MacIver, *The Iron Age in Italy* (1927); and for a literary treatment from other points of view, F. von Duhn, *Italische Gräberkunde,* vol. i. (1924). (D. R.-M.)

PICENUM, a district of ancient Italy, situated between the Apennines and the Adriatic, bounded north by the Senones and south by the Vestini. The whole territory was divided up among Latin-speaking settlers by the Lex Flaminia in 232 B.C.

It was in Picenum (at Asculum) that the Social War broke out in 90 B.C. Under Augustus it formed the fifth region of Italy, and included twenty-three independent communities. It was reached from Rome by the Via Salaria and the Via Caecilia.

At the end of the 2nd century A.D. the north-eastern portion of Umbria acquired the name Flaminia, from the high road. For the time it remained united with Umbria for administrative purposes, but finally passed to Picenum in the time of Constantine, and acquired the name of *Flaminia et Picenum Annonarium,* the main portion of Picenum being distinguished as *Suburbicarium.* When the exarchate of Ravenna was founded the part of Picenum Annonarium near the sea became the Pentapolis Maritima, which included the five cities of Ariminum, Pisaurum, Fanum Fortunae, Sena Gallica and Ancona. The exarchate was seized by Luitprand in 727, and Ravenna itself was taken by Aistulf in 752. In 753, however, the Emperor Pepin handed it over to the pope, a grant confirmed by Charlemagne.

PICHEGRU, CHARLES (1761–1804), French general, was born at Arbois, or at Les Planches, near Lons-le-Saulnier, on Feb. 16, 1761. His father was a labourer, but the friars of Arbois gave the boy a good education, and the Père Partault took him to the military school of Brienne. In 1783 he entered the first regiment of artillery, where he rapidly rose to the rank of adjutant-sub-lieutenant. At the Revolution he became leader of the Jacobin party in Besançon, and when a regiment of volunteers of the department of the Gard marched through the city he was elected lieut.-colonel. Quickly promoted to the command of the army of the Rhine, in co-operation with Hoche and the army of the Moselle, Pichegru reconquered Alsace and forced the lines of Haguenau and relieved Landau. In Dec. 1793 Hoche was arrested and Pichegru became commander-in-chief of the army of the Rhine-and-Moselle, succeeding Jourdan in the army of the North in Feb. 1794.

It was now that he fought his three great campaigns of one year. The English and Austrians held a strong position along the Sambre to the sea. After vainly attempting to break the Austrian centre, Pichegru suddenly turned their left, and defeated Clerfayt at Cassel, Menin and Courtrai, while Moreau, his second in command, defeated Coburg at Tourcoing in May 1794; then after a pause, during which Pichegru feigned to besiege Ypres, he again dashed at Clerfayt and defeated him at Rousselaer and Hooglede, while Jourdan came up with the new army of the Sambre-and-Meuse, and utterly routed the Austrians at Fleurus on June 27, 1794. Pichegru began his second campaign by crossing the Meuse on Oct. 18, and after taking Nijmwegen drove the Austrians beyond the Rhine. Then, instead of going into winter-quarters, he prepared his army for a winter campaign. On Dec. 28 he crossed the Meuse on the ice, and stormed the island of Bommel, then crossed the Waal in the same manner, and, driving the English before him, entered Utrecht on Jan. 19 and Amsterdam on Jan. 20, and soon occupied the whole of Holland. The former friend of Saint Just now offered his services to the Thermidorians, and after receiving from the Convention the title of "Sauveur de la Patrie," subdued the *sans-culottes* of Paris, when they rose in insurrection against the Convention on 12 Germinal (April 1). Pichegru then took command of the armies of the North, the Sambre-and-Meuse and the Rhine, and crossing the Rhine in force took Mannheim in May 1795.

When his fame was at its height he allowed his colleague Jourdan to be beaten, betrayed all his plans to the enemy, and took part in organizing a conspiracy for the return of Louis XVIII. His intrigues were suspected, and when he offered his resignation to the Directory in Oct. 1795, it was promptly accepted. He retired in disgrace. In the Council of Five Hundred (May 1797) he was the royalist leader, and planned a *coup d'état,* but on the 18th Fructidor he was arrested, and deported to Cayenne in 1797. Escaping, he reached London in 1798, and served on General Korsakov's staff in the campaign of 1799. He went to Paris in Aug. 1803 with Georges Cadoudal to head a royalist rising against Napoleon; but was arrested on Feb. 28, 1804, and on April 15, was found strangled in prison. He was a man of enormous strength and great personality.

There is no really good life of Pichegru; perhaps the best is J. M. Gassier's *Vie du général Pichegru* (1815). For his treason, trial and death, consult Montgaillard's *Mémoires concernant la trahison de Pichegru* (1804); Fauche-Borel's *Mémoires;* Savary, *Mémoires sur la mort de Pichegru* (1825); and G. Pierret, *Pichegru, son procès et sa mort* (1826); and Sir J. R. Hall, *General Pichegru's Treason* (1915).

PICHER, a city of Ottawa county, Oklahoma, U.S.A., in the north-eastern corner of the state, near the Kansas boundary; on Federal highway 66 and served by the Miami Mineral Belt and electric railways. The population was 9,676 in 1920 (99% native white) and was estimated locally at 18,000 in 1928. It is one of the principal mining centres in the "Tri-State region," which produces 60% of the zinc and 15% of the lead mined in the United States. The city is built entirely on leased land, owned by the Quapaw Indians. The first mine was opened in 1915. The city was incorporated in 1920, and has grown rapidly.

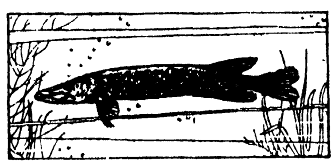
PICKENS, ANDREW (1739–1817), American soldier in the Revolutionary War, was born in Paxton, Pa., on Sept. 19, 1739. His family settled at the Waxhaws (in what is now Lancaster county), S.C., in 1752. He fought against the Cherokees in 1761 as a lieutenant. In the Revolutionary War he rose to brigadier-general (after Cowpens) in the South Carolina militia. On Feb. 14, 1779, with 300–400 men, he surprised and defeated about 700 Loyalists on Kettle Creek, Wilkes county, Ga.; and later in the same year at Tomassee defeated the Cherokees, who were allied with the British. Upon the surrender of Charleston (May 1780) he became a prisoner on parole, which he observed rigidly until, contrary to the promises made to him, Maj. James Dunlap plundered his plantation; he then returned to active service. His command (about 150 men) joined Gen. Daniel Morgan immediately before the battle of Cowpens, in which Pickens commanded an advance guard (270–350 men from Georgia and North Carolina) and twice rallied the broken American militia; for his services Congress gave him a sword. With Col. Henry Lee he harassed Lieut.-col. Banastre Tarleton, who was attempting to gather a Loyalist force just before the battle of Guilford court house; and with Lee and others, he captured Augusta (June 5, 1781) after a siege. At Eutaw Springs (Sept. 8, 1781) he commanded the left wing and was

wounded. In 1782 he defeated the Cherokees again. After the war he was active for several years in state politics, and in 1793–95 was a representative in Congress. He died in Pendleton district, S.C., on Aug. 17, 1817. He married in 1765 Rebecca Calhoun, an aunt of John C. Calhoun. Their son, ANDREW PICKENS (1779–1838), served as a lieutenant-colonel in the War of 1812, and was governor of South Carolina in 1816–18.

See E. B. Pickens, "Life of General Pickens," *Journal of Amer. Hist.*, vol. xviii., pp. 131–136 (1924).

PICKENS, FRANCIS WILKINSON (1805–1869), American politician, was born in Togadoo, St. Paul's parish, S.C., April 7, 1805, son of Andrew Pickens (1779–1838) and grandson of Gen. Andrew Pickens (1739–1817). He was educated at Franklin college, Athens, Ga., and at South Carolina college, Columbia, and was admitted to the bar in 1829. In 1832 he was elected to the State house of representatives, where he submitted a report denying the right of Congress to exercise any control over the States. He was a Democratic member of the national house of representatives in 1834–43, served in the South Carolina senate in 1844–45, was U.S. minister to Russia in 1858–60, and in 1860–62 was governor of South Carolina. He strongly advocated the secession of the Southern States; signed the South Carolina ordinance of secession; sanctioned firing upon the "Star of the West" (Jan. 9, 1861), which was bringing supplies to Anderson, and the bombardment of Ft. Sumter. He died at Edgefield, S.C., on Jan. 25, 1869

PICKEREL, the name used, especially in America, where there are several species which never reach a large size, for certain small pike (*q.v.*); in England small specimens of *Esox lucius*, the only species represented, are usually termed jack.



THE EASTERN PICKEREL, AVERAGE LENGTH ABOUT 2 FEET

PICKERING, EDWARD CHARLES (1846–1919), American physicist and astronomer, was born in Boston on July 19, 1846. He was graduated in 1865 in the Lawrence Scientific school of Harvard, where for the next two years he was a teacher of mathematics. Subsequently he became professor of physics at the Massachusetts Institute of Technology, where he established the first laboratory in America, in which students were instructed by actual contact with physical instruments and measurements. In 1876 he was appointed professor of astronomy and director at the Harvard college observatory. In 1877 when most observatories were devoting themselves to the old "astronomy of position" Prof. Pickering, who was a physicist rather than an old school astronomer, chose as his particular field of labour the photometry of the stars, thus presaging the trend of the new astronomy along lines of physics. He invented the meridian photometers (*see* PHOTOMETRY: *Stellar*), with which the brightness of more than 45,000 stars has been measured at Cambridge and Arequipa (Peru) observatories, and the resulting system generally adopted as an international standard. Prof. Pickering, personally, made more than 1,500,000 photometric settings.

Through the establishment of an observatory at Arequipa (1891), after two years of study it became possible to include measurements made on the stars throughout the Southern heavens within the scope of the Harvard college observatory's work.

The work of the observatory under Prof. Pickering may be summarized as including photometry, in which photometric magnitudes for 80,000 stars have been determined; a scale of photographic magnitude; a system of classification of variable stars; and a system of stellar spectroscopy which has been universally adopted. As a result of Pickering's work, the Harvard "photographic library" of stars contains more than 250,000 photographic plates. He died at Cambridge, Mass., on Feb. 3, 1919.

For bibliography and further biographical material see *Biographical Memoirs of National Academy of Sciences*, vol. vii., pp. 52–57. *See* also *Proceedings of the American Academy of Arts and Sciences*, vol. lvii., pp. 502–506 (Boston, 1922); *Monthly Notices of Royal Astronomy Society*, vol. viii., pp. 360–365.

PICKERING, TIMOTHY (1745–1829), American politician, was born at Salem, Mass., on July 17, 1745. He graduated from Harvard college in 1763 and was admitted to the bar in 1768. In the pre-Revolutionary controversies he identified himself with the American Whigs; and in 1776 he was a representative from Salem in the general court of Massachusetts. Early in 1775 he published *An Easy Plan of Discipline for a Militia*. In the same year he became judge of the court of common pleas for Essex county, and in the winter of 1776–77 he led an Essex regiment of volunteers to New York. He subsequently served as adjutant general, later as quartermaster general and was also a member of the board of war. In April, 1783, he drew up a plan for the settlement of the North-West territory, which provided for the exclusion of slavery. In 1785 he became a commission merchant in Philadelphia; but in Oct., 1786, soon after the legislature of Pennsylvania had passed a bill for erecting Wyoming district into the county of Luzerne, he was commissioned to organize the county. He offered to purchase for himself the Connecticut title to a farm, and in 1787 he was appointed a member of a commission to settle claims according to the terms of an act, of which he was the author, confirming the Connecticut titles (*see* WYOMING VALLEY and WILKES-BARRE). In 1790 he negotiated a peace with the Seneca Indians, and he concluded treaties with the Six Nations in 1791–94. Under Washington he was postmaster general (1791–1795), secretary of war (1795), and after December, 1795, secretary of state, to which position he was reappointed (1797) by Adams. In 1783, while he was quartermaster general, he had presented a plan for a military academy at West Point, and, as secretary of war, he supervised the West Point military post with a view to its conversion into a military academy. As head of the state department he soon came into conflict with Adams. His hatred of France made it impossible for him to sympathize with the president's efforts to settle the differences with that country peaceably. He was dismissed, after refusing to resign, in 1800. Returning to Massachusetts, he was elected a United States senator in 1803–11 and a member of the House of Representatives in 1813–17. As an ultra Federalist—he was a prominent member of the group known as the Essex junto—he strongly opposed the purchase of Louisiana and opposed the War of 1812. He died at Salem, Mass., on Jan. 29, 1829.

The standard biography is that by his son, Octavius Pickering (1791–1868), and C. W. Upham, *The Life of Timothy Pickering* (Boston, 1867–1873). In the library of the Massachusetts Historical Society at Boston, there are 62 manuscript volumes of the Pickering papers, an index to which was published in the *Collections* of the society, 6th series, vol. viii. (Boston, 1896).

His son, JOHN PICKERING (1777–1846), graduated at Harvard in 1796. He wrote on the languages of the North American Indians. He was a founder of the American Oriental Society and published a *Comprehensive Dictionary of the Greek Language* (1826).

Timothy Pickering's grandson, CHARLES PICKERING (1805–1878), was naturalist to the Wilkes exploring expedition of 1838–42, and in 1843–45 travelled in East Africa and India.

PICKERING, WILLIAM HENRY (1858–), American astronomer, was born in Boston, Mass., on Feb. 15, 1858, and in 1879 graduated at the Massachusetts Institute of Technology. He served as an assistant and instructor in physics at his Alma Mater from 1880 to 1887, and then became an assistant in astronomy at the Harvard college observatory. In 1890 he was made assistant professor of astronomy. He led expeditions for observing total solar eclipses to Colorado, 1878; Grenada, West Indies, 1886; California, 1889; Chile, 1893; and Georgia, 1900. While in southern California in 1889 he selected the Mt. Wilson site and established a temporary observatory there. In 1891 he established the Arequipa station of the Harvard observatory in Peru. He also established a meteorological station at an altitude of 16,650ft. upon Mt. Chahocoman, and accomplished the ascent of El Miste, 19,400 feet. He surveyed and determined the altitude of many other Peruvian mountains and returned to the United States by way of the Straits of Magellan in 1893. In 1894 he erected the observatory and telescope for Dr. Percival Lowell (*q.v.*) at Flagstaff, Ariz., and in 1900 erected a station for the Harvard observatory at Mandeville, Jamaica, in the West Indies. In 1899 he discovered Phoebe, and afterwards Themis,

9th and 10th satellites of Saturn, and demonstrated why their revolution was opposite in direction to all the other satellites. In 1904 he again went to California to make observations of the moon, in 1905 to Hawaii, and in 1907 to the Azores to compare their crater formations with those in the moon. His work in planetary photography and photometry was especially notable. In later years he turned more and more to the study of Mars.

Besides many papers in astronomical journals (*see* especially *Popular Astronomy*), he wrote *A Walking Guide to the Mt. Washington Range* (1882); *Investigations in Astronomical Photography* (1895); *Visual Observations of the Moon and Planets* (1903); *An Atlas of the Moon* (1903); *Lunar and Hawaiian Physical Features Compared* (1906); *A Search for a Planet Beyond Neptune* (1909); *A Statistical Investigation of Cometary Orbits* (1911); *Mars* (1921).

PICKERING, urban district and town in the North Riding of Yorkshire, England, 32 m. N.E. by N. from York by the L.N.E. railway, on which it is an important junction. Pop. (1921) 3,503. The town lies at the foot of the York moors at the entrance to one of the river ways into the Vale of Pickering. It is the centre of an agricultural and pastoral area with a broad belt of arable land in the vale given to cereal and fodder crops. North of Pickering is a moorland grazing area. Agricultural implements are manufactured there, and limestone and freestone are quarried in the vicinity.

A castle existed at Pickering before the Conquest, and the present ruin on a hill to the north of the town is partly Norman but mainly 14th century in style. A fragmentary keep and several towers remain. It was the prison of Richard II. before his confinement at Pontefract. During the Civil War, it was held by the royalists and suffered greatly in siege.

PICKETING: *see* TRADE UNIONS.

PICKETT, GEORGE EDWARD (1825–1875), American Confederate soldier, born at Richmond, Va., Jan. 25, 1825. Upon graduation at West Point in 1846 he was assigned to the 8th United States infantry; served with distinguished valour in all the battles of Gen. Scott in Mexico, including the siege of Vera Cruz and the storming of Chapultepec, where, it is said, he was first to scale the parapets and unfurl the American flag over the castle. After peace was restored, Pickett was transferred to Washington Territory where he was destined to play an important role in the north-west boundary controversy. In 1859 he was ordered to occupy San Juan island, where he prevented the landing of a superior force of British troops. On the outbreak of the Civil War he resigned his command (June 1861) and offered his services to the Confederacy. He was commissioned captain and after a short time was made a colonel. In Feb. 1862 he was appointed a brigadier-general and assigned to the command of a Virginia brigade of infantry. During that year he rendered able service in the battles of Williamsburg, Seven Pines, Gaines Mill and Fredericksburg. While leading his men at Gaines Mill he was severely wounded, but upon returning to his command in September he was made a major-general. At Gettysburg, his division was held in reserve until July 3 when it led the attack on Cemetery hill. The charge of Pickett's men is one of the most famous episodes of military history. Over three-quarters, 3,393 officers and men out of 4,500 were left on the field. He subsequently commanded the Confederate forces in North Carolina but after the failure to take Newbern, he turned north to defend Petersburg. His troops participated in the assault on Grant's line at Cold Harbor and performed excellent service in the closing campaign of 1865 at Dinwiddie court house and Five Forks. After the Civil War he went to Richmond and later to Norfolk where he was engaged in the insurance business. His death occurred in Norfolk on July 30, 1875.

See La Salle Corbell Pickett, *Pickett and his Men* (1899, rev. ed., 1913), and A. C. Inman, editor, *Soldier of the South; Gen. Pickett's War Letters to His Wife* (1928).

PICKFORD, MARY (1893–) (stage name of Gladys Smith), American motion picture actress, born at Toronto, Canada, April 8, 1893. Her first stage appearance was at the age of five; at eight she went on tour. She went to New York under the auspices of Belasco, creating the part of Betty Warren in *The Warrens of Virginia*. Her first motion picture work was undertaken with D. W. Griffith as an extra; but she returned to Belasco, taking the part of Juliet in *A Good Little Devil* at the Republic theatre in New York. In 1913 she returned to the screen with Famous Players Company, and rose to the first rank. In 1916 the Mary Pickford Film Corporation was organized and she received a salary higher than that paid to any other motion picture actress. In 1918 she became an independent producer and went to California. In 1919 she was the prime mover in the formation of the United Artists Corporation. She married Douglas Fairbanks, motion picture actor and producer, on March 28, 1920.

PICKLE. In the wider sense the term "pickle" is applied to any saline or acid preservative solution; in the narrower to vegetables preserved in vinegar. The word appears to be an adaptation of the Dutch *pekel*, brine, pickle; *cf.* Ger. *Pökel*. A solution of copper or zinc sulphate is used as a "pickle" for railway-sleepers or other wood, a brine containing salt and saltpetre as a preservative for meat, lime-water as "pickle" for eggs. Domestic pickles are made from small cucumbers, onions, cauliflowers, cabbages, mangoes, unripe walnuts and other fruits and vegetables, by either steeping or boiling them in salt-brine and vinegar.

PICO, an island in the Atlantic ocean, belonging to Portugal, forming part of the Azores archipelago; pop. about 25,000 and area 175 sq. miles. Pico rises to the height of 7,613 feet. The soil is of volcanic origin. The island was formerly famous for its Fayal wine (Fayal is, however, an adjacent island), but in 1852 the vines were destroyed by disease. Similar destruction affected the fruit trees (orange) and a period of emigration followed. The distress was alleviated by the planting of fig-trees and the cultivation of apricots. The chief town is Lagens do Pico.

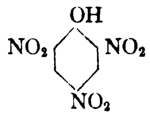
PICO DELLA MIRANDOLA, GIOVANNI, COUNT (1463–1494), Italian philosopher and writer, the youngest son of Giovanni Francesco Pico, prince of Mirandola, a small territory not far from Ferrara, afterwards absorbed in the duchy of Modena, was born on Feb. 24, 1463. In his fourteenth year Pico went to Bologna, where he studied for two years, and was much occupied with the Decretals. He then spent seven years wandering through Italy and France and collecting a precious library. Besides Greek and Latin he knew Hebrew, Chaldee and Arabic; and his Hebrew teachers introduced him to the Kabbalah. He settled in 1486 at Rome, where he set forth for public disputation a list of nine hundred questions and conclusions in all branches of philosophy and theology, but the pope prohibited them, and Pico had to defend the impugned theses in an elaborate *Apologia*. His personal orthodoxy was subsequently vindicated by Alexander VI. Pico was the first to seek in the Kabbalah a proof of the Christian mysteries and it was by him that Reuchlin was led into the same delusive path.

In his 28th year Pico published the *Heptaplus*, a mystical exposition of the Creation. Next he planned a great seven-fold work against the enemies of the Church, of which only the section against astrology was completed After leaving Rome he again lived a wandering life, often visiting Florence, to which he was drawn by his friends Politian and Marsilius Ficinus, and where also he came under the influence of Savonarola. Three years before his death he parted with his share of the ancestral principality, and designed, when certain literary plans were completed, to give away all he had and wander barefoot through the world preaching. But these plans were cut short by a fever which ended in his death at Florence on Nov. 17, 1494.

His works were published at Bologna in 1496 by his nephew, with a biography, which was translated by Sir Thomas More as *Life of John Picus, Earl of Mirandola*, in 1510. *See* Walter Pater's *Renaissance* (1878); the study by J. Rigg, prefixed to the reprint of More's *Life* in the "Tudor Library" (1890). Mortetani, *La filosofia cabbalistica di Pico della Mirandola* (Empoli, 1898); and A. Levy, *Die Philosophie Picos della Mirandola* (1908).

PICRIC ACID or **LYDDITE,** is a yellow crystalline solid melting at 122·5° C and owes its name to the intensely bitter and persistent taste of its yellow aqueous solution. As experiments regarding the use of picric acid as a high explosive were once conducted at the town of Lydd (Sussex), the name Lyddite became attached to the acid. The term melinite is employed in France and Germany, and shinosite indicates the Japanese variety of this

explosive. As its graphic formula (inset) indicates, it is a benzenoid derivative with three hydrogen atoms of the benzene nucleus replaced by nitro (NO_2) groups, and one replaced by a hydroxyl (OH) group, whence its name and formula 2:4:6 trinitrophenol $HO{\cdot}C_6H_2(NO_2)_3$. It is a typical example of a nitro-compound of the aromatic series, and was formerly employed as an acid dyestuff giving yellow shades on wool or silk. Although acting as a poison when administered in quantities exceeding a few milligrams, its saturated aqueous solution may safely be applied to burns and scalds with the object of subduing the pain, which it effects by paralysing the sensory nerve endings.



The ordinary method of manufacturing picric acid is to dissolve phenol in strong sulphuric acid thus making a phenolsulphonic acid, $C_6H_5OH+H_2SO_4=HO{\cdot}C_6H_4{\cdot}SO_3H$, which on treatment with a moderate excess of nitric acid regenerates sulphuric acid, and at the proper temperature gives finally trinitrophenol. This separates as an oily liquid which becomes solid on cooling. It is washed with cold water to remove excess of acids and then dissolved in hot water, from which it crystallizes in yellow scales, plates or needles, depending on the concentration of solution The picrates of ammonia and of the alkali metals sodium and potassium are most soluble, whereas the lead salt and a few others are sparingly soluble in water Certain organic bases, such as acridine, give more insoluble salts than metals When heated above its melting point picric acid puffs or burns with a smoky flash: a small amount may sublime as a yellow powder This burning does not appear to be dangerous when only small quantities are dealt with unless the external heating be rapid and extensive, so that the whole bulk under experiment is heated up; in that case the simple burning passes over into a kind of detonating decomposition. The metallic salts of picric acid are most liable to this violent form of explosion, in fact it is almost the only form of explosion they exhibit either on heating or under percussion The picrates of lead, bismuth and other heavy metals are extremely sensitive to friction or percussion as well as heating, especially when dry The pure acid itself is not dangerously sensitive to percussion, although a powerful and quick glancing blow will often induce decomposition The explosion of a very small amount of a picrate—as the lead or potassium salt—in contact with the acid, especially if the latter be in a compact state, generally induces a complete detonation. At one time picric acid was much in favour either as an ingredient of an explosive mixture with some special objective use or alone Among the mixed explosives containing picric acid may be mentioned Brugères powder, a mixture of 54 parts of ammonium picrate and 45 of potassium nitrate; Designolles' powder, potassium picrate, potassium nitrate and charcoal; and Emmensite, of similar composition, suggested by Mr Emmens, U.S.A. Many others were designed for blasting or similar purposes. (W. R. Ho.)

PICRITE, in petrology, an intrusive igneous rock of ultrabasic composition somewhat similar to peridotite (*q.v.*). The name, given by Tschermak in 1866, is derived from πικρός, "bitter," owing to the high percentage of magnesia (bitter earth) these rocks contain. The picrites are dark, heavy rocks largely composed of olivine and augite, with a small but variable amount of plagioclase felspar. Hornblende and biotite may also be present The picrites usually occur in sills or sheets, and seldom in large plutonic masses (unlike peridotites). Varieties of picrite include augite, enstatite and hornblende picrite.

The minerals of picrites are very frequently decomposed Serpentine partially or wholly replaces olivine, while hornblende (pilite), talc and chlorite appear as secondary products after the same mineral. Augite passes into hornblende or chlorite, and the essential felspar is often represented by epidote, prehnite and white mica. In some picrites, as in the peridotites, a "lustre mottling" is given by the poikilitic inclusion of olivine grains in large crystals of augite or hornblende. In the porphyritic varieties a residual brown glass may be present. Such rocks are known as picrite-porphyrites.

Many picrites clearly possess alkaline affinities. Thus the augite picrites of the Midland valley of Scotland and of the type locality in Moravia contain interstitial analcime and are closely related to the teschenites with which they are associated. Other picrites are more clearly "calc-alkaline" being associated with diorites or dolerites. The hornblende picrites of Carnarvonshire, Anglesey and other places belong here. In the Devonian rocks of the Fichtelgebirge and Nassau picrites accompany dolerites and proterobases, as they do also in Cornwall and Devon. The term picrite-basalt is reserved for felspar-poor basalts rich in olivine. (C E. T.)

PICROTOXIN, a neutral principle obtained from the *Cocculus indicus*, which is the fruit of the *Anamirta paniculata*. It is used in medicine externally as an antiparasitic. Internally it has been successfully used to check the night-sweats of phthisis. In large doses it is a powerful poison, causing unconsciousness, delirium, convulsions, gastro-enteritis and stimulation of the respiratory centre followed by paralysis, from which death sometimes results. Formerly *Cocculus indicus* berries were sometimes added to beer to increase the intoxicating effects. The chemical formula of picrotoxin is $C_{15}H_{16}O_6{\cdot}H_2O$.

PICTISH. The language of the ancient Picts is of uncertain origin and of doubtful affinity. "The Picts have left us a number of inscriptions in the Ogham character. No attempt to interpret these inscriptions as any form of Celtic has produced anything but bosh. Whatever may have been the Pictish language, these inscriptions assure us that it was certainly not Celtic" (R A. S. Macalister in *Antiquity* II., 7, 1928, p. 373.) Examination of the symbols found upon monumental stones in Pictland suggests analogies with certain elements in Bronze age sculpturings—a highly probable affinity if the Picts were the survivors of Bronze age aborigines, influenced by La Tène culture

The term *Pict* itself may be connected with the Latin *Pictones* and *Pictari* of Gaul In Irish they are known as *Cruithne*, in Welsh as *Prydyn,* which (*cf.* Prydein, or British) significantly resembles the earliest Greek name for the British Isle, *Pretonnic Islands.* From the matrilineal succession of their chiefs (the records being doubtful) it has been inferred that their social structure differed from that of other Gaelic speaking peoples Pictish extended to the north of Ireland, and was finally ousted by the Goidelic speech of the Scots, which was derived from Ireland

See T. R. Holmes, *Caesar's Invasion of Britain* (1907)

PICTOGRAPHY. In the history of writing a very large number of conventional marks are demonstrably reductions from still older forms, which have often developed out of pictographs. Pictography has left its traces in all parts of the world, but was most widely developed in the New World as a system lasting down to modern times.

Very simple pictures are drawn upon birch bark, indicating by their order the subjects in a series of song-chants with sufficient precision to enable the singer to recall the theme of each in his recitation. An account can be kept of sales or purchases by representing in perpendicular strokes the number of items, and adding at the end of each series a picture of the animal or object to which the particular series refers. Thus three strokes followed by the picture of a deer indicate that the hunter has brought three deer for sale. A conventional symbol (a circle with a line across it) is used to indicate a dollar, a cross represents ten cents, and an upright stroke one cent, so that the price can be quite clearly set forth. This practice is followed in many other parts of the world In clay tablets discovered by Sir Arthur Evans at Knossos, in Crete, a somewhat similar method of enumeration is followed; while at Athens conventional symbols were used to distinguish drachmae and obols upon the revenue records

In comparatively recent times the Dakota Indians invented a chronological table, or winter count, wherein each year is recorded by a picture of some important event which befell during that year. In these pictures a considerable amount of symbolism was necessary. A black upright stroke indicates that a Dakota Indian was killed, a rough outline of the head and body spotted with blotches indicates that in the year thus indicated the tribe suffered from smallpox Sometimes, in referring to persons, the symbol is of the nature of a rebus. Thus, Red Jacket, an Indian chief, was killed in the winter of 1807–8, this fact is recorded by a red coat

with two arrows piercing it and blood dripping. There is, however, nothing of the nature of a play upon words intended. Here the Mexicans proceeded a stage further, as in the often quoted case of the name of Itz-coatl, literally knife-snake, which is ordinarily represented by a reptile (*coatl*) with a number of knives (*itz*) projecting from its back. It is, however, also found divided into three words, itz-co-atl—knife-pot-water—and represented by a different picture accordingly. The Mexicans, moreover, to indicate that the picture was a proper name, drew the upper part of the human figure below the symbol, and joined them by a line, a practice adopted also amongst their northern neighbours when, as in names like Little-Ring, the representation would hardly be sufficiently definite. Simple abstract notions could also be expressed in this picture-writing. Starvation or famine was graphically represented by a human figure, with the ribs showing prominently. A noose amongst the Mexicans was the symbol for robbery, though more logically belonging to its punishment. In a Californian rock-painting sorrow is represented by a figure from whose eyes drop tears. This could be abbreviated to an eye with tears falling from it, a form recorded by Schoolcraft as existing amongst the Ojibwa Indians. The symbol is so obvious that it is found with the same value among Egyptian hieroglyphics.

To the more elaborate civilizations of the Old World, the development of writing from pictography can be ascribed—the Assyrians (*see* CUNEIFORM), Egyptians (*see* EGYPT) and Chinese (*see* CHINA). Here more complex notions had to be expressed. The development of the system can be traced through many centuries, and shows a tendency to conventionalize the pictorial symbols employed. Out of conventionalized forms develop (*a*) syllabaries, (*b*) alphabets. As regards the latter the historical evolution is traced in the article ALPHABET. The account given under CHINA (*language*) gives a good idea of the development of a syllabary from pictographic writing.

PICTON, SIR THOMAS (1758–1815), British general, born at Poyston, Pembrokeshire, joined the army in 1773 as an ensign. On the disbandment of the 75th regiment in 1783 Picton quelled a mutiny amongst the men by his prompt personal action and courage. After living in retirement on his father's estate for nearly twelve years, he went out to the West Indies in 1794. He took part in the capture of St. Lucia (for which he was promoted lieutenant-colonel) and in that of St. Vincent. After the reduction of Trinidad Abercromby made him governor of the island. He administered the island with such success that the inhabitants petitioned against the retrocession of the island to Spain. In October 1801 he was gazetted brigadier-general. But by this time the rigour of his government, as reported by his enemies, had led to a demand by humanitarians at home for his removal. He was charged with permitting the application of torture under the Spanish law which he had to administer. Colonel William Fullarton (1754–1808) procured the appointment of a commission to govern the island, with Picton as its junior member. Picton resigned, and on his return to England in December 1803 he was arrested by order of the privy council. He was tried in the court of king's bench before Lord Ellenborough in 1806 on one of the charges, on which the court returned a merely technical verdict of guilty, which was superseded in 1808 by a special verdict on retrial. In 1810, at Wellington's request, he was appointed to command a division in Spain. For the remaining years of the Peninsular War, Picton was one of Wellington's principal subordinates. The commander-in-chief, it is true, never reposed in him the confidence that he gave to Beresford, Hill and Craufurd, but in the resolute, thorough and punctual execution of a well-defined task Picton had no superior in the army. His début was unfortunate. On the Coa in July 1810 Craufurd's division became involved in an action, and Picton, his nearest neighbour, refused to support him, as Wellington's direct orders were to avoid an engagement. Details of the incident will be found in Oman, *Peninsular War,* vol. iii. Shortly after this, however, at Busaco, Picton found and used his first great opportunity for distinction. He repulsed the French attack with skill and resolution. He fought at Fuentes d'Onor, with Craufurd he stormed the breaches at Ciudad Rodrigo, and in command of the 3rd division was at the storming of Badajoz. Wounds compelled a temporary absence in England, but he again commanded the 3rd division at Vittoria, in the battles of the Pyrenees, and at Orthez and Toulouse.

On June 24, 1814, Picton received for the seventh time the thanks of the House of Commons for his great services and in 1815 he was made a G.C.B. Picton was severely wounded at Quatre Bras, but concealed his wound and retained command of his troops, and at Waterloo, two days later, was shot through the head by a musket ball. His body was brought home to London, and buried in the family vault at St. George's, Hanover Square. A monument was erected to his memory in St. Paul's Cathedral.

See Robinson's *Life of Sir Thomas Picton* (London, 1836), with which, however, compare Napier's and Oman's histories of the Peninsular War as to controversial points.

PICTOU, a seaport, port of entry, and capital of Pictou county, Nova Scotia, 90 m. N.E. by N. of Halifax, on a branch of the Canadian National railway. Pop. (1921) 2,988. It has several valuable industries, and is the shipping port for the adjacent coal-mines. The Academy was founded in 1818.

PICTS, the name given to an ancient Celtic race of the Stone Age inhabiting Britain (*q.v.*) and later the Highlands. In a battle of 640 they defeated the Britons, and for many years the inhabitants of the Roman provinces were exposed to devastating raids by the Picts and Scots. *See* STRATHCLYDE. They were finally conquered in 846 by Kenneth (*q.v.*) MacAlpine.

PICUS, the Latin name of the woodpecker. This bird being sacred to Mars was widely reverenced in ancient Italy. Occasionally Picus is met with as a minor deity, associated with Faunus, as in the (late and artificial) legend of Picus, Faunus and their capture by Numa, Ovid, *Fast.*, iii, 291 ff. Like many of the minor deities, Picus was rationalized into an ancient king, and a pedigree was made out as follows: Saturnus (*q.v.*), Picus, Faunus (*q.v.*), Latinus (*e.g.* Virgil, *Aen.*, vii. 45–49). Hence, in various late accounts (*a*) as Saturnus was identified with Cronus, Picus was made equivalent to Zeus; *see* Halliday in *Class. Rev.*, xxxvi. p. 110 (1922). (*b*) For some unknown reason, Varro (*ap.* Augustine, *de ciuit. Dei*, xviii., 15) interpolated into the genealogy, as father of Picus, Stercutius (Sterces, Sterculius, the spirit of manuring fields). (*c*) Picus is confused with Picumnus, a minor deity worshipped along with Pilumnus the spirit of the pestle (*pila*) (Nonius Marcellus, p. 834, Lindsay, citing Macer). (*d*) Ovid tells a romantic story to the effect that Picus loved a nymph Canens ("the Singer"), repulsed the advances of Circe (*q.v.*) and was turned by her into a woodpecker (*Met.*, xiv. 312 ff.). This seems to be Ovid's own invention; most authors (as Virgil, *Aen.*, vii. 189, Plutarch, *quaest. Rom.* 21) who tell the story of the metamorphosis, say Circe was his wife.

See Carter in Roscher's *Lexikon,* art. "Picus."

PIDDOCK, a bivalve mollusc which bores into chalk cliffs below the low-water line. Piddocks belong to the genus *Pholas,* of the class Lamellibranchia (*q.v.*), and are remarkable in being phosphorescent. (*See* PHOSPHORESCENCE: *Animal.*) The shell is curiously shaped in adaptation to their boring habit.

PIDGIN ENGLISH, the *lingua franca* of the seaports of China and the Straits Settlements, a jargon, mainly of corrupted English words following Chinese idiomatic usage. It is employed as a means of communication between foreigners and Chinese. "Pidgin" is the Chinese corruption of "business."

PIECE-OF-EIGHT, an obsolete Spanish coin, properly the *piastre* or *peso,* commonly also called a dollar, coined of silver, and divided into eight *reals,* whence "piece-of-eight." Its value was four shillings. In 1797, when the Bank of England suspended payment, millions of these coins were put into British circulation, countermarked with a small oval bust of George III. The piece-of-eight was current in the Spanish-American colonies.

PIECE-WORK, a term used to describe the method of industrial remuneration in which the worker is paid by the piece or job. In practice, where piece-work is arranged in trades that are organized, the payment per unit of work is arranged by negotiation between the employers and employed, as for example, in the English cotton industry. Very often the agreements arrived at

are extremely complicated, with various percentage variations upon a basic rate, so that the expression of piece-rate becomes very difficult for one outside the industry to understand. Agreements as to piece-work are often subject to a minimum wage arrangement. *See* Wage Systems in Industry.

PIEDMONT (pĭ-ăd'mŏnt), is a territorial division of north Italy, enclosed on all sides except towards the Lombard plain by the vast semicircle of the Pennine, Graian, Cottian, Maritime and Ligurian Alps. In 1859 it was divided into the four provinces of Alessandria, Cuneo, Novara and Torino (Turin) to which Aosta and Vercelli were added in 1927. It has an area of 11,340 sq.m. The people are chiefly engaged in agriculture—which is helped by irrigation. In 1927, the products were:

	Area	Tons
Wheat	833,000	461,800
Rye	124,000	56,980
Oats	41,000	22,040
Rice	169,400	362,580
Maize	373,250	297,700
French beans	87,000	18,660
Sugar beet	3,000	31,060
Hemp	7,100	2,270
Garden produce	10,250	58,760
Potatoes	73,500	211,500
Cocoons	.	6,270
Hay		2,668,100
Vines	703,750	651,600 (grapes) 8,087,000 (wine—gallons)
Fruits (various)		114,170
Chestnuts	263,375	59,980

Many are also occupied in the reeling and throwing of silk and in the manufacture of cotton (no fewer than 50,000 workers, of whom 37,000 are women), woollens and clothing; there are also considerable manufactures at Turin, Savigliano, etc. The Piedmontese dialect has been rather strongly influenced by French. The total population of Piedmont was in 1901 3,407,493, in 1921, 3,527,847. There are numerous summer resorts in the Alpine valleys. The chief railway centres are Turin, communicating with the Mont Cenis line, and with the Riviera by the railway over the Col di Tenda (in process of construction). The communications with Liguria are difficult owing to the approach of the mountains to the coast, but the electrification of the lines from Genoa to Turin and Milan has greatly improved the travelling facilities of this region.

Piedmont (Ital. *Piemonte;* Low Lat. *Pedemons* and *Pedemontium*), in Roman times until 49 B.C. formed a part of Gallia Transpadana, and in Augustus's division of Italy formed with what was later known as Lombardy the 11th region. It formed part of the Lombard kingdom, and it was not till about A.D. 1000 that the house of Savoy (*q.v.*) arose.

See E. Reynolds-Ball, *Unknown Italy: Piedmont and the Piedmontese* (London, 1927); D. Gribaudi, *Il Piemonte nell' antichità classica* (Turin, 1928).

PIEDMONT, a residential city of California, U.S.A., on the heights adjoining Berkeley and Oakland. It has few shops and no factories, and its building regulations prohibit the construction of multiple dwellings. The population was estimated locally at 9,000 in 1928.

PIEDRAS NEGRAS, formerly Ciudad Porfirio Díaz, a northern frontier town of Mexico in the State of Coahuila, 840m. N. by W. from Mexico City, on the Río Grande del Norte, 720ft. above sea-level, opposite the town of Eagle Pass, Texas. Pop. (1921) 14,233. An international bridge connects the two towns, and the Mexican International railway has its northern terminus in Mexico at this point. The town has an important transfer trade with the United States, and is the centre of a fertile district devoted to agriculture and stock-raising. Coal is found in the vicinity. The Mexican Government maintains a custom-house and military post here. The town was founded in 1849.

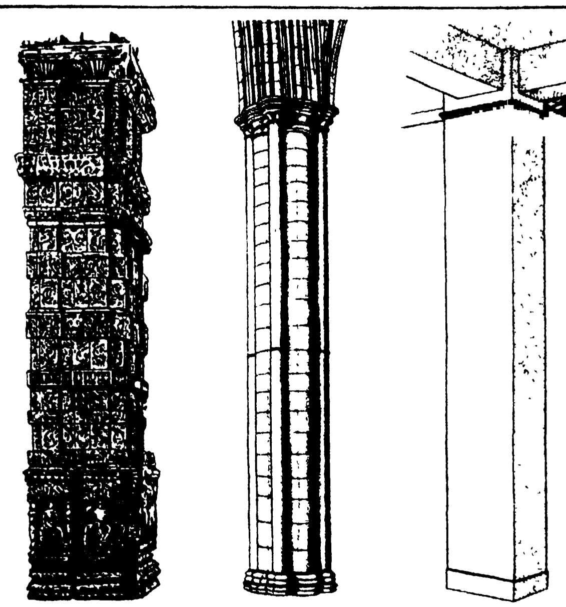
PIENZA, a town of Tuscany, Italy, in the province of Siena, 9 m. west of the town of Montepulciano by road, 1611 ft. above sea-level. Pop. (1921), 1,391 (town); 3,914 (commune). The place was originally called Corsignano and owes its present name to Aeneas Silvius Piccolomini, Pope Pius II. (*q.v.*) who was born here in 1405. The buildings which he caused to be erected by Bernardo Rossellino in 1460–1463 form a noble group of early Renaissance architecture round the Piazza del Duomo. The latter retains Gothic details in the interior, but the facade is simple Renaissance work. The other three sides are occupied by the episcopal and municipal palaces, and the Palazzo Piccolomini; the last, resembling the Palazzo Rucellai at Florence, is the finest, and is well furnished: in front of it is a beautiful fountain, and opposite it the fine Palazzo Ammannati. The canons' house contains a museum with some fine ecclesiastical vestments including an excellent 13th century cope of English origin, and enamels.

PIER. In architecture (*q.v.*) it usually denotes a vertical support in masonry, brickwork or concrete which carries an arch or superstructure. In this sense it is applied both to those portions of a structure which are visible above ground and to isolated or detached supports underground described as foundation piers. The term is sometimes applied to the solid parts of a wall between windows or voids, and also to the isolated masses of brickwork, masonry or concrete to which gates are hung.

Bridge Piers.—In the construction of bridges (*q.v.*) and viaducts, *pier* denotes the solid structure upon which the bridge superstructure (including arches) is supported. Occasionally in the case of high piers supporting viaducts and bridge superstructures the upper portions are constructed of open-braced iron- or steel-work.

Foundation piers for bridges are formed of solid masonry, brickwork or concrete and, sometimes, reinforced-concrete is employed for the purpose. In places where timber is abundant, as in some parts of the United States and Canada, wooden cribs filled with rubble stone or concrete have been used for raising the foundations of piers out of water.

Special provisions must be made for the foundations of piers where the ground is soft for some depth, or loose water-bearing strata are encountered, and especially where the piers of large



Indian Compound Brahmanical Temple Gwalior

English Gothic Salisbury Cathedral

Modern Concrete

Three types of pier used in architecture

bridges crossing rivers have to be constructed under water. Among the means employed in these situations are steel and iron cylinders, wells, caissons, bearing piles or some form of coffer-dam within which the foundations may be constructed. (*See* Caisson, Foundations, Coffer-dam.)

Piles are sometimes employed to provide both the foundations and the piers carrying a structure of viaduct character. Thus screw piles, having wide bearing-blades of cast-iron in the form of

a screw-thread turned about a central shaft or column of cast-iron or steel, are sometimes sunk through soft strata till they reach a firm bed, or one sufficiently consolidated by the superincumbent layers to enable it to support the weight imposed on the broad blades. Hollow, cast iron, cylindrical piles with a broad circular disc at the bottom to increase their bearing surface, have also been used for piers founded in sandy or silty strata of considerable thickness. They are sunk by hydraulic jetting, *i.e.*, the scouring away of the soft material from under the disc by means of a jet of water emitted under high pressure from a pipe lowered within the pile. Water jets are also employed to facilitate the sinking of screw and other forms of piles. (*See* FOUNDATIONS.)

Harbour Piers.—The term pier is often applied to works sheltering harbours such as the Tynemouth piers which are strictly breakwaters (*q.v.*). Landing stages also, whether solid or open, have for a long time been called piers, as the Admiralty pier and the Prince of Wales' pier at Dover, the former essentially a breakwater with provision for berthing vessels and landing passengers on its sheltered side. The jetties (*q.v.*) thrown out from the shore to protect the entrance to a river harbour are also sometimes described as piers. In North America the term is commonly employed for a wharf structure that projects into a river, fairway or harbour.

Promenade Piers.—Open promenade piers form a common feature at seaside resorts. Promenade piers are usually supported on open pile work of timber, cast iron or steel, but in recent years, reinforced concrete has been frequently employed both for the pile supports and superstructure. The open construction exposes little surface to waves or storms and does not interfere with the drift of shingle and sand along the coast. It is essential that the beams or girders carrying the deck of a promenade pier should be at an elevation well above the level of the crest of the highest wave. Timber piles are best suited for withstanding the shocks of vessels at landing stages, at which places they are generally used. In the case of reinforced-concrete landing stages, a falsework of timber is sometimes constructed in front of the main structure for this purpose. Screw piles are frequently used for promenade piers on sandy foreshores.

The pioneer of promenade piers in England was the old chain pier at Brighton, erected in 1822–3. It was founded on oak piles, was 1,136 ft. long and was destroyed by a gale in Dec. 1896. The length of promenade piers depends mainly on the distance from the shore at which sufficient depth is reached for steamers. Thus piers at Southend (Essex) and Southport (Lancs.) have been constructed across the wide sands in the estuaries of the Thames and Ribble respectively; the former over 1¼ m., the latter nearly a mile in length.

Works on bridge and other foundations are noted at the end of the article CAISSON. (N. G. G.)

In Architecture.—A pier in architecture is a vertical support carrying arches, a vault, a floor or a roof; especially one rectangular in plan; also, in mediaeval work, any support between the nave and aisles of a church. During the late Roman imperial period, pier design was carefully studied and in connection with such buildings as the basilicas, cross-shaped and other compound piers were developed to carry the cross arches and the groins or intersections of the vaulting. With the increasing use of vaulting for church naves and aisles, during the 11th and 12th centuries, pier design was still further developed. Although in England Norman piers are frequently great round columns, on the continent of Europe piers became common in which each arch or vaulting rib above was carried by a separate member of the pier. The earliest logical expression of this idea is found in Italian Lombard work, where a square pier has frequently an engaged column attached to each face; the one on the nave side carrying the cross-rib of the nave vault, that on the aisle side carrying the aisle vault cross-rib, and those on the other two sides carrying the pier arches between nave and aisles.

During the later Romanesque, pier plans were further complicated by the addition of smaller members to carry the subsidiary mouldings of the arches above, and larger members to carry the diagonal vaulting ribs. (*See* BYZANTINE AND ROMANESQUE ARCHITECTURE.) During the 13th and 14th centuries the piers of French Gothic churches were kept comparatively simple in plan, with great importance given to the capital at the level of the spring of the pier arch. Often it took the shape of a circular column with a few, large, simple attached vaulting shafts, as in Rheims cathedral (*c.* 1240). Toward the end of the 14th century, perhaps due to English influence, the column idea disappeared and was replaced by the more logical plan in which the pier was elaborately membered, not only by the additional development of vaulting shafts, but by breaking up the edges with projecting mouldings under the mouldings of the arches. Capitals became of less importance and vaulting shafts were carried unbroken through from floor to vault spring, capitals being placed merely on the separate mouldings of each arch or rib.

During the Flamboyant period this development was carried to its logical extreme; capitals were omitted entirely, and the pier plan became the combination of the various arch and vault rib mouldings continued down to the floor. Against this complexity a reaction was inevitable, and the other type of French Flamboyant pier developed, with smooth surface, either circular or wavy in plan, with the various vault rib and arch mouldings carried by the pier merely dying into it at their intersections. In England, during the Early English period, although circular piers are occasionally found, they were more frequently surrounded by entirely independent colonnettes, often of black Purbeck marble, which act as vaulting shafts and are tied to the body of the pier only at intervals by horizontal through stones with moulded edges. During the Decorated period attached shafts continued in use but the surfaces of the central core appearing between them were often richly moulded, and, in some cases, detached shafts disappeared entirely and the pier became a solid mass with surfaces lavishly moulded with strong projecting high lights and deeply cut shadows.

In the late Decorated period mouldings of the pier were sometimes the same as those of the arch above and capitals were omitted. This arrangement became much more frequent during the Perpendicular period. Pier-moulding profiles were softened and flattened like other mouldings of the period. (*See* GOTHIC ARCHITECTURE.) With the coming of the Renaissance pier design was much simplified, returning to the generally cross-shaped or twelve-cornered systems found in late Roman work, with all the projecting members treated either as classic imposts, engaged columns or pilasters.

Technically, the word pier is also applied to the solid portions of a wall between windows or other openings; and to the vertical posts at gateways, to which the gates are hung. The word pier is used of structures of timber or masonry projecting from a quay or sea wall and used either for loading and unloading ships, or in the case of summer resorts, for furnishing promenade space into the water. In America the word is loosely used synonymously with dock or landing stage.

PIERCE, FRANKLIN (1804–1869), fourteenth president of the United States, was born at Hillsboro, New Hampshire, Nov. 23, 1804. His father, Benjamin Pierce (1757–1839), served in the American army throughout the Revolutionary War, was a Democratic member of the New Hampshire house of representatives from 1789 to 1801, and was governor of the State in 1827. The son was prepared for college at Hancock, Francestown and Exeter academies and entered Bowdoin in 1820, where he formed a lifelong friendship with Nathaniel Hawthorne. After his graduation in 1824 he studied law and was admitted to the bar in 1827.

Entry into Politics.—Entering politics as a Democrat he became a member of the New Hampshire house of representatives in 1829, and was speaker of that body in 1831 and 1832. The following year he entered the national house of representatives. While he rarely spoke from the floor, he was an influential member of several committees, including the judiciary committee. A friend of President Jackson he supported administration policies. He adhered to a strict construction of the Federal Constitution, defended the Maysville veto, opposed the recharter of the bank of the United States, opposed appropriations to the U. S. military academy and favoured a volunteer army. During

his first term in Congress he married Jane Means Appleton, daughter of the president of Bowdoin college. In 1837 he entered the U.S. Senate. Being its youngest member, he was overshadowed by a galaxy of older and more prominent men such as Benton, Clay and Webster. Before his term expired he resigned his seat (1842) and returned to the practice of law at Concord, N.H., where he became Federal district attorney. In 1845 he was offered the Democratic nomination for governor of New Hampshire, also an appointment to fill an unexpired term in the U.S. Senate, and the next year the position of attorney-general in Polk's cabinet; but he rejected them all, declaring that he had permanently retired from political life.

Service in Mexican War.—Shortly after the outbreak of the war with Mexico in 1846 Pierce enlisted as a private at Concord, but soon became colonel of the 9th Regiment, and later a brigadier-general of volunteers. He was with Gen. Scott in the advance toward Mexico City. During the battle of Contreras he was thrown from his horse and received painful injuries. Despite the advice of Scott to the contrary he insisted on continuing the fight the next day and in the course of the battle he fainted. This fact, variously interpreted, was used both for and against him when he was later a candidate for the presidency. At the close of the war he returned to his law practice.

Election to Presidency.—Pierce became the Democratic nominee for president in 1852 "as a dark horse." Those in the foreground were Lewis Cass, Stephen A. Douglas and James Buchanan, but none of these proved to be available because of factional rivalries. A few politicians, foreseeing a deadlock, had prepared Pierce for the place. At the convention in Baltimore in June his name was first brought forward by the Virginia delegation on the 35th ballot, and on the 49th ballot he received an almost unanimous vote. Both the Democrats and the Whigs were too badly split for any real issues to appear in the campaign. The chief question in the public mind was the finality of the Compromise of 1850, and while both parties declared themselves in favour of it the Democrats were more thoroughly united in its support. As a result Pierce swept the country in the November election, receiving 254 electoral votes against 42 for his opponent, Gen. Winfield Scott.

Presidential Administration.—The youngest man to have been elevated to the presidency, Pierce was handsome, genial and possessed of a certain brilliance, which however was not profound. The Eastern element of the Democratic party which he directly represented was inclined for the sake of harmony and prosperity to oppose anti-slavery agitation and generally to placate Southern opinion. It was hence pro-Southern as a matter not only of political strategy but also of business expediency. Thus in the selection of his cabinet, as in both domestic and foreign policies of his administration, Pierce represented a coalition of Southern planters and Eastern business men. His cabinet included William L. Marcy of New York, secretary of state; Jefferson Davis of Mississippi, secretary of war; James Guthrie of Kentucky, secretary of the treasury; James C. Dobbin of North Carolina, secretary of the navy; Robert McClelland of Michigan, secretary of the interior; James Campbell of Pennsylvania, postmaster-general; and Caleb Cushing of Massachusetts, attorney-general. In his inaugural address Pierce interpreted his election as a popular mandate to maintain the Compromise of 1850 and bury the slavery controversy. He also forecast an aggressive, but honourable, foreign policy; he would "not be controlled by any timid forebodings of evil from expansion." In fact "the acquisition of certain possessions" (doubtless referring to Cuba in particular) was deemed essential to the country's safety and commerce.

Foreign Policy.—In accordance with the declarations of the inaugural Pierre Soulé, who had openly advocated the annexation of Cuba by means other than purchase if necessary, was appointed minister to Spain. When the Spanish Government showed its unwillingness to sell the island, Soulé, at the suggestion of secretary of State Marcy, held a conference with James Buchanan, minister to Great Britain, and John Y. Mason, minister to France, at Ostend, Belgium, as a result of which they issued the famous Ostend Manifesto. This was to the effect that if the United States were unable to obtain Cuba peacefully, "by every law, human and divine, we shall be justified in wresting it from Spain if we possess the power." In the storm of controversy which followed, the administration disclaimed responsibility for the document and recalled Soulé. The following year William Walker conducted a notorious filibustering expedition into Central America with the purpose of establishing a pro-slavery government to be brought under the control of the United States. He established himself as military dictator, then as president, of Nicaragua, and his regime was recognized by the Pierce administration. More fruitful of permanent results was the expedition sent out under Commodore Perry to Japan (1853) to induce her to open her doors to American trade. Lured by Yankee ingenuity and frightened by Western guns, she responded, and the result was the opening up of Japan. In the Koszta affair (1853) the government vigorously asserted the protection which it would offer those in the process of becoming its naturalized citizens. The administration also effected a reorganization of the diplomatic and consular service and the creation of the U.S. court of claims.

Domestic Policy.—Among the domestic policies of the Pierce administration were preparations for a transcontinental railroad and the opening up of the Northwest for settlement. It was in order to open the way for a southerly route to California through the lowest mountain passes that the Gadsden Purchase of 50,000 sq.m. of territory was acquired from Mexico in 1853 at a cost of $10,000,000. It was mainly to stimulate migration to the Northwest and facilitate the project of a central route to the Pacific that the Kansas-Nebraska bill was enacted in 1854, receiving the President's sanction. This opened two new territories for settlement with the slavery question to be settled in each by popular sovereignty. Thus the dread conflict was reawakened with the venom of incipient civil war. Pierce's administrative policies with reference to "bleeding Kansas" were pro-Southern. He thus lost much of his former support at the North and made himself unavailable as a candidate for a second term.

Save for a three years' tour in Europe, he lived at Concord, N.H., where he died on Oct. 8, 1869.

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PIERO DI COSIMO (1462–1521), the name by which the Florentine painter Pietro di Lorenzo is generally known. He was born in Florence in 1462, and worked in the *bottega* of Cosimo Rosselli (from whom he derived his popular name). He had the gift of a fertile fantastic imagination, which, as a result of his journey to Rome in 1482 with Rosselli, became directed towards the myths of classic antiquity. In Rome he assisted his master with the frescoes in the Sistine chapel. He proves himself a true child of the Renaissance in such pictures as the "Death of Procris," at the National Gallery, the "Mars and Venus," at the Berlin Gallery, the "Perseus and Andromeda" series, at the Uffizi in Florence, and the "Hylas and the Nymphs," of the late Benson collection. The "Immaculate Conception," at the Uffizi, and the "Holy Family," at Dresden, are good examples of his religious pictures. Piero was distinguished for his landscapes and their cheerful accessories. The only known portraits that can be definitely ascribed to him are, at the National Gallery, the so-called "Bella Simonetta," at Chantilly, the portraits of Giuliano di San Gallo and his father, at The Hague, and a head of a youth, at Dulwich. Vasari related that Piero excelled in designing pageants and triumphal processions for the pleasure-loving youths of Florence. Piero di Cosimo exercised considerable influence upon his fellow pupils Albertinelli and Bartolommeo della Porta and was the master of Andrea del Sarto. Examples of his work are also to be found at the Louvre in Paris, the Liechtenstein collec-

tion in Vienna, the Borghese and Corsini Galleries in Rome, the Berlin Museum, the Spedale degli Innocenti in Florence, and in the collections of Burke in London and Cornwallis West in Newlands Manor.

See Vasari *Vite;* F. Knapp, *Piero di Cosimo* (Halle, 1899); H. Haberfeld, *Piero di Cosimo* (Breslau, 1901).

PIERRE, the capital city of South Dakota, U.S.A., and the county seat of Hughes county; in the centre of the State, on the east bank of the Missouri river opposite the mouth of Bad river, at an altitude (at the State capitol) of 1,496 ft. It is on Federal highways 14 and 83; has a municipal airport; and is served by the Chicago and North Western railway. Pop. (1925 State census) 3,560. Four miles north of the city is a monument marking the geographical centre of the State and the approximate centre of North America. The State capitol (erected 1905–10) is a beautiful building 292 ft. long by 124 ft. wide and 161 ft. high to the top of the lantern. Near the capitol is an artificial lake, fed from an artesian well by water which never freezes, where swans, geese and wild ducks live the year round. The city owns more than a mile of river frontage, and its parks include a wooded island of 1,000 acres. Artesian wells supply the city not only with water but also with natural gas of high heating content. Pierre is the seat of a government Indian school and of Northern college (Christian; established 1927). The State Historical Museum (in the capitol) has many interesting relics, including a leaden plate, buried in 1743 by La Vérendrye on a hill across the river (within the present city of Fort Pierre) to claim the country for France, and discovered by high school children in 1913. Pierre is an important shipping point and centre of wholesale and jobbing interests. It has railroad shops, granite works and other manufacturing industries. The first permanent settlement by white men in South Dakota was made in 1817 by Joseph La Framboise, a fur trader, just below the mouth of Bad river. He called his post Ft. Teton. In 1822 Ft. Tecumseh was built 2 m. up-stream; and in 1832, when its site was washed into the river, Ft. Pierre Chouteau was erected to take its place, a mile farther up-stream and a little back from the river. It was named after Pierre Chouteau, Jr. (1789–1865), who had in 1804 succeeded his father in the Missouri Fur Company, and for 20 years Ft. Pierre (as it soon came to be called) was the chief fur-trading depot of the Upper Missouri country. In 1855 the United States bought the building and other property of the post and laid out around them a military reservation of 270 sq.m. (abandoned in 1857) which was the headquarters of operations against the Sioux and the scene of a council with their chiefs. In the early days steamboats plied regularly on the Missouri river as far as Ft. Benton (Montana) 1,000 m. above Pierre. The first sermon in South Dakota was preached in 1840 by the Rev. Stephen R. Riggs, a missionary to the Dakota Indians, on a spot near the free wagon bridge across the Missouri which bears his name. The city was platted in 1880, incorporated as a village in 1883, and chartered as a city in 1900. One of the few surviving herds of buffalo in the United States is quartered in the river brakes 4 m. north of Fort Pierre.

PIERREFONDS, a town of northern France, in the department of Oise, 9 m. S.E. of Compiègne by road. Pop. (1926) 1,097. Pierrefonds has an 11th to 16th century church, and its mineral springs are in some repute. The famous château was begun in the late 14th century by Louis d'Orléans, to whom the domain was given by Charles VI., and finished early in the 15th century. It was later held by the Burgundians, the English and the adherents of the League, from whom it passed to Henry IV. It was dismantled in 1622. The ruins, bought by Napoleon I., were faithfully restored, by order of Napoleon III., in 1858–95, under the direction, first of Viollet-le-Duc and afterwards of E. Boeswillwald. The building is rectangular in shape, with a tower at each corner and at the centre of each of the walls. A lofty keep defends the principal entrances on the south-west.

PIERROT [Ital. *Pedrolino*], the name given to the leading character in the French pantomime plays since the 18th century; transferred from the Italian stage, and revived especially in recent times. He is always in white, both face and costume, with a loose and daintily clownish garb, and is represented as of a freakish disposition. Modern pierrot plays have converted the pierrot into a romantic and pathetic figure. (*See* PANTOMIME.)

PIETAS, in Roman mythology, the personification of the sense of duty towards God and man and towards the fatherland. According to legend, a young woman in humble circumstances, whose father (or mother) was lying in prison under sentence of death, without food, managed to gain admittance, and fed her parent with milk from her breast. To commemorate her filial affection, a temple was dedicated (181 B.C.) by Manius Acilius Glabrio to Pietas in the Forum Holitorium at Rome, on the spot where the young woman had formerly lived. The temple was probably originally vowed by the elder Glabrio out of gratitude for the *pietas* shown during the engagement by his son, who may have saved his life, as did the elder Africanus that of his father at the battle of Ticinus (Livy xxi. 46); the legend of the young woman (borrowed from the Greek story of Mycon and Pero, Val. Max. v. 4, ext. 1) was then connected with the temple by the identification of its site with that of the prison. Pietas is shown on coins as a matron throwing incense on an altar, her attribute being a stork. Typical examples of "piety" are Aeneas, and Antoninus Pius, who founded games at Puteoli in honour of Hadrian.

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PIETERMARITZBURG, the capital of Natal, South Africa, 29° 46′ S., 30° 13′ E.; altitude 2,218 feet. Though only 41 m. inland, it is 73 m. by rail from the port of Durban. The main town is laid out on a low ridge between the Umsundusi River and the Dorp Spruit. Suburbs have grown up on two other ridges across the river to the south-east of the town, and also on the slopes of a marked escarpment, which rises over 1,500 ft. above the town on the north-west side. The low ground between the ridges is occupied either by Indian dwellings and cultivation, or by open spaces, laid out as public parks and sports grounds, with which the city is very well provided. On the west of the town are the botanical gardens. There are memorials of the Zulu, South African and World Wars. The town was founded in 1839 by Dutch immigrants and connected by railway with Durban in 1880.

Among the public buildings are the town hall, containing a remarkably fine organ and a good collection of pictures, the Provincial Council building, the Colonial offices, the Court house, the post office and the museum, which has an exceedingly good collection of the South African fauna. The Voortrekkers' museum is housed in what used to be a Dutch church. The Natal Society library is also admirable. The city is the seat of an Anglican bishop. It is noted for its agricultural show, held every June. There is a large number of high schools for day pupils and boarders, both in the city and outside. In addition there is a training college and a university college, a constituent of the University of South Africa. Means of locomotion are provided by a tramway system, jinrikshas, and motor cars. In 1921 the population included 9,992 natives, 6,944 Asiatics, 1,089 coloured people and 17,998 Europeans. The latter had increased by 1926 to 19,748.

PIETERSBURG, chief town of the Pietersburg district of the Transvaal, 177 m. by rail N.N.E. of Pretoria: altitude, 4,269 ft. Pop. (1921) 2,452 whites, 3,325 natives, 183 Asiatics and 103 coloured: total 6,063. The surrounding country contains minerals. To the east are the Klein Letaba and other low country goldfields; to the west are the Waterberg goldfields. Asbestos, tin and corundum also occur, the latter being exported in fair quantity. Cereals, tobacco, cotton and groundnuts are cultivated and towards the east, citrus estates have developed.

PIETERS HILL, 10 miles S.S.E. of Ladysmith, has given its name to the fourth and finally successful British attempt to relieve Ladysmith at the end of Feb. 1900 (*see* LADYSMITH and SOUTH AFRICAN WAR). Buller, having tried a frontal attack and two attacks on the right of the Boer lines, now resolved to assail their left, and the operations opened with the successful storming of their positions on the south bank of the Tugela east of Colenso, which fell into British hands after six days of methodical

fighting. Thereafter Buller drew back the bulk of his force to the north bank, its next objective being the group of hills immediately north of Colenso. On Feb. 27, the British right wing captured Pieters Hill, the northern buttress of the ridge, and next day Buller's cavalry entered Ladysmith, which had stood a four months' siege.

PIETISM, a movement in the Lutheran Church, which arose towards the end of the 17th and continued during the first half of the following century. The name of Pietists was given to the adherents of the movement as a term of ridicule, like that of "Methodists" somewhat later in England. The Lutheran Church had continued Melanchthon's attempt to construct the evangelical faith as a doctrinal system; and it appeared to many faithful adherents to have become a creed-bound theological and sacramentarian institution, where the dogmatic formularies of the Church had usurped the position which Luther himself had assigned to the Bible alone. The influence of the Reformed Church (*q.v.*) on the other hand, in spite of the predestinarianism of Calvin, made less for doctrine than the practical formation of Christian life. The Presbyterian constitution gave the people a share in church life which the Lutherans lacked, but it involved a dogmatic legalism which imperilled Christian freedom and fostered self-righteousness.

The direct originator of the movement for the revival of a practical and devout Christianity was Philip Jacob Spener, who combined the Lutheran emphasis on Biblical doctrine with the Reformed tendency to vigorous Christian life. Born at Rappoltsweiler in Alsace on the 13th of January 1635, trained by a devout godmother, who used books of devotion like Arndt's *True Christianity*, accustomed to hear the sermons of a pastor who preached the Bible more than the Lutheran creeds, Spener was early convinced of the necessity of a moral and religious reformation of the German Church. He studied theology, with a view to the Christian ministry, at Strassburg and entered upon his first pastoral charge at Frankfort-on-the-Main, profoundly impressed with a sense of the danger of the Christian life being sacrificed to zeal for rigid orthodoxy. Pietism, as a distinct movement in the German Church, was then originated by Spener by religious meetings at his house (*collegia pietatis*), at which he repeated his sermons, expounded passages of the New Testament, and induced those present to join in conversation on religious questions that arose. They gave rise to the name "Pietists." In 1675 Spener published his *Pia desideria*, or *Earnest Desires for a Reform of the True Evangelical Church*. In this publication he made six proposals as the best means of restoring the life of the Church: (1) the earnest and thorough study of the Bible in private meetings, *ecclesiolae in ecclesia;* (2) the Christian priesthood being universal, the laity should share in the spiritual government of the Church; (3) a knowledge of Christianity must be attended by the practice of it as its indispensable sign and supplement; (4) instead of merely didactic, and often bitter, attacks on the heterodox and unbelievers, a sympathetic and kindly treatment of them; (5) a reorganization of the theological training of the universities, giving more prominence to the devotional life; and (6) a different style of preaching, namely, in the place of pleasing rhetoric, the implanting of Christianity in the inner or new man, the soul of which is faith, and its effects the fruits of life. This work produced a great impression throughout Germany, and although large numbers of the orthodox Lutheran theologians and pastors were deeply offended by Spener's book, its complaints and its demands were both too well justified to admit of their being point-blank denied. A large number of pastors at once practically adopted Spener's proposals. In Paul Gerhardt the movement found a singer whose hymns are genuine folk poetry. In 1686 Spener accepted an appointment to the court-chaplaincy at Dresden, which opened to him a wider though more difficult sphere of labour. One of his most enthusiastic disciples was August Hermann Francke, who had founded the famous orphanage at Halle, and with the aid of Christian Thomasius and Spener founded the new university there. The theological chairs were filled in conformity with Spener's proposals. Spener died in 1705; but the movement, guided by Francke, spread over Middle and North Germany. One of its greatest achievements was the organization of the Moravian Church in 1727 by Count von Zinzendorf, Spener's godson and a pupil in the Halle Orphanage.

Pietism, of course, had its weaknesses. Many Pietists maintained that the new birth must always be preceded by agonies of repentance, and that only a regenerated theologian could teach theology, while the whole school shunned all common worldly amusements, such as dancing, the theatre, and public games. There thus arose a new form of justification by works.

As a distinct movement Pietism had run its course before the middle of the 18th century; by its very individualism it had helped to prepare the way for another great movement, the Illumination (*Aufklärung*).

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PIETRO DELLA VIGNA or **PIER DELLE VIGNE** [Petrus de Vineas or de Vineis] (*c.* 1190–1249), chancellor and secretary to the emperor Frederick II., born at Capua in humble circumstances, studied law at Padua. He became secretary to Frederick II., who made him *judex magnae curiae*, councillor, governor of Apulia, prothonotary and chancellor. The emperor, "of whose heart he held the keys," as Dante says, sent him to Rome in 1232 and 1237 to negotiate with the pope, to Padua in 1239 to induce the citizens to accept imperial protection, to England in 1234–35 to arrange a marriage between Frederick and Isabella, sister of King Henry III. He proved a skilful and trustworthy diplomat, and he persistently defended the emperor against his traducers and against the pope's menaces. At the Council of Lyons Pietro della Vigna entrusted the defence of his master to the jurist Taddeo of Suessa, who failed to prevent his condemnation. Frederick had his chancellor imprisoned and blinded without giving him a chance to rebut his accusers. He is said to have committed suicide in his prison at Pisa in 1249. His tragic fate gave rise to many legends.

Pietro della Vigna wrote verse in the vernacular tongue, of which two *canzoni* and a sonnet are extant. His letters (*Epistolarum libri vi.*, 2 vols., Basel, 1740), are of historical value. A collection of the laws of Sicily, a *Tractatus de potestate imperiali*, and another treatise, "On Consolation," in the style of Boëthius, are also attributed to him.

See Huillard-Bréholles, *Vie et correspondance de Pierre de la Vigña* (Paris, 1864); Presta, *Pier delle Vigne* (Milan, 1880); Capasso and Ianelli, *Pier delle Vigne* (Caserta, 1882); *see* also Frederick II.

PIG (a word of obscure origin, connected with the Low Ger. and Dut. word of the same meaning, *bigge*), a common name given to the domestic swine. (For the zoology, *see* Swine.)

British Breeds.—Twelve breeds are recognised in Britain:—

The *Large White* or large Yorkshire is a breed which has been evolved in the north of England and is now very wide-spread and important. The animals are large, long and deep and when young, even if heavily fed, do not readily become too fat. The head is long, light in the jowl, and wide between the eyes, with long thin ears inclined slightly forward and fringed with long fine hair. The neck is long, but not coarse, the ribs are deep, the loin wide and level, the tail set high, and the legs straight and set well outside the carcass. The whole body, including the back of the neck, is covered with straight silky hair, which denotes quality and lean meat. Pigs of this breed are very prolific, and they may be grown to enormous weights—over 11 cwt. alive.

The *Middle White* is considered to have been produced by crossing the Large White and the now extinct Small White. The latter was a small early maturing and excessively fat type of pig. The Middle Whites are built on a smaller scale than the Large Whites. They are shorter in the heads and legs, and fuller at the jowl, thicker and more compact in the body. The sows are not quite as prolific as those of the Large White breed, but, as their

produce matures earlier, they are much in demand for breeding porkers. If fed to heavy weights the animals become too fat.

The *Lincolnshire Curly Coated* or *Boston* pig is a local breed of great size and capacity for producing pork. It is very hardy and prolific, but somewhat coarse in the bone. It has an abundance of long curly hair, a short face and a straight nose, and the ears, not too long and heavy, fall over the face. It crosses well with the Large White, the Large Black and the Berkshire.

The *Large Black* breed, which vies with the Large White breed for size, has only since 1900 received national show-yard recognition; but there is ample evidence that, with its characteristic whole black colour with a mealy hue, length, fine hair and lop ear, the Large Black existed in the south of England for generations. It has been continuously and carefully bred in Cornwall, Devon, Essex and Suffolk, and from these centres it has rapidly spread all over the country. Large Blacks are exceedingly docile, and the ears, hanging well forward over the eyes, contribute materially to a quietness of habit which renders them peculiarly adapted to field grazing. On account of their hardiness and disposition to early maturity they have proved valuable for crossing. The Large Black Pig Society was incorporated in 1899.

The *Berkshire* is a black pig with a pinkish skin, and a little white on the face, pasterns, and tip of the tail. It has a moderately short head with a deep, compact carcass, and wide, low and well-developed hind-quarters, with heavy hams. The skin carries an abundance of fine hair. The Berkshire is an early-maturity breed which has been somewhat inbred, and is not so hardy and prolific as most breeds. The boars cross well with common stock. The breed produces meat of outstanding quality and is extremely difficult to beat in carcass competitions; it does best when fed for the pork market.

The *Tamworth* is one of the oldest breeds of pigs and is considered to be directly descended from the wild native pig. The colour is red or chestnut. The head, body and legs are long, and the ribs deep and flat. Originally a local breed in the districts around the Staffordshire town from which it takes its name, it is now extensively bred, and highly valued as a bacon pig.

The *Cumberland* is a pig of the Large White type. It is, however, shorter and thicker in form; it has a dished face and drooping ears. The hair is fine and sparse. The breed fattens readily and the pork is of good quality.

The *Long White Lop-Eared* was formed by amalgamating the Old Glamorgan and Welsh breeds, which were of a similar type. The general conformation is very similar to that of the Large Black. The animals are hardy and they do well in the open air.

The *Large White Ulster* is of the Large White type but compared with that breed it is shorter in the body, finer in the hair, thinner in the skin and possesses drooping ears. It is very suitable for the bacon trade and is kept in Ulster practically to the exclusion of all other breeds.

The *Gloucestershire Old Spots* is an old local type which was constituted as a pure breed in 1914. The breed is rather thicker in form than is the Large White. The colour is black and white in fairly large clearly defined spots. The head is of medium length; the ears are long and drooping. The animals are hardy and they are very suitable for the heavy pork trade.

The *Wessex Saddleback* and the *Essex* are two breeds of very similar conformation and colour markings. The colour is black with a white "saddle" and white fore-legs. The Essex also has white on the hind legs, the tail and the nose. The animals are of medium size and are considered to be hardy.

Management.—The brood sow should be lengthy and of a prolific strain, known to milk well. She is moderately fed and put to a boar of her own age when large enough, *i.e.*, seven to eight months old. She remains in a state of oestrum for about three days, and if not pregnant comes in heat again in three weeks. Breeding swine, male and female, run most of their time at pasture and receive a liberal allowance of green food or raw roots. The period of gestation is sixteen weeks. Six to eight pigs are reared of the first litter, and ten to twelve afterwards. Many brood sows are fattened to greatest profit after the second or third litter, but on the other hand the animals may be kept as long as they are satisfactory breeders. Two litters are produced in one year, as pigs are usually weaned at two months old, and the sow will take the boar at from three days to a week after the pigs are removed, according to condition.

The digestive system of the pig is not fitted to deal with fibrous or bulky fodders and the food should be highly concentrated. In practice pigs are fed largely on dairy by-products such as whey and separated milk, milling offals, cereal meals, waste potatoes and kitchen scraps. Pigs do well on mixtures of milk products and cereal meals or offals. If no milk or whey is available the meals or potatoes should be balanced with 10% of white fish meal or meat meal or other foodstuff rich in albuminoids. Kitchen scraps should be cooked and the fat skimmed off before being given to pigs. Potatoes are best fed in a cooked condition. Chalk and other mineral matter are often added.

Every endeavour should be made to provide young pigs with some milk or milk product for a time after weaning. Fattening pigs should be given from ⅕ to ¼ lb. of mixed cereal meals, or their equivalent of other foods, for every week of age. Thus at 12 weeks the pig should get about 2½ lb. of dry meal or its equivalent per day; at 20 weeks, about 4½ lb.; at 30 weeks, about 7½ lb. Another rough rule is to give 1 lb. of meal for every 25 lb. live weight. With dry food, water will of course have to be available. Sows in pig require about 5 lb. of meal or its equivalent per day; sows in milk need 10 or 12 lb. It is usual to spread the ration over three meals per day.

Porker pigs are frequently slaughtered when about 4½ months old and 100 lb. live weight; they yield about 65 lb. of dressed carcass. Many pigs are, however, marketed for pork at much greater weights. A typical bacon pig should weigh about 220 lb. live weight or 165 lb. carcass weight and should be ready for slaughter when 7–8 months old.

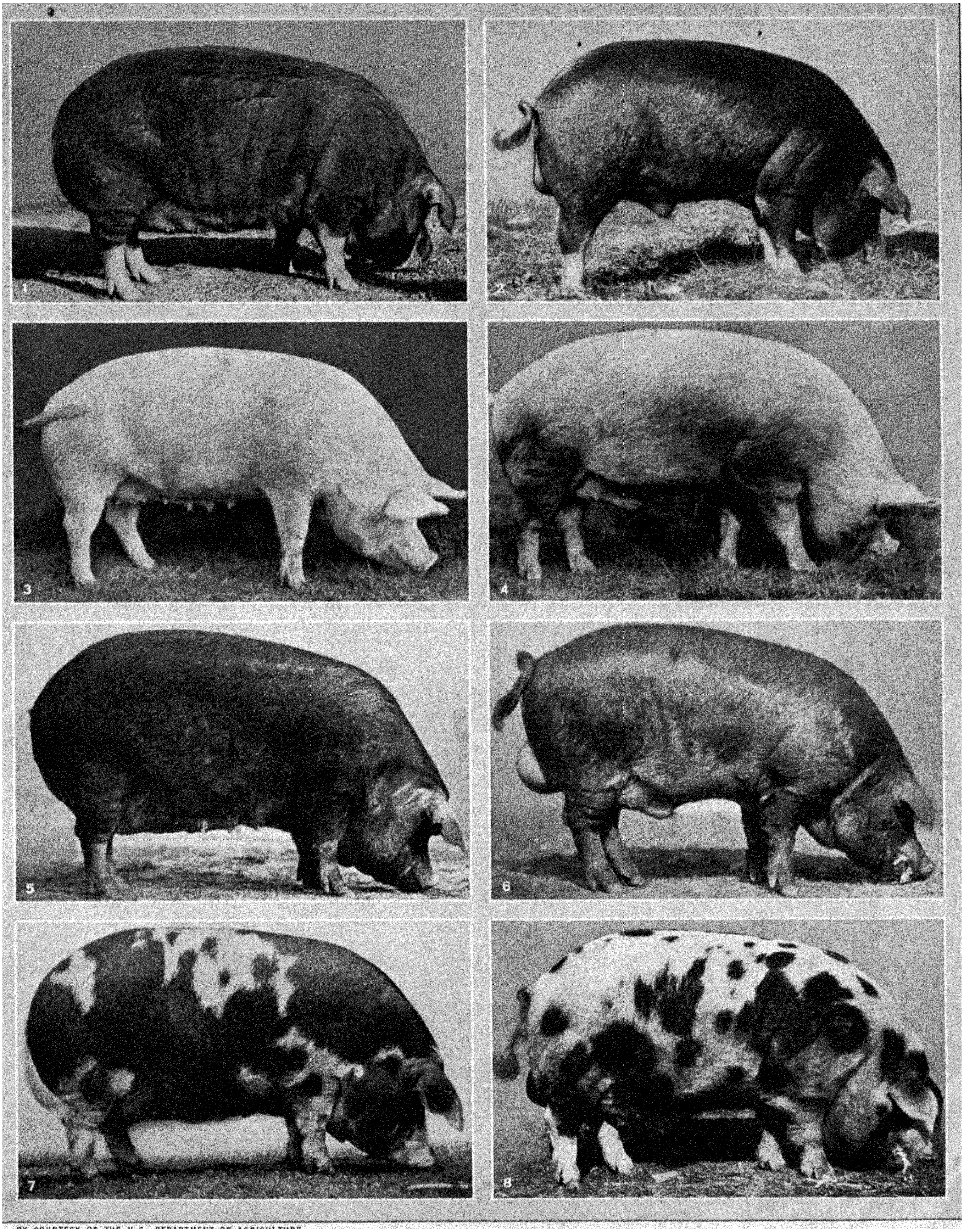
BIBLIOGRAPHY.—R. Wallace, *Farm Live Stock of Great Britain* (1923); C. S. Plumb, *Types and Breeds of Farm Animals;* Watson and More, *Agriculture: The Science and Practice of British Farming* (1928); Henry and Morrison, *Feeds and Feeding*. Also The *Herd Books* of the Breed Societies, and official publications of the Agricultural Departments of Great Britain, Canada and the United States.

(R. WA.; J. A. MO.)

The United States.—The *Poland China* breed originated in Ohio, principally in the counties of Butler and Warren. The foundation stock consisted of so-called Bedford, Woburn, Russian and Irish Grazier hogs, improved by an introduction of Berkshire blood. The breed was at first white and black spotted, but later the black body with white at the face, feet and tip of tail, became the standard colour. The breed is large in size, boars commonly weighing 1,000 lb., while sows at maturity often weigh as high as 800 lb. Lengthy proportions, combined with height, ruggedness of bone, and meat producing qualities, are especially stressed in this breed. The head of the Poland China is rugged in appearance, medium in length and slightly dished in the profile. The ear is rigid from the point of attachment on the head to approximately one-half to two-thirds of its length, with the tip one-half or one-third broken over. In body conformation, the Poland China is long, deep and tall. The shoulders are smooth and compact, and the back is evenly and smoothly arched. This breed is found in all parts of the United States, as well as in many other countries.

The *Duroc-Jersey* originated in the eastern part of the United States, mainly in New York and New Jersey. The foundation stock, it is thought, came from Africa, Portugal and Spain. In general, the conformation of the Duroc-Jersey resembles that of the Poland China. However, the head is smaller and more refined, and the back is somewhat more evenly arched. In colour this breed ranges from a light golden yellow to what approximates a mahogany brown. The ideal colour, however, is a deep golden yellow inclining to a cherry red.

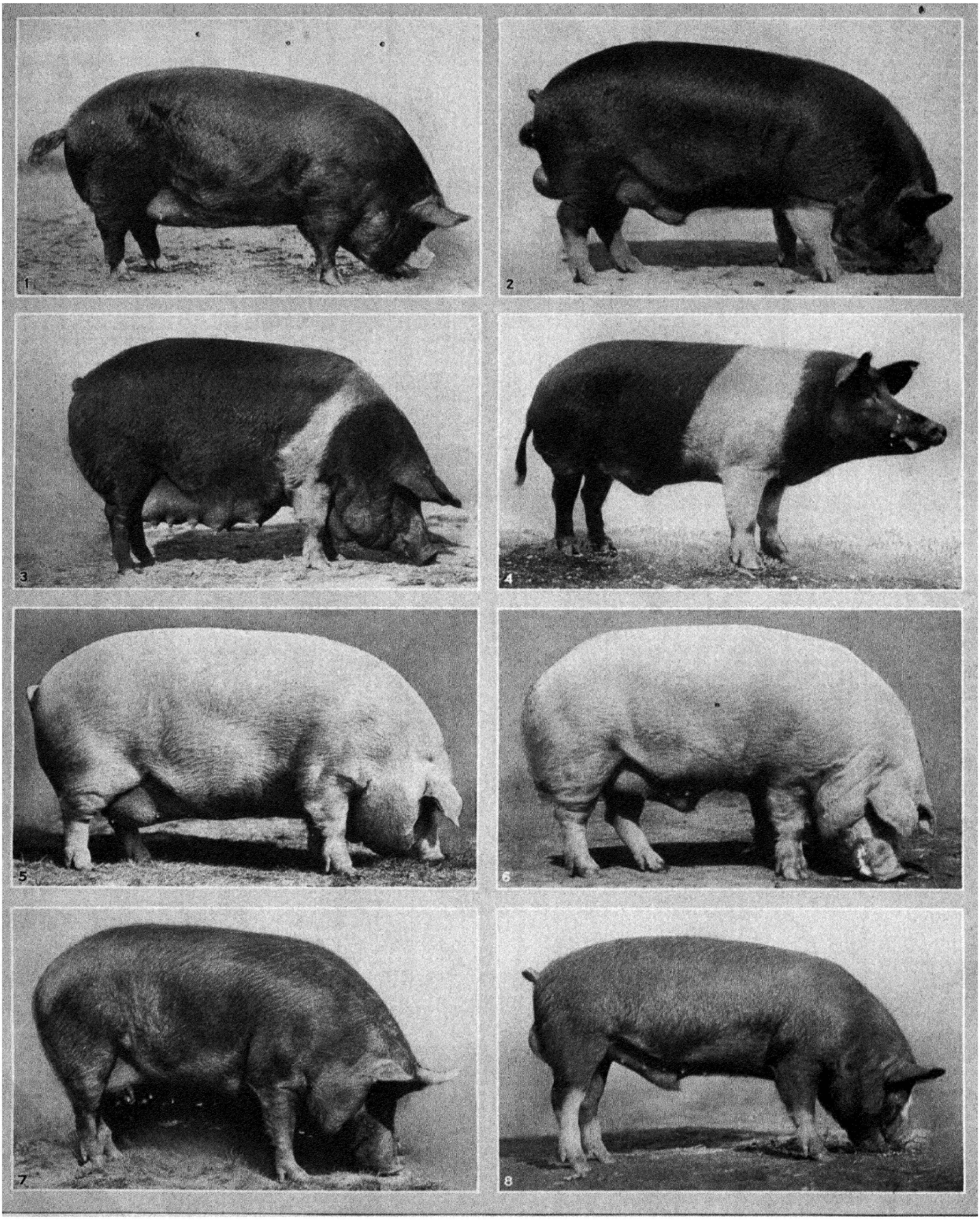
The *Chester White* originated in Chester county, Pa. The foundation stock consisted of native stock combined with English hogs, particularly the Large Yorkshire. Individual breeders have at various times attempted to establish other breeds similar in character and breeding to the Chester White. A notable example of this is the so-called O.I.C., which means the Ohio Improved



VARIOUS BREEDS OF PIGS

1. Poland China. Sow
2. Poland China. Boar
3. Yorkshire. Sow
4. Yorkshire. Boar
5. Duroc-Jersey. Sow
6. Duroc-Jersey. Boar
7. Spotted Poland China. Sow
8. Spotted Poland China. Boar

PIG



BREEDS OF PIGS

1. Berkshire sow
2. Berkshire boar
3. Hampshire sow
4. Hampshire boar
5. Chester White sow
6. Chester White boar
7. Tamworth sow
8. Tamworth boar

Chester White. This latter so-called breed is organized into a breed association, and the breeders record their animals separately from the Chester White. There seems to be little to distinguish one breed from the other. The Chester White is pure white in colour, although black or bluish spots known as freckles are frequently found on the hide. In size the Chester White does not quite rank with the Poland China or the Duroc-Jersey. Boars at maturity, however, often weigh 900 lb., while the females commonly reach a weight of 700 lb. A medium sized head and ear, clean, trim jowls, and an evenly turned back, are characteristic of the Chester White. Like the Poland China and Duroc-Jersey, one-half to one-third of the tip end of the ear is broken over. This breed is quite popular in the corn belt, but due to its white colour does not stand the sun as well as a dark coloured breed

The *Hampshire* breed, while a native of America, originated from English stock, probably the Wessex Saddle Back and the Essex. In colour markings the American Hampshire resembles these breeds The Hampshire has had its greatest improvement in Ohio, Illinois, Iowa and other corn belt States. The breed has gained its popularity through its fecundity, foraging properties and its ability to yield a high grade carcass. Among the common lard breeds in America the Hampshire is relatively small. It is extremely trim in its lines, is especially clean cut about its head, and is smooth and firm in its bone. The face of the Hampshire is straight in profile and the ears are rigid from point of attachment at the head to the tip end. The promoters of this breed discriminate against heavy jowls, dished faces and any tendency toward roughness.

The *Berkshire* breed is a native of England but has received considerable attention in America. It is classed as a lard breed and has been especially noteworthy because of the high quality of carcass it produces. The Berkshire has the same colour marking as the Poland China but is not so large in size The ears are rigid and the face is dished

The *Tamworth* and *Large Yorkshire* are the two most common bacon breeds in America Both these breeds received their origin in England and are similar in body conformation. They differ, however, in colour The Large Yorkshire is white, while the Tamworth is red, similar to the Duroc-Jersey in this respect. The bacon breeds less popular than the lard breeds (J. S C)

PIGEON, a name of Norman introduction for certain birds of the family Columbae (*see* DOVE). Perhaps the best known species to which the name is exclusively applied is the passenger pigeon (*Ectopistes migrarius*) of North America Formerly nesting in countless multitudes in the then "backwoods" of Kentucky, Ohio, and Indiana, this bird is now extinct, the last specimen dying in Cincinnati Zoological Gardens in 1914 The passenger pigeon was about the size of a turtle-dove, but with a long, wedge-shaped tail The male was a dark slate colour above and purplish-bay below; the female, drab above, dull white beneath. The beautiful fruit-pigeons (*Treron*) of tropical Africa, India, and the Malay Archipelago are, perhaps, the most delicately flavoured of all birds.

The largest forms are the giant crowned pigeons (*Goura*) of New Guinea; they have a beautiful filmy, fan-shaped crest on the head. The Nicobar pigeon (*Caloenas*) is remarkable for the long lustrous neck hackles and its peculiar gizzard

Pigeons lay two or three white eggs and the naked, helpless young are fed by a secretion from their parents' crops ("pigeon milk").

PIGEON-FLYING, the sport of racing homing-pigeons bred and trained for the purpose. It is of very recent date, although the use of birds as a means of carrying messages (*see* PIGEON POST) is of great antiquity. Belgium may be considered as *par excellence* the home of the sport, the first birds flown there probably coming from Holland Long distance flying began in 1818, with a match of 100m., while in 1820 there was a race from Paris to Liége, and in 1823 from London to Belgium. The Belgian *concours national*, a race of about 500m. from Toulouse to Brussels, was inaugurated in 1881, in which year the first regular races in Great Britain took place.

The sport was introduced into the United States about the year 1875, although regular racing did not begin until 1878. Since then it has gained widespread popularity. The speed depends very greatly upon the state of the atmosphere. In the race from Montargis to Brussels in 1876 in bright and clear weather, all the prize-winners made the distance of 270m. within 3½ hours, while in the same race in 1877, on a thick and stormy day, 30 hours passed before the first bird arrived

Training.—The loft should be on a commanding site. It is best made in the shape of a large room, suitably subdivided, protected from vermin, and provided with drinking troughs, rock salt and crushed mortar for the birds' use It should be fitted with a sufficient number of nests about 2ft. long, 20in. in breadth and height Arrangements should be made for allowing the pigeons to fly out daily for exercise; and they should be trained to re-enter the loft through bolting wires, which open inwards only, into a small chamber, to which an electric arrangement may be fitted so as to sound a bell and warn the owner of the arrival of a bird The food of birds in training consists of vetch, beans, maize, peas, broken rice and millet, in various proportions according to the country, climate and season of the year, the daily allowance for each bird being about 40 grammes weight.

Training should commence in warm weather, when the bird is about four months old, and consists in taking it out in a closed wicker basket and liberating or "tossing" it at gradually increasing distances from its loft, with several days interval of rest between the flights. The usual preliminary distances are, 1, 2, 5, 10 and 15 or 20m These tosses should all be made on the same line between the loft and, say, some neighbouring city, in order that a bird may always have to fly in the same general direction during the season. About 100m. may be expected of birds the first season; they do not reach their full distances until about the fifth year. The Belgian fanciers generally divide their birds into two classes, one for breeding and the other for racing though the latter are allowed to breed within certain limits Some fanciers always choose birds with chicks in the nest for long journeys, claiming that they return faster with this incentive. A seamless metal ring marked with the owner's name is slipped over the foot of the pigeon when only a few days old, and during its racing career the longer wing-feathers are stamped with the bird's records At the start of a race the competing birds are tossed together by a starter who takes the time Upon being released the homer ascends rapidly in spirals until, apparently descrying some familiar landmark on the horizon, it will fly straight and swiftly towards it. As the birds enter their home lofts the time is taken by the owner. A bird is not considered to have got "home" until actually through the door of its loft.

PIGEON POST. The use of homing pigeons to carry messages is as old as Solomon, and the ancient Greeks, to whom the art of training the birds came probably from the Persians, conveyed the names of Olympic victors to their various cities by this means Before the electric telegraph this method of communication had a considerable vogue amongst stockbrokers and financiers The Dutch Government established a civil and military pigeon system in Java and Sumatra early in the 19th century, the birds being obtained from Baghdad. Pigeons were employed during the siege of Paris in 1870–71 This led to a revival in the training of pigeons for military and naval purposes They have also been used by newspapers for reporting It has been found very important to establish registration of all birds In order to hinder the efficiency of the systems of foreign countries, difficulties were placed in the way of the importation of their birds for training, and in a few cases falcons were specially trained to interrupt the service in war-time, the Germans having set the example by employing hawks against the Paris pigeons in 1870–71. No satisfactory method of protecting the weaker birds seems to have been evolved, though the Chinese formerly provided their pigeons with whistles and bells to scare away birds of prey

During the World War pigeons were frequently used to bring back messages from advanced positions and often rendered very valuable service, but the development of wireless telegraphy will restrict their uses.

See L. du Puy de Podio, *Die Brieftaube in der Kriegskunst* (Leipzig

1872); Brinckmeier, *Anzucht, Pflege, und Dressur der Brieftauben* (Ilmenau, 1891).

PIG IRON. Crude cast iron, run from the blast furnace directly into moulds. The moulds originally were of sand formed in a way which suggested a nursing litter of pigs. (*See* IRON AND STEEL MANUFACTURE; BLAST FURNACE.)

PIGMENTS: *see* PAINTS, CHEMISTRY OF.

PIGMENTS OF SKIN AND HAIR. The pigment of the skin, the pigment of the blood, the pigment of the yolk of the egg, and the pigment of the butterfly's wing may each be regarded as representative of a chemical group of colouring matters, and into those four groups the great bulk of the pigments seen in the animal world may be placed.

The Pigment of the Skin.—The skin consists of two principal layers—the epidermis or superficial portion, and the dermis or deep portion. The dermis is not pigmented in man, nor is the epidermis in the so-called white races. In the negro the epidermis is densely pigmented, the pigment being present in granules. These granules are not uniformly distributed throughout the epidermis, which itself consists of many layers of cells, but they are confined to the layer of cells next to the dermis, and, therefore, farthest removed from the external surface.

The black pigment of the skin, which is called melanin, is situated in granules in the deepest layer of endo-dermal cells, namely, that placed immediately over the dermis. All the cells of the epidermis really are developed from this layer (the Malpighian layer) the constituents of which divide and work their way towards the surface. It might be supposed that all the epidermal cells should there be pigmented, but this is not so; as they get nearer the surface, they lose their pigment. This is well shown in the case of a blister. The fluid forms in the epidermis, separating the deeper from the more superficial portion; the covering of the blister in a negro is not pigmented.

In man the pigment is present as a quite inert deposit, the person being no more negroid at one time than another; but in many lower animals this is not so. The frog, for instance, will at one time be dark, at another pale. The melanin in the frog's skin is laid down in special cells known as melanophores; these may contract in minute balls, in which case the skin is pale, or they may expand, pushing out branches in all directions, in which case they form an almost continuous network of pigmented material.

The degree of expansion of the melanophores is regulated by circumstances, the following table being given by Hogben (abbreviated):—

Normal Responses of Common Frog

Background	20° C	10° C
Light:		
(*a*) Dry	Pallor	Generally pale
(*b*) Moist	Pallor	Darkening
Shaded or dark:		
(*a*) Dry	Pallor	Partial darkening
(*b*) Moist	Darkening	Darkening
Darkness:		
(*a*) Dry	Pallor	Partial darkening
(*b*) Moist	Darkening	Darkening

Evidently their dark background, low temperature and moistness tend to make the melanophores expand. The mechanism by which expansion of the melanophores in the frog is effected is bound up with a remarkable body situated underneath, and connected with the brain—the pituitary body (*see* art. HORMONES). This body secretes, no doubt at the bidding of the brain, a hormone into the blood which, acting on the melanophores, causes them to expand.

The pigment cells in the frog, unlike those in man, are situated at different levels; some are in the epidermis and some in the dermis. This arrangement has been exploited very completely by the chameleon. The chameleon possesses two layers of cells, each in the dermis. As an example may be taken an animal which alters in colour from a yellow or very pale green, through green to something nearly black. The cells of the outermost layer, called variously guanophores, leukophores, ochrophores, iridocytes and interference cells, are yellowish in colour; so far as is known, these cells do not alter either in shape or tint. Underneath these are the melanophores, also a similar but reddish type of cell called erythrophores. To take the melanophores, these send processes towards the surface more or less encircling the guanophores. Darkening in the colour of the chameleon is due to the migration of granules of melanin from the deeper portion of the melanophores into the more superficial tentacles which surround the guanophores. The actual colour which the animal presents is partly due to the mixture of colours which the various pigment cells present, and partly due to the scattering of light between these. The migration of the melanophore granules in the chameleon is due largely to the hormone adrenalin. The current belief that the chameleon takes on the colour of its surroundings is much exaggerated; the colour is influenced largely by light and temperature, and, so far as the author has been able to judge, in a very limited way by temper also; if the chameleon were annoyed it took on a darker colour.

Fish, too, have great powers of colour change within a certain scale of colours, which scale does simulate very closely the colour of the bottom on which they lie. Their colour change is also wrought by melanophores, but these seem more directly to be controlled by the nervous system and less by hormones than those of the frog. Thus, if a nerve going to a particular segment of the skin be severed the possibility of colour change appears to vanish.

The Chemical Nature of Melanin.—Melanin is closely related to two remarkable chemical substances found in the body. The one is the hormone adrenalin (which turns a blackish colour on exposure); the other is a substance, tyrosine, which is one of the breakdown products of protein.

The chemistry of melanin formation has been studied chiefly in the vegetable kingdom. A familiar example is seen when an apple is cut and the cut surface is exposed to air. The melanin is formed from tyrosine in the apple by oxidation; but the mere exposure of tyrosine to air will not produce melanin. There must also be a ferment present which effects the oxidation. This ferment is called tyrosinase. If two solutions—(1) tyrosine and (2) tyrosinase—both of which are colourless—be mixed and shaken with air the mixture first becomes a reddish colour and gradually turns to a dark brown. The reddish pigment appears to be an intermediate body between tyrosine and melanin. Recently, Raper and his colleagues have shown that the rôle of the tyrosinase lies in the formation of this reddish substance, the melanin being a more complicated body derived from the union of two molecules of this red substance.

The pigments in hair are formed on similar lines to those of skin. H. Onslow, the leading authority at the time of his death, wrote: "The colour of human hair depends upon the colour and form of the pigment (*i.e.*, whether it is diffused or deposited in granules) and upon the (air) vacuoles. . . . In light and sandy hair the pigment is chiefly diffused and of a yellowish red colour, but in darker hair the pigment is present as dark brown or black granules." Onslow recognizes three pigments in rabbits giving rise to six colours, the pigments being black, chocolate and yellow, which give rise to rabbits of those colours, and, when the pigments are diluted, to blue, fawn and cream respectively. The pigments may, however, be mixed, or in bands, giving rise to the agouti. With regard to whiteness, Onslow writes: "The hair of an animal may be white for one of three reasons—(1) the absence of either chromogen or enzyme; (2) the absence of both chromogen and enzyme; (3) the presence of an inhibitor of the enzyme."

Whilst most of the pigments in the integument consist either of melanin or some substance closely allied to it, a few are of quite a different origin.

The beak and the legs of fowl, for instance, are often yellow, the pigment being one known as carrotin—the same that colours the carrot. Its presence is, in a sense, accidental. It is not manufactured in the animal body, but exists in the vegetables eaten. It is absorbed into the blood during digestion and, being soluble in fat, it accumulates in places where fat exists. More especially is this the case in the yolk of the egg. Hens fed on foods com-

pletely free of pigment after a time lay eggs with colourless yolks; moreover, if fed on food containing other fat soluble pigments, the yolk becomes correspondingly coloured; eggs with bright red yolks are obtained if the dye "Soudan III." be mixed into the food.

It is remarkable that haemoglobin contributes little to the pigmentation of the skin—in man only in pathological conditions. In jaundice the yellow pigment is the same as ordinarily appears in the bile, and is practically haemoglobin stripped of its iron and of its protein. Closely related to bile pigment is uro-porphyrin, which occasionally appears in the skin, and then with very distressing results. The skin becomes exceedingly sensitive to light so that the individual requires veiling in the open air; otherwise he would suffer from sunburn amounting to inflammation.

Another sort of porphyrin is, however, found in the integument of some of the lower animals, as for instance, the brown line on the back of the earth-worm This is protoporphyrin; it is the pigment which forms the basis of haemoglobin and is most familiar as being that which colours brown eggs.

Finally, the distinction between *pigment* and *colour* must not be forgotten. Black eyes and blue contain the same pigment—melanin—black more than blue, but the blue hue is obtained from the way in which the light is reflected from the surfaces of the fibres of which the iris is made, and among which a number of pigment cells are disposed. (J BAR)

PIGOT, GEORGE, BARON (1719–1777), English governor of Madras, was born on March 4, 1719 and entered the service of the East India Company in 1736. He became governor and commander-in-chief of Madras in 1755 Having defended this place against the French in 1758–59 and occupied Pondicherry on behalf of the company, he resigned office in November 1763 and returned to England, being made a baronet in 1764 In the following year he obtained a seat in parliament, which he retained until his death, in 1766 he was created an Irish peer as Baron Pigot. Returning to India in 1775 to occupy his former position at Madras, Pigot was at once involved in a quarrel with the majority of his council, which arose out of the proposed restoration of the rajah of Tanjore. The governor was arrested by order of his opponents, and was still a prisoner when he died on May 11, 1777. In 1779 the matter was discussed in parliament, and four of those who were responsible for his arrest were tried and fined £1,000 each. Pigot, who left several illegitimate children, was never married, and his barony became extinct

PIG-STICKING or **HOG-HUNTING** is the sport of chasing the wild boar on horseback with a spear From the earliest times the pursuit of the wild boar has been a favourite pastime in Europe but the modern sport of pig-sticking is of Indian origin. It is now generally accepted as a fact that pig-sticking was the outcome of bear-spearing, which was popular amongst British sportsmen in Bengal until the beginning of the 19th century when bears had become so scarce that wild boars were substituted as the quarry Early in the 19th century it seems that the spear was generally thrown and Captain Johnson, writing in 1827, gives directions for throwing the spear, which was a weapon more in the nature of a javelin with different coloured ribbons attached to the butt so as to enable the owner to reclaim his spear. In 1830 Mr Mills, of the I C S , seems to have introduced the "jobbing" spear in his district and this weapon was universally used in Bengal. But the jobbing, or thrusting, spear was known before 1830 and was used regularly by officers of Lord Lake's Army as early as 1803 (*vide War and Sport in India: an Officer's Diary, 1802–1806*). At the present time there are really three types of spear in general use: the short Bengal spear which is about 5 feet long and is always used over-hand; the long Bombay spear, which may be as long as 10 to 12 feet and is always used under-hand like a lance; and a spear about 6 to 7 feet long, well leaded at the butt so as to balance about a foot from that end, which is generally used under-hand but which can, should circumstances so demand, be used over-hand. This last is the type of weapon common in the United Provinces and Delhi districts. The best type of horse is one that is fast and quick, yet not too big, as very rapid twists and turns must be made when following a pig which "jinks," or turns sharp in its tracks. For this same reason the horse must be perfectly balanced and well back on its hocks, while a good shoulder and long rein help it to stand up over bad ground.

A large area of land is controlled and hunted by a "Tent Club" which corresponds to a Hunt in England, and private expeditions after pig in any such area are forbidden by etiquette. A Tent Club is managed by an honorary secretary, which is an unfortunate title as this individual has powers and prestige similar to those of a M F H. in England The season varies in different districts but begins as soon as the heavy undergrowth, which springs up during the monsoon, has died sufficiently to enable riding across country, usually in January, and continues throughout the hot weather until the rains break towards the end of June. April, May and early June are the best months. Meets of a Tent Club take place, as a rule, once a fortnight and last for two to four days There are two methods of hunting Where the whole country is covered with girth-high grass and jhow (tamarisk) a long line of beaters advances while the "spears" ride with the line. These are divided into "heats" of three or four and only one heat may ride a boar that is put up, or "reared," by the beaters, the heat nearest the boar taking the hunt The rider who gains "first spear," that is who spears the boar first, claims the head and tusks as his trophy But where the boar inhabits thick patches of unridable jungle, as is the case in Central India and Guzerat, as well as in isolated cases in other parts, the heats wait in hiding outside while beaters drive out the boar. The rules for riding are the same in both cases.

There are various pig-sticking competitions the best known of which is the Kadir Cup. The word "Kadir" (pronounced "Karder") merely means the old bed of a large river. All the big Indian rivers are constantly changing their courses and the land which has at one time been under water may be anything from five to thirty miles in width Such land is a river Kadir and is overgrown with tamarisk and grass, intersected with nullahs (*i e.,* water courses, dry or full of water), and dotted with *jhils* (swamps). Villages are few and far between, while the ground is the haunt of wild boar and many other species of game, both big and small A large part of the Ganges Kadir has been controlled by the Meerut Tent Club since before the Mutiny, and the Kadir Cup is run annually in March in this country Competitors may enter two horses, but not more. Heats of three are determined by lots, and the gainer of the first spear in each heat qualifies for the second round, and so on to the semi-final and final heats The winning of the Kadir Cup, which was instituted in 1869, constitutes the blue ribbon of pig-sticking

Other pig-sticking competitions are the Guzerat Cup, which is run in Guzerat on similar lines to the Kadir Cup; the Nagpur Hunt Cup, which goes to the member of the Tent Club who gains the greatest number of first spears in the season, and the Muttra Cup, which was instituted in 1913 and is awarded to a team of three who actually kill the greatest proportion of boars to those hunted This event is run in the Jumna Kadir near Muttra.

Pig-sticking in India suffered severely during the War owing to the shortage of spears and many old Tent Clubs were automatically disbanded through lack of members and funds But there has been a great revival since 1919 and almost all the old Clubs have been resuscitated; the sport is as popular now as it has ever been in the past, and in 1927 one of the largest boars ever recorded as being speared was killed in the Gogra Kadir by the Fyzabad Tent Club This boar measured 37¾ inches at the withers and weighed 325 pounds.

The only other country where pig-sticking is practised is in Tangier, where there is a flourishing Tent Club.

Useful books on the subject are F B Simpson, *Letters on Sport in Eastern Bengal*, A E Wardrop, *Modern Pig-Sticking;* Sir R S S. Baden-Powell, *Pig-Sticking or Hog-Hunting* (G. BU.)

PIGWEED, a name applied to various plants, especially lamb's-quarters (*q v.*) and various species of amaranth (*q.v.*). The winged pigweed (*Cycloloma atriplicifolium*), of the Great Plains region of North America, is closely allied to lamb's-quarters. *See* illustration on page 924.

PIKE, ZEBULON MONTGOMERY (1779–1813), American explorer and soldier, was born at Lamington, Somerset county, N.J., the son of Zebulon Pike (1751–1834) a captain in the Revolutionary War, who remained in Federal service until 1812. The son entered his father's company as a cadet about 1794, and in 1799 or 1800 was commissioned first lieutenant. When in 1805 President Jefferson wished the upper Mississippi region of the Louisiana Purchase explored, Lieut. Pike, then 26 years of age, was selected to lead the expedition. With 20 soldiers he ascended the Mississippi from St. Louis past the Falls of St. Anthony to a place in Morrison county, Minn. Hence he made an expedition on foot to the fur-trading posts of the Northwest Company, a British concern, at Sandy, Leech and Cass Lakes, and took formal possession for the United States. He returned to St. Louis in April, 1806, and almost immediately was despatched at the head of an expedition to treat with Indian tribes and explore the country west and south-west of St. Louis to the headwaters of the Arkansas and Red rivers. After holding a grand council of the Pawnees, he ascended the Arkansas river through the Royal Gorge, and came in sight of the mountain which was named Pike's Peak in his honour. While searching for the Red river he came to the South Platte, marched through South Park, left it by Trout Creek pass, struck over to the Arkansas, which he thought was the Red river for which he was searching, and, going south and south-west, came to the Rio Grande del Norte (about where Alamosa, Conejos county, Colorado, is now) on the 30th of January 1807. There on the 26th of February he and a small number of his men were taken prisoners by Spanish authorities, who sent him first to Santa Fe, then to Chihuahua to General Salcedo, and by a roundabout way to the American frontier, where he was released on the 1st of July 1807. He was promoted captain (August 1806), major (May 1808), lieutenant-colonel (Dec. 1809) and colonel (July 1812). In 1808 he tried in vain to get an appropriation from Congress for himself and his men. He was military agent in New Orleans in 1809–1810, was deputy quartermaster-general in April–July 1812, and was in active service in the War of 1812 as adjutant and inspector-general in the campaign against York (now Toronto), Canada, and in the attack on York on the 27th of April 1813 was in immediate command of the troops in action and was killed by a piece of rock which fell on him when the British garrison in its retreat set fire to the magazine, just as his victorious soldiers were breaking in.

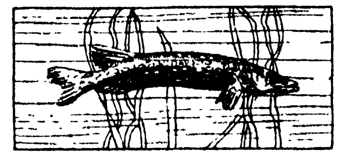
BY COURTESY OF THE IOWA EXPERIMENTAL STATION

ROUGH PIGWEED (ROOT ON RIGHT)

His *Account of an Expedition to the Sources of the Mississippi and through the Western Parts of Louisiana . . . and a Tour through the Interior Parts of New Spain* was published at Philadelphia, 1810; rearranged and reprinted in London, 1811, and has been published in many editions since, including translations into the French and Dutch. The standard edition with memoir and notes by Elliott Coues was published in 1895. In 1908 H. E. Bolton published some of the papers taken from Pike in Mexico (originals then in Mexican archives but forwarded to Washington in 1910) in the *American Historical Review* (vol. xiii., 798–827).

See the sketch by H. Whiting in vol. V., Ser. 2, of Jared Spark's *Library of American Biography.*

PIKE, fresh-water fishes generally distributed over the rivers and lakes of Europe, northern Asia, and North America, and forming a small family (*Esocidae*) of soft-rayed fishes. They are recognized by their elongate compressed body covered with small scales, a long head, long spatulate snout, and large mouth armed with strong and long teeth in the jaws and broad bands of smaller teeth on the palate and tongue. The teeth point backwards or can be depressed so as to offer no obstruction to any object entering the gape, but prevent its withdrawal in the opposite direction. The dorsal and anal fins are placed far back on the tail, thus greatly increasing the propelling power of the fish. Although pike lead rather a sedentary life, they are excelled by no other fresh-water fish in rapidity of motion when they dash upon their prey or dart out of reach of danger. In the Old World one species only is known (*Esox lucius*), which prefers lakes and sluggish reaches of rivers. It extends into Lapland in the north and as far south as central Italy and Constantinople, but is absent in Spain and Portugal The European species occurs also in eastern North America, and is common southwards to northern Ohio. But North American waters are tenanted by other species of pike of which the largest is the muskelunge or maskinonge of the Great Lakes (*E. nobilior*). The other American pike are smaller and generally named "pickerel." Pike are the most voracious of fresh-water fish. Large specimens will seize rats or water-voles, and are said to attack even foxes and small dogs. Individuals of *E. lucius* of 50 lbs. are not scarce, but much larger ones are on record. Pike are wholesome food, and are much esteemed in inland countries. According to the season and the climate they spawn in April or in May and sometimes as early as February.



BY COURTESY OF THE NEW YORK ZOOLOGICAL SOCIETY

PIKE (ESOX LUCIUS)

PIKE, a word which, with its collateral forms "pick" and "peak," has as its basic meaning "anything pointed or tapering to a point." The ultimate etymology is much disputed, and the interrelation of the collaterals is very confused. In Old English there are two forms (*pic*), one with a long and the other with a short vowel, which give "pike" and "pick" respectively. The first form gave in the 15th century the variant "peak," first with reference to the peaked shoes then fashionable, *pekyd schone*. In Romanic languages are found Fr. *pic*, Span. *pico*, Ital. *piccare*, to pierce, etc. There are also similar words in Welsh, Cornish and Breton. The Scandinavian forms, *e.g.*, Swed. and Nor. *pik*, are probably taken from English. While some authorities take the Celtic as the original, others look to Latin for the source. Here the woodpecker, *picus*, is referred to, or more probably the root seen in *spica*, ear of corn, and *spina*, prickle (English spike, spine). The current differentiation in meanings attached to pike, pick and peak are more or less clearly marked, though in dialects they may vary. Apart from the use as the name of the fish (*see* above), probably a shortened form of pike-fish, from its sharp, pointed beak, the common uses of the word are for a long hafted weapon with sharply pointed head of iron or steel, the common weapon of the foot-soldier till the introduction of the bayonet (*see* SPEAR, HALBERT, and BAYONET), and for a hill with a pointed summit, appearing chiefly in the names of such hills in Cumberland, Westmorland and North West Lancashire.

PIKE-PERCH, fresh-water fishes allied to the perch, but with strong teeth standing between smaller ones. They resemble the pike in their elongate body and head, and are dangerous enemies to other fresh-water fishes. They are excellent eating. In Europe two species occur, the more celebrated being *Lucioperca sandra*. It prefers the quiet waters of large rivers and clear, deep lakes, in which it reaches a weight of 25 to 30 pounds The second (*L. wolgensis*) is limited to rivers in southern Russia and Hungary. In North America two are distinguished; viz., *L. americana,* which grows to a weight of 20lb., and the smaller *L. canadensis;* both are abundant in the Canadian lakes and upper Mississippi, and the latter also in the Ohio.

PIKE'S PEAK, a famous mountain of the Rampart range of the Rocky Mountains in El Paso county, Colorado, U.S.A. Though surpassed in altitude (14,108 ft.) by many summits in the State, few have so commanding a location and none is so well known. From the summit the magnificent Sangre de Cristo range is in the foreground, while on a clear day not only its southernmost summit, Blanca Peak (14,390 ft.) is visible, but also the Spanish

Peaks (12,708 and 13,623 ft.) 100 m to the south, and Long's Peak 100 m to the north, and between them Mt. Lincoln, Gray's Peak and other giants, while the view extends eastward over a vast sweep of plains. At the base of the mountain are Manitou and Colorado Springs, whence tourists can make the ascent of the peak on horseback, by a cog-railway, 8·75 m long (opened in 1891), or by a well constructed automobile road

The lower slopes are covered with evergreen forests but the upper 2,500 ft. of the peak is bare granite. The summit is a comparatively level spot of nearly 60 ac extent. Pike's Peak was discovered in Nov. 1806 by Lieut Zebulon M Pike In 1819 it was first climbed by the exploring party of Major S H Long.

PIKES PEAK OCEAN TO OCEAN HIGHWAY, an American highway extending from New York city to San Francisco, Calif , a distance of 3,564 miles. Its central location makes it one of the most direct routes from ocean to ocean It runs directly past the base of Pikes Peak, up which is the Pikes Peak motor road, the highest in the world The roadway is paved hard and improved from the Atlantic to the Rockies and partly paved, hard, improved and graded the remainder of its length From New York city to Pittsburgh, Pa., this highway is also known as the William Penn highway. Columbus. O , Indianapolis, Ind , Springfield, Ill , St Joseph, Mo , Colorado Springs, Colo , Salt Lake City, Utah, Reno, Nev , and Sacramento, Cal., mark the general course of the highway.

PILATE, PONTIUS, of equestrian rank, was Roman governor of Judaea from A.D. 26 to A D 36, when he was recalled He kept the Roman peace in Palestine, but with little understanding of the people (Josephus, *Ant.* XVIII., iii., 1, 2; iv. 1, 2; *Jewish War*, II., ix., 2–4, Philo *ad Caium*, 38). One disturbance arose when Pilate used Temple funds for an aqueduct The reference in Luke xiii., 1, to the massacre of Galilean pilgrims in the act of sacrificing suggests the governor's ruthlessness in putting down riot It must be said, however, that the post of Roman Governor in Judaea was peculiarly difficult and it was to Pilate's credit that his rule lasted as long as ten years Both Pilate's part in responsibility for the crucifixion of Jesus Christ and the legal aspects of the trial have been much debated The Early Church blamed the Jews, and correspondingly tended to exonerate Pilate. The Third and Fourth Gospels, especially, suggest that extraordinary pressure was brought to bear upon the governor by the Jewish priests. Pilate may well have been impressed by the dignity and gentleness of the great Preacher of the Kingdom of God, and may also have given Him opportunity to save Himself (John xviii , 33–38; XIX , 9–11) There are many stories, all of uncertain value and in many cases legendary, telling of Pilate's later life and of his suicide. Pilate has been canonized in the Abyssinian church (June 25) and his wife Procla, or Procula, in the Greek (Oct 27)

BIBLIOGRAPHY —*See* Tacitus, *Annals* XV. 44; G. A. Muller, *Pontius Pilatus,* etc (1888) ; Innes, *The Trial of Jesus Christ*, etc (1899) , Regnault, *Une Province Procuratorienne,* etc. and *Le Procès du Christ* (1909), H Peter, *Pontius Pilatus*, etc (1907) , Husband, *The Prosecution of Jesus* (1916) , Schurer, *The Jewish People in the time of Jesus Christ.* For the apocryphal accounts, M. R. James, *Apoc Anecdota II* (Camb Texts and Studies vol v.) pp. 65–81 and *The Apocryphal New Test.*, pp. 94–165.

PILCHARD or **SARDINE** (*Sardina pilchardus*), a fish of the herring family, found on the Atlantic coasts of Europe north to the English channel, and represented in the Mediterranean by a smaller race (*S pilchardus sardina)* The genus *Sardina* includes also *S sagax* of Japan, California, Chile and South Africa, and *S neopilchardus* of southern Australia and New Zealand These resemble the European pilchard in being slender rounded fishes, with feeble teeth, with radiating ridges on the operculum, and with rich oily flesh The European fish is distinguished by a remarkable peculiarity, every alternate oblique row of scales being enlarged and covering the row behind it, so that the scales appear to number about 27 instead of 54 in a longitudinal series; exceptional specimens, with the scales on one side equal and apparently more numerous, have been described as hybrids between pilchard and herring! Pilchards swim in large shoals and feed on minute pelagic animals; they spawn in summer and their eggs float in the water; in the larva the dorsal fin is placed far back, and as the fish grows it migrates forwards to its position in the middle of the length of the fish. In Cornwall adult fish, about 10 in. long, are caught and are salted in barrels. The sardine industries of France and Portugal depend on smaller fish, which are tinned in oil Tinned Californian pilchards and Japanese sardines are also important products

PILE. As a textile term, this word indicates the surface of a cloth composed of an infinite number of loops of warp threads, or else of an infinite number of free ends of either warp or weft (filling) threads that stand erect from the foundation or ground structure of the cloth There are two general methods of distinguishing between such cloths; thus.—

1 When the loops are uncut, the pile is usually termed "looped pile."

2 When the same or similar loops are cut, either in the loom during weaving or by a special machine after the cloth leaves the loom, the pile is termed "cut pile "

Other names applied to such cut-pile fabrics in which the effect is formed by the *warp* threads are "velvet" and "plush," the former being used to define short-pile fabrics and the latter to define long-pile fabrics The word "velveteen" is used to distinguish the fabric when the pile is formed of *weft* or filling threads that have been cut.

Amongst the loop-pile fabrics may be mentioned Brussels tapestry and imitation Brussels carpeting, as well as Moquettes and the like. In some cases the surfaces of carpets, such as Wilton and Axminster, are formed of cut pile; and again, in other instances, both looped (uncut pile) and cut pile appear on the surface of the same fabric Imitation sealskins and several other kinds consist of mono-coloured pile, whereas all the above-mentioned carpets have surfaces upon which decorative designs appear in both kinds of pile and in several colours. (*See* CARPET; CARPET MANUFACTURE. For pile in building *see* FOUNDATIONS) (T. W)

PILGRIMAGE, a journey undertaken, from religious motives, to some place reputed as sacred These journeys play an important rôle in most pre-Christian and extra-Christian religions in the Catholic Church their acceptance dates from the 3rd and 4th centuries

The Pilgrimage in Pre- and Non-Christian Religions.—To the Germanic religions the pilgrimage is unknown. On the other hand, it is an indigenous element, not only in the creeds of Asia, but in those of the ancient seats of civilization on the Mediterranean The fundamental conception is always that the Deity resides—or exercises a peculiarly powerful influence—in some definite locality, and to this locality the devout repair, either in reverence of their god, or in quest of his assistance and bounty

One of the oldest homes of the pilgrimage is India There the army of devotees tends more especially to the Ganges—the hallowed river of Hindu belief. On the Ganges lies Benares, the holy city of Brahmanism and to look on Benares, to visit its temples and to be washed clean in the purifying river, is the yearning of every pious Indian Even Buddhism—originally destitute of ceremonial—has adopted the pilgrimage; and the secondary tradition makes Buddha himself determine its goals the place where he was born, where he first preached, where the highest insight dawned on him, and where he sank into Nirvana

The habit of religious expeditions to sacred places took deep root among the Egyptians, the Jews, and the Greeks, but the pilgrimage attained its zenith under Islam. For Mohammed proclaimed it the duty of every Mussulman, once at least in his life to visit Mecca; the result being that the birth-place of the Prophet is now the religious centre of the whole Mohammedan world. (*See* ISLAM; CARAVAN; MECCA.)

THE PILGRIMAGE UNDER CHRISTIANITY

The pilgrimages of Christianity presuppose the existence of those of paganism; but it would be an error to maintain that the former were a direct development of the latter. For primitive Christianity was devoid of any point by which these journeys of devotion might naturally have been suggested It was a religion without temples, without sanctuaries, and without ceremonial The

saying of the Johannine Gospel—that God is to be adored neither in Jerusalem nor on Gerizim, but that His true worshipper must worship Him in spirit and in truth—is in complete harmony with the old Christian piety. The Christian pilgrimage arose from devotion to the memory of Jesus; the faithful repaired to those places which were invested with memories of their Lord's earthly life. Bethlehem and Jerusalem became objects of such visits from the 2nd century; and from references in Eusebius and others, it is evident that the Christians of the 3rd and 4th centuries were in the habit of visiting Jerusalem for prayer; and that men travelled for purposes of prayer implies acceptance of the theory of sanctuaries which it is an act of piety to visit.

THE PILGRIMAGE IN THE ANCIENT CHURCH

The East.—In the passages cited above, Bethlehem and the Mount of Olives figure as the main goal of the pilgrim: and on the Mount of Olives the mind must naturally turn to the Garden of Gethsemane and the scene of the Ascension. It may seem surprising that there is no mention of Golgotha and the Sepulchre. But the visitation of these sites was rendered impossible to the Christians by the destruction of Jerusalem and the erection of the town of Aelia Capitolina. The one holy site in the town of Jerusalem, before the time of Constantine, was the so-called *Coenaculum,* which received its name in later years. It was regarded as the house in which—according to the Acts of the Apostles (xii. 12 *sqq.*)—Mary, the mother of John Mark, lived; and the belief was that there the Lord held the Last Supper, and that there the eleven assembled after the Ascension

The pilgrimage to Palestine received a powerful impetus from the erection of the memorial churches on the holy sites, under Constantine the Great, as described by Eusebius in his biography of the emperor (iii. 25 *sqq.*). At the order of Constantine, the accumulation of rubbish covering the supposed site of the burial-place of Jesus was removed, and the cave was discovered in which Joseph of Arimathea had laid the body of Jesus; and above this cave and the Hill of the Crucifixion the imposing church of the Holy Sepulchre was built (A.D. 326–336). The churches in Bethlehem and on the Mount of Olives were erected by Helena, the mother of Constantine, who herself undertook the pilgrimage to the Holy Land. These churches were then endowed with new sanctuaries of miraculous powers; and relics of Christ were found in the shape of the Cross and the nails. The result was an exaggerated importance attached to these pilgrimages, a view which led to energetic protests, especially from Gregory of Nyssa, who composed a monograph on the pilgrimages (*De iis qui adeunt Hierosol.*). Jerome, like Gregory, insists on the point that residence in Jerusalem has in itself no religious value: it is not locality, but character, that avails, and the gates of Heaven are as open in Britain as in Jerusalem (*Ep.* 58, 3).

But Jerome never denied the religious uses of the pilgrimage; he considered it an act of faith for a man to offer his prayers where the feet of the Lord had stood, and the traces of the Birth, of the Cross, and of the Passion were still to be seen (*Ep.* 47, 2). With the number of the pilgrims the number of pilgrim-resorts also increased. Of Jerusalem alone Jerome relates that the places of prayer were so numerous that it was impossible to visit them all in one day (*Ep.* 46, 9). In the Holy Land the list was still longer: the natives were ready to show everything for which the foreigners inquired, and the pilgrim was eager to credit everything. In her expedition to the East, Paula, the friend of Jerome, visited, among other places, Sarepta and Caesarea. In the first-named place she was shown the tower of Elijah; in the second, the house of Cornelius, that of Philip, and finally the grave of the four virgins. At Bethlehem she saw, in addition to the church of the Nativity, the grave of Rachel; at Hebron the hut of Sarah, in which the swaddling clothes of Isaac and the remains of Abraham's oak were on view (Hieron. *Ep.* 108).

In the West.—While pilgrim-resorts were thus filling the East, their counterparts began to emerge in the West. And here the starting-point is to be found in the veneration of martyrs. Care for the tombs of martyrs was sanctioned by immemorial custom of the Church; but, in this case also, a later age failed to preserve the primitive conception in its purity; and Augustine himself was obliged to defend the usage of the Church from the imputation that it implied a transference of heathen ceremonial to the sphere of Christianity (*Contr. Faust.* xx. 21). The martyrs were the local heroes of particular communities; but there were men whose life and death were of significance for the whole of Christendom—the apostles. Of these Peter and Paul had suffered martyrdom in Rome, and it was inevitable, from the nature of the case, that their graves should soon become a resort, not only of Romans born, but of strangers also. The Roman cemeteries were visited by numerous pilgrims even in the 3rd century: for the earliest *graffiti* in the papal crypt of the Coemeterium Callisti must date from this period (De Rossi, *Roma sotter.* i. 253 *sqq.;* Kraus, *Rom. Sott.* 148 *sqq.*).

Pilgrims were drawn to the graves of the saints convinced that there divine succour was certain; hence came the belief in a never-ending series of miracles there performed. Doubt was unknown. St. Augustine observes that, though Africa was full of martyrs' tombs, no miracle had been wrought at them so far as his knowledge extended. This, however, did not lead him to doubt the truth of those reported by others—a fact that is somewhat surprising when we reflect that the phenomenon caused him much disquiet and perplexity. Who, he asks, can fathom the design of God in ordaining that this should happen at one place and not at another? And eventually he acquiesces in the conclusion that God, who gives every man his individual gift at pleasure, has not willed that the same powers should have efficacy at every sepulchre of the saints (*Ep.* 78, 3).

THE PILGRIMAGE IN THE MIDDLE AGES

The mediaeval Church adopted the custom of the pilgrimage from the ancient Church. The young Germanic and Romance nations did precisely as the Greek and Romans had done before them, and the motives of these devotional journeys—now much more difficult of execution in the general decay of the great world-system of commerce—remained much the same. They were undertaken to the honour of God, for purposes of prayer, or in quest of assistance, especially health. But the old causes were reinforced by others of at least equal potency. The mediaeval Church was even more profoundly convinced than its predecessor that the miraculous power of Deity attached to the bodies of saints and their relics. But the younger nations—French, English and German—were scantily endowed with saints; while, on the other hand, the belief obtained that the home-countries of Christianity, especially Rome and Jerusalem, possessed an inexhaustible supply of these sanctified bodies.

Pilgrimages were consequently undertaken with the intention of securing relics. At first it was enough to acquire some object which had enjoyed at least a mere connection with the hallowed corpse. One enthusiast took a little wax dropped from the taper; another, a portion of the dust which lay on the grave; a third, a thread from the cloth covering the sarcophagus; still another plucked the flowers which visitors had planted above the tomb Before long, however, these humble trophies failed to content the pilgrims, and they began to devote their efforts to acquiring the actual bodies, or portions of them—frequently by honest means, still oftener by trickery. One of the most attractive works of early mediaevalism—Einhard's little book, *Translatio Marcellini et Petri*—gives a vivid description of the methods by which the bodies of the two saints were acquired and transported from Rome to Seligenstadt on the Main.

Far more important consequences, however, resulted from the fact that the mediaeval mind associated the pilgrimage with the forgiveness of sins. This conception of the pilgrimage, as a means of expiation or a source of pardon for wrong, was foreign to the ancient Church. It is quite in accordance with the keener consciousness of sin, which prevailed in the middle ages, that the expiatory pilgrimage took its place side by side with the pilgrimage to the glory of God. The pilgrimage became an act of obedience; and, in the books of penance (*Poenitentialia*) which date from the early middle ages, it is enjoined as an expiation for many of the more serious sins, especially murder or the less venial forms of

unchastity. The place to be visited was not specified; but the pilgrim, who was bound by an open letter of his bishop to disclose himself as a penitent, lay under the obligation, wherever he went, to repair to the churches and—more especially—the tombs of the saints, and there offer his prayers. On occasion, a chain or ring was fastened about his body, that his condition might be obvious to all; and soon all manner of fables gained currency. how, here or there, the iron had sprung apart by a miracle, in token that the sinner was thereby absolved by God.

As the system of indulgences (*q v*) developed, a new motive came to the fore which rapidly overshadowed all others: pilgrimages were now undertaken to some sacred spot, simply in order to obtain the indulgence which was vested in the respective church or chapel. In the 11th century the indulgence consisted in a remission of part of the penance imposed in the confessional, in return for the discharge of some obligation voluntarily assumed by the penitent Among these obligations, a visit to a particular church, and the bestowal of pious gifts upon it, held a prominent place; and during the whole period of mediaevalism, the number of pilgrims was perpetually on the increase

The Pilgrim Resorts.—The most important places of resort both for voluntary and involuntary pilgrimages, were still Palestine and Rome. On the analogy of the old *Itineraria*, the abbot Adamnan of Iona (d. 704) now composed his monograph *De locis sanctis*, which served as the basis of a similar book by the Venerable Bede (d. 735) His authority was a Frankish bishop named Arculf, who resided for nine months as a pilgrim in Jerusalem, and visited the remaining holy sites of Palestine in addition to Alexandria and Constantinople. Of the later itineraries the *Descriptio terrae sanctae*, by the Dominican Burchardus de Monte Sion, enjoyed the widest vogue. This was written between the years 1285 and 1295, but books of travel in the modern tongues had already begun to make their appearance The initiative was taken by the French in the 12th and 13th centuries, and the Germans followed in the 14th and 15th, while the *Book of Wayes to Jerusalem* of John de Maundeville (*c* 1336) attained extreme popularity, and was translated into almost all the vernacular languages

As a result of this steady increase in the number of pilgrims, the old arrangements for their accommodation were found deficient Consequently hospices arose which were designed exclusively for the pilgrim Those on the Alpine passes are common knowledge The oldest, that on the Septimer pass, dates from the Carolingian period, though it was restored in 1120 by the bishop Wido of Chur that on the Great St Bernard was founded in the 10th century, and reorganized in the 13th To this century may also be assigned the hospice on the Simplon, to the 14th those on the St Gothard and the Lukmanier Similarly, the Mediterranean towns, and Jerusalem in particular, had their pilgrim-refuges Service in the hospices was regularly performed by the hospital-fraternities—that is to say, by lay associations working under the authorization of the Church The most important of these was the fraternity of the *Hospitale hierosolymitanum*, founded between 1065 and 1075; for hence arose the order of St. John, the earliest of the orders of knighthood. (*See* ST. JOHN OF JERUSALEM, KNIGHTS OF.) In addition to the hospital of Jerusalem, numerous others were under its charge in Acre, Cyprus, Rhodes, Malta, etc Associations were formed to assist pilgrims bound for the East; one being the *Confrérie des pèlerins de Terre-Sainte* in Paris, founded in 1325 by Louis de Bourbon, count of Clermont (afterwards first duke of Bourbon).

But since, in the middle ages, the Holy Land was no longer held by a Christian Power, the protection of the pilgrims was no less necessary than their sustenance. This fact, after the close of the 11th century, led to the Crusades (*q.v.*), which in many respects are to be regarded as armed pilgrimages. For the old dream of the pilgrim, to view the country where God had walked as man, lived on in the Crusades—a fact which is demonstrated by the letters of Bernard of Clairvaux, with the songs of Walther von der Vogelweide and other Crusaders. And, since the strongest motive in the pilgrimage was the acquisition of indulgences, unnumbered thousands were moved to assume the Cross, when, in 1095, Urban II promised them plenary indulgence. The conquest of Jerusalem, and the erection of a Christian empire in Palestine, naturally welled the influx of pilgrims. And though in 1187 the Holy City again fell into the hands of the infidel, while in 1291 the loss of Acre eliminated the last Christian possession in Palestine, the pilgrimages still proceeded. It was not till the Reformation, the wars of the 16th century, and the loss of Rhodes, Candia and Cyprus to the Turks, that any appreciable alteration was effected When Ignatius de Loyola (*q v*) set sail in 1523 from Venice to Palestine, only some thirteen souls could be mustered on the pilgrim-ship, while eight or nine others sailed with the Venetian state-vessel as far as Cyprus A considerable number had abandoned their pilgrimage and returned home on the news of the fall of Rhodes

For pilgrimage overseas, as it was styled, the permission of the Church was still requisite The pilgrims made their journey in grey cowls fastened by a broad belt On the cowl they wore a red cross, and a broad-brimmed hat, a staff, sack and gourd completed their equipment. During their travels the beard was allowed to grow, and they prepared for departure by confession and communion Of their hymns many are yet extant ("Jerusalem mirabilis," "In gottes namen faren wir," etc.) Ships belonging to the knights of St John and the Knights Templars conducted the commerce with Palestine, and the pilgrims formed themselves into unions, elected a "master" and concluded their agreements, as to the outward voyage and return, in common The expenses of the journey to Palestine were no light matter In the 12th century they may be estimated at 100 marks of silver (£200) for the ordinary pilgrim. The expenses of the princes and lords were, of course, much heavier Duke William of Saxony who was in Jerusalem in 1461, spent no less than £10,000 on his journey (*See* Prutz, *Kulturgeschichte der Kreuzzuge*, pp. 106 *sqq*; Rohricht, *Deutsche Pilgerreisen*, p 42)

Great as was the number of pilgrims oversea, it was yet far exceeded by that of the visitants to the "threshold of the apostles," *i e*, Rome, which received their greatest impetus through the inauguration of the so-called Year of Jubilee

Of the other pilgrim-resorts, we shall only emphasize the most important Priority of mention is due to St James of Compostella (Santiago, in the Spanish province of Galicia). Here the attraction for the pilgrim was the supposed possession of the body of James the son of Zebedee The first connection of the apostle with Spain is to be traced in the *Poema de aris b Mar et xii apost dedic*, which is ascribed to Aldhelm (d 709) and contains a story of his preaching in that country The earliest account of the transference of his relics to the Peninsula is found in Notker Balbulus (d 912, *Martyrol in Jul xxv*). But in Spain belief in this cherished possession was universal, and, step by step, the theory won credence throughout the West In England indeed, the shrine of St James of Compostella became practically the most favoured devotional resort, and in the 12th century its visitation had attained such popularity that a pilgrimage thither was ranked on a level with one to Rome or Jerusalem In France St Martin remained the chief goal of the pilgrim; while Notre Dame de Sous-Terre in Chartres (with a portrait of the "black Virgin"), Le Puy-en-Velay (dep. Haute Loire), and others, also enjoyed considerable celebrity In England pilgrimages were made to the tomb of the murdered archbishop, Thomas à Becket, in Canterbury Cathedral The setting of Chaucer's *Canterbury Tales* gives a vivid idea of the motley company of pilgrims; but it seems probable that Germany also sent a contingent In addition, Walsingham, Peterborough, St. Davids, Holywell, and St Andrews in Scotland were much frequented In lower Germany, Cologne and Aix-la-Chapelle, in Switzerland Einsiedeln, were the principal resorts

In Italy the church of the Archangel on Mt Gargano was one of the most ancient centres of the pilgrimage Later the Portiuncula church at Assisi displaced all other resorts, with the exception of Rome; but in the 15th century it was overshadowed in turn by the "Holy House" at Loretto on the Adriatic. According to an extravagant legend, the house of Joseph and Mary in Nazareth was transported by angels, on the night of the 9th–10th of May

1291 to Dalmatia, then brought to the Italian coast opposite (Dec. 10, 1294), till, on the 7th of September 1295 it found rest on its present site. The pilgrimage thither must have attained great importance as early as the 15th century; for the popes of the Renaissance found themselves constrained to erect an imposing pilgrim church above the "Holy House."

The significance of the pilgrimage for the religious life of later mediaevalism cannot be adequately estimated. The possession of any extraordinary relic was everywhere considered a sufficient claim for the privileges of indulgences; and wherever this privilege existed, there the pilgrims were gathered together. All these pilgrimages, great and small, were approved and encouraged by the Church. And yet, during the whole of the middle ages, the voice of suspicion in their regard was never entirely stilled. Earnest men could not disguise from themselves the moral dangers almost inevitably consequent upon them; they recognized, moreover, that many pilgrims were actuated by extremely dubious motives; and they distrusted the exaggerated values set on outward works. The Roman papacy had no more zealous adherent than Boniface; yet he absolutely rejected the idea that Englishwomen should make the journey to Rome, and would willingly have seen the princes and bishops veto these pilgrimages altogether (*Ep.* 78). The theologians who surrounded Charlemagne held similar views.

When the abbess Ethelburga of Fladbury (Worcestershire) found her projected pilgrimage impracticable, Alcuin wrote to her, saying that it was no great loss, and that God had better designs for her: "Expend the sum thou hast gathered for the journey on the support of the poor; and if thou givest as thou canst, thou shalt reap as thou wilt" (*Ep.* 300). Bishop Theodulf of Orleans (d. 821) made an energetic protest against the delusion that to go to Rome availed more than to live an upright life (*Carm.* 67). To the same effect, the synod of Chalon-sur-Saône (813) reprobated the superstition which was wedded to the pilgrimage (*c.* 13); and it would be easy to collect similar judgments, delivered in every centre of mediaevalism. But, fundamentally, pilgrimages in themselves were rejected by a mere handful: the protest was not against the thing, but against its excrescences.

The Modern Pilgrimage.—The Reformation eradicated the belief in the religious value of visits to a particular locality. It is only pious memory that draws the Protestant to the sites consecrated by ecclesiastical history. On the other hand, while in the Eastern Church things have undergone little change the developments in the Roman Church show important divergences. The Year of Jubilee, in 1525, was unprecedented in its scant attendance, but the jubilees of 1575 and 1600 again saw great armies of pilgrims marching to Rome (*see* JUBILEE, YEAR OF). Fresh pilgrim resorts sprang up; mediaeval shrines, which had fallen on evil days, emerged from obscurity. The 19th century led to an extraordinary revival of the pilgrimage. Not only did new resorts spring into existence—*e.g.*, La Salette in Dauphiné (1846), and more particularly Lourdes (1858) in the department of Hautes Pyrénées—but the numbers once more attained a height which enables them to compete with the mediaeval figures. The dedication of the church of Lourdes, in 1876, took place in the presence of 30 bishops, 3,000 priests and 100,000 pilgrims. No new motives for the pilgrimage emerged in the 19th century, unless the ever-increasing cultus of the Virgin Mary may be classed as such, all of the new devotional sites being dedicated to the Virgin. For the rest, the desire of acquiring indulgences maintains its influence: but doubting voices are no more heard within the pale of the Roman Catholic Church.

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PILGRIM FATHERS. In American history "Pilgrims" is applied to the earliest settlers of the colony of Plymouth, Mass., and its more specific application is to the first emigrants, who sailed in the "Mayflower" in 1620. They were from the beginning Separatists from the Church of England; they had established Independent (Congregational) churches at Scrooby and Gainsborough early in the 17th century, and some of them had fled to Amsterdam in 1608 to avoid persecution, and had removed to Leyden in the following year. They sailed from Delftshaven late in July 1620, from Southampton on Aug. 5, from Plymouth on Sept. 6 and late in Dec. 1620 founded the colony of Plymouth, Massachusetts. (*See* MASSACHUSETTS; PLYMOUTH and MAYFLOWER.)

PILGRIMS' WAY, THE. From Winchester, in Hampshire, England, to Canterbury, in Kent, runs a road or way which can still be traced, now on the present made roads, now as a lane, bridle path, or cart track, now only by a line of ancient yews, hollies or oaks which once bordered it. To this old track the name of Pilgrims' Way has been given, for along it passed the stream of pilgrims coming through Winchester from the south and west of England and from the continent of Europe by way of Southampton to Canterbury Cathedral to view the place of the martyrdom of Thomas Becket, in the north transept, the relics in the crypt where he was first buried after his murder, in 1170, and the shrine in the Trinity Chapel which rose above his tomb after the translation of the body in 1220. There were two festivals for the pilgrimage, on the 29th of December, the day of the martyrdom, and on the 7th of July, the day of the translation. The summer pilgrimage naturally became the most popular. In 1538 the shrine was destroyed and the relics of the saint scattered, but the great days of the pilgrimage had then passed. Erasmus gives a vivid picture of the glories of the shrine and of all that the pilgrims saw on his visit with Colet to Canterbury in 1514.

This road, although its name of the Pilgrims' Way has for long confined it to the road by which the pilgrims came to Canterbury from Winchester, follows a far older track. Right back into British and even older times the main direction which commerce and travellers followed across southern and western England to the Straits of Dover and the Continent lay from Canterbury along the southern chalk slope of the North Downs to near Guildford, then by the Hog's Back to Farnham. At this point the oldest track went across Salisbury Plain towards Stonehenge and so on to Cornwall. From Farnham westward the only portion of this, the oldest track that can now be traced, is a small portion that still bears the name of the Harrow (*i.e.*, hoary, old) road. It was in early times abandoned for the road from Winchester to which the stream of travel and commerce from the Continent and the south and south-west of England was diverted.

The ancient road has been traced fully in Mrs. Ady's book *The Pilgrims' Way* (1893), and the older track in the fullest detail in Hilaire Belloc's *The Old Road* (1904).

PILKINGTON, FRANCIS (d. 1638), English madrigal composer, the details of whose early life are obscure, took his Mus.B. at Lincoln college, Oxford. He was attached to Chester cathedral about 1604, and a few years later was ordained. His chief works include a book containing 21 vocal pieces and a pavin for the lute and bass viol (1605), *The First Set of Madrigals and Pastorals* (1614), and *The Second Set of Madrigals and Pastorals* (1624).

PILLAU, a seaport and watering-place in the Prussian province of East Prussia, on the spit of sand (*Nehrung*) which separates the Frische Haff from the Baltic, on the north of the entrance channel, and 29 m. by rail from Königsberg. Pop. (1925) 7,036. Pillau is the place where Gustavus Adolphus of Sweden landed in 1626. It did not obtain civic privileges until 1725, but was fortified shortly after that date. It has a harbour, which serves as the outer port of Königsberg, and to some extent also of Elbing and Braunsberg. A new navigable channel was in 1900–1901 constructed across the Frische Haff from Pillau to Königsberg. Pillau has a school of navigation, and is a well-known pilot station. Ship-building and fishing are carried on.

PILLNITZ, a village in the republic of Saxony, situated on the right bank of the Elbe, 5 m. above Dresden. Pop. (1925)

1,107. The new palace was built in 1818 on the site of a building which was burnt. The place became a residence of the electors of Saxony about 1700. By the convention of Pillnitz in August 1791 the emperor Leopold II. and Frederick William II., king of Prussia, agreed to take common action against any attack on the part of France.

PILLORY, an instrument of punishment which consisted of a wooden post and frame fixed on a platform raised several feet from the ground, behind which the culprit stood, his head and his hands being thrust through holes in the frame (as are the feet in the stocks) so as to be held fast, exposed in front of it. This frame in the more complicated forms of the instrument consisted of a perforated iron circle, which secured the heads and hands of several persons at the same time, but it was commonly capable of holding only one.

In the statutes of Edward I. it is enacted that every pillory or "stretch-neck" should be made of convenient strength so that execution might be done on offenders without peril of their bodies. It was customary to shave the heads wholly or partially, and the beards of men, and to cut off the hair and even in extreme cases to shave the heads of female culprits. By the "Statute of the Pillory" (1266) the pillory was made the penalty for many small offences. In 1637 an attack was made on the Press, and the pillory became the recognized punishment of those who published books without a licence or libelled the Government. In 1816 the pillory was abolished except for perjury and subornation, and the perjurer Peter James Bossy was the last to stand in the pillory, at the Old Bailey for one hour on June 22, 1830. It was finally abolished in 1837 at the end of William IV.'s reign. In France the pillory, called *carcan,* was employed till 1832. In Germany it was known as *pranger.* The pillory was used in the American colonies, and provisions as to its infliction existed in the United States statute books until 1839; it survived in the State of Delaware until 1905. (*See* STOCKS.)

PILNYAK (1894-), Russian novelist. Boris Andreevich Vogau, who later took the pen name of Pilnyak, was born on Sept. 29, 1894 in Mojaisk, Moscow province. His childhood and early youth were spent on the Volga and among the peasants and the land administration "intellectuals." He studied economics at the Moscow commercial institute and began publishing stories in 1915. During the Bolshevik revolution Pilnyak lived in Moscow and also travelled through Russia studying the new conditions. In 1923 he visited England and Germany. His works deal with the first chaotic stage of transition from the old Tsarist Russia to the "new world" of the Soviet Republic. He is the most prominent figure in post-revolutionary fiction. His sympathies are with the peasants as opposed to the town and his stories are deliberately fragmentary and read like diaries and chronicles. His *Tales of the Wilderness* was translated by F. O'Dempsey (1924).

PILOCARPINE. This alkaloid (*see* ALKALOIDS) is a colourless oil which occurs in jaborandi leaves along with isopilocarpine and the related alkaloid, pilosine, $C_{16}H_{18}O_3N_2$ (Pyman, 1912). Pilocarpine, $C_{11}H_{16}O_2N_2$, was isolated independently by Hardy and by Gerrard in 1875. It boils at 260° C under 5mm. pressure, is freely soluble in water, alcohol, or chloroform, but not in ether or petroleum, and is dextro-rotary in solution. The salts crystallize well; the nitrate, which melts at 178° C, and the hydrochloride, whose melting point is 204–205° C, being those used in medicine. On evidence provided mainly by Jowett in England and Pinner in Germany a generally accepted constitutional formula for pilocarpine and isopilocarpine, which are regarded as stereoisomerides, has been put forward.

PILOÑA, a town of northern Spain on the Infiesto-Oviedo railway in the province of Oviedo; between the right bank of the river Piloña, a left-hand tributary of the Sella, and the Sierra de Abes (3,268 ft.). Pop. (1920) 18,323. Piloña is a densely populated mining and agricultural district.

PILOTAGE, as it is now understood, may be described as the art of conducting a vessel in or out of harbour, or in the neighbourhood of navigational dangers. The word "pilot" was formerly used to designate the steersman and later the sailing master; in fact, the art of piloting was divided into two parts: proper piloting, identical with what we now term navigating (*see* NAVIGATION), and common piloting, identical with the meaning of the word as given above. *See* PILOTAGE LAWS.

PILOTAGE LAWS. The present general British pilotage laws are contained in the Pilotage Act, 1913, which Act consolidated and amended the laws of pilotage as they existed under the Merchant Shipping Act, 1894. On the passing of the former Act, the Board of Trade, as the central authority, held enquiries, with the result that pilotage orders were made by it in respect of each District. Each pilotage order defines the limits of the district, names the pilotage authority therefor, states whether pilotage is compulsory or not therein, and empowers the authority to delegate any of its powers or duties to a pilotage committee, on which may sit representatives of both pilots and shipowners. The pilotage authority makes the necessary by-laws for the regulation of pilotage and pilots in its district, but these do not take effect until they are confirmed by the Board of Trade.

The principal pilotage authority is the Corporation of Trinity House, London, exercising jurisdiction in the London district, which extends from Orfordness to Selsea Bill, and in 38 other districts round the coasts of England and Wales. There are, however, about 60 other districts within which other pilotage authorities have jurisdiction.

Compulsory Pilotage.—A ship, whilst navigating in a district in which pilotage is compulsory, for the purpose of entering, leaving or making use of any port in that district, is required to be either under the pilotage of a licensed pilot of the district, or under the pilotage of a master or mate possessing a pilotage certificate for the district, who is bona fide acting as master or mate of the ship. A ship carrying passengers (other than an excepted ship) is, however, compelled to be under pilotage irrespective of whether the district in which she is navigating is a compulsory one or not. Under the Aliens Restriction (Amendment) Act, 1919, pilotage certificates cannot be granted to aliens, except to masters or mates of French nationality trading to the ports of Newhaven or Grimsby.

The following ships are excepted from compulsory pilotage: (1) Ships belonging to His Majesty. (2) Pleasure yachts. (3) Fishing vessels. (4) Ferry boats. (5) Ships of less than 50 tons' gross tonnage. (6) Ships exempted by by-law. (7) Tugs, dredgers, sludge vessels, barges and other similar craft belonging to or hired by a dock, harbour or river authority. (8) Ships calling at a port in a pilotage district for the sole purpose of taking on board or landing a pilot belonging to some other pilotage district.

The Board of Trade has the power, on the representation of parties interested, to revoke or vary any by-laws in a pilotage district, or require the pilotage authority to make by-laws. The licensing of a pilot by a pilotage authority does not involve any liability on the part of the authority for any loss occasioned by any act or default of the pilot.

Pilot Boats.—All pilot boats regularly employed in any district must be approved and licensed by the pilotage authority for that district, who may appoint or remove the masters thereof. Every pilot boat must be distinguished by the name of her owner and port on her stern, and her number on each bow, and the hull of the boat is usually painted black. When afloat the pilot boat must fly a red and white horizontal flag, known as a pilot flag, in a conspicuous position. A pilot flag must also be displayed by a vessel having on board a licensed pilot for the district, or a master or mate holding a pilotage certificate. The master of a ship subject to pilotage in a district must, under a penalty, display a pilot signal and keep it displayed until a licensed pilot comes on board, and if the master accepts the services of a pilot he must give him facilities for getting on board.

The following persons are liable to pay pilotage dues for any ship for which the services of a licensed pilot have been obtained, *viz.:* (a) the owner or master, or (b) the consignees or agents who have paid or are liable to pay any other charges on account of the ship, and these dues may be recovered in the same manner as fines under the Merchant Shipping Act, 1894. The pilotage dues on foreign ships, subject to compulsory pilotage, trading to and from

the port of London, have to be paid to the chief officer of customs and excise in that port, and such a ship may be detained until such dues are paid. It is an offence, punishable by a fine, if a licensed pilot demands or receives, and a master offers or pays, dues in respect of pilotage services at any other rates, whether greater or less, than those which are fixed by by-law.

Under section 633 of the Merchant Shipping Act, 1894, the owner or master of a ship was not answerable to any person for any loss or damage occasioned by the fault or incapacity of any qualified pilot acting in charge of that ship within any district where the employment of a qualified pilot was compulsory by law. Section 15 of the Pilotage Act, 1913, however, reversed this defence of compulsory pilotage, and enacted that the owner or master of a vessel navigating under circumstances in which pilotage is compulsory is answerable for any loss or damage caused by that vessel, or by any fault of her navigation, in the same manner as he would if pilotage were not compulsory. Section 15 of the Pilotage Act, 1913, did not, however, come into effect until Jan. 1, 1918, on which date section 633 of the 1894 Act was repealed. The difference which formerly existed under the Merchant Shipping Act, 1894, between British law and the law of most foreign countries as to the civil liability of the owner or master of a vessel employing a pilot under compulsion of law has therefore been removed since Jan. 1, 1918.

See *The Pilotage Act, 1913; Report of Departmental Committee on Pilotage 1911;* Digby & Cole, *Pilotage Law* (1913) (W. J. T. H.)

UNITED STATES

The power of administering all matters relating to pilotage was acquired by the Federal Government as incidental to the authority conferred on it under the Constitution. The first legislative action of the new Government was in 1789, when it delegated its authority to the several States "until further provision is made by Congress." Further legislation enacted subsequently has restricted the broad powers conferred in 1789, but the power of the Federal Government is exclusive only when it is exercised. State laws regarding pilotage are operative so long as they are not in conflict with Federal laws.

Among the acts of the Federal Government restricting the manner in which the several States may control pilotage are: laws which apply to pilotage on waters that are boundaries between States, permitting the master of a vessel to employ a pilot licensed by either State to pilot the vessel to or from such port; laws which prohibit discrimination in rates or pilotage as between vessels operating solely between ports in the State and those engaged in interstate traffic; laws which provide that all coastwise seagoing steamships shall be under the control and direction of pilots licensed under Federal authority; and laws which prohibit State pilots from levying pilotage on coastwise seagoing steamships.

Number and Appointment of Pilots.—In many States no maximum or minimum restriction is placed by statute on the number of pilots that may be appointed, the number being left to the discretion of the several pilotage authorities. In some cases both a maximum and minimum number are prescribed by law and in other States only a maximum number is mentioned. As a rule pilots are licensed by the local pilotage authority, but in several States they are appointed by the governor. In a majority of the States, pilots are licensed for life and lose their licences only because of negligence, incapacity, misconduct or infirmity. In the remaining States licences are granted for periods of one to four years and are renewable. Several grades of licences are generally issued, the grade varying with the draft of vessel which the holder of the licence is considered competent to conduct.

Qualification of Pilots.—In all States the primary qualification for appointment as pilot is actual experience in piloting vessels. A number of States require that applicants for licences as pilots must have served an apprenticeship of a specified number of years on boats of the pilots' association, either in accordance with the law of the State or by regulation of competent authority.

Authority.—In the United States, a pilot occupies the status of an officer of the ship when on board in the exercise of his duty, and his orders as such must be obeyed by the crew. When the master is on board, the orders of the pilot are considered to be those of the master's. The pilot is subject to the master in the matter of discipline but is not liable to any ship's duty except that of pilot. Once in charge of a vessel at sea, it is the duty of the pilot to stay by the ship until she reaches her destination or some place of safety, unless he is earlier discharged.

Liability of Pilots.—Pilots are generally required to give bond, usually $500, to secure the faithful performance of their duties and for the payment of all damages that may accrue from their negligence, unskillfulness or unfaithfulness. The bond is not required in some States, the amount is not specified in the laws of others and in still others it is fixed. The courts have held that while a pilot is responsible to the owner of a vessel for negligence or default in the performance of this duty, he is not liable for the vessel's loss when he has used his best skill and judgment, although the result shows that his best judgment was wrong.

Compulsory Pilotage.—Pilotage is generally compulsory upon certain vessels, or classes of vessels, approaching or departing from a harbour. Throughout the States, all public vessels of the United States and all steamships engaged in the coasting trade are exempt from compulsory pilotage. In respect to other vessels or classes of vessels there is wide variation in the laws of the several States. In the great majority of States compulsory pilotage is prescribed for all vessels, both of domestic and foreign registry, engaged in foreign trade, but not for any class of vessel in the domestic trade. In general the rule is that there has been a tender of the services of a pilot if there has been displayed the customary pilot signal on the usual cruising ground of pilot boats at sea, and there is a visible approach of the boat towards the incoming vessel. If the offer of pilot service is refused, the pilot becomes entitled to full fees or half pilotage, according to the local State law, and the liability for payment is enforceable in admiralty.

Compensation.—In general, pilotage fees are fixed by statute, based on the draught of the vessel. In some cases the rates are prescribed by the local pilotage authorities and the net tonnage of the ship is a factor in determining the pilotage charges. In a number of States where pilotage is compulsory, the full rate is not charged if the services of a pilot are refused. The various statutes commonly provide that pilotage fees are to be paid by and are recoverable from the master or owners of the vessel. In addition to fees for the actual work of pilotage, the statutes of practically every State permit certain extra charges to be made to cover loss of time occasioned by detention of vessel in quarantine or by carrying the pilot to sea when the pilot boat was ready to take him off.

Pilot Boats.—The days when a large number of sailing vessels were in the pilot service off the principal ports, each vessel owned and operated independently, have given way. In 1929 at practically every large port in the United States all of the licensed pilots belong to an association, owning and operating one or more specially constructed steamers which are maintained on the pilotage grounds, usually at the bar. These grounds are well known to mariners, who may safely count on finding there at practically all times a pilot boat displaying the Union Jack, with a sufficient number of pilots aboard to accommodate any reasonable number of vessels seeking to enter the port.

Bibliography.—For legislation on pilotage in the United States, *see* the Revised Statutes and the Statutes at Large of the United States, and the statutes of the several States in which pilot service is maintained, particularly Title 46, U.S. Code; Laws of 1909, New York, Ch. 42, Sec. 56; Revised Laws of Mass., 1902, as amended; Civil Code of 1906, California, Sec. 2036. (C. M. A.)

PILOT-FISH (*Naucrates ductor*), a pelagic fish of the family of horse-mackerels or *Carangidae,* well known to sailors from its habit of keeping company with ships and large fishes, especially sharks. It occurs in all tropical and subtropical seas, and is common in the Mediterranean. In summer pilot-fish accompany ships into port as far north as the south coast of England. It accompanies both ships and sharks on account of the supply of food which it derives from them, as does the remora (*q.v.*). All observers, however, agree that neither the

pilot-fish nor the sucking-fish is ever attacked by the shark. The pilot attains to a length of about 12in. A sharp keel runs along the middle of each side of the tail. The teeth are small, arranged in bands. On a bluish ground-colour, five to seven dark-blue or violet cross-bands traverse the body from back to belly. The pilot-fish spawns in the open sea.

PILOTY, KARL VON (1826–1886), German painter, born at Munich, on Oct. 1, 1826, was the son of Ferdinand Piloty (d. 1844), noted as a lithographer. His picture of "Seni at the Dead Body of Wallenstein" (1855) soon gained for the young painter the membership of the Munich Academy, where he succeeded Schorn (his brother-in-law) as professor. He also executed a number of mural paintings for the royal palace in Munich. For Baron von Schach he painted the justly celebrated "Discovery of America." In 1874 he was appointed keeper of the Munich Academy, being afterwards ennobled by the king of Bavaria. Piloty was the foremost representative of the realistic school in Germany. He was a successful teacher, and among his more famous pupils may be mentioned Makart, Lenbach, Defregger, Max and Grützner. He died at Munich on July 21, 1886.

PILSEN or PLZEŇ, the second town of Bohemia, Czechoslovakia, at the confluence of the Radbuza and Mze in a fertile and productive fruit and cereal basin. The vicinity is rich in coal and iron. The staple product is beer, exported to all parts of the world, which is closely followed by iron and steel goods and machinery, mainly from the Skoda factory, the greatest in the republic; spirits, leather goods, paper and earthenware are also produced in large quantities. The town is the trade and transport centre for the whole of south-west Bohemia and its cereal and cattle markets are famous.

Little is known of Pilsen till the 10th century and it did not become a town till 1272 but since then it has figured largely in Bohemian history and was a centre of Catholic resistance during the Hussite wars. Among its sights are the 13th century Gothic church with a tower 325 ft. high and a 16th century Renaissance town hall. Pop. (1923) 88,416.

PILSUDSKI, JOSEPH (1867–), Polish soldier and statesman, was born in Nov. 1867 in Zulow (Zulowo), County of Vilna (Wilno) of an ancient family tracing their origin from the Lithuanian Princes of Ginet, and educated at Wilno and Kharkov.

In 1887 Pilsudski was involved in an anti-Tsarist plot and sentenced to five years' penal servitude in Eastern Siberia, although the trial clearly established his innocence and his deprecation of terrorist methods. He returned to Wilno in 1892 and formed the Polish Socialist party (P.S.P.). In 1894 he began the *Robotnik* (The Workman), a secret paper of radical tendencies, edited, printed and distributed by Pilsudski himself. He was already a force. His courage, keen sense of humour, attractive personality and good breeding made him the idol of the working classes; he was revered by the intelligentsia for the tenacity of his convictions, for his fearlessness and his iron will.

His activities increased rapidly. Armed resistance against atrocities of the Russian government was introduced into the party programme. Armed detachments of workmen protected meetings and demonstrations against the police and military, and bloodshed became frequent. In 1900 Pilsudski and his wife, Marie Tuszkiewicz, whom he had married in 1894, were arrested in the offices of the *Robotnik* in Lódz and for a year he was kept in a special cell in the notorious "Tenth Pavilion" of the Warsaw Citadel. Simulating insanity, Pilsudski was transferred to the St. Nicholas Hospital in St. Petersburg, where his friends rescued him by an ingenious plot on May 13, 1901. He lived in London for some time following his escape from imprisonment and returned to Cracow in 1902.

During the Russo-Japanese war Pilsudski planned an insurrection. Frustrated through lack of munitions, he visited Japan to enlist her support, but again proved unsuccessful. After the Russian revolution of 1905 and the convocation of the Duma Polish revolutionary activities were discontinued, but the Russian Constitutional government continued the policy of its predecessors with regard to Poland. Pilsudski transferred his headquarters to Cracow and Lwow and commenced his activities amongst the refugees from the Russian provinces of the country. Here the idea of a "private Polish army" was conceived. An officers' school was established in Lwow and branches of the "sharpshooters" (Strzelec) formed throughout Galicia. Foreseeing the World War, Pilsudski hoped for a German and Austrian victory over Russia and a French victory over Germany. When war broke out, he consequently sided with Austria. The total strength of his "army" was 3,000 infantry and a squadron of cavalry insufficiently armed and equipped; the remaining 7,000 of his men were despatched to Hungary by the Austrian general command. His brigade took part in numerous battles in which it exhibited great bravery and exemplary discipline, while Pilsudski himself displayed the highest qualities as a leader. He refused, however, to let his legions be used outside of Polish territory. On the collapse of Russia, he turned against Germany and Austria. In July 1916 he resigned the command of the Polish legions in consequence of the abuses of the German and Austrian occupation authorities in Polish territory. At the same time he sought to establish relations with France and Great Britain through his colleagues, MM. Sokolnicki and Narutowicz. On Nov. 5, 1916, the independence of Poland was proclaimed by the Central Powers and Pilsudski accepted the position of Minister of War in the newly formed Council of State. Within a short time he formed the semi-secret Polish military organization, *i.e., Polska Organizacia Wojskowa* ("P.O.W."), which spread throughout the country and helped to disarm Germans and Austrians in 1918.

When the Polish legions in Russia, commanded by Gen. Musnicki, proclaimed Pilsudski their spiritual leader, and when his own legions refused, in July 1917, to take the oath of "fraternity of arms with Germany and Austria," Pilsudski was arrested by the Germans and imprisoned with his chief-of-staff Gen. Sosnowski in the fortress of Magdeburg, whence he was released in 1918 by the German revolutionary authorities. He arrived in Warsaw on Nov. 4 and completed the disarmament of the armies of occupation. The Regency Council, established by the Germans, resigned in his favour and all military organizations in the country submitted to his command. He was vested with dictatorial powers, and elected unanimously chief of State, while the army conferred on him the supreme honour of first marshal of Poland.

For Pilsudski's activities during the next years, *see* POLAND. His own chief interest was centred in the army, with which he was very popular, and at the head of which he undertook the campaigns of 1920 in the Ukraine and against the Russian advance on Warsaw. He had, however, many difficulties with other elements in the State and in 1923 he ceased to be chief of State and retired altogether from the army. In May 1926, however, his notorious dislike of the typically-Polish parliamentary wrangling and faction recalled him. He put himself again at the head of the army; a military demonstration on May 12 led to fighting in Warsaw and the resignation of the president. The national assembly, convoked by his successor, M. Rataj, elected Pilsudski president (May 31); but he refused the honour, and became only minister of war, while his friends MM. Masieki and Bartel were elected respectively president and premier. Pilsudski immediately carried through legislation greatly strengthening the position of the president against the parliament; but did not dissolve the latter or establish an open dictatorship, although he constantly prorogued it. In September, indeed, he took over the premiership himself; but seldom appeared in the Sejm, even when it was sitting. The elections of March 1928 gave his adherents a majority. Nevertheless Pilsudski, who had been in bad health, resigned the premiership, retaining, however, the ministry of war, chairmanship of the army council and inspectorate-general of the force. This change made little difference to his position in Poland and the vigorous abuse of the Sejm with which he motivated his actions was not actively resented. For the events of his real, though veiled dictatorship, which was popular in many circles and not aggressive in matters of foreign policy, *see* POLAND.

PIMA, a tribe of Indians on Gila and Salt rivers in southern Arizona, closely related to the Papago, who adjoin them on the south, and to the Pima Bajo in Sonora. They practised irrigation

and lived in permanent though rudely built villages. In their territory are the adobe ruins of Casa Grande and miles of prehistoric ditches. They are divided into five patrilineal totemic groups, make fair pottery and excellent basketry. They differ much from the other sedentary and agricultural natives of the south-west, the Pueblos. Consistently friendly to the whites, they long withstood the Apache courageously, fought back the hostile Yuman tribes, and sheltered those that took refuge with them. Estimated at 2,500 in 1775, they numbered 5,100 in 1921. *See* F. Russell, *Bur. Am. Ethn. Rep.* xxvi. (1908).

The Piman or Sonoran family, now recognized as a division of the larger Uto-Aztecan one, extended from Arizona to Jalisco, Mexico, and included the Pima, Papago, Opata, Tarahumare, Mayo, Yaqui, Tepehuane, Tepecano, Cora, Huichol and other groups. (A. L. K.)

PIMPERNEL (*Anagallis arvensis*), a small herb of the primrose family (Primulaceae), called also shepherd's clock and poor man's weather-glass, native to Europe and widely naturalized in North America from Newfoundland to the Pacific coast and southward to Mexico. It is a delicate annual with diffusely branching stems, with small, opposite, somewhat clasping, leaves, black-dotted beneath, and scarlet (rarely white) flowers, about ½ in. across, usually with a darker centre, opening only in bright sunshine, whence numerous popular names.

PIN, a small peg or bolt of metal or wood, not necessarily pointed, employed as a fastening to connect together different parts of an article, as a stop to limit the motion of some moving piece in a machine, as a support on which a small wheel may turn, etc., but most commonly a small metal spike, used for fastening portions of fabrics together, having one end pointed and at the other a bulbed head, or some other arrangement for preventing the spike from passing entirely through the cloth or other material with which it is employed. In one form or another pins of this last kind are of the highest antiquity, the earliest form doubtless being a natural thorn. Pins of bronze, and bronze brooches in which the pin is the essential feature, are of common occurrence among the remains of the bronze age. The ordinary domestic pin had become in the 15th century an article of sufficient importance in England to warrant legislative notice, as in 1483 the importation of pins was prohibited by statute. In 1540 Queen Catherine received pins from France, and again in 1543 an act was passed providing that "no person shall put to sale any pinnes but only such as shall be double headed, and have the heads soldered fast to the shank of the pinnes, well smoothed, the shank well shapen, the points well and round filed, canted and sharpened." At that time pins of good quality were made of brass; but a large proportion of those against which the legislative enactment was directed were made of iron wire blanched and passed as brass pins. To a large extent the supply of pins in England was received from France till about 1626, in which year the manufacture was introduced into Gloucestershire by John Tilsby. In 1636 the pinmakers of London formed a corporation, and the manufacture was subsequently established at Bristol and Birmingham, the latter town ultimately becoming the principal centre of the industry. So early as 1775 the attention of the enterprising colonists in Carolina was drawn to the manufacture by the offer of prizes for the first native-made pins and needles. At a later date several pin-making machines were invented in the United States. During the War of 1812, when the price of pins rose enormously, the manufacture was actually started, but the industry was not fairly successful till about the year 1836 when the Howe Manufacturing company was formed at Birmingham, Connecticut. Previous to this an American, Lemuel W. Wright, had in 1824 secured in England a patent for a machine to make solid-headed pins, which established the industry on its present basis.

Modern Pin Machinery.—In a modern pin-making machine wire of suitable gauge running off a reel is drawn in and straightened by passing between straightening pins or studs set in a table. When a pin length has entered it is caught by lateral jaws, beyond which enough of the end projects to form a pin-head. Against this end a steel punch advances and compresses the metal by a die arrangement into the form of a head. The pin length is immediately cut off and the headed piece drops into a slit sufficiently wide to pass the wire through but retain the head. The pins are consequently suspended by the head while their projecting extremities are held against a revolving cutter, by which they are pointed.

Then follows the finishing process, which consists of giving the pins the coating of tin which makes them silvery in appearance. In the case of brass pins, they are scoured, cleaned in argol (bitartrate of potash) and water and then tinned in a vat in a solution of water, oxalic acid and granulated tin mixed with the pins at a temperature of 100°C. Iron pins are tinned by an electrolytic process in an alkaline solution of a tin salt. After being washed and dried the pins are polished by being revolved in a barrel, mixed with dry bran or fine sawdust, from which they are winnowed as finished pins. The sizes of ordinary pins range from the 3½-in. stout blanket pin down to the finest slender gilt pin used by entomologists, 4,500 of which weigh about an ounce.

PINACEAE: *see* GYMNOSPERMS.

PINACOTHECA, the Greek name for a picture gallery, apparently reserved in Greece for one that was public, although used by the Romans for a picture gallery in a private house. In modern usage the term usually means the chamber forming the left wing of the Propylaea of the Athenian acropolis, which was used in ancient times as a picture gallery (Pausanias Bk. II., xxii. 6). Various modern public picture galleries bear the same or a similar name, such as those of Bologna and Turin, and at Munich the old and the new Pinakothek.

PINAR DEL RIO, capital of Pinar del Río Province, Cuba, about 107 m. S.W. by railway from Havana. Pop. (1919), 13,728. The city is in the fertile valley of the Guama. It is the centre of the tobacco industry of the Vuelta Abajo region. Its port is La Coloma, on the southern coast. The pueblo was created after 1773; but the history of the settlement goes back to 1571, and the parochial church dates from 1710.

PINCHBECK. When brass, the familiar alloy of copper and zinc, contains 12% to 15% of the latter metal, its colour simulates that of gold. In 1732, a London clockmaker, Christopher Pinchbeck, introduced a brass containing about 15% of zinc for the manufacture of imitation gold jewellery, and the yellow metal bore his name; hence the use of the term "pinchbeck" for flash or imitation jewellery. (*See* BRASS.)

PINCHOT, GIFFORD (1865–), American forester and public official, was born at Simbury, Conn., on Aug. 11, 1865. He graduated at Yale in 1889 and afterwards studied at the École Nationale Forestière, Nancy, France, and for briefer periods in Switzerland, Germany and Austria. Upon his return he began the first systematic forestry work in the United States, in the Vanderbilt forest at Biltmore, N.C. In 1896 he was made a member of the National Forest Commission that worked out the plan of U.S. forest reserves, and in 1897 he became confidential forest agent to the secretary of the Interior, to examine and report upon the reserves. In 1898 he was appointed chief of the division, later the bureau of forestry in the Department of Agriculture, which office he held until 1910. During the period of his administration, the entire forest system and administrative machinery of the bureau was built up, and Pinchot's enthusiasm and publicity work did much for the conservation movement in general. He also served as a member of the committee on public lands, 1903, and the Inland Waterways Commission, 1907. In 1908 he became chairman of the National Conservation Commission, and in 1910 president of the National Conservation Association. He founded the Yale School of Forestry at New Haven, as well as the Yale Summer School of Forestry at Milford, Pa., and in 1903 became professor of forestry at Yale. He was appointed State forester of Pennsylvania in 1920 and began a systematic administration of the large and important forest areas of that State. From 1923 to 1927 he was governor of Pennsylvania, and while in that office forced a reorganization of the State Government and the establishment of a budget system. He was also able, in 1923, to settle an important anthracite coal strike by arbitration.

Besides many articles in magazines, he has written *The White Pine* (1896); *The Adirondack Spruce* (1898); *A Primer of Forestry* (1899);

The Fight for Conservation (1909); *The Training of a Forester* (1917).

PINCKNEY, CHARLES (1757–1824), American statesman, was born on Oct. 26, 1757 at Charleston, S.C.; he was the son of Charles Pinckney (1731–84), first president of the first South Carolina provincial congress (1775), and a cousin of Charles Cotesworth Pinckney and Thomas Pinckney. He was studying law at the outbreak of the Revolutionary War, served in the early campaigns in the South, and in 1779 was elected to the South Carolina house of representatives. He was captured by the British at the fall of Charleston (1780), and remained a prisoner until the close of hostilities. In 1787 he was a delegate to the Federal constitutional convention, and on the same day (May 29) on which Edmund Randolph (*q.v.*) presented what is known as the Virginia plan, Pinckney presented a draft of a constitution which is known as the Pinckney plan Although the Randolph resolutions were made the basis on which the new constitution was framed, Pinckney's plan seems to have been much drawn upon. Furthermore, Pinckney appears to have made valuable suggestions regarding phrasing and matters of detail On Aug. 18, he introduced a series of resolutions, and to him should probably be accredited the authorship of the substance of some 32 or more provisions of the constitution Pinckney was president of the State convention of 1790 that framed a new constitution for South Carolina, was governor of the State 1789–92, a member of the State house of representatives in 1792–1796, and again governor in 1796–98 From 1799 to 1801 he was a member of the United States Senate He entered public life as a Federalist, but later became the leader in organizing the Democratic-Republican party in his State, and contributed largely to the success of Thomas Jefferson in the presidential election of 1800 By Jefferson's appointment he was American minister to Spain from 1801 to 1805 In general his mission was a distinct failure, his arrogance and indiscretions finally causing the Spanish government to request his recall He was again governor of South Carolina in 1806–08, and from 1819 to 1821 was a member of the National House of Representatives, in which he opposed the Missouri Compromise in a brilliant speech. He died at Charleston, S.C., on Oct. 29, 1824.

PINCKNEY, CHARLES COTESWORTH (1746–1825), American statesman, was born in Charleston, S C on Feb 25, 1746, the son of Charles Pinckney (d 1758), a prominent figure in colonial times, by his second wife, the celebrated girl planter, Eliza Lucas When a child he was sent to England, like his brother Thomas after him, to be educated Both of them were at Westminster and Oxford and were called to the bar, and for a time they studied in France at the Royal Military college at Caen Returning to America in 1769, C. C. Pinckney began the practice of law at Charleston He was a member of the first South Carolina provincial congress in 1775, served as colonel in the South Carolina militia in 1776–77, was chosen president of the South Carolina senate in 1779, took part in the Georgia expedition and the attack on Savannah in the same year, was captured at the fall of Charleston in 1780 and kept in confinement until 1782. He was an influential member of the constitutional convention of 1787, advocating the counting of all slaves as a basis of representation and opposing the abolition of the slave-trade He opposed as "impracticable" the election of representatives by popular vote, and also opposed the payment of senators, who, he thought, should be men of wealth Subsequently Pinckney bore a prominent part in securing the ratification of the Federal constitution in the South Carolina convention of 1788. In 1796 he succeeded James Monroe as minister to France. The Directory refused to receive him, and he retired to Holland, but in the next year, Elbridge Gerry and John Marshall having been appointed to act with him, he again repaired to Paris, where he is said to have made the famous reply to a veiled demand for a "loan" (in reality for a gift), "Millions for defence, but not one cent for tribute,"—another version is, "No, not a sixpence." The mission accomplished nothing, and Pinckney and Marshall left France in disgust, Gerry (*q v*) remaining When the correspondence of the commissioners was sent to the United States Congress the letters "X," "Y" and "Z," were inserted in place of the names of the French agents with whom the commission treated—hence the "X Y Z Correspondence," famous in American history. In 1800 he was the Federalist candidate for vice president, and in 1804 and again in 1808 for president, receiving 14 electoral votes in the former and 47 in the latter year. From 1805 until his death, on Aug 16, 1825, he was president general of the Society of the Cincinnati

PINCKNEY, THOMAS (1750–1828), American statesman and diplomat, was born in Charleston, S.C , on Oct 23, 1750, a younger brother of Charles Cotesworth Pinckney (*q v*) Educated in England, he returned to Charleston in 1773, and was admitted to the bar in 1774. During the American Revolution his early training at the French military college at Caen enabled him to render effective service to Gen Benjamin Lincoln, Count d'Estaing and Gen Horatio Gates In the battle of Camden he was badly wounded and captured, remaining a prisoner for more than a year Subsequently he was governor of South Carolina in 1787–89; presided over the State convention which ratified the Federal constitution in 1788; and was United States minister to Great Britain in 1792–96 During part of this time (1794–95) he was also envoy extraordinary to Spain, and in this capacity negotiated (1795) the important Treaty of San Lorenzo el Real; by that treaty the boundary between the United States and East and West Florida and between the United States and "Louisiana" was settled (Spain relinquishing all claims east of the Mississippi above 31° N lat), and the United States secured the freedom of navigation of the Mississippi to its mouth In 1796 Pinckney was the Federalist candidate for vice president, and in 1797–1801 he was a Federalist representative in Congress During the War of 1812 he was a major-general He died in Charleston on Nov 2, 1828 The Pinckneys, like many other South Carolina revolutionary leaders, were of aristocratic birth and politics, closely connected with England by ties of blood, education and business relations This renders the more remarkable their attitude in the American Revolution, for which they made great sacrifices

See C. C. Pinckney, *Life of General Thomas Pinckney* (Boston, 1895).

PIN-CLOVER (*Erodium cicutarium*), an annual herb of the geranium family (Geraniaceae), called also hemlock stork's-bill, and red filaree It is widespread as a weed in the Old World, and is extensively naturalized in North America from Nova Scotia to the Pacific coast, being especially abundant from Texas and Colorado westward to California and Oregon where it is highly esteemed as a forage plant The larger white-stemmed pin-clover, musk clover or filaree (*E moschatus*), native to Europe and locally naturalized in the United States, has become very abundant in California valleys

PINDAR (Gr Πίνδαρος, *c* 522–443 B C), the great lyric poet of ancient Greece was born at Cynoscephalae, in Boeotia, at the time of the Pythian games (*fr* 175, Bergk[4], 193)[1], which is taken by Bockh to be 522 B C He would thus be some thirty-four years younger than Simonides of Ceos He was the son of Daiphantus and Cleodice (or Cleidice) The clan of the Aegidae—tracing their line from the hero Aegeus—belonged to the "Cadmean" element of Thebes, *i e* , to the elder nobility whose supposed date went back to the days of the founder Cadmus Pindar stood, that is, within the circle of those families for whom the heroic myths were domestic records He had a personal link with the memories which everywhere were most cherished by Dorians, no less than with those which appealed to men of "Cadmean or of Achaean stock And the wide ramifications of the Aegidae throughout Hellas rendered it peculiarly fitting that a member of that illustrious clan should celebrate the glories of many cities in verse which was truly Panhellenic

Life.—Pindar is said to have received lessons in flute-playing from one Scopelinus at Thebes, and afterwards to have studied at Athens under the musicians Apollodorus (or Agathocles) and Lasus of Hermione In his youth, as the story went, he was defeated in a poetical contest by the Theban Corinna—who, in reference to his profuse employment of Theban mythology, is

[1]The references are to the edition of Pindar by C. A M Fennell (1893–99), and the fourth edition of Bergk's *Poetae lyrici graeci*.

said to have advised him "to sow with the hand, not with the sack." There is an extant fragment in which Corinna reproves another Theban poetess, Myrtis, "for that she, a woman, contended with Pindar" (ὅτι βανὰ φοῦσ' ἔβα Πινδάροιο ποτ' ἔριν) —a sentiment which hardly fits the story of Corinna's own victory. The facts that stand out from these meagre traditions are that Pindar was precocious and laborious. Preparatory labour of a somewhat severe and complex kind was, indeed, indispensable for the Greek lyric poet of that age. Lyric composition demanded studies not only in metre but in music, and in the adaptation of both to the intricate movements of the choral dance (ὀρχηστική).

Several passages in Pindar's extant odes glance at the long technical development of Greek lyric poetry before his time, and at the various elements of art which the lyrist was required to temper into a harmonious whole (*see*, e.g., *Ol.* iii. 8, vi. 91, xiii. 18, xiv. 15; *Pyth.* xii. 23, etc.). The earliest ode which can be dated (*Pyth.* x.) belongs to the twentieth year of Pindar's age (502 B.C.); the latest (*Olymp.* v.) to the seventieth (452 B.C.)[1]. He visited the court of Hiero at Syracuse; Theron, the despot of Acragas, also entertained him; and his travels perhaps included Cyrene. Tradition notices the special closeness of his relations with Delphi: "He was greatly honoured by all the Greeks, because he was so beloved of Apollo that he even received a share of the offerings; and at the sacrifices the priest would cry aloud that Pindar come in to the feast of the god"[2]. His wife's name was Megacleia (another account says Timoxena, but this may have been a second wife), and he had a son named Daiphantus and two daughters, Eumetis and Protomache. He is said to have died at Argos, at the age of seventy-nine, in 443 B.C.

Piety.—Among the Greeks of his own and later times Pindar was pre-eminently distinguished for his piety towards the gods. He tells us that, "near to the vestibule" of his house (*Pyth.* iii. 78), choruses of maidens used to dance and sing by night in praise of the Mother of the Gods (Cybele) and Pan—deities peculiarly associated with the phrygian music of the flute, in which other members of Pindar's family besides the poet himself are said to have excelled. A statue and shrine of Cybele, which he dedicated at Thebes, were the work of the Theban artists, Aristomedes and Socrates. He also dedicated at Thebes a statue to Hermes Agoraios, and another, by Calamis, to Zeus Ammon. The latter god claimed his especial veneration because Cyrene, one of the homes of his Aegid ancestry, stood "where Zeus Ammon hath his seat," *i.e.*, near the oasis and temple (*Pyth.* iv. 16). The author of one of the Greek lives of Pindar says that, "when Pausanias the king of the Lacedaemonians was burning Thebes, some one wrote on Pindar's house. 'Burn not the house of Pindar the poet'; and thus it alone escaped destruction." This incident, of which the occasion is not further defined, has been regarded as a later invention[3].

Better attested, at least, is the similar clemency of Alexander the Great, when he sacked Thebes one hundred and eight years after the traditional date of Pindar's death (335 B.C.). He spared only (1) the Cadmeia, or citadel, of Thebes (thenceforth to be occupied by a Macedonian garrison); (2) the temples and holy places; and (3) Pindar's house. While the inhabitants were sold into slavery, exception was made only of (1) priests and priestesses; (2) persons who had been connected by private ξενία with Philip or Alexander, or by public ξενία with the Macedonians; (3) Pindar's descendants. It is probable enough, as Dio Chrysostom suggests (ii. 33), that Alexander was partly moved by personal gratitude to a poet who had celebrated his ancestor Alexander I. of Macedon. But he must have been also, or chiefly, influenced by the sacredness which in the eyes of all Hellenes surrounded Pindar's memory, not only as that of a great national poet, but also as that of a man who had stood in a specially close relation to the gods, and, above all, to the Delphian Apollo.

Praise of Athens.—During the second half of Pindar's life, Athens was rising to that supremacy in literature and art which was to prove more lasting than her political primacy. Pindar did not live to see the Parthenon, or to witness the mature triumphs of Sophocles; but he knew the sculpture of Calamis, and he may have known the masterpieces of Aeschylus. It is interesting to note the feeling of this great Theban poet, who stands midway between Homeric epos and Athenian drama, towards the Athens of which Thebes was so often the bitterest foe, but with which he himself had so large a measure of spiritual kinship. A few words remain from a dithyramb in which he paid a glowing tribute to those "sons of Athens" who "laid the shining foundations of freedom" (παῖδες 'Αθαναίων ἐβάλοντο φαεννὰν κρηπῖδ' ἐλευθερίας, *fr.* 55, Bergk^4, 77), while Athens itself is thus invoked: ὦ ταὶ λιπαραὶ καὶ ἰοστέφανοι καὶ ἀοίδιμοι, 'Ελλάδος ἔρεισμα, κλειταὶ 'Αθᾶναι, δαιμόνιον πτολίεθρον (fr. 54, Bergk^4, 76). Isocrates, writing in 353 B.C., states that the phrase 'Ελλάδος ἔρεισμα, "stay of Hellas," so greatly gratified the Athenians that they conferred on Pindar the high distinction of προξενία (*i.e.*, appointed him honorary consul, as it were—for Athens at Thebes), besides presenting him with a sum of money (*Antidosis*, 166).

One of the letters of the pseudo-Aeschines (*Ep.* iv.) gives an improbable turn to the story by saying that the Thebans had fined Pindar for his praise of Athens, and that the Athenians repaid him twice the sum[4]. The notice preserved by Isocrates—less than one hundred years after Pindar's death—is good warrant for the belief that Pindar had received some exceptional honours from Athens. Pausanias saw a statue of Pindar at Athens, near the temple of Ares (i. 8, 4). Besides the fragment just mentioned, several passages in Pindar's extant odes bespeak his love for Athens. Its name is almost always joined by him with some epithet of praise or reverence. In alluding to the great battles of the Persian wars, while he gives the glory of Plataea to the Spartans, he assigns that of Salamis to the Athenians (*Pyth.* i. 76). In celebrating (*Pyth.* vii.) the Pythian victory of the Athenian Megacles, he begins thus: "Fairest of preludes is the renown of Athens for the mighty race of the Alcmaeonidae. What home, or what house, could I call mine by a name that should sound more glorious for Hellas to hear?" (*Cf.* also *Nem.* v. 49.)

Pindar's versatility as a lyric poet is one of the characteristics remarked by Horace (*Odes*, iv. 2), and is proved by the fragments, though the poems which have come down entire represent only one class of compositions—the *Epinicia*, or odes of victory, commemorating successes in the great games. The lyric types to which the fragments belong, though it cannot be assumed that the list is complete, are at least numerous and varied.

Fragments.—(1) Ὕμνοι, *Hymns* to deities—as to Zeus Ammon, to Persephone, to Fortune. The fragmentary ὕμνος entitled Θηβαίοις seems to have celebrated the deities of Thebes. (2) Παιᾶνες, *paeans*, expressing prayer or praise for the help of a protecting god, especially Apollo, Artemis or Zeus. (3) Διθύραμβοι, *Dithyrambs*, odes of a lofty and impassioned strain, sung by choruses in honour of Dionysus. (4) Προσόδια, *Processional Songs*, choral chants for worshippers approaching a shrine. (5) Παρθένια, *Choral Songs for Maidens.*

(6) Ὑπορχήματα, *Choral Dance-Songs*, adapted to a lively movement, used from an early date in the cult of Apollo, and afterwards in that of other gods, especially Dionysus. To this class belongs one of the finest fragments (84, Bergk^4, 107), written for the Thebans in connection with propitiatory rites after an eclipse of the sun, probably that of the 30th of April 463 B.C. (7) 'Εγκώμια, *Songs of Praise* (for men, while ὕμνοι were for gods), to be sung by a festal company. (8) Σκόλια, *Festal Songs.* The usual sense of σκόλιον is a drinking-song, taken up by one guest after another at a banquet. But Pindar's σκόλια were choral and antistrophic. One was to be sung at Corinth by a chorus of the ἱερόδουλοι attached to the temple of Aphrodite Ourania, when a certain Xenophon offered sacrifice before going to compete at Olympia. Another brilliant fragment, for Theoxenus of Tenedos, has an erotic character.

(9) Θρῆνοι, *Dirges*, to be sung with choral dance and the music of the flute, either at the burial of the dead or in commemorative rituals. Some of the most beautiful fragments belong to this class

[1]According to others, his latest poem is the eighth Pythian ode, 450 or 446.

[2] Πινδάρου γένος, in ed. Ald.

[3]A. Schäfer, *Demosthenes und seine Zeit.* iii. 119.

[4]Compare Jebb, *Attic Orators*, ii. 143.

(106–110, Bergk[4], 129–133). A number of small fragments, which cannot be certainly classified, are usually given as ἐξ ἀδήλων εἰδῶν, "of uncertain class."

The Epinicia.—The ἐπινίκια (*sc.* μέλη), or ἐπινίκιοι (*sc.* ὕμνοι), "Odes of Victory," form a collection of forty-four odes, traditionally divided into four books, answering to the four great festivals: (1) Ὀλυμπιονῖκαι (*sc.* ὕμνοι): fourteen odes for winners of the wild olive-wreath in the Olympian games, held at Olympia in honour of Zeus once in four years; (2) Πυθιονῖκαι: twelve odes for winners of the laurel-wreath in the Pythian games held at Delphi in honour of Apollo, once in four years, the third of each Olympiad; (3) Νεμεονῖκαι: eleven odes for winners of the pine-wreath in the Nemean games, held at Nemea, in honour of Zeus, once in two years, the second and fourth of each Olympiad; and (4) Ἰσθμιονῖκαι: seven odes for winners of the parsley wreath in the Isthmian games, held at the Isthmus of Corinth, in honour of Poseidon, once in two years, the first and third of each Olympiad. The Greek way of citing an ode is by the nomin. *plur.* followed by the numeral, *e.g.*, "the ninth Olympian" is Ὀλυμπιονῖκαι θ' The chronological range of the collection (so far as ascertainable) is 502 B.C. (*Pyth.* x.) to 452 B.C. (*Ol.* v.).

The general characteristics of the odes may be briefly considered under the following heads: (1) language; (2) treatment of theme; (3) sentiment—religious, moral and political; (4) relation to contemporary art.

Diction.—The diction of Pindar is distinct in character from that of every other Greek poet, being almost everywhere marked by the greatest imaginative boldness Thus (*a*) metaphor is used even for the expression of common ideas, or the translation of familiar phrases, as when a cloak is called (*Ol.* ix. 97) "a warm remedy for winds." (*b*) Images for the highest excellence are drawn from the farthest limits of travel or navigation, or from the fairest of natural objects, as when the superlative hospitality of a man who kept open house all the year round is described by saying, "far as to Phasis was his voyage in summer days, and in winter to the shores of Nile" (*Isthm.* ii. 41); or when Olympia, the "crown" or "flower" of festivals, is said to be excellent as water, bright as gold, brilliant as the noonday sun (*Ol* i *ad init*). This trait might be called *the Pindaric imagery of the superlative.* (*c*) Poetical inversion of ordinary phrase is frequent; as, instead of, "he struck fear into the beasts," "he gave the beasts to fear" (*Pyth.* v. 56) (*d*) The efforts of the poet's genius are represented under an extraordinary number of similitudes, borrowed from javelin-throwing, chariot-driving, leaping, rowing, sailing, ploughing, building, shooting with the bow, sharpening a knife on a whetstone, mixing wine in a bowl, and many more. (*e*) Homely images, from common life, are not rare; as from account-keeping, usury, sending merchandise over sea, the σκυτάλη or secret dispatch, etc. And we have such homely proverbs as, "he hath his foot in this shoe," *i.e.*, stands in this case (*Ol.* vi 8). (*f*) The natural order of words in a sentence is often boldly deranged, while, on the other hand, the syntax is seldom difficult. (*g*) Words not found except in Pindar are numerous, many of these being compounds which (like ἐναρίμβροτος, καταφυλλοροεῖν, etc) suited the dactylic metres in their Pindaric combinations Horace was right in speaking of Pindar's "nova verba," though they were not confined to the "audaces dithyrambi."

Subjects.—The actual victory which gave occasion for the ode is seldom treated at length or in detail—which, indeed, only exceptional incidents could justify. Pindar's method is to take some heroic myth, or group of myths, connected with the victor's city or family, and, after a brief prelude, to enter on this, returning at the close, as a rule, to the subject of the victor's merit or good fortune, and interspersing the whole with moral comment. Thus the fourth Pythian is for Arcesilaus, king of Cyrene, which was said to have been founded by men of Thera, descendants of one of Jason's comrades. Using this link, Pindar introduces his splendid narrative of the Argonauts. Many odes, again, contain shorter mythical episodes—as the birth of Iamus (*Ol.* vi), or the vision of Bellerophon (*Ol.* xiii.)—which form small pictures of masterly finish and beauty. Particular notice is due to the skill with which Pindar often manages the return from a mythical digression to his immediate theme. It is bold and swift, yet is not felt as harshly abrupt—justifying his own phrase at one such turn—καί τινα οἶμον ἴσαμι βραχύν (*Pyth.* iv. 247).

Religious, Moral and Political Sentiment.—*a.* The religious feeling of Pindar is strongly marked in the odes. "From the gods are all means of human excellence." He will not believe that the gods, when they dined with Tantalus, ate his son Pelops; rather Poseidon carried off the youth to Olympus. That is, his reason for rejecting a scandalous story about the gods is purely religious, as distinct from moral; it shocks his conception of the divine dignity. With regard to oracles, he inculcates precisely such a view as would have been most acceptable to the Delphic priesthood, viz., that the gods do illumine their prophets, but that human wit can foresee nothing which the gods do not choose to reveal. A mystical doctrine of the soul's destiny after death appears in some passages (as *Ol.* ii. 66 *seq.*). Pindar was familiar with the idea of metempsychosis (cf. *ibid.* 68), but the attempt to trace Pythagoreanism in some phrases (*Pyth.* ii. 34, iii. 74) appears unsafe. The belief in a fully conscious existence for the soul in a future state, determined by the character of the earthly life, entered into the teaching of the Eleusinian and other mysteries. Comparing the fragment of the Θρῆνος (114, Bergk[4], 137), we may probably regard the esoteric element in Pindar's theology as due to such a source.

b. The moral sentiment pervading Pindar's odes rests on a constant recognition of the limits imposed by the divine will on human effort, combined with strenuous exhortation that each man should strive to reach the limit allowed in his own case. Native temperament (φυή) is the grand source of all human excellence (ἀρετή), while such excellences as can be acquired by study (διδακταὶ ἀρεταί, *Ol.* ix. 100) are of relatively small scope—the sentiment, we may remark, of one whose thoughts were habitually conversant with the native qualities of a poet on the one hand and of an athlete on the other The elements of ὑγιεὶς ὄλβος—"sane happiness," such as has least reason to dread the jealousy of the gods—are substance sufficing for daily wants and good repute (εὐλογία). He who has these should not "seek to be a god" "Wealth set with virtues" (πλοῦτος ἀρεταῖς δεδαιδαλμένος), as gold with precious gems, is the most fortunate lot, *because* it affords the amplest opportunities for honourable activity Pindar does not rise above the ethical standard of an age which said, "love thy friend and hate thy foe" (cf. *Pyth.* ii. 83; *Isthm* iii 65). But in one sense he has a moral elevation which is distinctively his own; he is the glowing prophet of generous emulation and of reverent self-control.

c. The political sentiments of the Theban poet are suggested by *Pyth* xi. 52; "In polities I find the middle state crowned with more enduring good; therefore praise I not the despot's portion; those virtues move my zeal which serve the folk." If in *Pyth* ii. 87, a democracy is described as ὁ λάβρος στρατός, "the raging crowd," it is to be noted that the ode is for Hiero of Syracuse, and that the phrase clearly refers to the violence of those democratic revolutions which, in the early part of the 5th century B C , more than once convulsed Sicilian cities. At Thebes, after the Persian wars, a "constitutional oligarchy" (ὀλιγαρχία ἰσόνομος, Thuc. iii 62) had replaced the narrower and less temperate oligarchy of former days (δυναστεία οὐ μετὰ νόμων); and in this we may probably recognize the phase of Greek political life most congenial to Pindar. He speaks of a king's lot as unique in its opportunities (*Ol.* i. 113); he sketches the character of an ideal king (*Pyth.* iii. 71); but nothing in his poetry implies liking for the τυραννίς as a form of government. Towards the Greek princes of Sicily and Cyrene his tone is ever one of manly independence, he speaks as a Greek citizen whose lineage places him on a level with the proudest of the Dorian race, and whose office invests him with an almost sacred dignity. In regard to the politics of Hellas at large, Pindar makes us feel the new sense of leisure for quiet pursuits and civilizing arts which came after the Persian wars He honours "Tranquillity, the friend of cities" (Ἁσυχία φιλόπολις, *Ol* iv. 16). The epic poet sang of wars: Pindar celebrates the "rivalries of peace."

Love of Natural Art.—Pindar's genius was boldly original; at the same time he was an exquisite artist. "Mine be it to invent

new strains, mine the skill to hold my course in the chariot of the Muses; and may courage go with me, and power of ample grasp" (*Ol.* ix. 80). Here we see the exulting sense of inborn strength; in many other places we perceive the feeling of conscious art—as in the phrase δαιδάλλειν, so apt for his method of inlaying an ode with mythical subjects, or when he compares the opening of a song to the front of a stately building (*Ol.* vi. 3). Pindar's sympathy with external nature was deeper and keener than is often discernible in the poetry of his age. It appears, for example, in his welcome of the season when "the chamber of the hours is opened, and delicate plants perceive the fragrant spring" (*fr.* 53, Bergk[4], 75); in the passage where Jason invokes "the rushing strength of waves and winds, and the nights, and the paths of the deep" (*Pyth.* iv. 195); in the lines on the eclipse of the sun (*fr.* 84, Bergk[4], 107); and in the picture of the eruption, when Etna, "pillar of the sky, nurse of keen snow all the year," sends forth "pure springs of fire unapproachable" (*Pyth.* i. 20). The poet's feeling for colour is often noticeable—as in the beautiful story of the birth of Iamus—when Evadne lays aside her silver pitcher and her girdle of scarlet web; the babe is found, "its delicate body steeped in the golden and deep purple rays of pansies" (*Ol.* vi. 55).

Relation to Art.—The spirit of art, in every form, is represented for Pindar by χάρις—"the source of all delights to mortals" (*Ol.* i. 30)—or by the personified Charites (Graces). The Charites were often represented as young maidens, decking themselves with early flowers—the rose, in particular, being sacred to them as well as to Aphrodite. In Pindar's mind, as in the old Greek conception from which the worship of the Charites sprang, the instinct of beautiful art was inseparable from the sense of natural beauty. The period from 500 to 460 B.C., to which most of Pindar's extant odes belonged, marked a stage in the development of Greek sculpture. The schools of Argos, Sicyon and Aegina were effecting a transition from archaic types to the art which was afterwards matured in the age of Pheidias. Olympia forms the central link between Pindar's poetry and Greek sculpture. From about 560 B.C. onwards sculpture had been applied to the commemoration of athletes, chiefly at Olympia.

In a striking passage (*Nem.* v. *ad. init.*) Pindar recognizes sculpture and poetry as sister arts employed in the commemoration of the athlete, and contrasts the merely local effect of the statue with the wide diffusion of the poem. "No sculptor I, to fashion images that shall stand idly on one pedestal for aye; no, go thou forth from Aegina, sweet song of mine, on every freighted ship, on each light bark." Many particular subjects were common to Pindar and contemporary sculpture. Thus (1) the sculptures on the east pediment of the temple at Aegina represented Heracles coming to seek the aid of Telamon against Troy—a theme brilliantly treated by Pindar in the fifth Isthmian; (2) Hiero's victory in the chariot-race was commemorated at Olympia by the joint work of the sculptors Onatas and Calamis; (3) the Gigantomachia, (4) the wedding of Heracles and Hebe, (5) the war of the Centaurs with the Lapithae, and (6) a contest between Heracles and Apollo, are instances of mythical material treated alike by the poet and by sculptors of his day.

Place in Greek Literature.—In the development of Greek lyric poetry two periods are broadly distinguished. During the first, from about 600 to 500 B.C., lyric poetry is local or tribal—as Alcaeus and Sappho write for Lesbians, Alcman and Stesichorus for Dorians. During the second period, which takes its rise in the sense of Hellenic unity created by the Persian wars, the lyric poet addresses all Greece. Pindar and Simonides are the great representatives of this second period, to which Bacchylides, the nephew of Simonides, also belongs. These, with a few minor poets, are classed by German writers as *die universalen Meliker.* The Greeks usually spoke, not of "lyric," but of "melic" poetry (*i.e.*, meant to be sung, and not, like the epic, recited); and "universal melic" is lyric poetry addressed to all Greece. But Pindar is more than the chief extant lyrist. Epic, lyric and dramatic poetry succeeded each other in Greek literature by a natural development. Each of them was the spontaneous utterance of the age which brought it forth.

In Pindar we can see that phase of the Greek mind which produced Homeric epos passing over into the phase which produced Athenian drama. His spirit is often thoroughly dramatic—witness such scenes as the interview between Jason and Pelias (*Pyth.* iv.), the meeting of Apollo and Chiron (*Pyth.* ix.), the episode of Castor and Polydeuces (*Nem.* x.), the entertainment of Heracles by Telamon (*Isthm.* v.). Epic narrative alone was no longer enough for the men who had known that great trilogy of national life, the Persian invasions; they longed to see the heroes moving and to hear them speaking. The poet of Olympia, accustomed to see beautiful forms in vivid action or vivid art, was well fitted to be the lyric interpreter of the new dramatic impulse. Pindar has more of the Homeric spirit than any Greek lyric poet known to us. On the other side, he has a genuine, if less evident, kinship with Aeschylus and Sophocles. Pindar's work, like Olympia itself, illustrates the spiritual unity of Greek art.

The fact that certain glosses and lacunae are common to all our mss. of Pindar make it probable that these mss. are derived from a common archetype. Now the older scholia on Pindar, which appear to have been compiled mainly from the commentaries of Didymus (*c.* 15 B.C.), sometimes presuppose a purer text than ours. But the compiler of these older scholia lived after Herodian (A.D. 160). The archetype of our mss., then, cannot have been older than the end of the 2nd century. Our mss. fall into two general classes: (1) the older, representing a text which, though often corrupt, is comparatively free from interpolations; (2) the later, which exhibit the traces of a Byzantine recension, in other words, of lawless conjecture, down to the 14th or 15th century. To the first class belong Parisinus 7, breaking off in *Pyth.* v.; Ambrosianus 1, which has only *Ol.* i.–xii.; Mediceus 2; and Vaticanus 2—the two last-named being of the highest value. The editio princeps is the Aldine (Venice, 1513). A modern study of Pindar may be almost said to have begun with C. G. Heyne's edition (1773). Hermann did much to advance Pindaric criticism. But August Böckh (1811–21), who was assisted in his commentary by L. Dissen, is justly regarded as the founder of a scientific treatment of the poet. The edition of Theodor Bergk (*Poetae lyrici graeci,* 1878 new ed. by O. Schröder, 1900) is marked by considerable boldness of conjecture, as that of Tycho Mommsen (1864) by a sometimes excessive adherence to mss. A recension by W. Christ has been published in Teubner's series (2nd ed., 1896), also with Prolegomena and commentary (1896); and by O. Schröder (1908). The complete edition of J. W. Donaldson (1841) has many merits; but that of C. A. M. Fennell (1879–83; new ed., 1893–99) is better adapted to the needs of English students. The *Olympia* and *Pythia* have been edited by B. L. Gildersleeve (1885), the *Nemea* and *Isthmia* by J. B. Bury (1890–92); the *Scholia* by E. Abel (1890, unfinished) and A. B. Brachmann (1903). There is a special lexicon by J. Rumpel (1883). The translation into English prose by Ernest Myers (2nd ed., 1883) is excellent; verse translation by T. C. Baring (1875), and of the *Olympian Odes* by Cyril Mayne (1906), also the edition in the *Loeb Classical Library,* with Eng. trans. by J. Sandys (1915). Pindar's metres have been analysed by J. H. H. Schmidt, *Die Kunstformen der griechischen Poesie* (Leipzig, 1868–72). On Pindar generally, *see* L. Schmidt, *Pindar's Leben und Dichtung* (1862); F. D. Morice, *Pindar* (1879); A. Croiset, *La Poésie de Pindare* (1880); G. Lübbert, *Pindar's Leben und Dichtungen* (Bonn, 1882); W. Christ, *Geschichte der griechischen Litteratur* (1898); F. Dornseiff, *Pindars Stil* (1921). Bibliographical information on the earlier literature will be found in W. Engelmann, *Scriptores graeci* (1881); *see* also L. Bornemann, in *Jahresbericht über die Fortschrift der classischen Altertumswissenschaft* (ed. C. Bursian, vol. cxvi., 1904), with special reference to chronological questions and *Pythia,* i., ii., iii. Some considerable fragments of the paeans were discovered in 1906 by B. P. Grenfell and A. S. Hunt, see *Paeans* in *Oxyrhynchus papyri* (pt. v. 1908), and A. E. Housman, in *Classical Review* (Feb. 1908).

(R. C. J.; X.)

PINDARICS, the name by which was known a class of loose and irregular odes in fashion in England during the close of the 17th and the beginning of the 18th century. The invention is due to Abraham Cowley, who, probably in Paris, and perhaps in 1650, found a text of Pindar and determined to imitate the Greek poetry in English, without having comprehended the system upon which Pindar's prosody was built up. Cowley published, in 1656, 15 *Pindarique Odes,* which became the model on which countless imitators founded their pindarics. The erroneous form of these poems, which were absolutely without discipline of structure, was first exposed by Congreve, exactly half a century later. The laxity of these "pindarics" attracted the poets of the unlyrical close of the 17th century, and they served the purpose not only of Dryden and Pope, but of a score of lesser poets. Although the vogue of these forms hardly survived the age of Anne, something of the vicious tradition of them still remained, and even in the

odes of Wordsworth, Shelley and Coleridge the broken versification of Cowley's pindarics occasionally survives.

PINDARIS, a word of uncertain origin, applied to the irregular horsemen who accompanied the Mahratta armies in India during the 18th century. They received no pay, but rather purchased the privilege of plundering on their own account. The majority of them seem to have been Mohammedans. When the regular forces of the Mahrattas had been broken up in the campaigns conducted by Sir Arthur Wellesley and Lord Lake in 1802–4, the Pindaris made their headquarters in Malwa, under the tacit protection of Sindhia and Holkar. They usually assembled annually in November to set forth over British territory in search of plunder. In 1808–9 they plundered Gujarat, and in 1812 Mirzapur. In 1814 they were reckoned at 25,000 to 30,000 horsemen, half of them well armed In 1817 the marquess of Hastings obtained the consent of the East India Company to the organized campaign, known as the Pindari War. The Pindaris were surrounded on all sides by a great army, consisting of 120,000 men and 300 guns: and Sindhia, overawed, was forced to sign the treaty of Gwalior, consenting to aid in the extirpation of the Pindaris, whom he had hitherto protected The Peshwa at Poona, the Bhonsla raja at Nagpur and the army of the infant Holkar each took up arms, but were separately defeated The Pindaris themselves offered little opposition. Amir Khan, their most powerful leader, accepted the conditions offered to him His descendant is now Nawab of the state of Tonk in Rajputana

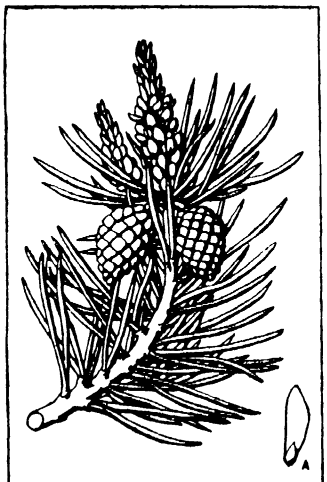
See J Grant Duff, *History of the Mahrattas* (1826); and Major Ross of Bladensburg, *Marquess of Hastings* (Rulers of India Series) (1893).

PINDUS, the ancient name for the mountains which separate Thessaly from Epirus, often used by modern geographers in a somewhat extended sense The folded Alpine chains are continued down the western coast of the Balkan peninsula, where in the north they form the Dinaric Alps In the neighbourhood of Scutari (Skadar), however, the direction of the coast-line undergoes a marked change, associated with a change in the trend of the mountain folds In the extended sense the name Pindus is applied to the chain of fold-mountains which extends from the Šar Planina, in the latitude of Scutari, southwards to about the latitude of the Gulf of Arta, and thus includes most of the mountains of Albania. As a rule massive limestones are less developed in the Pindus than in the Dinaric region, so that the karstic type of landscape is less frequent and less repellent than in the north, the prevailing types of rocks being often schists, grits and greenish eruptive rocks, especially serpentines The range rises to a maximum height of about 8,000 feet, and in places the original forests, mainly of oak and beech, have been preserved

PINE, a name given by the ancients to some of the resinous cone-bearing trees to which it is now applied, and, as limited by modern botanists, the designation of a large genus (*Pinus*) of true conifers, differing from the firs in their hard woody cone-scales being thickened at the apex, and in their slender needle-shaped leaves growing from a membranous sheath, either in pairs or from three to five together—each tuft representing an abortive branch, springing from the axil of a partially deciduous scale-leaf, the base of which remains closely adherent to the stem The numerous male catkins are generally arranged in dense whorls around the bases of the young shoots; the anther-scales, surmounted by a crest-like appendage, shed their abundant pollen by longitudinal slits; the two ovules at the base of the inner side of each fertile cone-scale develop into a pair of winged seeds, which drop from the opening scales when mature

The pines, which comprise about 70 species, are widely distributed over the north temperate zone, in the southern portions chiefly confined to the mountains, along which, in Central America, a few are found within the Tropics; in more northern regions they frequently form extensive forests, sometimes hardly mingled with other trees. One species occurs native in Great Britain; about 30 are indigenous to the United States and Canada Their soft, straight-grained, resinous and often durable wood gives to many kinds a high economic value, and some are among the most esteemed of timber trees.

Of the two-leaved species, *P. sylvestris,* the pine of northern Europe, may be taken as a type. When growing in perfection it is one of the finest of the group, and perhaps the most picturesque of forest trees; attaining a height of from 70 to 120 ft., it is of conical growth when young, but in maturity acquires a spreading cedar or mushroom-like top, with a straight trunk, two to four feet in diameter at the base, and gnarled twisted boughs, densely clothed at the extremities with glaucous green foliage, which contrasts strongly with the fiery red-brown bark. The leaves are rather short, curved, and often twisted; the male catkins, in dense cylindrical whorls, fill the air of the forest with their sulphur-like pollen in May or June, and pollinate the purple female flowers, which, at first sessile and erect, then become recurved on a lengthening stalk, the ovate cones, about the length of the leaves, are not fertilized until the next summer and do not reach maturity until the autumn of the following year They seldom open and scatter their seeds until the third year *P. sylvestris* is found, in greater or less abundance, from the hills of Finmark and the plains of Bothnia to the mountains of Spain and even the higher forest-slopes of Etna, while in longitude its range extends from the shores of the North Sea to Kamchatka Nowhere more abundant than in the Scandinavian peninsula, this tree is the true fir (*fur, fura*) of the old Norsemen, and still retains the name in Great Britain, though botanically now classed as a pine It grows vigorously in Lapland on the lower ground, while in south Norway it occurs up to 3,000 ft, though the great forests from which "Norway pine" timber is chiefly derived are on the comparatively lower slopes of the south-eastern dales: in the highest situations it dwindles to a mere bush It furnishes the yellow deal of the Baltic and Norway In Germany, both on the mountains and the sandy plains woods of "kiefer" are frequent and widely spread, while vast forests in Russia and Poland are chiefly composed of this species; in many northern habitats it is associated with the spruce and birch In Asia it abounds in Siberia and on the mountains of the Amur region, on the European Alps it occurs at a height of 5,600 ft, and on the Pyrenees it is found at still higher elevations In Great Britain natural forests of Scotch fir of any extent are only now found in the Highlands, chiefly on the declivities of the Grampians The tree is not at present indigenous in southern Britain, but when planted in suitable ground multiplies rapidly by the wind-sown seeds; on many of the sandy moors and commons natural pine woods of large extent have been thus formed during recent years The heartwood of the finer kinds of Scotch fir is of a deep brownish-red colour, abounding in the resin to which its durability is probably due For all indoor and most outdoor purposes it is as lasting as oak, and for ship planking is perhaps little inferior; from its lightness and elasticity it is well adapted for the construction of yachts and other small fast-sailing craft, and is said to be the best of all wood for masts and large spars; its weight varies from 30 to 40 lb per cubic foot Great numbers of young pines are annually cut for railway sleepers, mining timber and numerous agricultural applications; large quantities are consumed for wood-pavement The quality of the timber depends greatly on the soil and position in which the trees are grown The rapidity of growth is still more variable in Britain full maturity is attained in from 70 to 120 years, but in Norway the trunk increases much more slowly; Schubeler states that a tree felled in the Alten district (about 70° lat), measuring 2 ft 10 in in diameter, showed 400 annual rings



SCOTCH FIR (PINUS SYLVESTRIS)
Branch with male flowers above, young cones below, (A) winged seed

In the economy of the northern nations of Europe *P. sylvestris* is an important tree. In Scandinavia and Russia houses are chiefly constructed of its timber; and log-huts are made of the smaller trunks and lined and roofed with the bark. The inner bark is twisted into ropes, and, in times of scarcity, is kiln-dried, ground up and mixed with meal.

Vast numbers of Scotch firs are raised in nurseries for artificial planting; the seed is sown in the spring, being just covered with earth, and the seedlings transplanted in the second year into rows for further culture, or taken direct to the seed-bed for final planting; sometimes the seed is sown where the trees are intended to grow. A plantation of young Scotch firs requires frequent and careful thinning as the young trees increase in size; but pruning should be avoided as much as possible, except for the removal of dead wood.

In Great Britain *P. sylvestris* is subject to many insect depredations: the pine-chafer, *Hylurgus piniperda,* is destructive in some places, the larva of this beetle feeding on the young succulent shoots, especially in young plantations; the fir-weevil, *Hylobius abietis,* eats away the bark, and numerous lepidopterous larvae devour the leaves; the pine-sawfly is also injurious in some seasons. The removal of all dead branches from the trees and from the ground beneath them is recommended, as most of these insects lay their eggs in the decaying parts of the bark and among the dead leaves.

In common with other pines, *P. sylvestris* is subject to the attacks of various fungi. *Trametes radiciperda* attacks the roots and penetrates to the stem, causing rotting of the wood. The disease is difficult to eradicate, as the mycelium of the fungus travels from root to root in the soil. Rotting of the wood at the base of the trunk is also caused by *Agaricus melleus,* which spreads in the soil by means of its long purple-black, cord-like mycelial strands known as *Rhizomorpha.* Much damage is often caused by species of *Peridermium,* which often invade the soft portions of the inner bark to such an extent as to "ring" the stem or branch, or to cause an abnormal formation of turpentine which soaks into the wood and stops the upward passage of water; this causes the parts above the diseased area to perish.

Plantations in England are generally ready for final cutting in from 60 to 70 years, and many are cleared at a much earlier stage of growth, especially when protected from injury by pests. In England the pine is largely employed as a "nurse" for oak trees, its conical growth when young admirably adapting it for this purpose; its dense foliage renders it valuable as a shelter tree for protecting land from the wind; it stands the sea gales better than most conifers, but will not flourish on the shore like some other species. This pine is planted for ornament in the Eastern United States where it has become sparingly naturalized; it has also proved of value in afforesting treeless lands, as in the National forest in western Nebraska.

Large quantities of turpentine are extracted from this pine in Sweden and Russia by removing a strip of bark, terminating below in a deep notch cut in the wood, into which the turpentine runs, and from which it is scooped as it accumulates; but the product is not equal to that of the silver fir and other species. Tar is prepared largely from *P. sylvestris*; it is chiefly obtained from the roots.

Closely allied to the Scotch pine, and perhaps to be regarded as a mere alpine form of that species, is the dwarf *P. Pumilio,* the "krummholz" or "knieholz" of the Germans—a recumbent bush, generally only a few feet high, but with long zigzag stems, that root occasionally at the knee-like bends where they rest upon the ground. The foliage much resembles that of the Scotch fir, but is shorter, denser and more rigid; the cones are smaller but similar in form. Abounding on the higher slopes of the Bavarian and Tirolese Alps, it is a favourite shelter for the chamois; the hunters call it the "latschen," from its recumbent straggling habit.

The red pine, *P. resinosa,* of south-eastern Canada and the northern border of the United States from Minnesota eastward (so called from the colour of its bark), is a tree sometimes 120 ft. high, with a trunk 3 ft. or more in diameter. The somewhat glaucous leaves form dense tufts at the ends of the branches, and are 4 or 5 in. long; the ovate blunt cones are about half that length. The tree is of quick growth and the wood strong and resinous, but it is less durable than Scotch fir although much employed in shipbuilding.

P. Laricio, the Corsican pine, is one of the noblest trees of this group, growing to a height of 100 or even 150 ft., with a straight trunk and branches in regular whorls, forming in large trees a pyramidal head; the slender leaves, of a dark green tint, are from 4 to 7 in. long; the cones, either in pairs or several together, project horizontally, and are of a light brown colour. This pine abounds in Corsica, and is found in more or less abundance in Spain, southern France, Greece, and many Mediterranean countries. The tree is of very rapid growth, but produces good timber, much used in southern dockyards, and very durable, though less strong than that of *P. sylvestris*; the heart-wood is of a brownish-tint. In southern France it has been planted with success on the drift-sands of the Bay of Biscay, though it does not bear the full force of the sea-blast as well as the pinaster. In England it grows well in sheltered situations and well-drained soils. The black pine, *P. austriaca,* generally now regarded as a variety of *P. Laricio,* derives its name from the extreme depth of its foliage tints—the sharp, rigid, rather long leaves of a dark green hue giving a sombre aspect to the tree.

P. Pinaster, the cluster or pinaster, is an important species from its vigorous growth in the sand-drifts of the coast, for the purpose of binding which it has been grown more extensively and successfully than any other tree, especially on the dunes of the Bay of Biscay. Growing to a height of from 40 to 80 ft., the deeply-furrowed trunk occasionally reaches a diameter of 3 ft. or more at the base, where, like most sand trees, it usually curves upward gradually, a form that enables the long tap-roots to withstand better the strain of the sea gale; when once established, the tree is rarely overthrown even on the loosest sand. The branches curve upwards like the stem, with their thick covering of long dark green leaves, giving a massive rounded outline to the tree; the ovate cones are from 4 to 6 in. long, of a light shining brown hue, with thick scales terminating in a pyramidal apex; they are arranged around the branches in the radiating clusters that give name to the tree. The pinaster grows naturally on sandy soils around the Mediterranean from Spain to the Levant. On the drift-sands of France, especially in the Gironde, forests have been formed mainly of this pine; the seeds, sown at first under proper shelter and protected by a thick growth of broom sown simultaneously, vegetate rapidly in the sea-sand. and the trees thus raised have, by their wind-drifted seed, covered much of the former desert of the Landes with an evergreen wood. These forests of pinaster, apart from the production of timber in a once treeless district, have a great economic value as a source of turpentine. In England the cluster-pine has been largely planted on sandy districts near the sea, and has become naturalized in Purbeck and other wild tracts in the southern counties.

P. Pinea is the stone pine of Italy; its spreading rounded canopy of light green foliage, supported on a tall and often branchless trunk, forms a striking feature of the landscape in that country, as well as in some other Mediterranean lands. The beautiful reddish-brown shining cones, roundly ovate in shape, with pyramidal scale apices, have been prized from the ancient days of Rome for their edible nut-like seeds (pignons), which are still used as an article of food or dessert. They do not ripen until the fourth year, and are kept in the cone until required, as their abundant oil soon turns rancid.

Nearly approaching this is *P. excelsa,* the Bhotan or blue pine, which differs chiefly in its longer cones and drooping glaucous foliage. It is found in Kumaon and Bhotan and on some of the Nepal ranges, but does not grow in the moist climate of the Sikkim Himalayas; it is found at a height of 7,000 to 12,000 ft., and attains large dimensions.

P. Cembra is the stone pine of Siberia and central Europe. It abounds on the Alps, the Carpathians and the Siberian ranges, in Switzerland being found at an altitude of 4,000 to 6,000 ft. The seeds are oily like those of *P. Pinea,* and are eaten both on the Alps and by the inhabitants of Siberia; a fine oil is expressed

from them which is used both for food and in lamps. The growth of *P. Cembra* is slow, but the wood is of remarkably even grain, and is employed by the Swiss wood-carvers in preference to any other. Numerous species of pine are planted for ornament, afforestation, and timber production.

North American Pines.—The 35 or more species and major varieties of pine native to North America north of Mexico may be grouped in two sections, the *soft pines* and the *pitch pines.*

The *soft pines* have soft, close-grained wood, with thin nearly white sapwood; the sheaths of the leaf-clusters fall off early (deciduous); the leaves contain a single fibro-vascular bundle, and, excepting those of the nut pines, the leaves are in five-leaved clusters.

There are 11 species, only one of which, the eastern white pine, is found east of the Great Plains, the others occurring in the Rocky-Mountain region and on the Pacific coast.

The soft pines consist of four groups. (1) the *white pines,* large trees with long-stalked, thin-scaled, cylindrical cones, including the eastern white pine (*P. Strobus*), the western white pine (*P. monticola*) and the sugar pine (*P. Lambertiana*); (2) the *stone pines,* medium-sized trees with short-stalked, thick-scaled cones, including the limber pine (*P. flexilis*) and the whitebark pine (*P. albicaulis*); (3) the *foxtail pines,* rather small trees with short-stalked, ovoid, prickly cones, including the foxtail pine (*P. Balfouriana*) and the bristle-cone pine (*P. aristata*); and (4) the *nut pines,* small trees with leaves in one- to four-leaved clusters, globose cones and large edible seeds, including the piñon (*P. edulis*), the single-leaf piñon (*P. monophylla*), the Parry piñon (*P Parryana*) and the Mexican piñon (*P. cembroides*) By some authorities *P. edulis, P. monophylla* and *P. Parryana* are regarded as varieties of *P. cembroides.*

The eastern white pine, *P. Strobus*, known also as Weymouth pine, because of its large growth and soft even grain of its white wood, is one of the most valuable of North American timber trees It once formed extensive forests from Newfoundland to Manitoba and along the northern border of the United States from Maine to Minnesota and also southward in the mountains to Georgia but it has been so long sought for by the lumberer that most of the old trees have long disappeared On a deep rich soil *P Strobus* sometimes attains a height of 200 ft., and a trunk diameter of 4 to 6 feet The wood of the white pine is durable for indoor use, especially when protected by paint, its smooth easily-worked grain rendering it a favourite wood for the house-carpenter and joiner. The western white pine, *P. monticola*, a mountain species of the north-western United States and British Columbia, with light brown wood, is extensively cut for lumber, especially in Idaho

The sugar pine or giant pine, *P Lambertiana,* of California, the largest of known pines, rises to a height of 200 ft. to 220 ft., with a trunk from 6 ft to 8 ft, or occasionally 12 ft in diameter The head is of a pyramidal form, the lower branches drooping like those of a Norway spruce, its foliage is of a light bright green colour The pendent cones are very large, sometimes 18 in long and 4 in in diameter, with large nut-like seeds, which, pounded and baked, are eaten by the Indians It is lumbered extensively, the wood being highly valued for indoor carpentry.

The *pitch pines* have usually heavy, coarse-grained, mostly dark-coloured wood, with pale often thick sapwood, the sheaths of the leaf-clusters are persistent (except in the Chihuahua pine), the leaves have two fibro-vascular bundles, and are arranged mostly in three-leaved and two-leaved clusters There are some 24 species about equally divided in number between the region east of the Great Plains and the region extending from the Rocky Mountains to the Pacific coast.

The group of pitch pines with the leaves usually in three-leaved clusters includes several of the most valuable trees of North America. Among these are the longleaf pine (*P. palustris*), the slash pine (*P. caribaea*), the loblolly pine (*P. Taeda*), the pitch pine (*P. rigida*) and the pond pine (*P serotina*), of the southern States, and the western yellow pine (*P. ponderosa*), the Jeffrey pine (*P. Jeffreyi*) and the Arizona pine (*P. arizonica*), of the Pacific States. Other representatives of the three-leaved group are the Monterey pine (*P. radiata*), the knob-cone pine (*P. attenuata*), the digger pine (*P. Sabiniana*) and the Coulter pine (*P. Coulteri*), of California and Oregon, and also the Chihuahua pine (*P leiophylla*) of the Mexican border.

The group of pitch pines with leaves usually in two-leaved clusters also comprises several important trees. Among these are the red or Norway pine (*P. resinosa*), the grey or jack pine (*P Banksiana*), the spruce pine (*P. glabra*), the shortleaf pine (*P echinata*), the Virginia pine (*P. virginiana*), the sand pine (*P. clausa*) and the mountain pine (*P. pungens*), of the region east of the Rocky Mountains. Here belong also the lodge-pole pine (*P contorta*), found from New Mexico to Alaska, and the knob-cone pine (*P attenuata*), of California and Oregon. Other representatives of the two-leaved group are the bishop pine (*P. muricata*) and the rare Torrey pine (*P. Torreyana*), both confined to the California coast.

Long-leaf pine (*P. palustris*) is the "Georgia pitch pine," or yellow pine of the southern States; it abounds on sandy soils from the Carolinas, and Florida westward to Louisiana and Texas The most marked feature of the tree is its long tufted foliage—the leaves, of a bright green tint, springing from long white sheaths, being often a foot in length The tall columnar trunk, sometimes 120 ft high furnishes one of the most valued pine timbers of the United States, close-grained and resinous, it is very durable and polishes well, it is largely employed in construction work, and large quantities are exported, especially to Great Britain and the West Indies This tree is the chief lumber-producing pine of the southern United States; it also yields large quantities of tar and turpentine

The loblolly pine, *P. Taeda,* a tall tree with straight trunk and spreading top, covers great tracts of the "pine-barrens" of the southern States, but also frequently spreads over deserted arable lands that have been impoverished by long and bad farming, hence the woodsmen call it the "old-field" pine while, from the fragrance of its abundant resin, it is also known as the frankincense pine It is a fine species 80 to 100 ft high, having sometimes a girth of 6 or 8 ft The timber of this pine, though soft and brittle, is much used for lumber and the forests of it are of importance because of the turpentine they yield

The western yellow pine or bull pine, *P. ponderosa,* which grows from 150 ft to 200 ft high, with a massive trunk 5 ft to 8 ft in diameter, is noted for the extreme density of its wood, which barely floats in water, it is the most widely distributed pine tree of the mountain forests of western North America from British Columbia to South Dakota (Black Hills) and south to Texas and Mexico It is the chief lumber pine of the Pacific States, where it is second in importance only to the Douglas fir (*q v*) The Coulter pine, *P Coulteri,* is remarkable for its enormous cones (sometimes a foot long, 6 in in diameter, and weighing more than 4 lb), the scales end in long hooked points curving upwards; the leaves are long, rigid, and glaucous in hue. Nearly related to this is the digger pine, *P Sabiniana,* of California, the cones of which are 7 to 9 in long and 5 to 6 in in diameter, also with hooked scales, the large nut-like seeds are eaten by the Indians; the tree sometimes attains a height of 80 ft and a trunk diameter of 4 feet The beautiful Monterey pine, *P radiata,* found sparingly along the California coast, is distinguished by the brilliant colour of its foliage The Torrey pine, *P Torreyana,* with leaves 12 in. long, found only in a narrow strip some 8 m. in length, along the coast near San Diego, Calif, and on Santa Barbara island, is the least widely distributed of all known pines.

The pitch pine, *P rigida,* found from the coast of Massachusetts south-westward throughout the Appalachian region, is a tree of from 40 to 50 ft in height with rugged trunk, occasionally 3 ft in diameter; the short dark-green leaves are in thick tufts, contrasting with the pale yellowish, usually clustered cones, the scales of which are furnished with small curved spines. Large quantities of tar and pitch are obtained from this species. The tree is one of the few that will flourish in salt-marshes

Pine Lumbering in the United States.—The various native species of pine, several of which form forests of vast extent, constitute the chief source of the soft-wood (coniferous) lumber

produced in the United States. According to the census of manufactures the total cut in 1925 of both soft-wood and hard-wood lumber was 38,338,614,000 bd. ft.; this had an aggregate value at the mill of $1,074,248,000. Of this total there was cut from pine trees an aggregate of 18,191,284,000 bd. ft., valued at the mill at $500,660,114. The pine forests of the country, therefore, contributed 47·5% of the footage and 46·6% of the value of all lumber produced. For the same year the total cut of soft-wood lumber was 31,686,919,000 bd. ft., which had a mill value of $824,342,161. Toward these totals pine lumber furnished 57·1% of the footage and comprised 60·7% of the mill value. Further details confirming the pre-eminence of pine timber in the soft-wood lumber industry of the country are shown in the accompanying table

Production of Soft-wood (Coniferous) Lumber in the United States, 1925

Name of Wood	Production Board Feet	Av. Value at Mill per M bd. ft. $	Total Value $	% of U. S. Total Value
Pines	18,216,263,000	27·48	500,660,114	60·7
Yellow Pine	13,235,936,000	26·46	350,224,866	42·9
Western Yellow Pine	3,127,208,000	27·70	86,623,662	10·5
White Pine	1,521,128,000	32·58	49,558,830	6·0
Sugar Pine	306,992,000	44·79	13,750,162	1·6
Lodge-pole Pine	24,979,000	20·22	505,074	0·06
Other Conifers	13,495,635,000	23·98	323,682,047	39·3
Douglas Fir	8,154,373,000	20·94	171,752,571	20·8
Hemlock	2,139,631,000	21·58	46,173,236	5·6
Cypress	902,590,000	40·90	36,915,931	4·5
Redwood	510,639,000	33·99	20,420,454	2·5
Spruce	751,276,000	27·98	20,269,426	2·5
Cedar	372,162,000	38·80	14,439,886	1·8
White Fir	336,887,000	22·51	7,583,326	0·9
Larch (Tamarack)	306,991,000	18·25	5,602,586	0·7
Balsam Fir	19,686,000	26·65	521,631	0·06
Total Soft Woods (Conifers)	31,711,898,000	25·99	824,342,161	100·0

If the immense footage cut from the Douglas fir (*q.v.*), commonly known to a large part of the lumber trade as Oregon or western pine, is added to that produced from the true pines, then the total footage marketed as pine lumber amounted in 1925 to 26,356,657,000 bd. ft., with a mill value of $672,412,685, or 68·8% of the footage and 62 6% of the mill value of all lumber manufactured in the United States.

Commercially, the lumber cut from the various kinds of pine is known as *white, yellow, western yellow, sugar* and *lodge-pole* pine, and is classified under these descriptive names in the census of manufactures. White-pine lumber includes that produced from the eastern white or Weymouth pine, the western white pine, the grey or jack pine and the Norway or red pine, the two last named belonging botanically with the yellow pines. Prior to 1900 the eastern white pine was one of the chief lumber-producing trees in America, but the original forests have become so depleted that the tree now contributes only a minor fraction of the lumber marketed as white pine. The lumber from the eastern white, the grey and the red pine is mostly cut in the northern border States from Maine to Minnesota. Western white-pine lumber is practically all produced in Idaho (389,267,000 bd. ft.) and Washington (90,559,000 bd. ft.).

Yellow-pine lumber is cut mainly in the southern States; 70% of the total is produced in five States: Mississippi, Louisiana, Alabama, Texas and Georgia, which rank in the order named. The kinds of pine furnishing yellow-pine lumber all belong to the pitch pine group, and include the longleaf, loblolly, shortleaf, sand, slash, pitch, spruce, pond, mountain and Virginia pine, the longleaf, shortleaf, loblolly and slash pines ranking among the most important.

Western yellow-pine lumber, practically all cut from *P. ponderosa*, is produced chiefly in Oregon, 32%; California, 25%; Washington, 14%, and Idaho, 12%.

Sugar-pine lumber, cut from a single species (*P. Lambertiana*) and produced commercially only in California (97·5%) and Oregon (2·5%), in 1925 commanded the highest average price at the mill of any pine lumber cut in the United States. Lodge-pole pine lumber is produced in small quantities in the Rocky Mountain States—Wyoming contributing 48%; Colorado, 42%, Montana, 5%; and Utah, 4%, of the total footage. *See* UNITED STATES: *Fauna and Flora*, Plate VII., and the map showing forest distribution.

For further details *see* F. Engler and A. Prantl, *Die natürlichen Pflanzenfamilien* (1887–1908); A. Veitch, *Manual of the Coniferae* (1915); C. S. Sargent, *Manual of the Trees of North America* (1905, 2nd. ed. 1922); L. H. Bailey, *Manual of Cultivated Plants* (1924); G. B. Sudworth, "Check List of the Forest Trees of the United States," *U.S. Dept. Agric. Misc. Cir.* 92 (1927).

PINE-APPLE. The pine-apple so called consists in reality of the inflorescence of the plant, the originally separate flowers of which, together with the bracts supporting them, become fleshy and consolidated into one mass. The swelling and fusion of the tissues take place after the process of fertilization, and it may be that the richly perfumed succulent mass is an aid in the distribution of seed by affording food to certain animals. In the highly developed cultivated pines, however, it frequently happens that the seeds do not ripen properly. The pine-apple, *Ananas sativus*, is a member of the family Bromeliaceae, of tropical American origin, where it is widely spread; and it is now naturalized in the tropical regions of the Old World. It is cultivated on an extensive commercial scale in the Hawaiian Islands.

Evelyn in his *Diary* mentions tasting a pine-apple from Barbados at the table of Charles II., and this is we believe the first mention of the fruit in English literature. For many years pine-apples

PINE-APPLE (ANANAS SATIVUS), FROM A MODERN PHOTOGRAPH OF PINE-APPLES GROWING IN THE OPEN

were cultivated in large private gardens, but owing to the great developments in the West Indies, etc., they are no longer grown in Britain or Europe.

PINE-BEETLE, the name applied to several beetles (*see* COLEOPTERA) that attack pines and other coniferous trees, particularly in North America. The most important of these are *Dendroctonus ponderosa* which has done great damage to the timber of the Black Hills forest reserve; it attacks the main trunk of the tree. The wood engraver bark beetle (*Xyleborus coelatus*) attacks the white and yellow pines (*Pinus strobus* and *P. palustris*), while *X. pubescens* feeds on *P. inops*. All these beetles belong to the bark-boring family *Scolytidae*. (*See* COLEOPTERA; ENTOMOLOGY: *Economic*.)

PINE BLUFF, a city of Arkansas, U.S.A., 45 m. S.S.E. of Little Rock, on the south bank of the Arkansas river, at an altitude of 215 ft.; county seat of Jefferson county. It is served by the Missouri Pacific and the St. Louis Southwestern railways, and has a municipal airport of 224 ac., 1·5 m. north of the city. Pop. (1920) 19,280 (33% negroes); estimated locally at 30,000 in 1928. The city stands on bluffs overlooking the river. It is the seat of the State industrial school for boys, and of the Agri-

cultural, Mechanical and Normal school for negroes (opened 1875), a branch of the State university. Its wholesale and jobbing business covers most of southern Arkansas, and parts of Texas, Louisiana and Mississippi. Its manufactures in 1925 were valued at $10,142,154, and include railway shops, lumber-mills and woodworking plants, and factories making locomotive and car castings, brake shoes, automobile bodies and tops, mixed feeds, cotton yarn and knit underwear. The cotton exchange handles 150,000 bales in a normal year, of which 40,000–70,000 bales (of strong fibre, and averaging 1⅛ in. in length of staple) is grown in Jefferson county. There is an ample supply of natural gas and hydro-electric current. The city's assessed valuation for 1927 was $12,856,850. Bank deposits on June 30, 1928, aggregated $13,226,667. Pine Bluff was laid out in 1832 and chartered as a city in 1885.

PINEHURST, a winter resort in the long-leaf pine region of the Sand Hills of North Carolina, U.S.A.; 62 m. S.W. of Raleigh, on Federal highways 1 and 15 and the Norfolk Southern railroad, 650 ft. above sea-level. The resident population was about 1,500 in 1928 (33% negroes), and the number of visitors averages about 10,000 through the season (October to May). Pinehurst has 81 holes of golf, laid out by Donald Ross, 100 m. of bridle paths, and generous provision for polo, tennis, archery, trap and rifle range shooting, flying and horse-racing.

PINEL, PHILIPPE (1745–1826), French physician, was born at Saint-André, Tarn, France, on April 20, 1745. He took his doctor's degree at Toulouse in 1773. His first publication was a French translation of William Cullen's *Nosology* (1785); it was followed by an edition of the works of G. Baglivi (1788), and in 1791 he published a *Traité medico-philosophique sur l'aliénation mentale* in which he advocated a more humane treatment of the insane. It is on this advocacy and on the practical effect he was able to give to his ideas that his fame rests. His opportunity came with his appointment in 1792 as head physician of the Bicêtre, and two years afterwards of the Salpêtrière. His chemical lectures at the Salpêtrière formed the basis of his *Nosographie philosophique* (1798) which was further developed in *La Médicine clinique* (1802). Pinel was made a member of the Institute in 1803, and soon afterwards was appointed professor of pathology in the École de Médecine. He died at Paris on Oct. 26, 1826.

See notices by E. Pariset and Esquirol in *Mémoires de l'Académie de Medicine* (1828).

PINE-NUT or **PINON:** *see* NUT.

PINERO, SIR ARTHUR WING (1855–), English dramatist, was born in London on May 24, 1855, the son of John Daniel Pinero, a Jewish solicitor, whose family was of Portuguese origin, long established in London. A. W. Pinero was engaged in 1874 as an actor at the Theatre Royal, Edinburgh, and came to London in 1876, to play at the Globe theatre. Later in the year he joined the Lyceum company, of which he remained a member for five years. The first piece of his to see the footlights was *£200 a Year,* played in Oct. 1877, at the Globe theatre for the benefit of F. H. Macklin.

The first play to make a hit was *The Money Spinner* (Theatre Royal, Manchester, Nov. 1880); but in *The Squire* (St. James's Theatre, Dec. 1881) he attempted serious drama, and gave promise of the qualities of his later work. In 1883 and 1884 Pinero produced seven pieces, but the most important of his works at this period were the successful farces produced at the Court theatre: *The Magistrate* (March 1885), which ran for more than a year; *The Schoolmistress* (March 1886); *Dandy Dick* (Jan. 1887), revived in February 1900; *The Cabinet Minister* (April 1890), and *The Amazons* (March 1893). Two comedies of sentiment, *Sweet Lavender* (Terry's, March 1888) and *The Weaker Sex* (Theatre Royal, Manchester, Sept. 1888), met with success, and *Sweet Lavender* has enjoyed numerous revivals. With *The Profligate* (Garrick, April 1889) he returned to the serious drama.

The Second Mrs. Tanqueray (St. James's, May 27, 1893) dealt with the converse of the question propounded in *The Profligate,* but with more art and more courage. The piece aroused great discussion, and placed Pinero in the front rank of living English dramatists. It was translated into French, German and Italian, and the part of Paula Tanqueray, created in the first place by Mrs. Patrick Campbell, attracted many actresses, among others Eleonora Duse. His later plays include *The Notorious Mrs. Ebbsmith* (Garrick, March 13, 1895), *The Benefit of the Doubt* (Comedy, Oct. 1895), *The Princess and the Butterfly* (St. James's, April 7, 1897), *Trelawney of the Wells* (Court, Jan. 30, 1898), *The Gay Lord Quex* (Globe, April 8, 1899), *Iris* (Garrick, Sept. 21, 1901), *Letty* (Duke of York's, Oct. 8, 1903), *A Wife Without a Smile* (Wyndham's, Oct. 9, 1904), *His House in Order* (St. James's, Feb. 1, 1906), *The Thunderbolt* (St. James's, May 9, 1908), *Mid-Channel* (St. James's, Sept. 2, 1909), *The Big Drum* (1915), *The Freaks* (1918) and *The Enchanted Cottage* (1922). Pinero was knighted in 1909.

His *Plays* (11 vols. 1891–1895) have prefaces by M. C. Salaman. *See* also H. Hamilton Fyfe, *A. W. Pinero* (1902).

PINEROLO, city and episcopal see of Piedmont, Italy, in the province of Turin. Pop. (1921) 14,634 (town); 19,033 (commune). It is built on a hill-side just above the valleys of the Chisone and the Lemina, at a height of 1,234 ft. above the sea, 24 m. by rail S.W. of Turin. Till 1696 it possessed a citadel regarded as the key of Italy, in which Fouquet, De Caumont, Lauzun and the man with the iron mask were imprisoned, and city walls constructed by Thomas I. of Savoy.

PIN-EYED, a botanical term for flowers which occur in two forms, one of which shows the stigma at the mouth of the corolla, as in the primrose; the term is contrasted with thrum-eyed, where instead of a single stigma like one head of a pin there is a ring of five stamens visible.

PING-PONG: *see* TABLE TENNIS.

PINK, in botany, the common name for plants of the genus *Dianthus* of the family Caryophyllaceae. They are characterized by the presence of simple leaves borne in pairs at the thickened nodes, flowers terminating the axis and having a tubular calyx surrounded by a number of overlapping bracts, a showy corolla of five free long-stalked petals, ten stamens proceeding, together with the petals, from a short stalk supporting the ovary, which latter has two styles and ripens into a pod-like many-seeded capsule. The species are herbaceous perennials of low stature, often with very showy flowers. They are natives chiefly of southern Europe and the Mediterranean region, a few being found in temperate Asia and South Africa. Four species are wild in Great Britain. Of these, *D. armeria,* Deptford pink and *D. deltoides,* maiden pink, are generally distributed, *D. caesius,* Cheddar pink, occurs only on the limestone rocks at Cheddar, and *D. gallicus* only on the sand dunes of Jersey. Two others, *D. plumarius* and *D. Caryophyllus,* are more or less naturalized, and are interesting as being the originals of the pinks and of the carnations and picotees of English gardens. Garden pinks are derivatives from *D. plumarius,* a native of central Europe, with leaves rough at the edges, and with rose-coloured or purplish flowers. The use of "pink" for a colour is taken from the name of the plant.

The carnation (*q.v.*) and picotee are modifications of *Dianthus Caryophyllus,* the clove pink. This is a native of Europe, growing on rocks in the south, but in the north usually found on old walls. The carnation includes those flowers which are streaked or striped lengthwise—the picotees are those in which the petals have a narrow band of colour along the edge, the remainder of the petal being free from stripes or blotches. These by the old writers were called "gillyflowers." The sweet-william of gardens is a product from *Dianthus barbatus.*

The sea-pink, or thrift, *Armeria vulgaris,* is a member of the family Plumbagineae; it is a widely distributed plant found on rocky and stony sea-shores and on lofty mountains.

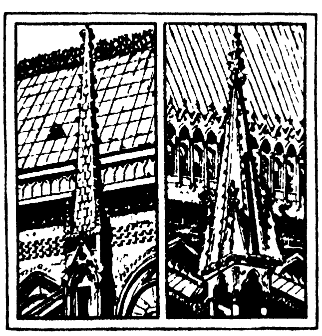
PINKERTON, ALLAN (1819–1884), American detective, was born in Glasgow, Scotland, Aug. 25, 1819. In 1842 he emigrated to Chicago, Ill., and in 1843 he removed to Dundee, Kane county, Ill. Here he ran down a gang of counterfeiters and was therefore appointed a deputy-sheriff of Kane county in 1846 and immediately afterwards of Cook county, with headquarters in Chicago. There he organized a force of detectives to capture thieves who were stealing railway property. This organization developed in 1852 into Pinkerton's National Detective Agency,

since well known for its activities in industrial disputes, etc. Some of his notable successes were the capture of the principals in the theft of $700,000 from Adams Express Company in 1866, and the uncovering of a plot to assassinate President-Elect Lincoln in February 1861, when he arrived in Baltimore on his way to Washington. In 1861 Pinkerton organized a system of obtaining military information in the Southern States, and from this system he developed the Federal secret service. One of his detectives, James McParlan, from 1873 to 1876 lived among the Molly Maguires (*q.v.*) in Pennsylvania and secured evidence which led to the breaking up of the organization. Pinkerton died in Chicago on July 1, 1884. He published *The Molly Maguires and the Detectives* (1877), *The Spy of the Rebellion* (1883), in which he gave his version of President-elect Lincoln's journey to Washington; and *Thirty Years a Detective* (1884).

PINKNEY, WILLIAM (1764–1822), American lawyer and statesman, was born in Annapolis, Md., on March 17, 1764. He was admitted to the bar in 1786, and from 1788 to 1792 practised in Harford county. In 1788 he was a member of the State convention which ratified the Federal Constitution for Maryland (1788–92), and in 1795 of the house of delegates (where in 1788 and 1789 he defended the right of slave-owners to free their slaves), and from 1792 to 1795 of the State executive council. From 1796 to 1804 he was commissioner to England to determine the claims of American merchants under the Jay Treaty of 1794 and adjusted a claim of $800,000 for Maryland on the Bank of England. In May 1806, with James Monroe, then minister at London, he was commissioned to treat with the British Government concerning the capture of neutral ships in time of war: from 1807 to 1811, after Monroe's return to America, he was resident minister in London. He was elected to the Maryland senate in Sept. 1811 and later was attorney-general of the United States, until 1814. In Aug. 1814 he was wounded at Bladensburg. He served in the National house of representatives Jan.–April 1816, and from 1816–18 was minister plenipotentiary to Russia and special minister to Naples, where he attempted to secure indemnity for the losses to American merchants by seizure and confiscation during the rule of Murat in 1809. He was a member of the committee which drew up the Missouri Compromise (*q.v.*). He was a member of the United States Senate from 1820 until his death, at Washington, on Feb. 25, 1822.

See William Pinkney, *The Life of William Pinkney* (1853) (1810–83); Henry Wheaton, *Some Account of the Life, Writings and Speeches of William Pinkney* (1828).

PINNACLE, in architecture, any vertical, decorative motive serving as the upper termination of a building or other form; hence, metaphorically, a summit or topmost limit. The word is distinguished from finial (*q.v.*) as signifying a larger motive, sometimes of considerable complexity, whereas a finial is a single ornament, and from tower or turret by the fact that a pinnacle is always a strictly subsidiary motive. Thus a Gothic tower and spire may be decorated with pinnacles, each one of which is capped by a finial. The chief architectural development of the pinnacle was in connection with buttresses (*q.v.*) of late Romanesque and Gothic buildings, as the addition of a pinnacle to a buttress not only added to the stability by increasing the weight, but also gave a decorative termination to the vertical line. Earlier pinnacles are simple square or rectangular structures capped with gable roofs or small spires, as in St. Remi at Reims (middle 12th century), and in the west front of Rochester cathedral (1130). With the development of the flying buttress (*q.v.*) pinnacles were increased greatly in size, and especially in France, in richness, and usually decorated with colonnettes on the outer corners and arches and crocketted gables above, sometimes with the addition of slender crocketted spires. Those of Notre Dame at Paris (end of 12th and beginning of 13th centuries) are typical. The most beautiful of the developed Gothic buttress pinnacles are those of the choir of Reims cathedral (*c.* 1240), in which the solid portion is preceded by an open shrine with a statue of an angel. In England, pinnacles were especially developed during the Decorated Period (*q.v.*) and play an important part in the tower designs in which they serve to soften the transition between a square tower and a spire above. Characteristic examples are those of Beverley minster (*c.* 1350) and the tower of St. Mary's at Oxford (*c.* 1300).



PINNACLE. LEFT: NOTRE DAME, PARIS; RIGHT: REIMS CATHEDRAL

The modern emphasis on vertical lines, resulting from steel construction, has led to a recrudescence of the use of pinnacles, and, especially in the tall buildings of America, they are common decorations of the sky line and of the various set-backs.

PINOCLE is a game of cards, similar to the French game of "bezique." It can be played by two, three or four persons.

Short Pinocle is played with two packs, from which all cards below the 9's are left out. The cards remaining are in order of value: 9, knave, queen, king, 10, ace (high). Twelve cards are dealt to each player, four at a time, and the next card is turned as a trump. It is placed under the pack, face up. If it is a 9, it is called the "dix" (pronounced "deece"), and the dealer scores 10 points for turning it. If any other card is turned, either player who has a 9 of trumps, after he has taken a trick, may take up the turned trump into his hand, and put his 9 face up, under the pack, and score 10 points for his 9. The holder of the other dix may lay it on the table, after he has taken a trick, and add 10 to his score.

The scoring is done by "melding," a word which comes from a German verb *melden,* to announce. After either player has taken a trick, he can lay the cards to be melded on the table, face up, and add the value of that meld to the score, but only one meld can be made after each trick taken. The values of the meld are as follows: the dix is 10; a marriage (any king and queen of same suit) 20; a royal marriage (a king and queen of trumps) 40; pinocle (the knave of diamonds and queen of spades) 40; 4 aces of different suits 100; 4 kings of different suits 80; 4 queens of different suits 60; 4 knaves of different suits 40; a royal straight (ace, 10, king, queen and knave of trumps) 150.

In melding, at least one new card must be laid out for each new meld. For instance, with spades for trumps, holding 150, the king and queen should be laid out first, and 40 trumps melded; then, after taking another trick, the ace, 10 and knave are laid down, and 150 melded. Then, if the player has the knave of diamonds, after taking another trick, it may be laid by the queen of spades, and pinocle melded. This order of melding, however, can only be followed when there are enough cards left in stock to be sure the player will have time, as no meld can be made after the last card is drawn from the stock. Otherwise 150 should be melded at once.

The cards left after the trump is turned are called "stock cards," and after each trick is taken in, and laid away, face down, each player draws a card, the winner drawing first. After they draw, no player can meld until he has taken another trick. Each player keeps in mind a count of the cards he has taken in play. They count as follows: aces 11, tens 10, kings 4, queens 3, and knaves 2 points; and he adds the total of those made to his melding score. The player who takes the last trick also adds 10. The total of the points in the two hands, including the last trick, is 250.

A player may follow suit, trump or discard, but after the last stock card has been drawn, each must follow suit or trump. If void both of the suit and trump, he may discard. One who violates this law loses the cards in the tricks he has won, in that hand. The game is 1,000 points, and when a player who has the lead believes that the value of cards in the tricks he has taken, added to the points he has already scored, equals 1,000, he may call "out" and stop the play. If he is short of the points, he loses the game.

Auction Pinocle has generally taken the place of short pinocle. Only in number of cards used, the values of the melds and the values of the cards and dixes are the games the same. Only three can play auction pinocle. If a fourth takes part, each dealer in turn takes no cards, and sits out during the play, but wins or loses the same as those who play against the successful bidder.

Fifteen cards are dealt to each player, usually three at a time, and at some time during the deal, three cards are dealt to the table, face down, and remain there. These are often called the "widow" or "dummy." Each player in turn, beginning with the eldest hand, may pass or may bid for the privilege of declaring the trump, and playing the hand. If all pass, the hands are thrown up, and there is a new deal. If bids are made, the first bid usually must be at least 200 or 250 (in some clubs at least 300), but may be whatever more the bidder thinks he can make. Each following bid must be at least 10 more, and the bidding continues until two players have passed. A player who has passed cannot bid again on that hand. When two pass, the bidding stops, and the contract goes to the last bidder, who becomes the contractor. The contractor now turns the three cards in the "widow" face up on the table, and adds them to his hand. He declares a trump, and lays his melds on the table, face up. In addition to the melds given above, the contractor may meld a "round trip" 240, if he holds a king and a queen in each suit, but if he makes this meld, a royal straight counts only 110. If these values, added, make his bid, he has won his contract, and the other players pay; but if, after counting his melds and dixes, he is short of the points bid, and his opponents refuse to concede the contract, he may play the hand and try to make up the shortage from the count of the cards in the tricks he takes. If he feels he cannot make his bid, he does not play, but pays

If the contractor decides to play, he takes all the cards up from the table, lays three not melded, face down from his own hand, which count as a trick for him. If he fails to lay these cards out, he loses. If he lays a trump he must announce it He now leads, and the other two are partners against him In the play of the hand, every player must follow suit or trump If void both of the suit led and trumps, a player may discard any card on the trick If trumps are led, each player that follows must play a higher card and win the trick if he can If void of trumps, he may discard The last trick counts ten for the one who wins it. If the number of points made by the value of the cards in the tricks the contractor wins, added to the points in his meld, make the number that he has bid, he collects for the number of points bid, from the players, no matter how many points he has made If the bid is 300, and he makes 500 points, he can only collect for 300. If the contractor plays the hand and fails to make his contract, he must pay double.

Each deal is a complete game, and is usually paid for at once by the losers For convenience, instead of keeping a score, each player usually takes 25 poker chips At the end of the hand, each player pays 2 chips for any loss under 300, 3 chips for a loss between 300 and 340, 5 chips for a loss from 350 to 390, 10 chips for a loss from 400 to 440, 15 chips from a loss from 450 to 490, 20 chips for a loss of 500. These figures are purely arbitrary. Players give any value they wish to each chip At the end of the sitting, each player owes for the 25 chips he had at the beginning, and collects for all the chips he has won, or pays for all the chips he has lost. (C. L. P)

PINSK, a town of Poland, in the province of Polesie, at the confluence of the Strumen and Pina rivers, 196 m S W by rail of Minsk. The river Pina connects it with the fertile regions in the basin of the Dnieper, and, by means of the Dnieper-and-Bug canal, with Poland and Prussia, while the Oginski canal connects it with the basin of the Niemen. Pottery, leather, oil, soap and beer are the chief products of the local industries The draining of the marshes around Pinsk was begun by the Russian government in 1872, and by 1897 8,000,000 acres had been drained at an average cost of 3s. per acre. Pinsk (Pinesk) is first mentioned in 1097 as a town belonging to Sviatopolk, prince of Kiev In 1132 it formed part of the Minsk principality. After the Mongol invasion of 1239–42 it became the chief town of a separate principality, and continued to be so until the end of the 13th century. In 1320 it was annexed to Lithuania; and in 1569, after the union of Lithuania with Poland, it was chief town of the province of Brest. Pinsk was annexed to Russia in 1795, and restored to Poland in 1918.

PINT, a liquid measure of capacity, equivalent to ⅛ of a gallon (derived probably through Spanish, from Lat *pincta*, *picta*, a painted or marked vessel). The imperial British pint = ·57 of a litre, 34·66 cu. in. The United States standard pint = ·47 of a litre, 28⅞ cu. in.

PINTO, FERNÃO MENDES (1509–1583), Portuguese adventurer, was born at Montemôr-o-Velho, of poor parents, and entered the service of a noble lady in Lisbon. He embarked for India in 1537 in a fleet commanded by the son of Vasco da Gama, and for 21 years travelled, fought and traded in China, Tartary, Pegu and the neighbouring countries, sailing in every sea, and introducing the musket into Japan. Though he was 13 times a captive and 17 times sold into slavery, his gay and dauntless spirit brought him through every misfortune He was soldier and sailor, merchant and doctor, missionary and ambassador; moreover, as the friend and travelling companion of St Francis Xavier, he lent the apostle of the Indies the money with which to build the first Jesuit establishment in Japan.

In Jan. 1554 Pinto was in Goa, waiting for a ship to take him to Portugal, when he decided to devote a large part of his capital to the evangelization of Japan. The viceroy appointed him ambassador to the king of Bungo in order to give the mission an official standing, and on April 18th he set sail with the provincial, Father Belchior Nunes. The missioners did not reach Japan until July 1556 On Nov. 14, 1556, Father Belchior and Mendes Pinto began their return voyage and reached Goa on Feb. 17, 1557. During his stay of a twelve-month there, Pinto left the company, being dispensed from his vows for want of vocation at his own request, though a modern authority states that he was expelled because he was a *marrano, i e*, had Jewish blood. He finally returned to Portugal on Sept 22, 1558, and settled at Pragal near Almada, where he married and wrote his famous book, the *Peregrination;* the ms , in fulfilment of his wishes, was presented by his daughter to the Casa Pia for penitent women in Lisbon, and it was published by the administrators in 1614. Philip II. of Spain gave him (1583) a pension for his services in the Indies. But the reward came too late, for he died on July 8

Pinto was on the whole a careful observer and truthful narrator, but he invented on occasion, and often repeats stories at second hand. Some witty Portuguese parodied his name into *Fernão, mentes? Minto!* ("Ferdinand, do you lie? I do!"), and the English dramatist Congreve only expressed the general opinion of the unlearned when he wrote in *Love for Love*, "Mendes Pinto was but a type of thee, thou liar of the first magnitude" In the narrative portions of his work Pinto's style is simple, clear and natural He did for the prose of Portugal what Camoens did for its poetry

The *Peregrination* has gone through many editions subsequent to that of 1614, and in 1865 Castilho published excerpts in his *Livraria classica portugueza* with an interesting notice of Mendes Pinto's life and writings. Versions exist in German (3 editions), French (3 editions), Spanish (4 editions), and in English by Henry Cogan, London (1663, 1692 and—abridged and illustrated, with introduction by Arminius Vambéry—1891). Cogan omits the chapters relating to Mendes Pinto's intercourse with, and the last days of, St Francis Xavier, presumably as a concession to anti-Catholic prejudice

See Christovão Ayres, *Fernão Mendes Pinto* (Lisbon, 1904) *Fernão Mendes Pinto e o Japão* (Lisbon, 1906); also *Subsidios . . . para a biographia de Fernão Mendes Pinto* by Jordão de Freitas (Coimbra, 1905).

PINTO. The brown, black and blue spots of discoloration of the whole body endemic in Mexico, Panama, Colombia and Venezuela, and known under the name were first held by Gastambide (*Presse med Belge*, 1881, Nos 33–41) as due to a vegetable parasite, whose spores and mycelial filaments may be detected among the deeper rows of cells of the rete mucosum The disease appears to be one of poverty, but it is contagious, and is sometimes seen in the well-to-do In villages of Tabasco (Mexico) it is said that 9% of the people thus suffer

PINTURICCHIO (1454–1513), Italian painter of the Umbrian School, whose full name was BERNARDINO DI BETTO (BENEDETTO) DI BIAGIO, the son of a citizen of Perugia, Benedetto or Betto di Biagio. He was probably a pupil of Fiorenzo di Lorenzo; and the two masters appear to have co-operated in the execution of the "Adoration of the Magi" from S Maria Nuova, now in the Pinacoteca of Perugia. After assisting Perugino in

the execution of his frescoes in the Sistine Chapel, Pinturicchio was employed by Niccolo Buffalini, advocate to the papal consistory, to decorate a little Gothic chapel in Ara Coeli on the Capitol with frescoes illustrating the life of San Bernardino of Siena. These frescoes were probably executed about 1484. They show the master at his best. The colouring is exceedingly harmonious, the landscape backgrounds full of atmosphere. Pinturicchio was employed by the Della Rovere family to decorate a series of chapels in the church of S. Maria del Popolo. The "Adoration of the Shepherds," in the chapel built by Cardinal Domenico della Rovere, was probably done about 1500. In the lunettes under the vault Pinturicchio's assistants painted small scenes from the life of St. Jerome.

The last paintings completed by Pinturicchio in this church were the frescoes on the vault over the retro-choir, a very rich and well-designed piece of decorative work, with main lines arranged to suit their surroundings in a very skilful way. No finer decoration of a quadripartite vault exists.

In 1492 Pinturicchio was summoned to Orvieto, where he painted two Prophets and two of the Doctors in the duomo. In the following year he returned to Rome, and was employed by Pope Alexander VI. (Borgia) to decorate a suite of six rooms in the Vatican, which Alexander had just built. Of these rooms, called after their founder the *Appartamenti Borgia,* five still retain his frescoes. The upper parts of the walls and vaults are not only covered with painting, but further enriched with delicate stucco work in relief. Pinturicchio employed many assistants. The second room, however, with scenes from the lives of saints, was painted by the master himself, and contains one of his famous works, "The Dispute of St. Catherine."

On the vault of the sacristy of S. Cecilia in Trastevere, Pinturicchio painted the Almighty surrounded by the Evangelists. During a visit to Orvieto in 1496 Pinturicchio painted two more figures of the Latin Doctors in the choir of the duomo—now, like the rest of his work at Orvieto, almost destroyed.

Among his panel pictures the following are the most important. An altarpiece for S. Maria de' Fossi at Perugia, painted in 1496–1498, now moved to the picture gallery, is a Madonna enthroned among saints, graceful and sweet in expression. Another fine altarpiece, similar in delicacy of detail, and probably painted about the same time, is that in the cathedral of San Severino—the Madonna enthroned looks down towards the kneeling donor. The Vatican picture gallery has the largest of Pinturicchio's panels—the Coronation of the Virgin, with the apostles and other saints below. Several well-executed portraits occur among the kneeling saints. Other panel paintings by Pinturicchio exist in the cathedral of Spello, in the Siena gallery, at Perugia, and in the collection of the Earl of Crawford at Haigh Hall.

In 1501 Pinturicchio painted several fine frescoes in S. Maria Maggiore at Spello—all very decorative and full of elaborate architectural accessories. One of them, the Annunciation, is signed "Bernardinvs Pintvrichivs Pervsinvs." The most striking of all Pinturicchio's frescoes, both for brilliance of colour and their wonderful state of preservation, are those in the cathedral library at Siena, a large room built in 1492 by Cardinal Francesco Piccolomini, afterwards Pius III. In 1502 the cardinal contracted with Pinturicchio to decorate the whole room with arabesques on the vault, and on the walls ten scenes from the life of Aeneas Sylvius Piccolomini, Pius II., the uncle of Cardinal Francesco.

The contract specially provided that the cartoons, their transference on to the walls, and all the heads, were to be by Pinturicchio's own hand, thus contradicting Vasari's assertion that the cartoons were the work of Raphael. The series were finished in 1507. Outside the library, over the door, we have the coronation of Pius III. in which he has introduced his own portrait, and standing by him is a youth who bears some resemblance to Raphael. In 1513, the year of his death, he painted a highly finished panel with Christ bearing His Cross, now in the Palazzo Borromeo in Milan. He died at Siena, on Dec. 11, 1513, and is ranked as one of the greater Umbrian painters. His worth has been undervalued, partly owing to the dislike which tinges Vasari's biography of him. Even Crowe and Cavalcaselle hardly did him justice. G. Morelli has however disproved the myth that Raphael, then a youth of 20, supplied cartoons or drawings for the aged master in his work in the Libreria del Duomo, Siena. These drawings (Venice) are not by Raphael but by Pinturicchio.

See G. Morelli, *Italian Masters in German Galleries* (1883); Vermiglioli, *Mémoire di Pinturicchio* (Perugia, 1837); and the valuable notes and appendix of Milanesi's edition of Vasari, iii. 493–531 (Florence, 1878); E. Steinmann, *Pinturicchio* (Leipzig, 1898); E. M. Phillipps, *Pinturicchio* (1901); W. Bombe, *Geschichte der Peruginer Malerei* (1912).

PINWELL, GEORGE JOHN (1842–1875), British water-colour painter, was born at Wycombe, and educated at Heatherley's Academy. Like Frederick Walker and A. B. Houghton, he belonged to a group whose style was derived from drawing upon wood for book illustration. As he died young his works are few, but their promise was great. His earliest drawings appeared in *Lilliput Levée.* He did a little work for *Fun* and executed several designs for the silversmiths, Elkingtons. In 1863 his first drawing appeared in *Once a Week,* and from that time his work was in constant demand in current periodicals. His most important productions, made for the Dalziel brothers, were illustrations of Goldsmith, of Jean Ingelow's poems, Robert Buchanan's *Ballads of the Affections,* and the *Arabian Nights.* Of Pinwell's pictures in colour, which are distinguished by a remarkable, jewel-like quality and marked by his strong love of pure, bright colour and opalescent effect, the chief are the two scenes from the *Pied Piper of Hamelin, Gilbert à Becket's Troth, Out of Tune* or *The Old Cross, A Seat in St. James's Park,* and *The Elixir of Life.*

In 1874 Pinwell fell seriously ill and went to Africa for the winter. He painted several remarkable pictures at Tangier, but he returned to die on Sept. 8, 1875.

See G. C. Williamson, *Life of George J. Pinwell* (1900).

(G. C. W.; X.)

PINZON, a family of Spanish navigators, of Palos in Andalusia, three members of which—Martin Alonzo, Francisco and Vicente Yañez, brothers—were associated with Columbus in the discovery of America.

MARTIN ALONZO PINZON, born about the middle of the 15th century, in the expedition of 1492, commanded the "Pinta," on which his brother Francisco was pilot. On Oct. 6, he suggested to Columbus (when already in the longitude of the Bermudas) to change the course of the expedition from due west to south-west; on Oct. 7 this suggestion was adopted, bringing the fleet to the landfall at Guanahani (San Salvador, Watling Island) in the Bahamas (Oct. 12, 1492). On Nov. 21, near the east end of the north coast of Cuba, he left Columbus, making eastward in search of the supposed gold-land. On Jan. 6, 1493, he rejoined the admiral, but on the return journey again left him and landed at Bayona in Galicia. He died soon afterwards.

VICENTE YAÑEZ PINZON commanded the "Nina" in 1492–1493 and remained loyal to Columbus throughout. In after years he made important discoveries on his own account. In December 1499 he sailed with four caravels across the Atlantic to the south-west, and on Feb. 7, 1500, he landed at Cape S. Agostinho, near its most easterly projection (called by him Cape Santa Maria de la Consolacion). Proceeding southwards a short distance, he then turned north, followed the coast to the north-west, discovered the Amazon estuary, and went as far as what is now Costa Rica. After touching at Haiti, and losing two of his vessels among the Bahamas, Vicente returned to Palos in September 1500. Although he was created governor of the newly discovered lands by Ferdinand and Isabella, he did not take possession. In 1507 he sailed with Juan Diaz de Solis along the east coast of Central America. In 1509, again with De Solis, he coasted the Atlantic side of South America as far as the La Plata estuary, hoping to find an opening westwards leading to the Spice Islands. According to Herrera, he reached 40° S., not recognizing the La Plata and turning back about the mouth of the Rio Negro, but this is probably an exaggeration. After 1523 all traces of Vicente are lost.

See Navarrete, *Coleccion de viajes;* Washington Irving's *Columbus,* Bk. XIV., ch. ii.; bibliography in Joaquim Caetano da Silva's *L'Oyapoc et l'Amazone* (Paris, 1861); Herrera, *Indias Occid.,* Dec. I., lib. vi. cap. 17; lib. vii., caps. 1 and 9 (Madrid, 1730); Oviedo, *Hist. general de las*

Indias, lib. xxiii. cap. 1 (Madrid, 1852); O. Peschel, *Geschichte der Erdkunde*, pp. 230, 233, 249 (Munich, 1865); *Zeitalter der Entdeckungen*, pp. 305, etc., 426; Jose Maria Asensio, *Cristoval Colon, su vida, sus viajes, sus descobrimientos* (Barcelona, 1891); Cesareo Fernandez Duro, *Colon e Pinzon*.

PIOMBINO, a seaport of Tuscany, Italy, in the province of Pisa, 8 m. by rail W.S.W. of Campiglia Marittima (which is 53 m. S.S.E. of Pisa), 62 ft. above sea-level, at the southern extremity of the peninsula of the Monte Massoncello. Pop. (1921) 20,692 (town); 23,622 (commune). It is the port of embarkation for Elba, the nearest point of which is about 6 m. to the south-west, and originally belonged to Pisa. It gives the title of prince to the Buoncompagni Ludovisi family, who, however, no longer own it. Large iron-smelting and tin plate works are situated here. In 1926 5,995 ships, of 945,218 tons, entered and cleared the port, while at Portoferraio, in Elba, 6,184 ships, of 1,214,432 tons, entered and cleared.

PIOTRKÓW, a town of Poland, in the province of Lodz, and formerly the seat of the high court of Poland, on the railway from Warsaw to Vienna, 90 m. south-west of the former and 5 m. west of the river Pilica. Pop. (1921), 41,000. It is a well-kept town, with numerous gardens, and has flour-mills, saw-mills, tanneries, agricultural machinery works, and breweries. One of the oldest towns in Poland, Piotrków was in the 15th and 16th centuries the place of meeting of the diets, and here the kings were elected.

PIOZZI, HESTER LYNCH (1741–1821), English writer, well known as the friend (Mrs. Thrale) of Samuel Johnson, was born on Jan. 16, 1741, her father being John Salusbury of Bobbel, Carnarvonshire. In 1763 she married Henry Thrale, a rich Southwark brewer, whose house was at Streatham on the south-east corner of Tooting Bec Common. There was very little sympathy between the lively girl and Thrale, who was 13 years her senior, but gradually she drew round her a distinguished circle of friends.

She was introduced to Samuel Johnson in 1765 by Arthur Murphy, who was an old friend of her husband's. In 1766 Johnson paid a long visit to Streatham, and from that time was more or less domesticated with the Thrales. (*See* JOHNSON, SAMUEL.) Fanny Burney was another of her friends. She was very sensitive, and sometimes thought that Mrs. Thrale gave herself airs of patronage. Meanwhile, in 1772, Thrale was threatened with bankruptcy. The situation was saved by his wife's efforts, and in the next year Thrale travelled, leaving her in charge of his affairs. He was twice returned for the borough of Southwark, chiefly through her efforts. In 1781 Thrale died, and Dr. Johnson helped the widow with her business arrangements, advising her to keep on the brewery, until she "cured his honest heart of its incipient passion for trade, by letting him into some, and only some, of its mysteries." The brewery was finally sold for £135,000.

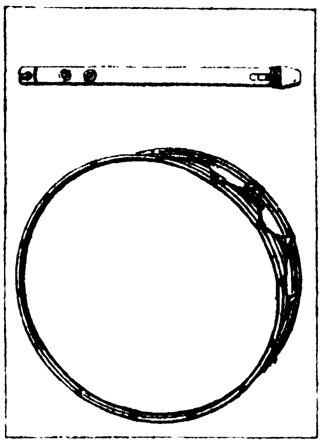
Mrs. Thrale had met Gabriele Piozzi, an Italian musician, in 1780. In 1784 they were married. Johnson told Miss Burney that he drove the memory of Mrs. Thrale from his mind, burning every letter of hers on which he could lay his hand. The Piozzis presently left England to travel in Italy. At Florence they fell in with Robert Merry and the other "Della Cruscan" writers ridiculed by William Gifford in his *Maeviad* and *Baviad*, and she contributed some verses to their *Florence Miscellany* in 1785. In 1786 she published *Anecdotes of the late Samuel Johnson, during the last twenty years of his life*, which was severely criticized by Boswell. She was ridiculed by "Peter Pindar" in *Bozzy and Piozzi; or the British Biographers, A Town Eclogue* (1786). But though Miss Burney and some others held aloof, the Piozzis found plenty of friends when they returned to London in 1787. Piozzi died at Brynbella, a villa he had built on his wife's Carnarvonshire estate in 1809, and Mrs. Piozzi gave up her Welsh property to her husband's son, and spent most of the rest of her life at Bath and Clifton. She retained her vivacity to the last, celebrating her 80th birthday by a ball to six or seven hundred people at Bath. She died at Clifton on May 2, 1821.

From 1776 to 1809 she kept a note-book which she called "Thraliana." Her well-known poem of the "Three Warnings" is to be found in many popular collections. *Letters to and from the late Samuel Johnson* appeared in 1788; *Observations and Reflections made in the course of a Journey through France, Italy and Germany*, in 1789; and in 1801 she published *Retrospection; or a review of the most striking and important events, characters, and situations . . . which the last eighteen hundred years have presented to the view of mankind* (1801).

See *Letters and Literary Remains of Mrs. Piozzi (Thrale)*, edited with notes and an *Introductory Account of her Life and Writings* by *A. Hayward* (1861); *Piozziana; or Recollections of the late Mrs. Piozzi by a Friend* (1833), the anonymous friend being Edward Mangin (1772–1852); L. B. Seeley, *Mrs. Thrale, afterwards Mrs. Piozzi* . . . (1891), and G. Birkbeck Hill, *Johnsonian Miscellanies* (1897); also Percival Merritt, *The True Story of the So-called Love Letters of Mrs. Piozzi* (1928), which exposes the misrepresentation of the "love letters" to William Conway the actor written when she was an old lady and published in 1843. The copies of these letters are shown to be grossly misleading. Also works noted in bibliography to JOHNSON, SAMUEL.

PIPE, a hollow stem of clay, wood or other material with a bowl at one end used for smoking tobacco, opium or other narcotic, or any medicinal substance. *See* PIPE, SMOKING and TOBACCO PIPE.

PIPE and TABOR, a popular mediaeval combination of a small pipe or flageolet and a small drum. The tabor being fastened to the performer's left elbow, the hands remained free, the right beating the little drum with a stick to mark the rhythm, while the left held and fingered the pipe with thumb and first two fingers. The pipe and tabor are said to be of Provençal origin.



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

THE PIPE AND TABOR, STILL IN USE IN CERTAIN PARTS OF FRANCE

PIPE CLAY. A natural clay, one of the names given to impure kaolin or china clay. It occurs in beds where kaolin has been washed away from its original site and deposited in a hollow. It is used to make primitive tobacco pipes and for whitening military belts, etc.

PIPE-FISH, the name given to fishes which, with the sea-horses, form the family *Syngnathidae* of the order *Solenichthyes*. The pipe-fishes are long and slender, with the body encased in bony rings, and a small, toothless mouth at the end of a long, tube-like snout; the gill-filaments are reduced in number and appear as rounded lobes or tufts. About 100 species are known from warm seas, and a few from rivers. Pipe-fishes frequent sea-weeds, and swim slowly by rapid undulations of the small dorsal fin.

PIPE-LINE: *see* PETROLEUM.

PIPER, CARL, COUNT (1647–1716), Swedish statesman, was born at Stockholm on July 29, 1647. In 1689 he was made one of the secretaries of state, and Charles XI. recommended him on his deathbed to his son and successor, Charles XII. Piper became the most confidential of the new sovereign's ministers. In 1697 he was made a senator and set over domestic affairs while still retaining his state-secretaryship. In 1698 he was created a count, in 1702 appointed chancellor of Uppsala University, and during the first half of the Great Northern War, as the chief of Charles's perambulating chancellery, he was practically prime minister. But he belonged to the school of Bengt Oxenstjerna (*q.v.*) and was therefore an avowed advocate of a pacific policy. He protested in vain against nearly all the military ventures of Charles XII., *e.g.*, the War of Deposition against Augustus of Saxony and Poland, the invasion of Saxony, the raid into the Ukraine. Again and again he insisted that the pacific overtures of Peter the Great should at least be fairly considered, but his master was always immovable. Piper was taken prisoner at Poltava (1709), and died at Schlüsselburg on May 29, 1716.

See W. L. Svedelius, *Count Carl Piper* (Stockholm, 1869).

(R. N. B.)

PIPERACEAE, in botany, the pepper family, comprising seven genera with 1,150 species, tropical herbs and shrubs. The leaves have a pungent flavour and the flowers lack both calyx and corolla. *Piper* includes the pepper (*q.v.*)

PIPERAZINE, a colourless crystalline solid melting at 104° C and boiling at 145° C, soluble in water and used medicinally as a uric acid eliminant. Piperazine, $C_4H_{10}N_2$, was first obtained by A. v. Hofmann by the action of ammonia on ethylene dichloride or dibromide. It is manufactured from the latter dihalide and aniline, the intermediate product, diphenylpiperazine, being converted successively into its dinitroso-compound and piperazine.

PIPERINE, an alkaloid (*see* ALKALOIDS) found in the fruits of certain peppers. It forms white prisms, melts at 128°–129° C, is almost insoluble in water, but readily so in alcohol or ether, and is a very weak base, salts being only formed with mineral acids, and these are dissociated by water. Alcoholic potash decomposes piperine, $C_{17}H_{19}O_3N$, into piperidine, $C_5H_{11}N$, and piperic acid, $C_{12}H_{10}O_4$, indicating that the alkaloid is a piperidide of piperonylic acid. It was synthesized (Rugheimer, 1882) by the action of piperonyl chloride on piperidine.

PIPERITONE is the sole ketonic constituent of eucalyptus oils, from which it may be either fractionally distilled or extracted with sodium bisulphite. It occurs in the "peppermint group" of eucalyptus leaf-oils, in association with *l*-α-phellandrene, and has been found altogether in 23 species; these grow mainly in south-eastern Australia and Tasmania, and are characterized by a butterfly-wing leaf-venation. A maximum content of about 45% of piperitone is reached in the oil of the Broad-leaved Peppermint (*E. dives*). Piperitone, $C_{10}H_{16}O$, Δ^1-menthen-3-one, is a colourless liquid (b.p. 232°), with an odour of peppermint. The eucalyptus ketone is laevo-rotatory, with $[\alpha]\hat{D}$–53·9°; but *d*-piperitone, having $[\alpha]\hat{D}$–62·5°, has been isolated from the essential oil of a Himalayan grass, *Andropogon Jwarancusa*. The optically active ketone racemizes easily, owing to enolization. When hydrogenated according to Paal's method, *l*-piperitone yields mainly *d-iso*-menthone, and by reduction in other ways it has been used commercially as a source of *dl*-menthol. It may be oxidized to thymol.

PIPERNO (anc. *Privernum*), a town of the province of Rome, Italy, 54 m. S.E. of Rome by rail. Pop. (1921), 7,414. The mediaeval town was founded in the 10th century on a hill 490 ft. above sea-level, by refugees from the Roman town of Privernum, lower down (118 ft. above sea-level) on the high-road, 1¼ m. to the north, at the mouth of a low pass leading through the Volscian mountains to the valley of the Sacco. Here are scanty remains of the Roman period, though the ruins are largely mediaeval. The ancient Volscian town probably stood on the site occupied by the mediaeval and modern town. Privernum was finally captured in 329 B.C., and in 318 the tribus Oufentina was founded (*see* LATIUM). The mediaeval town has a picturesque piazza, with a Gothic cathedral (1283), and a Gothic town-hall; and Gothic churches. Polygonal terrace walls of the Roman or pre-Roman period exist at various places in the vicinity.

See H. H. Armstrong in *American Journal of Archaeology* (1911), 44 *sqq.*, 170 *sqq.*, 386 *sqq.*

PIPE ROLLS or the Great Rolls of the Exchequer are a long series of financial records of the English crown. The first extant Pipe Roll is that for the 31st year of the reign of Henry I. The continuous series begins with the second year of Henry II.'s reign and the annual succession of rolls is almost unbroken till 1834, when the last relics of the ancient financial system of the English mediaeval kings were swept away. The most plausible explanation of the name Pipe Rolls is that when rolled up and stacked in their presses the rolls looked like pipes. Up to the beginning of the 13th century the Pipe Rolls are the only consecutive series of official records which have survived; it was not until the reign of John that the Chancery records were systematically preserved. Therefore, the value of the Pipe Rolls for the last half of the 12th century can hardly be overestimated. By them the narratives of the chroniclers can be checked, and from them most of our knowledge of the actual working of the legal system in Henry II.'s reign comes. They are a mine of information about the personnel of the government and the gradual development of the new administrative offices. They are the best authority for the descents of the great families of feudal England. For the historian of English towns they provide a vast mass of material. Calculations as to the amount of the royal revenue have been made from them, but such calculations can only be approximate, since much money was paid directly into the king's privy purse and recorded in no roll that survives.

Consisting of a varying number of skins of parchment about 14 inches wide and a yard long sewn together at the top, the rolls are not easy to consult. Their matter too is not easy reading, nor their method of book-keeping easy to understand. The accounts are entered county by county, the sheriff being responsible for the account of his shire. Other accounts, known as foreign accounts, appear sometimes on the rolls, accounts of royal manors by their custodians, accounts of escheats, or of towns. The clerks enter debts long after all hope that they may be paid has passed away. In 1883 the Pipe Roll Society was formed to publish the rolls up to 1200. It hopes to carry the work up to the end of John's reign. In later centuries, the Pipe Rolls lose much of their importance, but interesting matter can be found in the foreign accounts which continue to appear on the rolls. When the escheat rolls begin one great source of foreign accounts is lost to the Pipe Rolls. In this way by a process of splitting off, and the setting up of new accounting offices the ancient sheriff's account recorded in the Pipe Rolls becomes insignificant and stereotyped. The continuation of the series to 1834 is a remarkable illustration of English administrative conservatism. (D. M. S.)

PIPERONAL, an aromatic aldehyde with an agreeable smell, resembling that of heliotrope. It forms long colourless crystals, which melt at 37° C and boil at 263° C and is much used in perfumery. It is only slightly soluble in cold water, but readily soluble in alcohol and in ether. It is also called heliotropine, and is protocatechuic aldehyde methylene ether, $CH_2O_2{\cdot}C_6H_3{\cdot}CHO$. It is prepared by oxidizing piperic acid with potassium permanganate (R. Fittig, 1869), by condensing methylene iodide with protocatechuic aldehyde (R. Wegscheider, 1893), or by oxidizing isosafrole with chromic acid. When heated with dilute hydrochloric acid to 200° C it yields protocatechuic aldehyde, $C_7H_6O_3$, and carbon. It readily combines with sodium bisulphite and with various bases (ammonia, aniline, methylamine, etc.).

PIPE SMOKING. The original source of the idea of smoking must be sought in the sense of smell. This was much keener in primitive man than in man of the more advanced stages. With the pleasure derived from aroma, there was probably a sense of mystery at the sight of the smoke rising up into the air. Thus there was an element of religious ceremony in the burning of pleasant-smelling substances among primitive folk, in whatever part of the world we may be able to study their ways.

The ritual element is enhanced by another circumstance. Herodotus, in the fifth century B.C., describes a practice of the Scythians, a Mongol people settled in south-eastern Europe, between the Carpathian mountains and the River Don. Throwing the leaves of a certain plant (which was probably hemp) upon a fire, they sit round and, inhaling the smoke, "they grow drunk with the fumes as the Greeks do with wine," until they jump up and begin to dance and sing. Herodotus seemed to regard this simply as an orgy; but inhalation was certainly used to produce a super-normal condition of mind in many parts of the world. When Columbus discovered America, he found the habit established of inhaling tobacco, to induce a state of trance, during which visions were seen, which were accepted as divine revelations. The intoxicating vapour at Delphi which inspired the Pythian priestess may have been artificially produced, since no natural source has been found.

The invention of an implement to concentrate the smoke was an advance. Such an implement is the Y-shaped tube described by G. Fernandez de Oviedo in his *History of the Indies* (1535). The two horns of the "Y" were inserted in the nostrils, and smoke from tobacco burning in a censer was drawn up through the tube. This was the ceremonial method of smoking prevalent in the Antilles when Columbus and his followers reached them, side by side with a common use of the tobacco-leaf rolled up and smoked like a cigar. Bernal Diaz, who accompanied Cortez to Mexico, describes the inhalation of tobacco through a tube. But we have much earlier evidence from Mexico. At the ruined city of Palenque, in the southern province of Chiapas, there are the

remains of a "Temple of the Cross," which seems to belong to the beginning of the second century A.D. Here, on one of two stone slabs on either side of a doorway, is represented a figure of a priest, clad in a jaguar-skin cloak and a head-dress representing a mythical bird, who is blowing out a smoke-offering through a straight tube. This Palenque sculpture is the work of the Mayas, the mysterious race which preceded the Toltecs and the Aztecs in Mexico. Other Maya sculptures portray the straight smoking-tube, both as an emblem in one of the hands of Chac, the god alike of rain-and-thunder and of fertility, and as an apparently ordinary implement for smoking. Lionel Wafer, at the end of the 17th century, speaks of a roll of tobacco, 2ft. or 3ft. long and as thick as a man's wrist, being lighted by a boy, and the smoke being puffed into the faces of a company who made funnels of their hands and inhaled it.

Whatever the original use of the straight tube (which is found in a variety of materials—bone, wood, cane, stone of kinds not too hard to work, and pottery), the use of it as a pipe for tobacco ages before America was discovered by the early European adventurers is well established. The first modification of the type is that found in the burial-mounds of the Muskogee Indians, in the south-eastern portion of what is now the United States The tube is bent up at one end, with a widening of the "bowl" formed by this end. Pipes on these lines were obviously the model for the clay pipe as known to Europe, which is only natural, since the first Europeans to introduce the use of the tobacco-pipe into their own countries learned the habit of smoking not from the West Indies, but from the Indians of the eastern mainland.

The next modification of the tube, which is found in Ohio and Virginia in the burial-mounds of another Indian tribe, the Algonquins, converts it from a one-piece to a two-piece pipe. Whatever the material used, usually some kind of stone, the stem was liable to be broken, necessitating a makeshift stem, if the bowl was to continue in use From this the transition is easy to a bowl alone, into which a wooden stem could be inserted.

While the tobacco-pipe was thus evolving in North America apparently a two-piece pipe arose independently in South America. In the upper part of the southern continent true pipes were not used, though the Y-shaped tube, of which we have already heard, was employed for inhaling snuff. Otherwise cigar-smoking was the ordinary form of indulgence in tobacco But in South Brazil in 1650 the traveller Jan Nieuhoff found a great Indian tribe smoking pipes with bowls made of nut-shells and with stems of reed or hollowed wood. This kind of pipe, with a small bowl, was the prototype of the pipes of Turkey, Persia and the Far East, since the Portuguese took it with them from Brazil along their trade-route in the Old World Much larger pipes were also used by the same Brazilian tribe, with bowls of stone, clay, or wood, and are found to-day among their descendants, now living on the Upper Amazon.

The two-piece pipe is also found in the steppes of Central and Western Asia, and the Kalahiri region of South Africa Both these are woodless countries, scantily inhabited by people mostly nomadic. Here "earth-smoking" is found The most primitive method is to dig a small pit in the ground, to serve as a bowl; to insert a stick through the earth to the bottom of this pit; and then to withdraw the stick, leaving a hollow tube The smoker has to lie flat on the ground and apply his mouth to the end of the tube An improvement on this uncomfortable method is the fashioning of a rough bowl of clay above the surface of the ground, with a tube formed as before with the aid of a stick. Such an earth-pipe, when dry, can be detached and carried about. The insertion of a separate mouthpiece into the end of the hollow tube would convert it into a two-piece pipe. In quite a different part of the world, among some of the North American Indians, a hollow reed stuck into a bowl made of wet clay is said to serve as an emergency pipe.

The credit of the first invention of the pipe cannot be assigned to any one people nor is it certain that smoke proceeded always from tobacco-leaf. There is hemp, which, in many parts of the world at least, long preceded tobacco. There are many herbs, such as henbane, which were commonly used in Europe, for how many centuries we do not know. Opium-smoking, on the other hand is a late development. Early evidence concerning the tobacco-pipe comes from America only, for the reason that the tobacco-plant is a native of America. The theory that both the plant and the habit of smoking derived originally from Africa and reached the western coast of America by way of the Indian and Pacific Oceans, rests on an insufficient basis Smoking, no doubt, is a custom of great antiquity in Africa; but it is the smoking of hemp, as exemplified notably among the Bushmen of the Kalahiri Desert The evolution in Africa of the pipe for hemp-smoking has, so far as we can tell, been from the earth-pit, through the simple tube, to the *Dakka* (hemp) pipe, which is the ancestor of the water-pipes of various kinds used for tobacco in the East Among the Bushmen an animal's horn, generally an antelope's, is used as the water-vessel Among other African tribes ox-horns, gourds, bamboos and wooden stems are to be seen. It was thus the African hemp-smokers who gave to the smokers of tobacco this idea of using a pipe in which fumes should be filtered and cooled by passing through water.

See A. Dunhill, *The Pipe* (1924), the *British Museum Handbook to the Ethnographical Collection* (2nd ed 1925); the *British Museum Guide to the Maya Collection* (1923) (A D)

PIPIL, a dialect of the Nahuabl or Aztec language In southern Mexico, Guatemala and western Salvador there are four groups of Indians who speak a Nahua dialect, related to but more primitive than Aztec These four groups are. (1) *Pipil of Soconusco,* (2) *Pipil of the upper Motagua valley,* (3) *Pipil of Escuintla,* and (4) *Pipil of Salvador.* At the time of the Spanish conquest several explanations of the presence of these Mexican Indians in Central America were given by the natives. It was said that the Aztec emperor, Ahuitzotl (1486–1502), sent colonists to spy out the land and prepare for a never accomplished conquest This tale fails to account for the large and well-built cities occupied by the Pipil. More generally it is thought that they were Toltec (*q v*) who either migrated from Mexico with one of the early priest-kings named Quetzalcoatl, or, more probably, fled after the downfall of the Toltec empire in the 11th century. The Spanish historian Juan de Torquemada in support of the last hypothesis has preserved a significant migration legend Numerous ruined cities are attributed to the Pipil by archaeologists Of these the most important are Santa Lucia Cazumalhualpa and Baul in Gautemala and Chalchuapa, Cihuatan and Tehuacan in Salvador These sites yield characteristic stone carvings and pottery types. The present culture of the Pipil varies from village to village In general it reflects that of their neighbours such as the Quiché (*q v*)

BIBLIOGRAPHY.—Juan de Torquemada, *Monarquia Indiana,* lib iii cap. 40 (1723); Diego Garcia de Palacio, *Relación* (1860), for ancient customs; Walther Lehmann, *Zentral Amerika* (1920), for linguistics, Herman Strebel, *Sculptures of Santa Lucia Cosumahuapa* (Annual Report of Smithsonian Institution for 1899); and S K Lothrop, *Pottery Types in El Salvador, in Indian Notes and Monographs,* vol i No. 4 (1927), for archaeology. (S K. L)

PIPIT, a sub-family of birds having a great resemblance in habits and appearance to the larks (*q v*). They differ however in several important characters They are associated with the wagtails (*q v*) in the Passerine family *Motacillidae* Pipits, of which over 50 species have been described, occur in almost all parts of the world, but in North America are represented by only two species—*Neocorys spraguii,* the prairie-lark of the northwestern plains, and *Anthus ludovicianus,* the American titlark which last is nearly allied to the water-pipit of Europe, *A. spipoletta* To English readers the best-known species is the titlark or meadow-pipit, *A. pratensis,* a bird abundant on pastures, moors, and uncultivated districts generally; but in some localities the tree-pipit, *A arboreus,* takes its place, and where it does so it attracts attention by its loud song, which is delivered (as in all the pipits) on the wing. Another species, the rock-pipit, *A. obscurus,* scarcely ever leaves the sea-coast and is found almost all round the British Islands. The South African genus *Macronyx,* remarkable for the extreme length of its hind claw, differs and has brighter coloration

PIPPIN or **PEPIN,** the name of three members of the Carolingian family.

back into the hand.

Pique.—If the elder hand scores, in hand and play, 30 or more, before the younger hand counts anything in that deal, he gains a *pique,* for which he scores 30.

Repique.—If a player scores in hand alone 30 or more before his adversary reckons anything, he gains a *repique,* for which he adds 60 to his score. Equalities do not prevent piques or repiques. A player who has an equal point or sequence scores nothing for it. Therefore if, notwithstanding the equality, a player makes 30, in hand and play, or in hand, by scores which reckon in order before anything his adversary can count, he gains a pique or a repique.

The order in which the scores accrue is of importance. For the sake of convenience, the elder hand finishes his reckoning before the younger begins. The scores, however, whether made by the elder or younger hand are recordable in the following order. (1) *carte blanche;* (2) point; (3) sequences; (4) quatorzes and trios; (5) points made in play; (6) the cards. This will often affect a pique or repique. Thus, a pique can only be made by the elder hand, as the one he reckons in play when he leads his first card counts before points subsequently made in play by the younger hand. The younger, therefore, cannot make 30 in hand and play before the elder scores one But the one reckoned by the elder hand when he leads his first card does not prevent his being repiqued, because scores made in hand have precedence of points made in play. The elder leads his first card and counts for it before the younger reckons, simply as a convenient way of stating that he has nothing in hand which is good. Again, say A has a quint (good), a tierce, and a quatorze (good). He scores 32 in hand alone; but, if his point is not good, he does not gain a repique, because the younger hand's point is recordable in order before the sequences and quatorze. *Carte blanche,* taking precedence of all other scores, saves piques and repiques. It also counts towards piques and repiques A *capot* does not count towards a pique, as the *capot* is not made in play. It is added after the play of the hand is over. A player who reckons nothing that hand as a penalty is not piqued or repiqued if he holds any cards which, but for the penalty, would have reckoned before his adversary reached 30. The game most commonly played now ("short game") consists of 4 hands only, the last and first being doubled, and 100 points added for the game.

See "Cavendish," *The Laws of Piquet and of Rubicon Piquet, adopted by the Portland Club, with a Treatise on the Game* (1882), "Cavendish," *Guide to Piquet* (1898); R. F. Foster, *Hoyle's Games* (1928). (W. DA)

PIRANDELLO, LUIGI (1867–), Italian dramatist and novelist, was born on June 28, 1867, on a country estate near Girgenti (Sicily). He first went to Rome at the age of 19, staying there until 1891, when he went to Germany and graduated in philosophy at the University of Bonn. He subsequently returned to Rome and taught at the girls' high school until 1923 His first literary essays were in verse, a volume entitled *Mal giocondo* published in 1889, followed by a poem *Pasqua di Gea* (1891) and *Elegie renane* (1895). Another Sicilian writer, Luigi Capuana, persuaded him to devote himself to fiction, and in 1894 he published his first novel, *L'esclusa,* in which his somewhat bitter realism already finds expression. Besides the novel, *Il turno,* he began to publish short stories: *Amori senza amore* (1894) *Quando ero matto* (1903), *Beffe della morte e della vita* (1902, 1903), *Bianche e nere* (1904), etc. In 1904 his most celebrated novel, *Il fu Mattia Pascal,* appeared, the story of a man, who having shammed being dead, tries in vain to begin his life anew in a different atmosphere and under another name. Other collections of short stories followed: *Erma bifronte* (1906), *La Vita Nuda* (1910), *Terzetti* (1912). He set forth his artistic creed in two volumes entitled *Arte e scienza* (1908). In 1913 his novel, *I vecchi e i giovani,* describing the drama of Italian life after the Risorgimento, was published in the *Rassegna contemporanea.* Other volumes of short stories appeared between 1914 and 1926, such as *La trappola* (1915), *Un cavallo nella luna* (1918), *Il carnevale dei morti* (1919), *Tu ridi* (1920), and another novel *Uno, nessuno e centomila* was published in the *Fiera letteraria.*

In 1920 he said of his own art:—

I think that life is a very sad piece of buffoonery; because we have in ourselves, without being able to know why, wherefore or whence, the need to deceive ourselves constantly by creating a reality (one for each and never the same for all), which from time to time is discovered to be vain and illusory . . . . My art is full of bitter compassion for all those who deceive themselves; but this compassion cannot fail to be followed by the ferocious derision of destiny which condemns man to deception.

This despairing outlook attained its most vigorous expression in Pirandello's plays. In his youth he had shown a certain contempt for the drama, but in 1912 he was persuaded by the Sicilian playwright, Nino Martoglio, to dramatize one of his own short stories, *La Morsa,* as a one-act piece. His first three-act comedy, *Se non così* (1917), was produced by Marco Parga at Milan in 1913; and then many plays—dramas and comedies—of which the most celebrated are *Il berretto a sonagli; Liola* (1917); *Così è se vi pare* (1918); *L'uomo, la bestia e la virtù* (1918); *Ma non è una cosa seria* (1918); *Come prima, meglio di prima* (1920); *Sei personaggi in cerca d'autore* (1921); *L'imbecille; Enrico IV.* (1922); *Vestire gli ignudi* (1922); *La vita che ti diedi; L'altro figlio; Ciascuno a suo modo; La sagra del signore della nave; La giara.*

Pirandello's dramatic art was at first criticized for being too "cerebral," for not seeing life as it really is and for arbitrarily deforming it. The Roman critics first discovered the real meaning of Pirandello's ideology and the human sense of his plays. His main themes are the necessity and the vanity of illusion, the multiform appearances, all of them unreal, of what is presumed to be the truth, man is not what he thinks he is, but he is "one, no one and a hundred thousand," accordingly as he appears to this person or to that, and is always different from what he creates himself in his own mind. Hence the supreme catastrophe, when a moral looking-glass suddenly reveals to him the image of himself which others see, *i e.,* what he *is* to others. Most of Pirandello's plays deal with a lower middle class milieu, peopled with clerks, teachers, lodging-house keepers, etc., from whose modest vicissitudes he draws conclusions of vast human significance. Typical is *Cosi è se vi pare,* in which he proves that it is impossible to know the real truth. *Enrico IV.* develops in a broader sense; that is, a drama in which we have a man who renounces his changing, empty and vain existence to play the part of a madman, and pretends to believe himself an historical personage, Henry IV. All this might be merely theatrical trickery if it were not seared by a deep anguish, characterizing a philosophy which has destroyed all faith in the absolute, in reality, in any fixed limits outside individual personality.

Pirandello's plays have rapidly achieved success throughout Italy and abroad, and have been translated into some 15 languages. In 1925 he created an art theatre of his own in Rome, where new Italian and foreign plays are performed, and in the summer of the same year he brought his company on a tour to England to produce his own plays in London (at the New Oxford theatre), to Paris, Basle and 18 theatres in Germany. Everywhere he met with an enthusiastic reception. (S. D'A.)

See W Starkie, *Luigi Pirandello* (1926) and F. Pasini, *Luigi Pirandello* (1927, bibl.).

PIRANESI, GIOVANNI BATTISTA, Italian engraver, was born in the earlier half of the 18th century. He was a Venetian who settled in Rome, where he devoted himself to engraving the ancient monuments. The explanatory texts engraved on many of his plates prove that his work was inspired by archaeological interest; but he was more artist than archaeologist

The most important of his publications are: *Antichità Romana de' Tempi della Repubblica* (1798); *Le Antichità Romane,* 4 vols. (1756); *Della magnificenza ed architettura de' Romani* (1761); and *Vedute di Roma* (135 plates engraved between 1748 and 1778, with two plates added later by F. Piranesi). He developed a powerful manner of etching. In his foregrounds the broad lines are strengthened with the graver. He achieves bold contrasts of tone which justify the large scale of his prints. Among his finest plates are the fanciful compositions in the *Opere Varie di Architettura* (1750) and in the *Carceri* (1750). He died in 1778.

PIRANO, a seaport of Istria, Italy, in the province of Pola,

22 m. S.W. of Trieste by rail. Pop. (1921) 7,665 (town), 14,158 (commune). It has picturesque Venetian walls and buildings. On the coast near are extensive salt pans. The Venetians defeated the fleet of Frederick Barbarossa off Pirano in 1177. It surrendered to Venice in 1283 and was incorporated with Austria, together with the rest of Istria, in 1813. It was the birthplace of the violinist Tartini. Near Pirano is the favourite seaside resort of Porto Rose.

PIRATE and **PIRACY.** Sir J. Fitzjames Stephen in his *Digest of Criminal Law* defined piracy as follows: "Taking a ship on the High Seas or within the jurisdiction of the Lord High Admiral from the possession or control of those who are lawfully entitled to it and carrying away the ship itself or any of its goods, tackle, apparel or furniture under circumstances which would have amounted to robbery if the act had been done within the body of an English county." (*Cf. A. G. for Hong-Kong* v. *Kwok-a-Sing,* 1873, L.R. 5 P.C. 179.) Piracy, being a crime not against any particular State but against all mankind, may be punished under international law in the competent court of any country where the offender may be found or into which he may be carried. But, whilst the practice of nations gives to every one the right to pursue and exterminate pirates without any previous declaration of war (pirates holding no commission or delegated authority from any sovereign or state), they may not be killed without trial except in battle. Those who surrender or are taken prisoners must be brought before the proper tribunal and dealt with according to law.

Following the sinking of merchant vessels at sight by German submarines in the World War, by the Washington Treaties (1921–22) between the United States, the British Empire, France, Italy and Japan, attacks upon, and destruction of, merchant vessels upon visit and search by any person in the service of any Power were declared acts of piracy, and such persons may be brought to trial before the civil or military authorities of any Power within the jurisdiction of which he may be found. It was held by the Federal District Court of New York, in the suits brought against the Cunard Steamship company for damages arising out of the sinking at sight of the "Lusitania" by a German submarine, that such sinking was an illegal act. See *The Lusitania* (1918) 251 Fed. 715; *Scott's Cases,* 784–90. (X.)

HISTORY

It is impossible to say at what period in the world's history piracy began. References to this form of robbery occur in early literature. It was rampant in the Mediterranean in the days of the Roman republic, and it is recorded that Julius Caesar, when a young man, fell into the clutches of a gang of sea-robbers who held him prisoner until ransomed, and that after his release he returned with some soldiers who captured his late gaolers and crucified the whole crew. Amongst the early pirates of which records still exist are the Phoenicians, while there are numerous references to sea-rovers in the Odyssey. Out of the dim North, the Vikings (*q.v.*) are known to have come south to plunder the coasts of Britain, Ireland and France, in A.D. 789 and onwards. For many centuries the north-east coast of Africa was the headquarters of the Barbary pirates (*q.v.*) or Moors, as they were commonly called, who had their chief strongholds at Algiers, Sallee and Tripoli. From these harbours they sailed out to harry passing ships, or plunder the opposite coast of Spain, carrying back their Christian captives to sell as slaves. In spite of numerous punitive attacks, these fierce sea-robbers were not finally stamped out until 1830. All through the Tudor reigns piracy was rampant around the British isles, particularly in the south of Ireland and in the Scilly isles, where safe retreats existed for the pirate and where receivers of plunder were to be found willing to buy the goods that the pirate had to offer.

As in the case of the land thief, the sea thief could not exist without a market for his ill-gotten goods. It would be useless for a pirate to seize a well-laden merchant ship, if he had nowhere he could dispose of his prize. Sir William Monson in his book *Naval Tracts,* records how he was sent in 1605 to search for pirates in the Shetlands and Hebrides. But it was in Ireland where he found what he looked for. At Broad Haven he met with an Irish gentleman, of the name of Cormat or Cormac, whose house he describes as being the "well-head of all pirates." Here the Irishman lived in great style and trafficked with the pirate captains, many of whom were the lovers of his daughters.

As life became more difficult for the pirates in the home waters, they migrated further afield, where they could practise their calling with less interference. Thus piracy spread to the far-off West Indies, and the coast of New England, and eventually to the Red sea and Madagascar. For many years the latter island was the happy haunt of the pirates, where they lived in security, married native women, and reigned as petty kings. From here they were able to lay heavy toll on passing ships sailing between England and the East Indies.

The natural haunts of the pirates were in archipelagos and indented coasts, and there at one time or another such places as the Greek islands, the Indian ocean, the coast of Cilicia, the British Isles, Norway and the West Indies became their lurking places.

In England itself, up to the 16th century, piracy was not uncommon, and it was no unusual event for the inhabitants of the Cinque ports to sally forth in their small ships and plunder any passing vessel, and on more than one occasion the fleet of New Romney attacked and plundered the ships of its rival, Yarmouth.

The West Indies.—The West Indies were well prepared for practical exploration both geographically and historically. Since the 16th century the buccaneers (*q.v.*) had preyed upon the Spaniard, and there were innumerable hiding-places, hidden bays in uncharted islands, where pirates could meet in safety and divide the spoils and prepare for their next adventure. During the 17th century the island of Tortuga, or Turtle island, off the coast of Hispaniola, became a regular pirate republic. Good markets for stolen plunder were to be found on the New England coast, and in Jamaica and at New Providence island, as well as in Ireland and certain places in the west of England.

Much of the piracy in the West Indies and America was the direct outcome of the Spanish policy of forbidding her colonists the right of trading with foreigners, in spite of her inability to supply their needs herself. Naturally the Spanish Americans were only too eager to buy smuggled goods, at very low prices, and were not likely to be very particular to enquire where the goods came from. England and France also tried to insist on their colonists trading exclusively with themselves, at their own prices, which, combined with the almost total lack of policing by the regular navies, led to wholesale buying of smuggled merchandise, procured by irregular methods. It was not until the reign of William III., about 1700, that workable laws were made for trying pirates, and even then it was often difficult to get a jury to condemn a pirate who was looked upon as a public benefactor. Owing to the difficulty of policing the seas, particularly in distant waters, the custom arose in the reign of Charles I., and continued until that of George I., of granting free pardons to all pirates who would surrender themselves by a certain date. The result was that when things had become too warm for a pirate, he would make his submission to the authorities and receive the royal pardon, and, as soon as ever his booty was spent, resume his old practices. One of the greatest wholesale pardoning of pirates was carried out by Captain Woodes Rogers at New Providence in the Bahamas in 1718. At this time there were more than 2,000 freebooters entrenched in this pirate stronghold, but Rogers dealt so successfully with them that almost all surrendered.

Organization.—The ranks of the pirates were recruited from a type of seafaring man who disliked steady work with its small rewards, and preferred a life of danger, with a prospect of gaining sudden wealth. After every European war ships would be laid up and crews disbanded. There being no honest employment for all these sailors, they were compelled by circumstances to take any employment at sea that offered itself; and as often as not this consisted of signing on in a ship where no questions were asked, and no wages paid, but where every member of the crew took a share of any profits which might accrue from the voyage.

Very often when a pirate captured a merchant ship the crew of the latter were invited to join the pirates. Some would do so

willingly, others only under compulsion. Most pirates when brought to trial pleaded that they had been compelled to join the pirates, and had done so only to save their lives. It often happened that amongst the members of a captured crew there would be some "sea-artist," as a particularly skilful navigator was called, and he would be compelled to sign on whether he wished to or not. A common source of piracy was the privateer, an armed ship that sailed under a letter of marque, which was apt to drift into piracy, when its legitimate prey was not forthcoming, to supply the prize-money which paid the wages of officers and crew. This fact was pointed out by Cotton Mather (*q.v.*), the New England divine, in one of his "hanging sermons" delivered at Boston to condemned pirates. In one which he preached in 1704 called "A Brief Discourse occasioned by a Tragical Spectacle of a Number of Miserables under Sentence of Death for Piracy," he stated, "the Privateering Stroke so easily degenerates into the Piratical, and the Privateering Trade is usually carried on with an Unchristian Temper, and proves an Inlet into so much Debauchery and Iniquity."

The same view was expressed by Nelson when he declared that all privateers were no better than pirates, although this wide accusation cannot be allowed to include such famous and patriotic privateers as Captain Fortunatus Wright or Commodore Walker. Many a shady privateer was little better than a pirate, and the letter of marque under which he sailed a mere pretence, as in the case of a pirate who plundered Spanish ships in the 17th century, under a commission sold to him by the governor of a Danish West India island, himself a reformed pirate. This document, written in Danish, proved, when translated, to entitle the holder to hunt for goats and wild pigs on the island of Hispaniola and nothing more.

The establishment of a pirate gang usually took one of two forms. The most usual was for a few ringleaders to plot a mutiny on board a merchant ship. At a prearranged signal the mutineers would seize the officers and kill them and any members of the crew who resisted, and throw their bodies overboard.

But many a pirate who eventually rose high in his profession began in a very small way. Often a handful of desperate characters would steal a boat and row or sail along the coast by night, until they surprised the crew of some small schooner, and became masters of her. In this they would venture further afield, until by cunning or force they got possession of a larger ship. The downfall of most pirates was brought about by their utter lack of discipline, for, unless the elected captain was a man of unusual strength of character, as was the famous Captain Bartholomew Roberts, he was unable to keep his crew in order, and sooner or later, disaster overtook them, through careless navigation or at the hands of a better-disciplined hostile ship.

One of the first formalities of a newly created pirate crew was the drawing up and signing of the ship's articles, which would include such rules as the following, taken from those of Captain John Phillips of the "Revenge":

1. Every man shall obey civil Command; the Captain shall have one full Share and a half in all Prizes; the Master, Carpenter, Boatswain and Gunner shall have one Share and a quarter.

6. That Man that shall snap his Arms, or smoak Tobacco in the Hold without a cap to his Pipe, or carry a Candle lighted without a Lanthorn, shall receive Moses's Law (that is 40 Stripes lacking one) on the bare Back.

9. If at any time you meet with a prudent Woman, that Man that offers to meddle with her, without her Consent, shall suffer present Death.

Another matter, considered to be of great importance, was the choice of a flag, whose chief object was to "strike terror into all beholders." The favourite design was a skull and cross-bones; though sometimes a whole skeleton was depicted, holding in one boney hand a rummer or glass of punch, and in the other a sword or dagger. Whenever possible the pirates carried a surgeon, who was treated with a certain amount of respect.

Famous Characters.—The ordinary pirate was merely a criminal who lived for himself alone, and lacked any sense of ambition other than to get rich quickly, and must not be placed in the same category with the Vikings, who although sea-robbers and murderers, worked in large and, to a certain extent, organized bands; as did the Mediterranean pirates in Roman times who formed a highly organized brotherhood of desperadoes. The ordinary pirates boasted that they "declared war upon the whole world" and possessed no honour even amongst themselves.

A few of the most famous pirates may be briefly mentioned. Captain John Avery, *alias* Every, *alias* Bridgeman, familiarly known as "Long Ben" or the "Arch-Pirate," was born at Plymouth about 1665, took to the sea and rose to mate in a merchant ship; headed a mutiny and was elected captain; proved himself a daring pirate leader, and after much success off the Guinea coast and in the West Indies sailed to the Red sea, where he seized a rich ship of the Great Mogul, reported to have on board 100,000 pieces of eight and the Mogul's young and lovely daughter. He took both to Madagascar where he settled down as a reigning monarch. In 1696 he was at Boston, where he bribed the governor to allow him and his crew to land and dispose of their plunder. He died in poverty at Bideford after being tricked out of his ill-gotten gains by certain merchants of Bristol. Charles Johnson wrote a play called *The Successful Pyrate,* which was acted at Drury Lane, in 1713, and which was modelled on Avery's career.

Bartholomew Roberts was, perhaps, the greatest of all pirates. Born in Wales in 1682, he died fighting in 1722. He was credited with having taken over 400 ships during his career, and was remarkable for his discipline, for being a teetotaler, and allowing no women or gambling aboard his ships.

Edward Teach, *alias* Blackbeard, a picturesque blackguard, was killed on Nov. 17, 1718, in a hand-to-hand combat with Lieut. Robert Maynard, of H.M.S. "Pearl."

Captain Misson, a Frenchman of good family, was unique in combining active piracy with socialistic ideals. He reigned for many years over a Utopian republic in Madagascar.

Two women pirates, Anne Bonny and Mary Read, deserve mention, as both rose high in their ancient dual professions.

The famous Captain Kidd was no pirate at all, but the victim or scapegoat of political intrigue.

With the peace of 1815 came a great increase in West Indian piracy, which was assisted by the inability of the Spanish authorities to cope with the pirates while their colonies were seething with revolt. At last the British and American navies combined to root out the evil once and for all in the Atlantic, although piracy lasted in the Greek islands until nearly 1850.

The end of piracy, after centuries, was brought about by public feeling, backed up by the steam-engine and telegraph. The last relic exists to-day in China, where a nest of troublesome pirates still carries on the old trade in spite of the navies of the foreign powers. The Chinese pirates ship themselves as ordinary coolie passengers on a coastal steamer and, at a given signal, produce revolvers and hold up the officers and crew and compel them to navigate the ship to their headquarters at Bias bay, where the ship is plundered and officers and passengers held for ransom.

BIBLIOGRAPHY.—Mommsen's *History of Rome;* Monson's "Naval Tracts" in *Churchill's Voyages,* v., 5 (London, 1744–46), and in Navy Record Society (1902); *State Trials,* vols. xiii., xiv., xv. (London, 1812); Captain Charles Johnson's *General History of the Pyrates* (1724) gives full and accurate details of the lives, activities and death of the most notorious pirates of the early 18th century; and a second volume, published in London in 1726, does the same for the Madagascar pirates. It used to be said that Charles Johnson was inaccurate and unreliable, but recent research has proved again and again that, whoever he was, he had first-hand knowledge of his subject and is to be relied upon in almost every detail. F. C. Bradler, *Piracy in the West Indies and its Suppression* (1923); G. F. Dow and J. H. Edmonds, *The Pirates of the New England Coast* (1630–1730). *See* also Publications of Marine Research Society, Salem, Mass., 1923.

(P. Go.)

PIRELLI AND CO. and SOCIETÀ ITALIANA PIRELLI OF MILANO, Italy, are now one of the largest industrial organisations throughout all Italy, with a large number of international ramifications, employing at the end of 1928 over 30,000 hands all over the world, specialising in the manufacture of electric cables, tyres of all descriptions and general India-rubber and gutta-percha goods. Founded in 1872 by Ing. Giovanni Battista Pirelli, at present a member of the Italian Senate and president of the company, they have gradually increased in

importance, developing large factories in Italy (Milano, Bicocca, Spezia and Vercurago), Spain (Villanueva y Geltrù and Manresa) and in the Argentine (two factories in Buenos Aires).

Pirelli-General Cable Works, Ltd., 144, Queen Victoria Street, London, E.C.4., with factories in Southampton and Eastleigh, England, are among the most prominent British manufacturers of electric cables; Pirelli, Ltd., own a large factory on a site of 63 acres at Burton-on-Trent, manufacturing pneumatic, semi-pneumatic and solid tyres; these English factories employ British labour throughout.

Another Pirelli company owns large rubber plantations at Boenisari, Isle of Java. Financial and commercial Pirelli companies operate from Barcelona, Brussels, Bucharest, Copenhagen and Paris, and Pirelli agents are active in practically every commercial centre throughout the world. Pirelli also own, or have controlling interests in, cotton-spinning and weaving mills, copper drawing mills and other branches of industry.

Among the lines in which the Pirelli companies specialise should be mentioned submarine telegraph cables laid across the Atlantic Ocean; high tension underground cables for abnormal working pressures, installed in New York and Chicago; pneumatic, semi-pneumatic and solid automobile, motorcycle and bicycle tyres. (M. S. L.)

PIRENNE, HENRI (1862–), Belgian historian, was born at Verviers on Dec. 23, 1862. He first lectured at the University of Liége, and in 1886 became professor at the University of Ghent. His *Histoire de Belgique*, of which five volumes had appeared in 1925, completely revolutionized the current conceptions of Belgian history and nationality by showing how, from the time of the Germanic invasions, Flemings and Walloons were drawn together by community of tradition and economic interest. Pirenne's works on mediaeval cities and social conditions include *Les anciennes démocraties des Pays-Bas* (1910, Eng. trans. 1915) *Recueil des documents relatifs à l'histoire de l'industrie drapière en Flandre* (with G. Espinas, 4 vol., 1906–24) and *Mediaeval Cities: Their Origins and the Revival of Trade* (Princeton, 1925). He was the first president of the "Union Académique Internationale" (1920–23) and received many foreign honours.

PIRKE ABOTH, lit. Chapters of the Fathers, a collection of proverbs arranged chronologically and giving a *catena* of Jewish scholars. The treatise belongs to the IVth Order (*Neziqin*) of the Mishnah and deals with the history of tradition. This, the so-called Oral Law (*Torah she-be-'al Peh*, Deut. iv. 14: v. 22–33, especially 31; and other passages) supplemented the Written Law (*Torah she-be-khethabh*). The Oral Law in Aboth is traced back from Moses, through Joshua, the elders and Prophets, to the Men of the Great Synagogue, a body the existence of which is now merely doubted but which was formerly denied categorically. Through Simon the Just (either Simeon grandson of Jaddua, High priest, 310–291 B.C., or his grandson, 219–199) and Antigonus of Socho, both survivors of the Great Synagogue, tradition is carried on by five pairs of teachers (*Zūgōth*, ζυγόν) to Hillal and Shammai (30 B.C.). Henceforward the sayings of their disciples and successors are given until ch. iv., which concludes with El'azarhaq-Qappar (end of 2nd cent. A.D.). Chapters iii. and iv. are not strictly chronological. Chapters v. and vi. are of later date. Chapter v. combines historical, legendary and didactic elements, miracles are explained and a series of things, sayings and qualities are grouped numerically, *e.g.*, ten *Ma'amaroth* or *Logoi* are said to have created the world; vi. is called the "chapter of the acquisition of the Law" and was probably added for liturgical purposes. Aboth is written in simple Hebrew. The aphorisms are of great intrinsic beauty and are of extreme historical importance not only for Judaism but for the environment of nascent Christianity. The chapters are read, on different occasions, in most Jewish rites.

BIBLIOGRAPHY.—Pirke Aboth may be studied in English in Singer's *Authorized Daily Prayer Book* pp. 184 *sqq.* I. Abrahams Notes (pp. clxxvi. of the *annotated edition* should be consulted). The reader is also referred (a) to the *Jew. Enc.* s.v. *Abot.* (b) *Abot* in *Encyclopaedia Judaica* vol. I. Berlin (1928). (c) R. Travers Herford's two editions (1) in R. H. Charles *Apocrypha and Pseudepigrapha*, vol. II. (1913) and (2) publ. by *Jewish Inst. of Religion Press* (1925), on which see S. B. Maximon's article on pp. 325 *sqq.* of *Jewish Studies in Memory of Israel Abrahams* (1927). The older editions of C. Taylor and H. Strack are still of great value.

PIRMASENS, a town of Germany, in the Bavarian Palatinate, 40 m. W. by S. of Speyer, on the railway from Biebermühle. Pop. (1925) 42,996. Pirmasens owes its name to a St. Pirmin, who is said to have preached Christianity here in the 8th century. It originally belonged to the count of Hanau-Lichtenberg, but passed to Hesse-Darmstadt in 1736. The staple industry is the production of boots and shoes; but organs, leather and machines are also manufactured.

PIRNA, a town in the republic of Saxony, on the left bank of the Elbe, 11 m. above Dresden, and on the railway to Bodenbach and Prague. Pop. (1925) 30,460. Pirna, originally a Slavonic settlement, was for many years in the alternate possession of Bohemia and Meissen, but it became permanently united with the latter, and thus with Saxony, in 1405. The most notable edifices are the Gothic parish church, built in the 16th century and restored in 1890, and the old town-hall. Excellent sandstone is found on both banks of the Elbe. There are manufactures of glass, machinery, cigars, pottery, slates and enamelled goods and cotton spinning and wood sawing. The Sonnenstein, a fortress on an eminence above the town, was erected in the 16th century.

PIROGUE or **PIRAGUA** (the French and Spanish forms respectively of a Caribbean word for this type of vessel; it has at various times taken many corrupt forms, *e.g.*, *periagua*, *pettiaugua*, *pettyoagar*), originally the native name of a vessel made by hollowing out the trunk of a tree, a "dug-out"; hence applied to many different developments of this type of vessel used in the West Indies and along the American coast. An early improvement was to split the "dug-out" into two sections and insert a flat bottom of planking to widen it; another form had a lee-board, was decked in at either end, and had two masts.

PIRON, ALEXIS (1689–1773), French epigrammatist and dramatist, was born at Dijon on July 19, 1689. His father, Aimé Piron, an apothecary, wrote verse in the Burgundian patois. Alexis began life as clerk and secretary to a banker, and then studied law. In 1719 he went to Paris. In that year jealousy of the regular actors produced an edict restricting the Théâtre de la Foire, or licensed booths at fair times, to a single character on the stage, and Piron made a great success with a piece called *Arlequin Deucalion*, representing Deucalion immediately after the Deluge. In 1728 he produced *Les Fils ingrats* (known later as *L'École des pères*) at the *Comédie Française*. He attempted tragedy unsuccessfully in *Callisthène* (1730), *Gustave Vasa* (1733) and *Fernand Cortès* (1744). Piron returned to comedy with *La Métromanie* (1738). His most intimate associates at this time were Mlle. Quinault, the actress, and her friend Marie Thérèse Quenaudon, known as Mlle. de Bar whom he married in 1741. He died on Jan. 21, 1773. His best title to remembrance lies in his epigrams. The burlesque epitaph on himself, in which he ridicules the Academy—

Ci-gît Piron, qui ne fut rien,
Pas même académicien

is well-known. Grimm called him a "machine à saillies."

Piron published his own theatrical works in 1758, and after his death his literary executor, Rigoley de Juvigny, published his *Oeuvres complètes*. M. Bonhomme produced a critical edition in 1859, completed by *Poésies choisies et pièces inédites* in 1879.

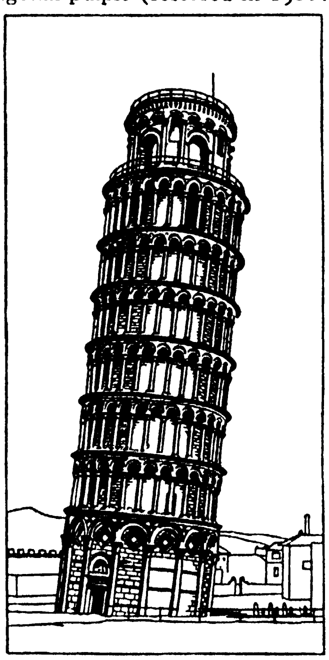
PIROT, a town of South Serbia, Yugoslavia. Pop. (1921) 10,462. It lies amid romantic scenery, and is the seat of a prefecture and a tribunal. The inhabitants are engaged in the manufacture of jewellery, thin cloth, woollen braid and carpets. The latter, woven on hand looms by women and children, are its speciality, and are noted for their excellent quality, designs and colouring. There are several schools, a large mosque and a curious old square leaning tower. The mediaeval fortress is believed to have been built on the site of the Roman fortress Quimedava, on the military road from Old Naissus (Nish) to Philippopolis. Outside the town is an early modern entrenched camp. Pirot, which is strategically important, was captured by the Serbs in the Russo-Turkish War (1877–78) and was ceded to Serbia by the Treaty of Berlin (1878). In the war between Serbia and Bulgaria in 1885 Pirot was

occupied by the Bulgarians and held by them till peace was signed.

PIRRIE, WILLIAM JAMES, 1st Viscount (1847–1924), British shipbuilder and engineer, was born at Quebec on May 31, 1847, and educated at Belfast Royal Academic institution. In 1862 he entered the shipbuilding firm of Messrs. Harland and Wolff of Belfast, becoming partner in 1874 and later chairman. His success was particularly associated with the building by his firm of the White Star line steamships, the first being launched in 1870. From 1896 to 1897 he was lord mayor of Belfast. In 1906 he was raised to the peerage as Baron Pirrie. In 1918, towards the close of the World War, he was made controller-general of merchant shipping. In 1921, on the King's visit to Belfast to inaugurate the new parliament of Northern Ireland, he was created a viscount. He died on June 6, 1924.

PISA, a town and archiepiscopal see of Tuscany, Italy, capital of the province of Pisa, on the Arno, 7 m. from the sea, and 49 m. W. of Florence by rail. Pop. (1921) 51,774 (town), 68,933 (commune). It retains its mediaeval walls, 6¼ m. in circuit; the citadel now contains barracks. The cathedral, the baptistery, and the famous leaning-tower form a group by themselves at the north-west corner of the town. The two former are built in black and white marble, a characteristic found in Pisan churches elsewhere also. (*See* Sardinia.)

The architects of the cathedral were Buschetto and Rinaldo, both probably Pisans. The church is in plan a Latin cross, 311½ ft. long and 252 ft. wide across the transepts inside. The nave, 109 ft. high, has double, the transepts single, vaulted aisles: and at the intersection of nave and transepts is a dome. The columns of the nave and side aisles are ancient. The west front is the finest part of the exterior: the range of arches running round the base is repeated by four open arcades. The three bronze doors were re-made after the fire of 1596; that of the south side (1180) is by Bonanno. The mosaics in the apse were designed by Cimabue, and the splendid decagonal pulpit (restored in 1926: see *Per la recostruzione del pergamo di Giovanni Pisano,* 1926) is by Giovanni Pisano. The baptistery, begun in 1153, is a circle 100 ft. in diameter and is covered with a cone-surmounted dome 190 ft. high on which stands a statue of S. Ranieri. The lowest range of semicircular arches consists of 20 columns, and the second of 60; and above this is a row of 18 windows in the same style separated by as many pilasters. In the interior, which is supported by four pilasters and eight columns, the most striking features are the octagonal font and the hexagonal pulpit, erected in 1260 by Niccola Pisano. The campanile or "leaning tower of Pisa," begun by Bonanno in 1174, is round. The walls at the base are 13 ft. thick, and at the top about half as much; they are constructed throughout of marble. The basement is surrounded by a range of semicircular arches supported by 15 columns, and above this rise six arcades with 30 columns each. The eighth storey, which contains the bells, is of much smaller diameter than the rest of the tower, and has only 12 columns. The height of the tower is 179 feet. The tower was 15½ ft. out of the perpendicular when measured in 1829, and 16½ ft. in 1910. There is no reason to suppose that the architects intended that the campanile should be built in an oblique position; it would appear to have assumed it while the work was still in progress. The foundations are not more than 10 ft. deep, and their circumference only that of the tower. The Campo Santo, lying to the north of the cathedral, owes its origin to Archbishop Ubaldo (1188–1200) who made the spot peculiarly sacred by bringing 53 shiploads of earth from Calvary. The building, erected in the Italian Gothic style by Giovanni Pisano in 1278–83, is of special interest for its famous frescoes by various Tuscan artists, including a "Last Judgment" by Francesco da Volterra after Orcagna (1370–71); Benozzo Gozzoli (23 Old Testament scenes, 1468–84), and also for the large collection of Roman sculptures which it contains. Other notable churches are: S. Andrea, S. Pierino, S. Michele in Borgo (11th century), S. Sepolcro, erected by Diotisalvi (*c.* 1150), S. Nicolò, with a four-storied tower (*c.* 1230), S. Caterina (1252), S. Francesco (13th century) with frescoes by Taddeo Gaddi (in the adjacent monastery is the interesting museum and picture gallery); S. Maria della Spina, an elegant little church of white marble (1325–29); and the Renaissance church of the Tuscan order of St. Stephen from plans by Vasari (after 1562), who also reconstructed the palace of the order.



THE LEANING TOWER OF PISA
Begun in 1174 and completed in 1350, the campanile is 179 ft. high and leans more than 16 ft. out of the perpendicular

The main streets of the older part of the town have porticoes. There are wide quays, with fine buildings, on each side of the Arno, but the town, as a whole, is quiet, owing much of its importance to its being the junction for Florence, Lucca, and Volterra, on the main line between Rome and Genoa. The university, founded in 1338, had 1,096 students in 1925–26; it has a natural history and other museums and a botanical garden. There is also an engineering school (103 students), a veterinary institute (114 students), and an agricultural institute (109 students). In the vicinity are the royal villa and stud-farm (horses and dromedaries) of San Rossore (the name is a corruption of Lussorio, *see* Fordungianus), and the mineral baths of San Giuliano, alkaline-ferruginous, with temperature 91·4° to 105·8° F. At the mouth of the Arno, joined to the city by a steam tramway (on the way is the old church of S. Piero in Grado) is the seaside resort of Marina di Pisa, also known as Bocca d'Arno, a well known centre for landscape painters. At Navacchio, 5 m. E. of Pisa, is a biscuit factory, 4 m. N. of which is Calci, and near it the large monastery of the Certosa di Pisa.

The ancient Pisae on the right bank of the Arno was only 2 m. from the sea, the delta having increased since. It is believed to have been founded from Pisae in Elis and is first mentioned in history as the place at which a Roman army from Sardinia landed in 225 B.C. Being situated on the coast road (Via Aemilia), it was important as a frontier fortress against Liguria, for the fertility of its territory, and its quarries and timber for shipbuilding. Scanty ruins of Roman baths exist near the modern Lucca gate on the north. The older town occupied the same site. (T. A.)

HISTORY

Little is known of Pisa during the barbarian invasions, but it is an ascertained fact that it was one of the first towns to assert its independence of Byzantine rule. During the first years of the Lombard rule the necessity of defending the Italian coast from the attacks of the Byzantines was favourable to the development of the Pisan navy.

Early Wars.—In 1003 we find records of a war between Pisa and Lucca, which, according to Muratori, was the first waged between Italian cities in the middle ages. But the military development and real importance of Pisa in the 11th century must be attributed to the continuous and desperate struggle it maintained against the tide of Saracenic invasion from Sicily. Numerous legends and fables of the old chroniclers serve to attest the importance of Pisa in those days. The Saracens repeatedly attacked the town, but were repulsed, and the Pisans themselves assumed the offensive in Calabria, Sicily, and even in Africa. In 1015 a memorable expedition was undertaken by the united forces of Pisa and Genoa against Mogahid, better known in the Italian chronicles as Mugeto, whom they drove from Sardinia. Again invading the island, he was again attacked and defeated by the same adversaries, leaving a brother and son, or, as some authorities aver, a wife and son, prisoners in their hands. Sardinia continued to be governed by native "judges" who were like petty sovereigns, but were now subject to the sway of Pisa. This was

the primary cause of the jealousy of the Genoese and of the wars afterwards made by them upon Pisa. Meanwhile the Pisans flourished more and more, and continued hostilities against the Saracens. In 1062 their ships returned from Palermo laden with spoil. Thus it is not surprising that Pisa should already have had its own code of laws (*Consuetudini di mare*), which in 1075 were approved by Gregory VII., and in 1081 confirmed by a patent from the emperor, Henry IV. The oldest of Pisan statutes still extant is the *Breve dei consoli di mare* of 1162.

Commercial Prosperity.—In 1099 the Pisans joined in the second crusade, proved their valour at the capture of Jerusalem, and derived many commercial advantages from it; for within a short time they had banks, consuls, warehouses and privileges of all kinds in every Eastern port. Thus while the commune of Pisa was still under the rule of the marquises of Tuscany, all negotiations with it were carried on as with an independent state officially represented by the archbishop and consuls. The aristocrats were the dominant party, and filled the highest offices of the republic, which, in the 12th century, rose to great power, both on sea and land, by its wars with the Lucchese, Genoese and Muslims. In the years 1113 and 1115 it achieved a still greater enterprise. The Pisan fleet of 300 sail, commanded by the archbishop, Pietro Moriconi, attacked the Balearic Isles, where as many as 20,000 Christians were said to be held captive by the Muslims and returned loaded with spoil and with a multitude of Christian and Muslim prisoners. The former were set at liberty or ransomed, and among the latter was the last descendant of the reigning dynasty. Immediately afterwards, the 14 years' war with Genoa broke out. The two republics contested the dominion of the sea, and both claimed supreme power over the islands of Corsica and Sardinia. A papal edict awarding the supremacy of Corsica to the Pisan Church proved sufficient cause for the war, which went on from 1118 to 1132. Then Innocent II. transferred the supremacy over part of Corsica to the Genoese Church, and compensated Pisa by grants in Sardinia and elsewhere. Accordingly, to gratify the pope and the emperor, Lothair II., the Pisans entered Neapolitan territory to combat the Normans. They aided in the vigorous defence of the city of Naples, and twice attacked and pillaged Amalfi, in 1135 and 1137, with such effect that the town never regained its prosperity. The war with Genoa never came to a real end. Even after the retaking of Jerusalem by the Muslims (1187) the Pisans and Genoese again met in conflict in the East, and it was plain that there could be no lasting peace between these rival powers until the one or the other should be crushed. The greatness and wealth of the Pisans at this period of their history is proved by the noble buildings by which their city is adorned. The foundations of the cathedral were laid in 1063, and its consecration took place in 1118; the baptistry was begun in 1152, and the campanile (the famous leaning tower) in 1174 And all three magnificent structures were mainly the work of Pisan artists, who gave new life to Italian architecture, as they afterwards renewed the art of sculpture.

RIVALRY WITH FLORENCE AND GENOA

The chief authority was still vested in the nobles, who, both in Pisa and in Sardinia, exercised almost sovereign power. They formed the real strength of the republic, and kept it faithful to the empire and the Ghibelline party. The Guelph and popular element which constituted the force and prosperity of Florence was hostile to Pisa, and led to its downfall. Owing to the political and commercial interests binding Florence to the Roman court, the Guelph element naturally prevailed there, while growth of its trade and commerce necessarily compelled that republic to encroach on waters subject to Pisan rule. And, although Pisa had hitherto been able to oppose a vigorous resistance to Genoa and Lucca, it was not so easy to continue the struggle when its enemies were backed by the arms and political wisdom of the Florentines, who were skilled in obtaining powerful allies The chroniclers ascribe the first war with Florence, which broke out in 1222, to a ridiculous motive. The ambassadors of the rival states in Rome are said to have quarrelled about a lapdog—which merely shows that there were already so many general and permanent reasons for war that no special cause was needed to provoke it. In 1228 the Pisans met and defeated the united forces of Florence and Lucca near Barga in the Garfagnana, and at the same time they despatched 52 galleys to assist Frederick II in his expedition to the East. Shortly after this they renewed hostilities with the Genoese on account of Sardinia, and war was intermittent down to 1259, when it terminated in the decisive victory of the Pisans and the consolidation of their supremacy in Sardinia. But meanwhile Florence had made alliance with Genoa, Lucca and all the Guelph cities of Tuscany against its Ghibelline rival: the pope had excommunicated Frederick II. and all his adherents; and, as a crowning disaster, the death of Frederick in 1250 proved a mortal blow to the Italian Ghibelline cause. Nevertheless the Pisans were undaunted. Summoning Siena, Pistoia and the Florentine exiles to their aid, they boldly faced their foe, but were defeated in 1254 Soon after this date we find the old aristocratic government of Pisa replaced by a more popular form. Instead of the consuls there were now 12 elders (*anziani*); besides the podestà, there was a captain of the people; and there was a general council as well as a senate of 40 members. The rout of the Tuscan Guelphs on the field of Montaperti (1260) restored the fortunes of Pisa But the battle of Benevento (1266), where Manfred fell, and the rout of Tagliacozzo (1268), sealing the ruin of the house of Hohenstaufen in Italy and the triumph of that of Anjou, were fatal to Pisa. For the republic had always sided with the empire and favoured Conradin, whose cruel end struck terror into the Ghibelline faction The pope hurled an edict against the Pisans and tried to deprive them of Sardinia, while their merchants were driven from Sicily by the Angevins The internal condition of the city was affected by these events Owing to the increasing influence of the Guelph and popular side, to which the more ambitious nobles began to adhere for the furtherance of personal aims, the aristocratic Ghibelline party was rapidly losing ground. At this time Count Ugolino della Gherardesca had become the virtual head of the republic, and, in order to preserve its independence and his own sway, inclined to the Guelphs and the popular party, in spite of the Ghibelline traditions of his race. He was supported by his kinsman, Giovanni Visconti, judge of Gallura, in Sardinia; but almost all the other great families vowed eternal hatred against him, and proclaimed him a traitor. In 1274 he and Visconti were driven into exile. Both then joined the Florentines, took part in the war against their native city, and laid waste its surrounding territories In 1276 the Pisans were compelled to agree to very grievous terms—to exempt Florentine merchandise from all harbour dues, to yield certain strongholds to Lucca, and to permit the return of Count Ugolino Thus the count again became a powerful leader in Pisa. Visconti, however, was dead.

This was the moment chosen by Genoa for a desperate and decisive struggle with her perpetual rival. For some years the hostile fleets continued to harass each other and engage in petty skirmishes, as if to measure their strength and prepare for a final effort. On Aug 6, 1284, at the great battle of Meloria 72 Pisan galleys engaged 88 Genoese, and half the Pisan fleet was destroyed The chroniclers speak of 5,000 killed and 11,000 prisoners; and, although these figures must be exaggerated, so great was the number of captives taken by the Genoese as to give rise to the saying—"To see Pisa, you must now go to Genoa." This defeat crushed the power of Pisa She had lost her dominion over the sea, and the Tuscan Guelphs again joined in attacking her by land. Count Ugolino had taken part in the battle of Meloria and was accused of treachery At the height of his country's disasters he sought to confirm his own power by making terms with the Florentines, by yielding certain castles to Lucca and by neglecting to conclude negotiations with the Genoese for the release of the prisoners, lest these should all prove more or less hostile to himself This excited a storm of opposition against him. The archbishop, Ruggieri, having put himself at the head of the nobles, was elected podestà by the Lanfranchi, Sismondi and Gualandi, and a section of the popular party. The great bell of the commune called together the adherents of the archbishop; the bell of the people summoned the partisans of the count. After

a day's fighting (July 1, 1288) the count, his two sons and his two grandsons were captured in the palazzo del popolo (or town hall), and cast into a tower belonging to the Gualandi, and known as the "Tower of the Seven Streets." Here they were all left to die of hunger. Their tragic end was afterwards immortalized in the *Divina Commedia*. The sympathies of Dante Alighieri, the Florentine patriot and foe of Rome, were naturally in favour of the victims of an aristocratic prelate opposed to all reconciliation with Florence.

The Florentines were now allied with Lucca and Genoa, and a few of their vessels succeeded in forcing an entry into the Pisan port, blocked it with sunken boats, and seized its towers. In 1293 they secured a profitable peace. They and the other members of the Guelph league were freed from all imposts in Pisa and its port. In addition to these privileges the Genoese also held Corsica and part of Sardinia; and throughout the island of Elba were exempted from every tax. They likewise received a ransom of 160,000 florins for their Pisan prisoners.

In 1312 the arrival of the Emperor, Henry VII., gladdened the hearts of the Pisans, but his sudden death in 1313 again overthrew their hopes. He was interred at Pisa, and Uguccione della Faggiuola remained as imperial lieutenant, was elected podestà and captain of the people, and thus became virtual lord of the city. As a Ghibelline chief of valour and renown he was able to restore the military prestige of the Pisans, who under his command captured Lucca and defeated the Florentines at Montecatini on Aug. 29, 1315. In 1316, however, he was expelled in an outburst of popular fury. But Pisa's freedom was forever lost. Uguccione della Faggiuola was succeeded by other lords or tyrants of whom the most renowned was Castruccio Castracane, a political and military adventurer of much the same stamp as Uguccione himself. With the help of Louis the Bavarian, Castruccio became lord of Lucca and Pisa, and was victorious over the Florentines; but his premature death in 1328 again left the city a prey to the conflicts of opposing factions. New lords, or petty tyrants, rose to power in turn during this period of civil discord, but the military valour of the Pisans was not yet extinguished. By sea they were almost impotent—Corsica and Sardinia were lost to them forever—but they were still formidable by land. In 1341 they besieged Lucca in order to prevent the entry of the Florentines, to whom the city had been sold for 250,000 florins by the powerful Mastino della Scala. Aided by their Milanese, Mantuan and Paduan allies, they gave battle to their rivals, put them to rout at Altopascio (Oct. 2), and then again excluded them from their port. Thereupon the Florentines obtained Porto Talamone from Siena and established a navy of their own. By this means they were enabled to capture the island of Giglio, and, attacking the Pisan harbour, carried off its chains, bore them in triumph to Florence, and suspended them in front of the baptistery, where they remained until 1848. Then in pledge of the brotherhood of all Italian cities, they were given back to Pisa, and placed in the Campo Santo.

The war was now carried on by the free companies with varying fortune, but always more or less to the hurt of the Pisans. In 1369 Lucca was taken from them by the emperor Charles IV.; and afterwards Giovan Galeazzo Visconti, known as the count of Virtù, determined to forward his ambitious designs upon the whole of Italy by wresting Pisa from the Gambacorti. For at this time the conflicts of the Raspanti faction, headed by the Gherardesca, with the Bergolini led by the Gambacorti, had left the latter family masters of the city. At Visconti's instigation Piero Gambacorti, the ruler of the moment, was treacherously assassinated by Jacopo d'Appiano, who succeeded him as tyrant of Pisa, and bequeathed the state to his son Gherardo. The latter, a man of inferior ability and daring, sold Pisa to the count of Virtù, receiving in exchange 200,000 florins, Piombino, and the islands of Elba, Pianosa and Monte Cristo. Thus in 1399 Visconti took possession of Pisa, and left it to his natural son, Gabriele Maria Visconti, who was afterwards expelled from its gates. But even in this century of disaster the Pisans continued to encourage not only commerce, but also the fine arts. In the year 1278 they had entrusted the erection of their fine Campo Santo to Nicola and Giovanni Pisano, by whom the architectural part of it was completed towards the end of the century. In the following year the first artists of Italy were engaged in its decoration, and the celebrated frescoes attributed to Orcagna (*q.v.*) were painted on its walls. Others were afterwards supplied by Benozzo Gozzoli and men of lesser note, and the labour of ornamentation was only discontinued in 1464.

The Victory of Florence.—Meanwhile, in 1406, the Florentines made another attack upon Pisa, besieging it simultaneously by sea and land. Owing to the starving condition of its defenders, and aided by the treachery of Giovanni Gambacorti, they entered the city in triumph on Oct. 9, and sought to "crush every germ of rebellion and drive out its citizens by measures of the utmost harshness and cruelty." Such were the orders sent by the Ten of War to the representatives of the Florentine government in Pisa, and such was then the established policy of every Italian state. Consequently for a long time there was a continual stream of emigration from Pisa. The Medici pursued a humaner course. In 1472 Lorenzo the Magnificent tried to restore the ancient renown of the Pisan university. To that end he filled it with celebrated scholars, and, leaving only a few chairs of letters and philosophy in Florence, compelled the Florentines to resort to Pisa for the prosecution of their studies. But nothing could now allay the inextinguishable hatred of the conquered people. When Charles VIII. made his descent into Italy in 1494, and came to Sarzana on his way to Tuscany, he was welcomed by the Pisans with the greatest demonstrations of joy. And, although that monarch was ostensibly the friend of Florence, they did not hesitate, even in his presence, to assert their own independence, and casting the Florentine emblem, the Marzocco, into the Arno, made instant preparations for war. Between 1499 and 1505 they heroically withstood three sieges and repulsed three attacking armies. But their adversaries always returned to the assault, and, what was worse, yearly laid waste their territories and destroyed all their crops. Soderini, who was perpetual gonfalonier of Florence, and Machiavelli, the secretary of the Ten, urged on the war. In 1509 Florence encamped her forces on three sides of the distressed city, which at last, reduced to extremity by famine, was compelled to surrender on June 8, 1509. Thenceforth the Florentines remained lords of Pisa. But now, mainly owing to the efforts of Soderini and Machiavelli, the conquerors showed great magnanimity. They brought with them large stores of provisions which were freely distributed to all; endeavoured to succour the suffering populace in every way, and gave other assistance to the wealthier classes. Nevertheless, emigration continued even on a larger scale than in 1406, and the real history of Pisa may be said to have ended. In Naples, in Palermo, in all parts of Italy, Switzerland and the south of France, we still find the names of Pisan families who quitted their beloved home at that time. The Florentines immediately built a new citadel, and this was a great bitterness to the Pisans. The Medici, however, remained well disposed towards the city. Leo X. was an active patron of the university, but it again declined after his death. The grand duke, Cosimo I., a genuine statesman, not only restored the university, but instituted the "uffizio dei fossi" or drainage office for the reclamation of marsh lands, and founded the knighthood of St. Stephen. This order played a noble part in the protection of Tuscan commerce, by fighting the Barbary pirates and establishing the prestige of the grand-ducal navy (*see* MEDICI). Under the succeeding Medici, Pisa's fortunes steadily declined. Ferdinand I. initiated a few public works there, and above all restored the cathedral, which had been partly destroyed by fire in 1595. These dreary times are brightened by one glorious name—that of Galileo Galilei.

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Mittel-Italiens (1867); for the monuments and inscriptions *see* A. Da Morrona, *Pisa illustrata* (Leghorn, 1812) and G. R. de Fleury's *Les Monuments de Pise au moyen âge* (1866); also Repetti's *Dizionario geografico della Toscana, s.v.* "Pisa." For Dante's connection with Pisa, see *Dante e i Pisani*, by Giovanni Sforza (Pisa, 1873). *See* also *The Story of Pisa and Lucca* by Janet Ross and Nellie Erichsen in Dent's "Mediaeval Towns" (1907), and T. B. Supino's *Pisa*, in the *Italia artistica* series. (P. V.; L. V.)

PISA, COUNCIL OF (1409). The great schism of the west had already lasted thirty years, and the efforts which had been made to restore unity within the Church by the simultaneous resignation of the two rival pontiffs had been in vain, when in the spring of 1408, the state of affairs being desperate, the idea arose of assembling a council to effect a union without the co-operation of the popes. The initiative came from those cardinals who had one after the other seceded either from Gregory XII. or Benedict XIII. The day after the opening of the council, proceedings were started against the two popes, who, it was agreed, were to be eliminated. In order to depose them with some show of legality, it was necessary, as a preliminary, to convict them of heresy, and it began to be seen that their tenacity of power, and the ruses by which they evaded the necessity of abdicating, however harmful might be their consequences, did not in themselves constitute a clearly-defined heresy. On the 5th of June 1409 was read the definitive sentence: that as heretics, and therefore separated from the Church, Pedro de Luna (Benedict XIII.) and Angelo Corrario (Gregory XII.) were *ipso facto* deposed from any office; they must not be obeyed, nor assisted, nor harboured.

In order to complete their task the cardinals present at Pisa, authorized by delegation of the council, shut themselves up in conclave, and elected one of their number, Peter Philarges, cardinal of Milan, as the new pope, who assumed the name of Alexander V. They had hoped to save the Church, but unfortunately the result of their efforts, generous as they were, was that the schism increased in bitterness, and that instead of the unity for which the Church craved, three popes continued to flourish. Both the deposed pontiffs protested against the legality of the council of Pisa; each had numerous partisans, and the thesis, constructed rather to meet the exigencies of the case, which attributed to a synod assembled by the cardinals the right of constituting itself judge of a sovereign pontiff, was far from being established. The council was proceeding to occupy itself with reform when it was dissolved by Alexander V. (August 1409).

Bibliography.—*See* Jacques Lenfant, *Histoire du concile de Pise* (1731); Mansi, *Concil.*, xxvii.; F. Stuhr, *Die Organisation und Geschäftsordnung der Pisaner und Konstanzer Konzils* (1891); N. Valois, *La France et le grand schisme d'occident*, iv. 3–107, 175 *seq.* (1902); *see* also art. Constance (Council of).

PISAN, CHRISTINE DE (1364–*c.* 1430), French poet, of Italian birth, was born at Venice in 1364. When she was four years old she was brought to her father, a councillor of the Venetian Republic, in Paris, where he held office as astrologer to Charles V. At fifteen Christine married Étienne du Castel, who became Charles's notary and secretary. After the king's death in 1380 her father lost his appointment, and died soon after; and when Christine's husband died in 1389 she found herself without a protector, and with three children depending on her. This determined her to have recourse to letters as a means of livelihood. Her first ballads were written to the memory of her husband, and as love poems were the fashion she continued to write others—*lais, virelais, rondeaux* and *jeux à vendre*—though she took the precaution to assure her readers (*Cent balades*, No. 50) that they were merely exercises. In 1399 she began to study the Latin poets, and between that time and 1405, as she herself declares, she composed some fifteen important works, chiefly in prose, besides minor pieces.

The earl of Salisbury, who was in Paris on the occasion of the marriage of Richard II. with Isabella of France (1396), took her elder son, Jean du Castel (b. 1384), and reared him as his own; the boy, after Salisbury's death (1400), being received by Philip of Burgundy, at whose desire Christine wrote *Le Livre des faitz et bonnes moeurs du sayge roy Charles* (1405), valuable as a first-hand picture of Charles V. and his court. Her *Mutation de fortune*, in which she finds room for a great deal of history and philosophy, was presented to the same patron on New Year's Day, 1404. It possesses an introduction of great autobiographical interest. In *La Vision* (1405) she tells her own history, by way of defence against those who objected to her pretensions as a moralist. Henry IV. of England desired her to make his court her home, and she received a like invitation from Galeazzo Visconti, tyrant of Milan. She preferred, however, to remain in France, where she enjoyed the favour of Charles VI., the dukes of Berry and Burgundy, the duchess of Bourbon and others.

Christine was a champion of her own sex. In her *Dit de la rose* (1402) she describes an order of the rose, the members of which bind themselves by vow to defend the honour of women. Her *Épître au dieu d'amour* (1399) is a defence of women against the satire of Jean de Meung, and initiated a prolonged dispute with two great scholars of her time, Jean de Montreuil (d. 1415) and Gonthier Col, who undertook the defence of the *Roman de la rose*. Christine wrote about 1407 two books for women, *La Cité des dames* and *Le Livre des trois vertus*, or *Le Trésor de la cité des dames*. She was devoted to her adopted country. During the civil war she wrote a *Lamentation* (1410) and a *Livre de la paix* (1412–1413), but after the disasters of the campaign of Agincourt she retired to a convent. We have no more of her work until 1429, when she broke her silence to write a song in honour of Joan of Arc. Of the circumstances of her death nothing is known but it probably took place about this time.

Her poems were edited by Maurice Roy for the Société des anciens Textes français (1886, etc.), and her *Livre du chemin du long estude*, by Puschel (Berlin, 1887). There are monographs by Raimond Thomassy (Paris, 1838); E. M. D. Robineau (Saint-Omer, 1882); and Friedrich Koch (Goslar, 1885). It is possible that Jean Castel, who was chronicler of France under Louis XI., was Christine's grandson. Hoccleve imitated her *Épître au dieu d'amour*, in his "Letter of Cupid" (*Chaucerian and other Pieces*, ed. W. W. Skeat, 1897). A translation of her *Épître d'Othéa* was made (*c.* 1440) by Stephen Scrope for his stepfather, Sir John Fastolf, and is preserved in a MS. at Longleat. This was edited (1904) for the Roxburghe Club by W. G. F. Warner as *The Epistle of Othea to Hector, or the Boke of Knyghthode. The Moral Proverbs of Christyne de Pise*, translated by Earl Rivers, was printed in 1478 by Caxton, who himself translated, by order of Henry VII., her *Livre des faitz d'armes, et de chevalerie*, a treatise on the art of war, based chiefly on Vegetius. Her *Cité des dames* was translated by Brian Anslay (London, 1521).

PISANO, ANDREA (*c.* 1270–1348), Italian sculptor, was born about 1270, and first learned the trade of a goldsmith. His style was influenced to some extent by Giovanni Pisano. His chief works were executed at Florence, and the formation of his mature style was due rather to Giotto than to his earlier masters. Of the three world-famed bronze doors of the Florentine baptistery, the earliest one—that on the south side—was the work of Andrea; he spent many years on it; and it was finally set up in 1336[1]. It consists of a number of small quatrefoil panels—the lower eight containing single figures of the Virtues, and the rest scenes from the life of the Baptist. At the death of Giotto in 1337, Andrea was appointed architect of the campanile, and built the two stories of niches above the work of Giotto. Of the beautiful panel-reliefs which decorate the campanile those representing "The Crane," "Weaving," "Daedalus," "Navigation," "Hercules," "Agriculture," "Theatre" and "Medicine," display the style of Andrea Pisano. The duomo contains the chief of Andrea's other Florentine works in marble. In 1347 he was appointed architect in the duomo of Orvieto, which had already been designed and begun by Lorenzo Maitani. The date of his death must have been shortly before 1349.

See M. Reymond, *La Sculpture Florentine* (Florence, 1897).

PISANO, GIOVANNI (*c.* 1249–after 1314), Italian architect and sculptor, was the son of Niccola Pisano. He developed and extended into other parts of Italy the renaissance of sculpture initiated by his father. He spent the first part of his life as a pupil and fellow worker of Niccola and appears as his collaborator at the fountain of the great piazza at Perugia. Between 1278 and 1283 he was employed on the cloister, which surrounds the Campo Santo at Pisa. In 1284 Giovanni was appointed "capo maestro" of the new cathedral at Siena. He began the magni-

[1] The date on the door, 1330, refers to the original wax model.

ficent façade. His design, however, was modified by the architects who succeeded him. From 1298 to 1301 he was employed on the pulpit of San Andrea at Pistoia. Then followed the pulpit of the cathedral at Pisa, completed in 1311. It was taken to pieces some two hundred years later, but fragments are to be seen at Pisa, and in the Berlin museum. The figures for the tomb of the Empress Margaret, now in the Palazzo Bianco at Genoa, were executed soon after the Empress' death in 1311. A number of statues of "The Virgin and Child" have been attributed to him on stylistic evidence. Among these the three most important are at Prato; in the Campo Santo, Pisa; and in the Arena chapel at Padua. The Cathedral of Pisa has a fine figure of the Madonna carved in ivory. Giovanni's early work was inspired by his father Niccola. Later his figures and draperies displayed the expressive flow of lines appertaining to the Gothic style. Like the work of most stonemasons in mediaeval times, his sculpture forms part of an architectural design. The subject matter of his carving was dictated by the liturgy of the church, and his interpretations are imbued with deep religious feeling.

See M. Sauerlandt, *Bildwerke des Giovanni Pisano* etc. (1904); A. Brach, *Nicola und Giovanni Pisano und die Plastik des XIV. Jahrhunderts in Siena* (1904); I. Supino, *Arte Pisana* (Florence, 1904), and *Pisa* (1918); V. Lusini, *Il duomo di Siena* (Siena, 1911); P. Bacci, *Dedalo* I. p. 319.

PISANO, NICCOLA (*c.* 1225–*c.* 1278), Italian sculptor and architect settled at Pisa. A document among the archives of the Sienese Cathedral calls him son of "Petrus de Apulia," and most modern writers believe that he not only was a native of the province of Apulia in southern Italy, but also that he gained there his early instruction in the arts of sculpture and architecture. Except through his works, little is known of the history of Niccola's life. In 1259 as an incised inscription records, he finished the marble pulpit for the Pisan baptistery; this is his most important early work, and is entirely classical in spirit.

It is a high sexagon, on semicircular arches, with trefoil cusps, supported by seven marble columns, three of which rest on white marble lions. In design it presents a combination of Gothic forms with classical details. Five of the sides of the main sexagon have panels with subjects—the Nativity, the Adoration of the Magi, the Presentation in the Temple, the Crucifixion and the Last Judgment. These are all works of the highest beauty, and a wonderful advance on anything of the sort that had been produced by Niccola's predecessors. The drapery is gracefully arranged in broad simple folds; the heads are full of the most noble dignity; and the stately beauty of the Madonna could hardly be surpassed. The panel with the Adoration of the Magi is perhaps the one in which Niccola's study of the antique is most apparent. The veiled and diademed figure of the Virgin Mother, seated on a throne, recalls the Roman Juno; the head of Joseph behind her might be that of Vulcan; while the youthful beauty of an Apollo and the mature dignity of a Jupiter are suggested by the standing and kneeling figures of the Magi.

The beautiful relief of the Deposition from the Cross in the tympanum over a side door at San Martino at Lucca was probably Niccola's most important work. Then followed the Arca di San Domenico, in the church at Bologna consecrated to that saint. This work was completed in 1267 in collaboration with the Domenican Fra Guglielmo. The most magnificent of Niccola's works is the great pulpit in Siena cathedral. It is much larger than that at Pisa, being an octagon on cusped arches and columns. The contract for this work (1266) discloses the names of Niccola's assistants:—Arnolfo (di Cambio) Donato, and Lapo—besides his son Giovanni. In the reliefs of this pulpit can be traced the influence of the great Gothic sculptors of France. They mark the beginning of a new epoch in the history of Italian sculpture; classical repose is sacrificed for expression of religious emotions.

Niccola's last great work of sculpture was the fountain in the piazza opposite the west end of the cathedral at Perugia. This is a series of three basins rising one above another, each with sculptured decoration; it was begun in 1274 and completed, with the co-operation of Niccola's son Giovanni, and of Arnolfo di Cambio. Niccola appears also to have had knowledge of architecture, for, when he signed the contract for the pulpit in Siena, he stipulated that he might go to Pisa four times a year to attend consultations about the building of the cathedral and baptistery. Many important buildings are ascribed to him by Vasari without corroboration. In 1278 Niccola is mentioned for the last time as working on the fountain in Perugia. The first record of his death occurs in Sienese archives under the date Aug. 30, 1287.

See SCULPTURE, and general histories of Italian art; Symonds, *Renaissance in Italy;* K. Frey, Vasari I. (1911, 1909, p. 423); I. Supino, *Arte Pisana* (Florence 1904); M. Reymond, *La sculpture florentine I* (Florence, 1897); A. Brach, *Nicola and Giovanni Pisano* (Strassburg 1904).

PISANO, VITTORE (1397–1455), commonly called PISANELLO, Italian medallist and painter, was the son of a Pisan father called Bartolommeo and a Veronese mother. He was one of the leading artists of his age, and enjoyed great celebrity during his lifetime. Guarino, a distinguished humanist, sings his praises in lines such as these: "Great is the renown that comes to Verona from the excellence of your work," and "Our age has produced you to be numbered with the great sculptors and painters of antiquity." We know nothing concerning Pisanello's artistic education. Vasari, who likes to derive all great art from Florence, states that he studied under Andrea del Castagno in Florence. But he was more probably trained in Verona in the traditions of Altichiero. About 1422 he worked in conjunction with Gentile Fabriano in the great council hall of the doge's palace in Venice. During their stay in Venice the two artists exercised a great influence on the development of Venetian art. Pisanello was much favoured by the princes and potentates of Italy. There is evidence that he worked at various times at Ferrara, Mantua, Milan, Pavia, Naples, Rome, Venice and Verona. He was well received at the courts of his patrons; he designed their costumes, the patterns of the material they used, the harness for their horses, besides painting their portraits and Madonna pictures.

Unfortunately, only very few of his paintings have survived. These are: the fresco of "The Annunciation" in S. Fermo at Verona and the fresco painted on the arch of the Pellegrini chapel in S. Anastasia, in the same city, representing "St. George Mounting his Horse"; three easel pictures may be singled out as representative of the master; the "Miraculous Stag appearing to St. Eustace" in the National Gallery, London; the portrait of a princess of the house of Este in the Louvre; and the portrait at the gallery in Bergamo of Lionello d'Este, who was one of the artist's chief patrons and admirers. These panels are carefully finished to the minutest detail, and are beautifully drawn. The Louvre possesses in the Vallardi book a number of delicate and spirited pen drawings by Pisanello. These detailed studies of nature, in which animals figure very largely, seem to have been his great delight and display the powers of an extraordinary draughtsman. But it is for his medals and plaques that Pisanello is best known. Although he was not, as was at one time asserted, the inventor of the medal, it was he who initiated this form of art as one of the most characteristic productions of the Renaissance. Pisanello's earliest medal was probably that of the Greek emperor John VII. Paleologos, dated about 1438–39.

See Aloiss Heiss, *Les Médailleurs de la Renaissance* (1881); G. F. Hill, *Pisanello* (1905); J. de Foville, *Pisanello et les Médailleurs Italiens* (1908); G. Biadego, *Pisanus Pictor* (Venice, 1908); *Les Dessins de Pisanello et de son École conservés au Louvre* (1911–20). (I. A. R.)

PISAURUM (mod. Pesaro, *q.v.*), an ancient town of Umbria on the Via Flaminia, 26 m. from Ariminum and 8 from Fanum Fortunae. A Roman colony was founded here in 184 B.C., at the mouth of the river Pisaurus (mod. Foglia; the sea has since receded about half a mile). It was destroyed by the Goths in 539, and restored by Belisarius in 545.

PISCES, the "Fishes," in astronomy, the twelfth sign of the zodiac, represented by two fishes tied together by their tails, and denoted by the symbol ♓. In Greek legend Aphrodite and Eros, while on the banks of the Euphrates, were surprised by Typhon, and sought safety by jumping into the water, where they were changed into two fishes. This fable, however, as in many other similar cases, is probably nothing more than an adaptation of an older Egyptian tale. The constellation contains only faint stars

without any striking grouping.

Piscis australis or *Austrinus,* the southern fish, is a constellation of the southern hemisphere. It contains Fomalhaut, a star of the first magnitude.

Piscis volans, the flying fish, is a constellation introduced by John Bayer in 1603. The name is now abbreviated to *Volans.*

PISCICULTURE. The species of food-fish that can be kept successfully in ponds throughout their lives from egg to adult are exceedingly limited in number. The various breeds of gold fish and top-minnows (*Cyprinodonts*) are familiar examples and the carp is an example of food-fishes capable of similar domestication. In the United States the eastern brook trout and the black bass are almost as fully domesticated. Various other food-fishes, both marine and fresh-water, can be kept in ponds for longer or shorter periods, but refuse to breed, while in other cases the fry obtained from captive breeders will not develop. Consequently there are two main types of pisciculture: (1) the rearing in confinement to an edible stage of the young of domesticated breeders; (2) the stocking of natural waters with eggs or fry from captured adults.

Fish-rearing.—Of the first type of pisciculture there are several examples of commercial importance in the cultivation of fresh-water fishes. The pond culture of carp is important in China and Germany, but in England it has long fallen out of use and is not likely to be resumed so long as other fresh fish can be obtained and distributed so readily as is now the case. In the United States pond culture of carp has been practically discontinued because of the prejudice of native Americans against the fish and because of its great increase in natural waters which now afford a large commercial yield. In Germany, on the other hand, intensive methods have been applied to pond culture with remarkable results in recent years.

In the United States some species of trout and charr have become so thoroughly domesticated that many commercial trout hatcheries have been established, some of them with a score of ponds heavily stocked with eastern brook trout (*Salvelinus fontinalis*) sorted into different ponds according to size and fed usually on slaughter house offal in addition to such natural food as they may obtain. Under this system the trout grow twice or three times as fast as the wild ones, a growth of from 7 to 11 in. during the first year being no exception. Some of the male fish are killed and sold before they are sexually mature; but most of the fish are kept until they reach sexual maturity in the second fall of their life at the age of 20 months and are then stripped and sold immediately thereafter.

Next in order of importance are the North American basses and sunfishes (family *Centrarchidae*), all of which make "nests." The most important members of the family are the largemouth (*Aplites salmoides*) and smallmouth (*Micropterus dolomieu*) black bass which are propagated in large numbers of State, national and private ponds. Artificial nest-boxes with bottoms covered with material suitable for the species are placed in the ponds, the fish spawn in them and the male guards the nests and schools of fry. The schools of young, usually numbering several thousand to the nest, are transferred to rearing ponds and fed on Japanese *Daphnia* raised in small separate ponds and on other food. Young bass are usually planted as fingerlings, 3 or 4 in. long or as yearlings. They could be raised for the market, but the cost would be prohibitive. In addition to the bass seven species of sunfishes are cultivated in the United States by similar, but simpler methods.

In the lagoons of the Adriatic and the salt marshes of various parts of France examples of the cultivation of salt-water fish are to be found analogous to the pond culture of fresh waters. Here, as in ancient Greece and Rome, it is the practice to admit young fish from the sea by sluices, into artificial enclosures or "viviers" and to keep them there until they are large enough to be used. An interesting modification of this method of cultivation has been introduced into Denmark. The entrances to the inner lagoons of the Limfjord are naturally blocked against the immigration of flatfish by dense growths of sea-grass (*Zostera*) although the outer lagoons are annually invaded by large numbers of small plaice from the North sea. The fishermen of the district consequently combined to defray the expenses of transplanting large numbers of small plaice from the outer waters to the inner lagoons, where they were found to thrive far better than in their natural habitat. The explanation has been shown by Dr. Petersen to be due to the abundance of food, coupled with the lack of overcrowding of the small fish. This transplantation of small plaice in Denmark has been annually repeated for many years with the most successful results and a suitable subvention to the cost is now an annual charge upon the Government funds.

As a result of the international North sea fishery investigations, it has been proposed to apply the same principle for the development of the deep-sea fishery in the neighbourhood of the Dogger Bank. Experiments with labelled plaice, carried out in 1904 by the Marine Biological Association, showed that small plaice transplanted to the Dogger Bank in spring grew three or four times as rapidly as those on the inshore grounds, and the same result, with insignificant variations, has been obtained by similar experiments in later years. (See *Reports* of the Ministry of Agriculture and Fisheries cited at the end.) In this case the deep water round the Dogger Bank acts as a barrier to the emigration of the small plaice from the shores. It has consequently been proposed that the small plaice should be transported in millions to the bank by well vessels every spring. It is claimed, as further result of the experiments, that from May to October the young fish would be practically free on the shallow part of the bank from the risk of premature capture by trawlers, and that the increased value of the fish, consequent upon their phenomenal growth rate, would greatly exceed the cost of transplantation. The development of seining on the Dogger Bank since 1919 has probably increased the risk of premature capture, but satisfactory information on this point is lacking. In the experiments made by the English Ministry of Fisheries the transplanted fish retaken by seiners amounted to about 20% of the total recaptured in 1922 and 1923, but the actual months are not stated.

Not unlike the work on plaice is the rescue work carried on in the United States, chiefly by the Bureau of Fisheries, but also by the States of Minnesota, Wisconsin, Iowa and Illinois. With the recession of the waters of the Mississippi river after spring freshets, many fishes become land-locked in temporary ponds or sloughs. By removing them to permanent waters they are saved from death due to drying of the ponds. In 1926 the Bureau of Fisheries seined about 150,000,000 impounded fish and returned them to open waters and similar work is undertaken each year.

In France and Japan the methods of oyster and mussel culture are similar in principle to those just described. A breeding stock is maintained to supply the ground or the "collectors" with spat, and the latter, when sufficiently grown, is then transplanted to the most favourable feeding grounds, care being taken to avoid the local overcrowding which is so commonly observed among shell-fish under natural conditions.

Fish-hatching.—The second and more familiar type of pisciculture is that known as fish-hatching, with which must be associated the various methods of artificial propagation. Fertilization of the spawn is easily effected by "stripping" the eggs from the female into a moistened pan and immediately adding the milt of the male by the same process (the dry or Russian method). Water is next repeatedly added and poured off to wash the milt from the eggs, which soon swell and harden so that they may be transferred to the hatching apparatus without injury. Although simple floating hatching boxes may often be used in natural waters, for large-scale operations hatcheries are constructed and the type of apparatus employed in them depends on the eggs to be hatched. For the smaller and lighter semi-buoyant or demersal eggs, such as those of whitefish (*Coregonus*), shad (*Alosa sapidissima*), etc., tall glass jars are used provided with a central inlet pipe through which water reaches the bottom of the jar and flows upward through the eggs to escape at the top. The dead eggs float and are removed by siphoning. The jars are grouped into "batteries," each of which may be merely a number of jars set on a table and supplied with water from a pipe above them, as in hatching shad. For hatching whitefish and pike-perch

eggs a battery may consist of more than 200 jars arranged in four superimposed tiers on two sides of a complicated system of wooden troughs, which serve to convey water to and from them.

For hatching the larger and heavier demersal eggs of trout and salmon primitive apparatus, still in use in parts of Europe, consists of long wooden troughs in which the eggs lie on gravel in running water. In more modern hatcheries, in order to economize space and utilize the water supply to the best advantage, the troughs are divided into "boxes" by transverse partitions and the boxes are filled with trays or baskets of eggs. The partitions are so constructed that the water which flows along the trough from box to box is given an upward or downward movement through the eggs in each box. For hatching trout eggs ten shallow wooden trays with bottoms of wire gauze each supporting a single layer of eggs are stacked in each box, covered by an empty tray and latched down by a cross-bar. A trough of five boxes carries from 500,000 to 750,000 eggs. The trout fry remain on the trays until a week or ten days before the yolk sac is absorbed and are then planted or transferred to rearing ponds. Four Pacific salmon baskets of wire screen are half filled with eggs (about 30,000), and one basket is placed in each box with the top projecting above the water so that no eggs can escape. The newly-hatched fry fall through the meshes in the bottom of the basket and remain on the bottom of the box until the heavy yolk is so far absorbed that they are able to swim upward. They may be then planted or held and fed in artificial ponds near the hatcheries to be planted when a year or more old.

For the buoyant eggs of cod, use is commonly made of the McDonald or tidal hatching box which is so constructed that a jet of water gives a rotary motion to the eggs while an intermittent siphon causes the water in the box to rise and fall at regular intervals, so that the rotating eggs are carried up and down much as they would be by the waves of the open sea.

The hatching of the eggs, whether of fresh or salt-water fishes presents no serious difficulties, if suitable apparatus is employed; but the rearing of fry to an advanced stage, without serious losses, is less easy, and in the case of sea-fishes, with pelagic eggs, the larvae of which are exceedingly small and tender, is still an unsolved problem, although recent work carried out at the Plymouth laboratory of the Marine Biological Association, in England, is at least promising. It has been found possible to grow pure cultures of various diatoms, and by feeding these to various larvae kept in sterilized sea water, great successes have been attained. In fresh-water culture there may be little advantage in artificial hatching, unless it is followed by a successful period of rearing. Thus the Howieton Fishery Company (England) recommended their customers to stock their streams either with unhatched ova sown in redds or with three-months-old fry. Their experience is "that there is no half-way house between ova sown in redds and three-months-old fry. Younger fry *may* do, but only when ova would do as well and at half the cost." In marine hatcheries, on the other hand, it is the invariable practice to hatch the eggs, although the fry have to be put into the sea at the most critical period of their lives, in an environment which teems with predacious enemies.

Some of the advances made in the United States in recent years in the cultivation of fish and shell-fish are shown by the examples which follow. They suggest the importance of a detailed knowledge of the life-history of the forms to be cultivated and the advantages of rearing to a suitable stage.

Decline in the Pacific salmon fishery led to the establishment of hatcheries until in 1921 there were 90 such establishments maintained by the United States, by the individual States, and by British Columbia. But in spite of the great hatchery output, the fishery continued to decline alarmingly in certain localities. This apparent failure of the hatcheries to rehabilitate the fisheries led the authorities of the United States and British Columbia to promote a co-operative and detailed study of the life history of the Pacific salmon in the hope that this would reveal better means of artificial propagation or enable fisheries restrictions to be intelligently applied, while in 1924, by act of Congress, full control of the Alaskan fisheries was placed in the hands of the Department of Commerce and has since been exercised by its Bureau of Fisheries.

There are five species of Pacific salmon (*Oncorynchus*) all of which ascend from the sea into the rivers to spawn and are captured in commercial nets on the upward journey. Unlike the Atlantic salmon, they invariably die after spawning, but the young hatched from their eggs return to the sea after a longer or shorter stay in fresh water. Investigations of the past ten years have added many important details of the life history. The method of investigation consists, in part, in marking the young by removal of some of the fins, releasing them in fresh water at various ages and in various places and recovering the marked fish when they return from the sea to fresh water to spawn. In part it consists of the microscopic study of the markings of the scales of returning adults. From these the age, rate of growth and period of time spent in fresh water may be determined. From these investigations it is now known that the fry may begin their return to the sea soon after hatching (pink and chum salmon), or may remain in fresh water for a year (silver salmon) or from one to four years (red salmon), or, as in the chinook, they may either start for the sea soon after hatching or when 12 or 18 months old. The age at return to fresh water also varies. In the pink it is invariably two years, in the chum from two to five or six years, in the silver three years, in the red three to seven years, in the chinook two to seven or eight years.

The salmon of each species almost invariably come back to spawn in the stream or lake in which they were hatched (parent stream). The most important discovery of recent years is this confirmation of the "parent stream theory" with the resultant conception of each species as made up of numerous self-contained colonies or races of interbreeding individuals. It results that if commercial fishing or other obstruction of a stream prevents so many individuals of any race from returning to their home spawning-ground that an adequate breeding stock is not maintained, that race is depleted or disappears and its racial ground is not afterward colonized by other races. It is then essential that commercial fishing be so conducted as to permit the escapement to the spawning ground of enough breeding fish of each colony to maintain that colony. In Alaska, the U.S. Bureau of Fisheries now requires a "spawning escapement" of 50%. This regulation was first imposed in 1924 and in 1926 the run of pink salmon, a two year fish, was the largest ever known. How large the spawning escapement must be to maintain a racial population in any locality is not yet definitely known. Actual counts made under the direction of Dr. Gilbert have shown that in the Karluk river, Alaska, three red salmon returned in 1926 for each parent fish of the 1921 spawning escapement. This ratio does not include the fish of the 1921 hatch that returned in earlier years or those still to return. If the proportion should prove to hold for all seasons an escapement of less than one-third would serve to maintain the race.

From studies made on the return of young salmon marked and released in fresh water, evidence is accumulating that artificial propagation may be made effective. It has been found that marked fingerlings of the Alaskan sockeye or red salmon, released in the Columbia river in the fall of their first year, fail to return, but if released in the spring of their second year, they return; success does not necessarily depend merely on the release of great numbers of large and vigorous fingerlings, but on their release at the right age, the age at which they naturally begin their seaward voyage. It has been found, further, that since each tributary (Columbia river) supports a separate colony it is inadvisable to transfer fingerlings from one tributary to another. Different racial groups start their spawning migrations at different times and each starts at such a time as to bring it to the spawning grounds when conditions there are suitable for laying of the eggs and development of the young of that race. If fingerlings are released on an alien ground they will return as adults to it, but they may then find the conditions on it unsuited to them at the time of their return. By releasing the fry or fingerlings of each race on its home ground and at the right age better results may be expected from hatchery operations than have been reached up

to this time. Thus in an experiment on the Columbia river the number of returning adults, recaptured after having been marked as fingerlings and released on their home ground when of suitable age, was 30 times that necessary to produce the eggs from which they came (Holmes). Increased runs of Pacific salmon are also reported by Canadian officials as the result of hatchery operations in the Frazer river.

In the United States many of the natural oyster beds have been so exploited that they have disappeared and others are greatly depleted. The great size of the beds, the high cost of labour and the relatively low price of the product make the method of pond culture current in France and Japan (*see* p. 936) impracticable. Culture consists at present wholly of rehabilitating the beds in natural waters and increasing their number (planted beds). About half the 30,000,000 bu. of oysters marketed annually are now obtained from planted beds and in the New England States about 90% are from that source.

It has long been known that fertilized eggs could be obtained by cutting open oysters and stripping the apparently ripe milt and eggs from them, but recently oysters have been induced to spawn naturally in tanks of sea water by permitting the temperature to rise to about 70° F and in this way better results have been obtained. But, for artificial culture, large numbers of the minute larval oysters must be raised to the fixed or spat stage. This has been hitherto impossible owing to the difficulty of retaining them in tanks while supplying them with running water. Until they are several days old they pass readily through felt or the finest silk bolting cloth. A new filtering material, known as "filtros" has now proved entirely satisfactory and several lots of larvae have been reared to the spat stage by investigators of the U.S. Bureau of Fisheries. Seed oysters for planting have become increasingly scarce and costly, but if the method referred to becomes a part of commercial oyster culture they may be produced in quantity at a cost much below that of collecting them from the beds.

In the United States the supply of the species of fresh water mussels from which pearl buttons are made has declined in recent years with the result that much work has been done on methods of cultivating these forms. The larvae (*glochidia*), after expulsion from the gills of the female mussel, become parasitic on the gills of fish from which they draw their nourishment and from which they fall after transforming into young mussels. In the earlier attempts to increase the mussel supply, fish artificially inoculated with glochidia were released into natural waters and not only fish captured for the purpose, but great numbers of rescued fish (*see* above) were used. In 1926 fish rescued and released by the U.S. Bureau of Fisheries had been inoculated with nearly 3,000,000,000 glochidia taken from about 40,000,000 mussels. Later experiments showed that the inoculated fish could be held in troughs until the young mussels dropped from them. The latter are then cared for during the first season of their growth. But the number of glochidia that can be safely carried by a single fish is limited, and the inflammation caused by over-infestation results in many deaths. Hence, a method was sought of rearing the glochidia without permitting their attachment to a fish host. Although the inoculation of both fish to be held captive and of those to be released is still practised, it recently has been found that the glochidia may be reared to young mussels in an artificial medium which supplies the nourishment normally drawn from the fish host and makes the use of the latter unnecessary. With perfection of the technique it is practically certain that young mussels will soon be raised and distributed in large numbers without employing fish hosts.

In the lobster (*Homarus*) the eggs are carried attached to the appendages of the lower surface of the abdomen of the female and average 30,000 in lobsters 13 in. long. The larvae hatched from the eggs pass through a remarkable series of transformations at successive moults. During the first four stages they are minute and free-swimming and subject to destruction by storms and countless enemies; but at the close of the fourth stage, or in the fifth, they become ambulatory, descend to the bottom and show an ability to protect themselves. "One lobster at this stage is worth many thousands in the first" (Herrick). Owing to the hard outer shell it is not possible to "strip" the lobster and cultivation, therefore, consists in rearing the naturally-hatched young through the helpless free-swimming stages to the ambulatory bottom stage capable of self protection. The most successful method is that devised by Mead and his co-workers and first used at Wickford, R.I., under the auspices of the Rhode Island commissioners of inland fisheries.

The unit apparatus is a wooden box 10 ft. square and 4 ft. deep with screened openings in the bottom and on two opposite sides near the top. The boxes, in groups of six, float with tops above water, supported by rafts 75 ft. long anchored in the sea in a protected situation where the water is of suitable quality. Near the bottom of each box a horizontal two-bladed propeller, with a radius of about 4½ ft., is made to revolve by means of suitable shafts and gearing driven by a naphtha motor or other power source. The propeller draws water through the screened opening in the bottom of the box and forces it upward in a spiral course to its escape through the side openings. Egg-bearing or "berried" lobsters are placed in one of the boxes just before the eggs are ready to hatch and, as hatching takes place, the fry are carried toward the top of the box and kept in suspension as though in the open sea. For rearing, the fry are transferred to other boxes where they secure natural food from the entering sea water but are also supplied abundantly with other food, preferably chopped, cooked beef, which is kept in suspension by the current and retained in the box by the screens. During the six to eight weeks season 500,000 "fourths" may be reared in 24 boxes. The method is believed to produce about 80 times as many fourths as are necessary to maintain the normal population of adults and heavy captures are therefore possible without depleting the grounds.

Objects and Utility of Fish-hatcheries.—The earlier advocates of artificial propagation and fish-hatching seem to haye been under the impression that the thousands of fry resulting from a single act of artificial propagation meant a corresponding increase in the numbers of edible fish when once they had been deposited in suitable waters; and also that artificial fertilization ensured a greater proportion of fertilized eggs than the natural process. For the first proposition there is no evidence, while the second proposition is now discredited. The advantage of artificial hatching lies in protecting the unhatched eggs from the very large destruction to which they are subjected under natural conditions. But it is recognized that the great fertility of fishes is nature's provision to meet a high mortality—greater in sea-fishes with minute pelagic eggs—a condition which entails a greater delicacy of their larvae at the time of hatching. Artificially propagated eggs and fry must submit, *after planting*, to the same mortality as the other eggs and fry around them. Consequently it is useless to plant out eggs or fry unless in numbers sufficiently great to increase appreciably the stock of eggs and fry of the same age already existing. It is this, combined always with the suitability of the external conditions, which accounts for the success of the best-known experiments of American pisciculturists.

The shad fisheries of the streams of the east coast of the United States declined on the whole 74% from 1896 to 1923, and are now totally destroyed in many streams, in spite of plants of fry which reached the large total of 400,000,000 in 1898, but owing to the difficulty of obtaining breeding fish, has since then in general, declined to about 35,000,000 in 1923. We have still little knowledge of the habits and life history of the shad, of the extent and direction of its migrations. Its ascent of streams has been often impeded by dams, and pollution has doubtless adversely affected the spawning migration, vitiated the breeding grounds and destroyed the fry. Artificial hatching has failed to maintain the species in Atlantic waters under these handicaps and in the face of intensive fishing. Under more normal physical conditions and with fuller knowledge of the life history of the species it might be effective in these waters as it begins to be in the case of the Pacific salmon. The artificially propagated eggs of the shad from the eastern rivers of the United States were planted in those of California, where the species did not naturally

occur. The conditions were suitable, and the species became at once acclimatized and has increased greatly. Similarly, reservoirs and streams can be stocked with various kinds of fish not previously present. But in the case of indigenous species the breeding stock must be very seriously reduced before the addition of the eggs or fry of a few score or hundreds of fish can appreciably increase it.

In the case of sea-fishes it is becoming increasingly recognized that the millions of cod fry which are annually turned out of the American, Newfoundland and Norwegian hatcheries are but an insignificant fraction of the billions of fry naturally produced. A single female cod liberates, according to its size, from one to five million eggs in a single season. Yet the annual output of fry from each of these hatcheries rarely exceeds 200,000,000, *i.e.*, the natural product of a few hundred cod at most. In Britain, marine hatcheries have been established by the Fishery Board for Scotland in the Bay of Nigg, near Aberdeen, by the Lancashire Sea Fisheries Committee at Peel, and by the Government of the Isle of Man at Port Erin. These establishments have been principally devoted to the hatching of the eggs of plaice. But again the maximum output of fry from any one of these establishments has not exceeded 50,000,000 in any single year. As a single female plaice produces about 200,000 eggs per annum, this output does not exceed the natural produce of a few hundred fish. Under these circumstances the probable utility of the operations could be admitted only if the fry were sedentary and could be planted in suitable localities where young fish were naturally scarce. But the fry drift with the currents as helplessly as the eggs, and the *a priori* objections to the utility of the operations have in no case been met by satisfactory evidence of tangible results.

The Scottish Fishery Board carried out a large scale experiment from 1896 to 1908 which was very illuminating (Fulton, 26th *Report*). They attempted to measure the density of young plaice on the beaches of Loch Fyne during six years when plaice fry were liberated in the loch and a similar period when none were added. From 1896 to 1901 the quantities of fry added were 4, 21, 19, 16, 30 and 51 millions annually, the number of eggs naturally present in the loch being estimated at nearly 500,000,000 in 1898 (Williamson, 17th *Report*). Although the figures of young plaice on the beaches yielded an average density which was twice as great in the first period as in the second (88:40 per hour), there was little or no correspondence from year to year between the density of young fish and the number of fry planted. The highest record corresponded with the year of maximum output of fry (1901), but the next highest occurred in 1905, when no fry were planted, and the third occurred in the first year (1896), when the number planted was negligible (4,000,000). Assuming (which is not certain) that the coincidence in 1901 was significant, it nevertheless appears that the natural fluctuations in the number of young plaice were unaffected by the hatching operations except in the one year when the number of fry liberated exceeded 50,000,000 and thus formed an appreciable proportion (10%) of the number estimated to be naturally present. Even these numbers do not provide Loch Fyne with a regular plaice fishery.

In the United States the utility of the cod-hatching operations has, in the past, been often asserted by representatives of the Bureau of Fisheries, but practically the only evidence adduced is the occasional appearance of unusual numbers of cod in the neighbourhood. It has not been established that the fluctuations in the local cod fisheries bear any relation to the extent of the hatching operations, while the earlier reports of the commissioner of fisheries contain evidence that similar fluctuations occurred before the hatching of "Fish Commission Cod" began.

The situation is much the same with regard to the operations of the Newfoundland hatcheries at Dildo. (*See* Fryer, *Reports* x.–xii. of H.M. inspectors of sea fisheries, E. and W.)

The most exact investigations bearing upon this problem are those undertaken in Norway in connection with the cod-hatching operations at Arendal under Captain Dannevig. Four fjords were selected on the south coast of Norway in proximity to the hatchery, and the usual number of fry (10 to 30 millions) was planted in the spring in alternate fjords, leaving the intermediate fjords unsupplied. The relative number of young cod in the various fjords was then carefully investigated throughout the succeeding summer and autumn months. It was found that there was no relation between the abundance of young fish and the presence or absence of "artificial" fry. In 1904, 33,000,000 fry were planted in Sondelfjord and young fish were exceptionally abundant in the following autumn (three times as abundant as in 1903, when no fry were planted). But their abundance was equally striking in other fjords in which no fry had been planted, while in 1905 all the fjords were deficient in young cod whether they had been planted with fry from the hatchery or not. (For a summary of these investigations see *Papers* on "Artificial Fish-hatching in Norway" by Captain Dannevig; and Dahl, *Report* of the Lancashire Sea Fisheries laboratory for 1906, Liverpool, 1907.)

It would seem clear that the attempts hitherto made to increase the supply of sea-fish by artificial hatching alone have been unsuccessful. The experience gained has doubtless not been wasted, but the direction to be taken by future work is plain. The energy and money devoted to hatching operations should be diverted to discover a means of rearing on a large scale the just-hatched fry of the more sedentary species to a sturdy adolescence. When that has been done it will be possible to deposit the young fish in suitable localities, on a large scale, with a reasonable prospect of influencing the local abundance of the species of fish in question. The increase of the supply of the migratory marine species, such as the cod, depends on a more complete knowledge of habits, life histories and migrations. With this knowledge in hand these fisheries *may* be maintained or increased either through regulation or by artificial propagation or by both means; until it is in hand the effect of artificial propagation cannot be estimated.

In the smaller bodies of fresh water there is no doubt of the effectiveness of hatchery operations, but in the Great Lakes of North America there is no dependable evidence of their value. Official statistics studied by P. Reighard in 1908 showed, on their face, a correlation between the average intensity of the plants of whitefish fry in certain regions of the Great Lakes during three five-year periods from 1892 to 1906 and the average catch of whitefish for the same periods. Intensive planting was found to be correlated with an increased fishery output and was recommended. On the other hand Dr. Koelz, who has an intimate knowledge of the fisheries operations of the Great Lakes is doubtful of the value of statistics based largely on reports of interested parties, the fishermen. He points out further that the planted fry are a very small fraction of those presumably hatched naturally (0·35% in Lake Huron in 1900).

The decline in the coregonine fisheries of the Great Lakes is further evidence of the inadequacy of present hatchery methods Whether the whitefish (*Coregonus clupeaformis*) has declined is uncertain, but the bluefin of Lake Superior and the bloater of Lake Ontario (both forms of *Leucichthys nigripinnis*) have become commercially extinct and in 1925 the important Lake Erie herring (*L. artedi*) suddenly gave out and has not since regained its commercial importance. The bluefin and bloater were never propagated artificially, but hundreds of millions of Lake Erie herring eggs have been hatched annually. It appears from these three cases that, for some unknown reason, *when the breeding stock of a gregarious fresh-water species has been reduced below a certain numerical minimum the decrease continues.* In the case of the bloater it has led to extinction and the important Lake Erie herring, in spite of extensive hatchery operations, appears now to be faced with extinction. The value of artificial hatching as hitherto carried out in the Great Lakes is now questioned in the United States for the reasons stated above and in Canada the abolition of hatcheries has been advocated by Prof. Knight of the biological board of Canada. It is probable that the life histories and migrations of many species approach in intricacy those of the Pacific salmon with its numerous, independent, self-sustaining colonies or races. Until these intricacies are resolved by prolonged research and hatchery operations adjusted to them, it is felt that artificial propagation is, in most cases, carried on

blindly and that success depends on chance.

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(W. GA.; J. REI.)

PISCINA, originally a fish pond; later any artificial pool or tank, such as a bathing or swimming pool. Ecclesiastically the term is used for the stone basin with a drain emptying upon virgin soil, in which the utensils of the mass are cleaned and ritual ablutions performed. In mediaeval churches, especially in England, piscinae are most frequently in the chancel, close to the altar and often set in recessed, arched niches of great beauty.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART

A PISCINA IN EXETER CATHEDRAL

PISEK, a town of Czechoslovakia, on the Otava, a tributary of the Vltava, in one of the cereal and cattle basins of south Bohemia and on a main line from Prague to Budějovice, Linz and Vienna. Pop. (1927), 16,306.

PISEMSKY, ALEXEY FEOFILACTOVICH (1820–1881), Russian novelist, was born on his father's estate in the province of Kostroma, on March 22, 1820, the son of a major who had risen from the ranks. From the gymnasium of Kostroma he passed through Moscow university, and spent over 20 years in the government service. His first novel, *Boyarstchina,* was forbidden by the censor. His principal novels are *Tyufyak* ("A Muff"), 1850; *Tysyacha Dush* ("A Thousand Souls"), 1862; and *Vzbalomuchenoe marye* ("A Troubled Sea"), giving a picture of the excited state of Russian society about the year 1862. His *Gorkaya sudbina* ("A Bitter Fate"), depicting the dark sides of the Russian peasantry, obtained for him the Ouvaroff prize. He died at Moscow on Feb. 2, 1881. Pisemsky was a realist, and took an objective view of the unrest among the intelligentsia, which made him very unpopular in Moscow literary society. His best work is his description of the life of the common people. He learnt to know them thoroughly when investigating conditions in the Russian interior.

PISHIN, a district of Baluchistan. It consists of a large plain surrounded on three sides by hills, which formerly belonged to Afghanistan but was ceded to the British by the treaty of Gandamak in 1879. This plain is the focus of routes leading from Sind and the Punjab frontier districts to Kandahar, and is intersected by the Sind-Pishin railway. For administrative purposes it is included in the district of Quetta-Pishin; pop. (1921) 137,082.

PISHPEK: *see* FRUNZE.

PISIDIA, the name given to a country in the south of Asia Minor, immediately north of Pamphylia, by which it was separated from the Mediterranean, while it was bounded on the north by Phrygia, on the east by Lycaonia, Isauria and Cilicia, and on the west and southwest by Lycia and a part of Phrygia. It was a rugged and mountainous district occupied by wild and lawless races of mountaineers. The Pisidians are not mentioned by Herodotus, either among the nations that were subdued by Croesus, or among those that furnished contingents to the army of Xerxes. They furnished a pretext to the younger Cyrus for levying the army with which he designed to subvert his brother's throne, while he pretended to put down the Pisidians who were continually harassing the neighbouring nations by their lawless forays (Xen. *Anab.* i. 1, 11, etc.). They assume a more prominent part in the history of Alexander the Great, to whose march through their country they opposed a determined resistance. In Strabo's time they had passed under the Roman dominion, though still governed by their own petty chiefs.

Notwithstanding its rugged and mountainous character, Pisidia contained in ancient times several considerable towns, the ruins of which exist. The most important are Termessus, near the frontier of Lycia, a strong fortress in a position of great natural strength, and commanding one of the principal passes into Pamphylia; Cremna, another mountain fortress, north of the preceding, impending over the valley of the Cestrus; Sagalassus, a little farther north, a large town in a strong position, the ruins of which are among the most remarkable in Asia Minor, and Antioch, known for distinction's sake as Antioch of Pisidia, and celebrated for the visit of St. Paul. This was situated in the extreme north-east of the district immediately on the frontier of Phrygia, between Lake Egerdir and the range of the Sultan Dagh and was reckoned in the Greek and earlier Roman period, *e.g.*, by Strabo, as a city of Phrygia.

We have no clue to the ethnic character and relations of the Pisidians, except that we learn from Strabo that they were distinct from the neighbouring Solymi, who were probably a Semitic race, but we find mention at an early period in these mountain districts of various other tribes, as the Cabali, Milyans, etc., of all which, as well as the neighbouring Isaurians and Lycaonians, the origin is wholly unknown, and in the absence of monuments of their languages must remain so.

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PISO, the name of a distinguished Roman plebeian family of the Calpurnian gens which continued in existence till the end of the 2nd century A.D. Nearly fifty of its members were prominent in Roman history, but the following deserve mention.

1. LUCIUS CALPURNIUS PISO CAESONINUS, Roman statesman, was the father-in-law of Julius Caesar. In 58 B.C., when consul, he and his colleague Aulus Gabinius entered into a compact with P. Clodius, with the object of getting Cicero out of the way. Piso's reward was the province of Macedonia, which he administered from 57 to the beginning of 55, when he was recalled, perhaps in consequence of the violent attack made upon him by Cicero in the senate in his speech *De provinciis consularibus*. On his return Piso addressed the senate in his defence, and Cicero replied with the speech *In Pisonem*. Piso issued a pamphlet by way of rejoinder, and there the matter dropped, Cicero being afraid to bring the father-in-law of Caesar to trial. At the outbreak of the civil war Piso offered his services as mediator, but when Caesar marched upon Rome he left the city by way of protest. He did not, however, definitely declare for Pompey, but

remained neutral. After the murder of Caesar he insisted on the provisions of his will being carried out, and for a time opposed Antony. Subsequently he became one of his supporters, and is mentioned as taking part in an embassy to Antony's camp at Mutina.

2. LUCIUS CALPURNIUS PISO, surnamed *Frugi* (the worthy), Roman statesman and historian, was tribune in 149 B.C. He is known chiefly for his *lex Calpurnia repetundarum,* which started the system of establishing regular courts for the trial of particular offences in place of the old system of special tribunals being appointed for each case. As praetor (136) and consul (133) Piso fought against the slaves in Sicily.

See ANNALISTS; C. Cichorius in Pauly-Wissowa's *Realencyclopädie* (1897), vol. iii., pt. 1; H. Peter, *Historicorum romanorum reliquiae* (1870), vol. i.; Teuffel-Schwabe, *Hist. of Roman Lit.* (Eng. trans.), § 132, 4. On the lex Calpurnia, *Corpus inscr. latinarum,* i., No. 198, with Mommsen's commentary; A. H. J. Greenidge, *Hist. of Rome, 133–104* B.C. (1904).

3. GNAEUS CALPURNIUS PISO, Roman statesman, was consul in 7 B.C. and subsequently governor of Spain and proconsul of Africa. In A.D. 17 Tiberius appointed him governor of Syria, with secret instructions to thwart Germanicus, to whom the eastern provinces had been assigned. The indignation of the people at the death of Germanicus, and the suspicion that Piso had poisoned him, forced Tiberius to order an investigation. Piso committed suicide, though it was rumoured that Tiberius, fearing incriminating disclosures, had put him to death.

See H. Schiller, *Geschichte der römischen Kaiserzeit* (1883), vol. i.

PISSARRO, CAMILLE (1831–1903), French painter, was born at St. Thomas in the Danish Antilles, of Jewish parents of Spanish extraction. He went to Paris at the age of twenty, and, as a pupil of Corot, came into close touch with the Barbizon masters. Though at first he devoted himself to subjects of the kind associated with the name of Millet, his interest was entirely absorbed by the landscape, and not by the figures. He fell under the spell of the rising impressionist movement, and threw in his lot with Monet and his friends. Like Monet, he made sunlight, and the effect of sunlight on the objects of nature, the chief subjects of his paintings, whether in the country or on the Paris boulevards. About 1885 he took up the method of the pointillists, but after a few years of these experiments he returned to a broader manner. In the closing years of his life he produced some of his finest paintings, in which he set down with admirable truth the peculiar atmosphere and colour and teeming life of the boulevards, streets and bridges of Paris and Rouen. He died in Paris in 1903.

Pissarro is represented in the Caillebotte room at the Luxembourg, and in almost every collection of impressionist paintings. A number of his finest works are in the collection of M. Durand-Ruel in Paris.

PISTACHIO NUT, the fruit of *Pistacia vera* (family Anacardiaceae), a small tree which is a native of Syria and generally cultivated in the Mediterranean region. It has a delicious flavour and is much prized by the Greeks and other Eastern nations. It is not so large as a hazel nut, but is rather longer and much thinner, and the shell is covered with a somewhat wrinkled skin. The pistachio nut is the species named in Gen. xliii. 11 as forming part of the present which Joseph's brethren took with them from Canaan, and in Egypt it is still often placed along with sweetmeats and the like in presents of courtesy. The small nut of *Pistacia Lentiscus,* not larger than a cherry stone, also comes from Smyrna, Constantinople and Greece. *P. Lentiscus* is the mastic tree, a native of the Mediterranean region, forming a shrub or small tree with evergreen pinnately-compound leaves with a winged stalk. "Mastic" (from *masticare,* to chew) is an aromatic resinous exudation obtained by making incisions in the bark. It is chiefly produced in Asia Minor and is used by the Turks as a chewing gum. It is also used as a varnish for pictures. *P. Terebinthus,* the Cyprus turpentine tree, a native of southern Europe, Asia Minor and North Africa, yields Chian turpentine from incisions in the trunk.

PISTOIA or **PISTOJA,** a town and episcopal see of Tuscany, Italy, in the province of Florence, from which it is 21 m. N.W. by rail on the main line to Bologna, with a branch to Lucca. Pop. (1921) 40,712 (town); 70,517 (commune). It is situated on a slight eminence (210 ft.) near the Ombrone, one of the tributaries of the Arno, immediately below the Apennines. It is on the site of the Roman *Pistoriae,* near which in 62 B.C. Catiline was slain and his forces destroyed. Excavations in the Piazza del Duomo led to the discovery of a large private house (end of 1st century B.C.). During the middle ages Pistoia was the scene of constant conflicts between the Guelphs and Ghibellines; here the great struggle took place which resulted in the creation of the Bianchi and Neri factions (Dante, *Inferno,* xxiv. 121). In 1302–06 it was besieged and eventually taken by the armies of Florence and Lucca, and in 1325 it became subject to Castruccio of Lucca. In 1351 it was obliged to surrender to Florence, and thenceforth shared its fate.

The city is still surrounded by walls, dating from shortly after the siege of 1302–06; while two inner lines of streets represent two earlier and inner lines of wall. A number of skilful artists between 1287 and 1399, made the great silver altar and frontal of the cathedral now in a chapel on the south side. The cathedral (13th century) has a campanile (218 ft. high) porch and façade with small arcades in black and white marble in the Pisan style as in other churches of Pistoia. It contains many fine sculptures—the monument of Cino da Pistoia, lawyer and poet, Dante's contemporary (1337), by Cellino di Nese, surrounded by his scholars, and Verrocchio's monument to Cardinal Forteguerra (1474). The octagonal baptistery is by Cellino (*c.* 1337). Among the earlier churches the principal is Sant' Andrea (1166), enriched with sculpture; in the nave is Giovanni Pisano's magnificent pulpit, imitated from his father's pulpit at Pisa. Other churches are S. Giovanni Fuorcivitas (so called because it was outside the line of the earliest, pentagonal, enceinte of the middle ages), with one of the long sides elaborately adorned with small arcades in the Pisan style, in black and white marble, also with sculpture by Gruamons (1162) on the façade. Within are a beautiful group of the Visitation by Andrea della Robbia, and a fine pulpit by Fra Guglielmo of Pisa (1270). S. Bartolomeo in Pantano and S. Pietro Maggiore closely resemble it. San Francesco al Prato is a fine church of the end of the 13th century with interesting frescoes of the school of Giotto. San Domenico, a noble church, begun in 1294, contains the beautiful tomb of Filippo Lazari by Bernardo and Antonio Rossellino (1462–67) and other works of art. The Madonna dell' Umiltà (1494–1567) and S. Maria delle Grazie have fine Renaissance interiors, by the local architect Ventura Vitoni. The Palazzo del Comune and the Palazzo Pretorio, once the residence of the podestà, are both fine specimens of 14th-century architecture. The Ospedale del Ceppo has remarkable reliefs in enamelled and coloured terra-cotta on its exterior. Besides various medallions, there is a frieze of figures in high relief along the whole front—groups representing the Seven Works of Mercy—executed by Andrea Della Robbia between 1514 and 1525.

The word "pistol" is derived (apparently through *pistolese,* a dagger—dagger and pistol being both small arms) from Pistoia, where that weapon was largely manufactured in the middle ages.

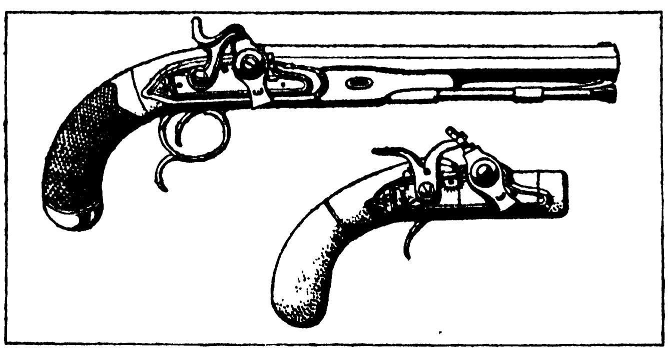
PISTOIA, SYNOD OF, a diocesan synod held in 1786 under the presidency of Scipione de' Ricci (1741–1810), bishop of Pistoia, and the patronage of Leopold, grand-duke of Tuscany, with a view to preparing the ground for a national council and a reform of the Tuscan Church. The synod was attended by 233 beneficed secular and 13 regular priests, and decided with practical unanimity on a series of decrees which, had it been possible to carry them into effect, would have involved a drastic reform of the Church on the lines advocated by "Febronius" (*see* FEBRONIANISM). The decrees were issued with a pastoral letter of Bishop de' Ricci (*see* SACRED HEART), and were warmly approved by the grand-duke, at whose instance a national synod of the Tuscan bishops met at Florence on the 23rd of April 1787. The temper of this assembly was, however, wholly different. The bishops refused to allow a voice to any not of their own order, and in the end the decrees of Pistoia were supported by a minority of only three. They were finally condemned at Rome by the bull *Auctorem fidei* of the 28th of August 1794.

Bibliography.—De' Ricci's own memoirs, *Memorie di Scipione de' Ricci, vescovo di Prato e Pistoia*, edited by Antonio Galli, were published at Florence in 2 vols. in 1865. Besides this his letters to Antonio Marini were published by Cesare Guasti at Prato in 1857; these were promptly put on the Index. *See* also De Potter, *Vie de Scipion de' Ricci* (3 vols., Brussels, 1825), based on a ms. life and a ms. account of the synod placed on the Index in 1823. There are many documents in Zobi, *Storia civile della Toscana*, vols. ii. and iii. (Florence, 1856). The acts of the synod of Pistoia were published in Italian and Latin at Pavia in 1788.

PISTOL, a small fire-arm designed for quick work and personal protection at close quarters, and for use in one hand. It was originally made as a single- and also double-barrelled smooth bore muzzle-loader, involving no departure in principle from the ordinary fire-arms of the day. With the introduction of revolvers and breech-loading pistols and the application of "rifling" to musket barrels, came also, in the early half of the 19th century, the rifling of pistol-barrels.

HISTORY

Pistols are understood to have been made for the first time at Pistoia in Italy, whence they receive their name. Caminelleo Vitelli, who flourished in 1540, is the accredited inventor. The first pistols, in the 16th century, had short single barrels and heavy butts, nearly at right angles to the barrel. Shortly afterwards the pattern changed, the butts being lengthened out almost in a line with the barrels. These early pistols were usually fitted with the wheel-lock (*see* Gun). Short, heavy pistols, called "daggs," were in common use about the middle of the 17th century, with butts of ivory, bone, hard wood or metal. A chiselled Italian dagg of 1650, for example, had a slightly bell-nosed barrel of about 8in. in length and 14 bore. The German wheel-lock military pistols used by the Reiters, and those made for nobles and gentlemen, were profusely and beautifully ornamented. Pistols with metal hafts were common in the 16th and 17th centuries, many beautiful specimens of which, silver-mounted, were made in Edinburgh and used by Highlanders. Duelling, when in vogue, caused the production of specially accurate and well-made single-barrelled pistols, reliable at twenty paces. The pattern of this pistol seldom varied, its accuracy at short range equalling that of more modern ones, the principle of a heavy bullet and light charge of powder being employed. The first double-barrelled pistols were very bulky weapons made with the barrels laid alongside one another, necessitating two locks and two hammers. There was also the "over and under" pistol, one barrel being laid over the other. This was a more portable weapon, only requiring one lock and hammer, the second barrel being turned round by hand, after the first had been fired, or,



FORSYTH LOCK PISTOL AND MODEL PREPARED FOR SUBMISSION TO THE BRITISH HOUSE OF COMMONS IN 1840

as an alternative, the flash-hole being adjusted to the second barrel by a key. These pistols were first made with flint and steel locks and subsequently for percussion caps. Double "over and under" pistols were also made with a trigger mechanism that served to discharge both barrels in turn.

Revolvers.—A revolver is a single-barrelled pistol with a revolving breech containing several chambers for the cartridges, thus enabling successive shots to be rapidly fired from the same weapon without reloading. The ordinary pistol has long been superseded by the revolver. The first revolver, fired with the percussion cap, was made with the whole of the barrels, six, seven or eight, revolving in one piece, and was known as the "pepper-box." It was "single action," *i.e.* the hammer was raised and the barrels revolved by the pull of the trigger. This weapon was cumbrous and no accurate aim could be taken with it owing chiefly to the strength and resistance of the main-spring and the consequent strong pull required on the trigger. The principle of a revolving breech to one barrel, which superseded the "pepper-box," is an old one in the history of fire-arms, dating from the 16th century. At first the breech cylinder was revolved by hand, as in the revolving arquebus or matchlock, a specimen of which is now in the Tower of London, but this was subsequently improved by introducing geared mechanism, by which the pull of the trigger or the cocking of the hammer, or both, do the work. There exists a pistol of the time of Charles I. which is rotated automatically as the hammer is raised.

In 1814 a self-acting revolver mechanism of a crude pattern was produced in England. Four years later Collier used a separate spring to rotate the chamber. In 1835, an American, Samuel Colt, produced and patented the first practical revolving pistol, the idea of which was obtained by him, it is stated, from an ancient "revolving" weapon in the Tower of London. The chambers of the first Colt revolver were loaded with powder and bullets from the muzzle end, and each chamber had a nipple that required to be capped. It was the invention of the copper cap that made the Colt revolver possible. Under the old priming system with exposed powder in a pan the difficulty of separate and effective ignition with the revolving cylinder was almost insuperable.

The first American revolver makers caused the cocking of the hammer to revolve the cylinder, while the English makers effected this by the pull of the trigger. In 1855, Adams of London, and also Tranter of Birmingham, brought out the double-action revolver, in which the revolution of the cylinder could be effected by both these methods. When the revolver is cocked and fired by pressing the trigger, greater rapidity of fire is obtained than when the hammer is cocked with the thumb, but accuracy is impaired, as the trigger requires a long pull and considerable force in order to compress the mainspring and revolve the cylinder. The double action revolver was, therefore, a great advance on the single action, enabling the first and also following shots, if desired, to be accurately fired by a moderate pressure of the trigger after the hammer had been cocked by the thumb; or, alternatively, the revolver could be rapidly fired, if necessary, by the trigger action alone. Many revolvers on the Colt principle were in use during the Crimean War and the Indian Mutiny, and proved of valuable service to British officers.

As rim-fire, pin-fire and central-fire cartridges were successively introduced, breech-loading revolvers were constructed to use them. Messrs. Smith & Wesson, of Springfield, U.S.A., produced the first metal cartridges for revolvers. Pin-fire cartridges, paper and metallic, were used on the continent of Europe for Lefaucheux and other revolvers, and these and rim-fire cartridges are still used for revolvers of small calibre. But since the central-fire cartridge has proved its superiority for guns, its principle has been generally applied to pistol cartridges.

The alteration of the muzzle-loading to the breech-loading chamber in the revolver involved no decided change of type. The original Colt, as a breech-loader, remained practically the same weapon as before, with a changed chamber. A hinged flap uncovered the breech-chamber on the right, and as each chamber reached that point the empty cartridge case was ejected by means of an ejecting-rod carried in a tube attached to the under side of the barrel and kept in place by a spiral spring, and the chamber reloaded. The next improvement was greater ease and rapidity of extraction, obtained first by Thomas's invention of making the barrel and chamber slide forward on the frame of the pistol. The extractor, being fast to the pivot, retained the cartridges until the chamber was pushed clear of them. Then the chamber was made to swing on one side, as in the Colt pistol of that time, enabling all the cartridges to be simultaneously extracted. Finally, self-extracting revolvers with jointed frames

were introduced, in which the dropping of the barrel forces out the extractor as in an ordinary double gun, the extractor acting simultaneously in all the chambers of the pistol. A spring returns the extractor to its place when the empty cartridge cases have been ejected. These are now known as "break-down" actions.

This type of revolver originated with Smith and Wesson, but they and other gun makers greatly improved on the original model. Between this American pattern and the English, as made by Webley, the chief difference is that in the Smith and Wesson, model 1888, the holding-down bolt or catch was upon the barrel, and it engaged with the top of the standing breech; whereas in the Webley the bolt was upon the standing breech and gripped the extremity of the hinged barrel. In the ·45, 1902 model, used by the British in the World War, this catch was eliminated. The frame was solid and the cylinder made to swing out to the left for the purpose of extracting, ejecting and recharging. The hinged type of revolver is most convenient for use on horseback, as the pistol can be opened, the cartridges extracted and the weapon reloaded with one hand.

Automatic Pistols.—After it had been shown that automatic machine guns could be made which would fire, extract and eject the empty round, and also load the next round into the chamber, application of this principle to pistols was attempted, and the first automatic pistol to appear was the Borchardt in 1893. This was not very certain in its action and was soon displaced in favour by the Mauser 7·65mm., 1898 model. This latter was provided with a wooden holster which could be attached to form a stock or butt. Later the bore was increased to 9mm., and in this pistol a more powerful cartridge was used, giving to its nickel-jacketed bullet a high velocity. This latter weapon, provided with a holster and sighted up to 1,000 yards, was used occasionally by the Boers during the last Boer War. Thus, it may be said, the vogue was started, and great development on these lines took place both in Europe and America. (X.)

MODERN REVOLVERS

Modern automatic pistols have many advantages over contemporary revolvers, and the armies of most nations are now armed with them with the exception of Britain, France, and at one time Russia. In the British navy the ·455 Webley Revolver is used.

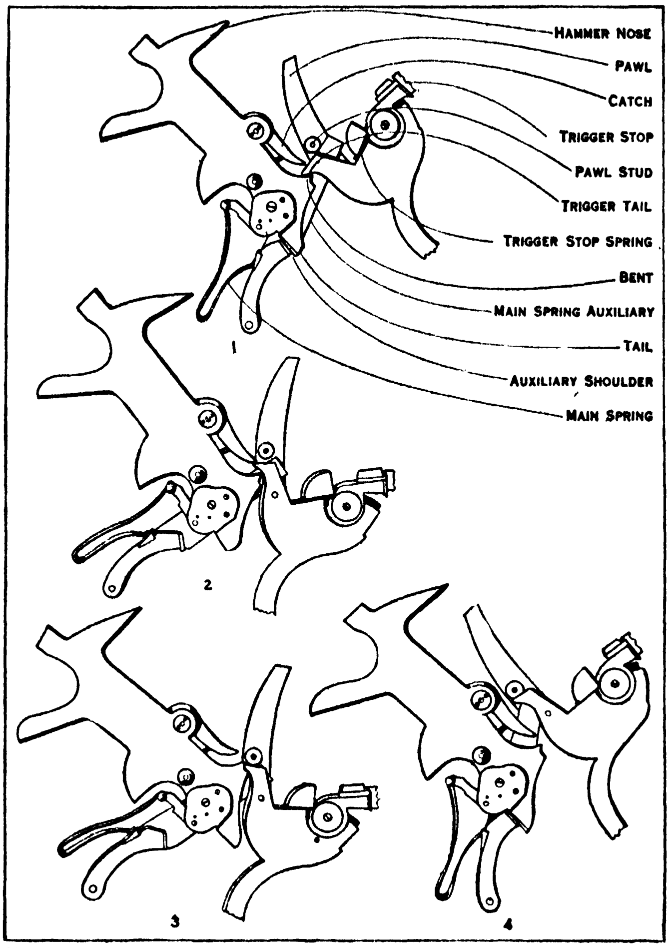
All revolvers are hand operated, but modern automatic pistols all rely for their operation on the effect of firing a round. The automatics are claimed to have the following advantages over revolvers—(a) Rapidity of fire, (b) rapidity of recharging (this is done by filled magazines), (c) each magazine holds more rounds, (d) flatter and more easily carried, and other minor points. Automatic implies continuous action in a machine gun, but it has not that meaning when applied to pistols, which, though called automatic are really semi-automatic in action, and require a separate pull of the trigger to fire each shot.

While admitting the advantages claimed for automatics, it is held that the revolver is:—(1) More certain, because, (a) it is positively manipulated by hand; (b) it is immune from questions of incorrect functioning due to variable recoil with slightly erratic ammunition; (c) being less complicated, it is more free from troubles due to mud and dirt or lack of lubrication. (2) A miss-fire is instantly corrected by pulling the trigger without moving the revolver or altering the aim. With the Automatic, the weapon has to be lowered, eyes removed from the enemy or target, and both hands used to overcome the stoppage that arises from the miss-fire, a difference perhaps of a few seconds of time that may be of vital importance. (3) Less liable to accidental discharge.

In ammunition used for automatic pistols the bullets have cupro-nickel envelopes, and they usually have a velocity rather more than medium. These envelopes help to facilitate the feeding of the round without friction or jamming in the magazine, and also when being forced from the magazine into the chamber. Were these bullets of unjacketed lead, they might not "take" the rifling in the barrel at the velocities employed, and hence the shooting would be inaccurate. Such jacketed bullets being much harder than lead have more penetrating power, and a great deal of their energy may be wasted, and expended in the further forward motion of the bullet after penetration.

The different makes of the modern revolver may be said to differ from each other in details only, and a description of the four main features of the revolver mechanism will be generally applicable to all. These four main features are, cocking and firing, cylinder rotation, rebound and safety.

Cocking and Firing.—All revolvers now are of the double action type, previously described, *i.e.*, cocking the hammer with the thumb; or, "pulling through" with the trigger when the hammer is forward. In both cases the hammer rotates about its axis, and in so doing compresses a spring, the mainspring, which is the driving force of the hammer (*see* diagram).



WEBLEY REVOLVER: (1) NORMAL FIRING POSITION. (2) SECOND FIRING POSITION SHOWING TRIGGER MECHANISM. (3) THIRD FIRING POSITION. (4) FOURTH FIRING POSITION

As the hammer is caused to rotate by the thumb in single action, its toe bears against and underneath the tail of the trigger, and this is caused to revolve about its axis until a point is reached when a bent in the toe of the hammer engages with the tail of the trigger. The mainspring, having been compressed, keeps the trigger in engagement with the bent of the hammer. If the trigger now be pulled, it will rotate still further until the tail of the trigger slips from the bent of the hammer when the hammer will fly forward to fire the round. In the "pull through" action, an accessory to the hammer comes into play, namely, the hammer catch. This, at its top end, rotates round an axis on the front of the hammer, while its bottom end is caused to protrude by a spring housed between the two and known as the hammer catch spring. When the trigger is pulled its tail, rotating upwards, engages with the bottom of the hammer catch, and so rotates it and the hammer in the opposite direction. Eventually a point is reached when the hammer catch and the trigger tail clearing each other, the hammer flies forward and fires the round.

Cylinder Rotation.—Another feature common to all revolvers is the means of rotating and positioning the cylinder of chambers. Around the central axis of the cylinder and protruding from its

rear face are the teeth of the ratchet, one tooth per chamber. To the inside of the tail of the trigger is pivoted the pawl. When the trigger is pulled the tail rises, bringing with it also the pawl. The top of the pawl bears against a tooth of the ratchet, so, when the pawl rises, it rotates the ratchet, and brings up the next chamber the full distance to place it in true alignment with the barrel (*see* diagram).

To prevent over-rotation of the cylinder, stops are provided which prevent movement beyond the exact amount necessary to ensure this alignment. Thus while these stops prevent over-rotation and the pawl prevents rebound, perfect alignment of the chamber and barrel is secured as is also that of the cartridge cap and hammer. These cylinder stops, pivoted to the trigger and influenced by a spring, protrude upwards through the bottom of the frame, and engage in slots on the outside circumference of the cylinder. They are so constructed as to disengage from these slots as the pressure on the trigger is released, and the latter starts to go forward. Were these stops to remain in their slots, the cylinder could not be rotated. (The Webley ·455 Revolver has two such stops, others usually have one.)

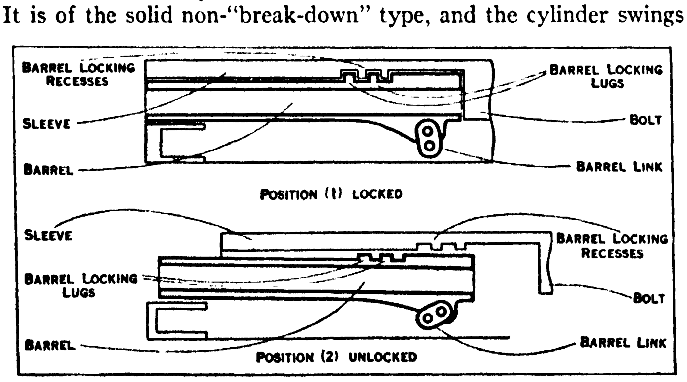
Rebound Action.—Furthermore, the cylinder could not be rotated were the hammer nose to remain in the indentation made in the cap of the cartridge case after being struck by the hammer. To meet this, rebound action is employed, *i.e.*, as the trigger starts to move forward after a shot has been fired, the hammer is caused to revolve slightly to the rear and thus clear its nose from the cartridge cap (*see* diagram).

In the Webley and Colt this action is effected by the lower arm of the mainspring pressing down on the mainspring auxiliary, a shoulder on which bears against the tail of the hammer so rotating it and returning it to its normal position.

Safety Action.—Accidental discharge through the hammer being knocked forward is also guarded against. In the Webley and Colt the tail of the hammer is shaped, so that if its top be pushed forward, its tail causes the auxiliary to rise. The front end of this bears against a stud on the pawl so raising it. It, in turn, raises the trigger, which meets the down-coming hammer catch, thus preventing further hammer movement. (*See* diagram.)

These last two actions are provided for in the Smith & Wesson by a block underneath the hammer. When the trigger is pulled this block is forced to the rear against a spring. As the trigger is released the block moves forward, a step on it meeting a step on the tail of the hammer, thus effecting the rebound action. As the trigger moves further forward, the block passes under the hammer tail and so prevents any forward movement by the top of the hammer.

The French army revolver is the 8mm. Modèle d'Ordonnance. It is of the solid non-"break-down" type, and the cylinder swings



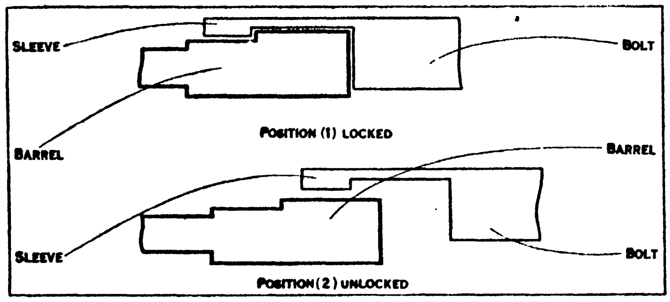
THE LOCK OF A COLT AUTOMATIC PISTOL

out to the right for ejection and loading. In the ·3 Russian Nagant, endeavours are made, both in the action and the ammunition, to bridge the space between the front of the cylinder and the breech of the barrel, through which gas escapes, a defect which is present in all other revolvers.

AUTOMATIC PISTOLS

Such weapons are now numerous and vary greatly in design, with calibres ranging from ·455 to ·250 inches. In all cases, however, their operation is depended on the result of firing a round. If the base of the cartridge be not supported in the chamber when it is exploded, it will be blown to the rear, the gas will escape, the bullet will not be projected, and the firer will also probably suffer.

Automatic Pistols can be divided into two main types, *i.e.*, (a) Those in which the barrel and bolt are positively locked to-



THE LOCK OF A WEBLEY & SCOTT AUTOMATIC PISTOL

gether till the bullet's exit. (b) Those dependent on inertia with no mechanical locking. The latter, for sealing the breech, rely on the weight of the moving parts which place the round in the chamber, and which hold it there by the assistance of strong springs, together with the friction on extraction caused by the cartridge case expanding under the explosion and gripping the walls of the chamber.[1]

The small bore pocket pistols are frequently of type (b). However, in view of the requirements of a revolver or pistol, previously referred to, type (a), which permit of a heavy bullet and a heavy charge, are usually the most employed for military purposes. There are two sub-divisions of type (a) namely, (1) Those in which the barrel and bolt recoil together in the same plane for a short distance prior to unlocking. (Luger Parabellum, Mauser [Germany], Frommer.) (2) A lowering movement of the barrel during recoil, which unlocks itself from the bolt after a short distance.[2] (Webley & Scott, Colt.)

The Luger functions on somewhat similar lines to the Maxim or Vickers Machine Gun. In it the bolt is supported by a toggle joint, the centre hinge of which is below the level of the ones on either side of it and bears against the metal of the frame. Locked in this way, barrel and bolt recoil together until the centre hinge meets a ramp and is forced upwards so breaking the joint and knuckling the bolt back against the compression of a spring.

Not quite similar to (1) and (2) above, is a third form of barrel movement, *i.e.*, a turning motion of the barrel during recoil, thus bringing about unlocking. (Steyr and Savage.)

Of type (b) a Browning 9mm. Military Model, manufactured in Belgium and marked F.N. (Fabrique National) is the weapon of Belgium, Holland and of some S. American States.

Owing to the similarity in outward appearance between various automatic pistols, not much can be learnt from photographs. However, on this page are diagrammatical sketches of the principles employed in some of the locking actions mentioned above.

Magazines.—All these pistols have magazines holding from 7–10 rounds, in three of which the magazines can be loaded while assembled by means of chargers, namely, the Bayard (out of date), Mauser and the Steyr. Safety catches are usually of two types, namely, thumb levers and grip levers. The former when applied, disconnect the hammer from the sear, so that pulling the trigger has no effect. The grip levers are at the back of the stock, and when not gripped by the hand as when firing, cause the hammer and sear to be disconnected with the same result as above.

Holding-open devices are embodied in most automatic pistols, and warn the user that the magazine is empty. The magazine platforms, or levers operated by them, rise when the maga-

[1]The cartridge cases of automatic pistols are always cylindrical. The greatest friction and therefore gripping of the chamber is produced by such cases when expanded.

[2]In this type the barrel and sleeve lock; the bolt, which is solid with the sleeve, seals the breech when this locking is effected.

zine is empty and hold back the recoiling parts, thus putting the pistol temporarily out of action.

A danger common to most automatic pistols is that when the magazine is removed a live round is usually left in the chamber, and, if forgotten, may result in an accident. Hammerless pistols give no indication as to whether the pistol is cocked or not. On the other hand, with hammers projecting at the rear of the pistol there is a possibility of cocking the hammer by an accidental knock or by friction.

There is only one well known sample of a semi-automatic revolver, namely, the Webley Fosbery ·45. In it is the usual six chambered cylinder. When the round is fired, the cylinder and barrel recoil and in so doing the cylinder is made to turn half the distance necessary for aligning of the next chamber with the hammer. After recoil a strong spring forces the recoiling portions forward and the cylinder rotates through the remaining necessary distance. (H. R. A.)

PISTOLE. The French name given to a Spanish gold coin in use from 1537; it was a double *escudo,* the gold unit, and was worth 16s. 11½d. sterling. The name was also given to the *louis d'or* of Louis XIII. of France, and to other European gold coins of about the value of the Spanish coin.

PISTON: *see* STEAM ENGINE; INTERNAL COMBUSTION ENGINES; PUMPS.

PITCAIRN, a borough of Allegheny county, Pennsylvania, U.S.A., 15 m. S.E. of Pittsburgh, on the Pennsylvania railroad. Pop. (1920), 5,738 (93% native white); 1928 local estimate, 7,000. The Pennsylvania company has railroad shops and freight yards here employing large numbers. Electrical goods, bricks and concrete blocks are manufactured in the borough, and there are coal mines in the vicinity. The borough was incorporated in 1894.

PITCAIRNE, ARCHIBALD (1652–1713), Scottish physician, was born at Edinburgh on Dec. 25, 1652. He took his M.A. degree at Edinburgh university in 1668, and after courses in Edinburgh and Paris he obtained in 1680 the degree of M.D. at Rheims. He began practice at Edinburgh, and in 1692 was appointed professor of medicine at Leyden. Among his pupils were Richard Mead and H. Boerhaave, and both of them attributed much of their skill to what they learned from Pitcairne. In 1693 Pitcairne settled once more in Edinburgh. He persuaded the Edinburgh town council to permit himself and certain of his medical friends to treat without fee the sick paupers in "Paul's Work," on condition of being allowed to dissect such of the bodies as were unclaimed by their relatives. In this way he may be said to have the credit of laying the foundation of the great Edinburgh school of medicine. He died on Oct. 20, 1713.

PITCH. The name of various substances of dark colour and of extremely viscid and tenacious consistency when subjected to heat. (O. Eng. *pic,* an adaptation of Lat. *pix, picis,* Gr. πίσσα, πίττα, allied with Gr. πίτυς, pine-tree, Lat. *pinus.*) Strictly the term is applied to the resinous substance obtained as a solid residuum by the distillation of wood-tar (*see* TAR), or the non-resinous substance similarly produced from coal-tar (*q.v.*). The name is also applied to the natural mineral substances, *i.e.,* asphalt or bitumen (*qq.v.*).

PITCH, MUSICAL. The pitch of a musical sound is precisely defined by a vibration number recording the frequency of the pulsations of a tense string, a column of air or other vibrator, in a second of time. In Great Britain and America the complete vibration to and fro is taken as the unit; elsewhere the vibration in one direction only. The only official standard is the French, dating from 1859, preserved by a tuning-fork vibrating 870·9 (double vib. 435·45) at a temperature of 15° Centigrade (59° Fahr.) in a second. The vibration number stated in the edict establishing, in the year named, the diapason normal is 870 (435). Vibrations increase in rapidity as a note rises and decrease as it falls. Any note may be a pitch note. For orchestras custom has settled upon *a'* in the treble clef, for organs and pianos in Great Britain *c''*, and for modern brass instruments *b* flat'.

We are not without a clue to the pitch usual in the classic Greek and Alexandrian ages: the vocal octave to which the lyre was adapted was noted as from *e* to *e'*. As in choruses barytone and low tenor singers always prevail, *d–d'*, at French or at medium pitch, would really be the Greek singing octave; we may therefore regard it as a tone lower than that to which we are accustomed. But to sing the lower Greek modes in or near the vocal octave it was necessary to transpose (μεταβολή) a fourth upwards, which is effected in modern notation by a flat placed upon the B line of the staff; thus modulating from our major key of C to that of F. This transposition has had, as we shall see, much to do with the history of our subject, ultimately influencing the ecclesiastical chant and lasting until the 17th century of our era. It does not appear from any evidence that the keyboards—when there were more than one—of the early organs were arranged for transposition, but it is certain that the Flemish harpsichords to 1650 were made with double keyboards to accommodate it (*see* Hipkins's *History of the Pianoforte,* 1897). But a positive identity of pitch cannot be claimed for any period of time, and certainly not for the early organs; the foot-rule of the organ-builder, which had to do with the lengths of the pipes, and which varied in every country and province, could easily cause a difference of a semitone. Scale and wind-pressure are also important factors. But with all these often opposed conditions, we find less variation than might be expected, the main and really important divergence being due to the necessity of transposition, which added a very high pitch to the primarily convenient low one.

The first to attempt to define pitch would seem to have been Arnold Schlick (*Musica ausgeteutscht und ausgezogen,* Heidelberg, 1511), who gives a measure, a line of 4⅞ Rhenish inches, which, he says, multiplied sixteen times, should be the lowest F of a small organ. He gives no diameter or wind-pressure. Dr. A. J. Ellis used this indication to have an organ pipe made which with one-sixteenth diameter and a wind-pressure of 3¼in., at one-fourth Schlick's length, gave *f'* 301·6, from which he derived a just major third of *a'* 377, which would compare very well with an old Greek *a'*. Schlick goes on to say the organ is to be suited to the choir and properly tuned for singing, that the singer may not be forced to sing too high or too low and the organist have to play chromatics, which is not handy for every one. Further, he says pitch cannot be exactly defined, because voices vary; he nevertheless gives the measure above mentioned for the low F, but if a larger organ is built to include the still lower C, then this C must be *of the same measurement,* the reason being that a greater part of church music ends in "grambus," a word understood by Schlick's editor to mean the transposition of a fourth. The larger high-pitch organ will therefore be at *a'* 502·6.

The Halberstadt organ was, according to Praetorius, built in 1361, and repaired or rebuilt 1495. He gives the longest pipe of this organ, B natural, as 31 Brunswick feet, and the circumference 3½ft. He further tells us this pitch was a tone, nearly a tone and a half, higher than a suitable church pitch (*Chorton*), for which he gives a diagram. Dr. Ellis had pipes (now preserved in the Royal Institution, London) made to reproduce both these pitches at 3¼in. wind-pressure. The Halberstadt pitch was found to be *a'* 505·8; the *Chorton,* 424·2. Ellis used mean-tone temperament in calculating this lower pitch; but as he used just intonation for the Halberstadt, it seems preferable to substitute it for the *Chorton,* thus reducing it to *a'* 422·8. Praetorius's *Cammerton,* or chamber pitch, formulated in his diagrams for voices and instruments, is, he says, a whole tone higher; equivalent, therefore, to *a'* 475·65. Nearly all the German organs were tuned to this higher pitch. The lower vibration number is justified by the three divisions of the male voice, bass, tenor and alto, as given by Praetorius, whose *Cammerton* very closely corresponds with Bernhardt Schmidt's Durham organ, 1663–1668, the original pitch of which has been proved to have been *a'* 474·1. The Halberstadt pitch is nearly a semitone higher, which again agrees with the statement of Praetorius, and also Schlick's high C organ. Yet it would seem that there had been a still higher pitch used in the old ecclesiastical music. In one passage Praetorius distinctly says the old organ high pitch had been a whole tone above his *Cammerton,* with which we shall find his *tertia minore* combines to make the required interval. The term *tertia minore,* or *inferiore,* is used by Praetorius to describe

a low pitch, often preferred in England and the Netherlands, in Italy and in some parts of Germany. An organist, instead of transposing a whole tone down from the *Cammerton,* would for the *tertia minore* have to transpose a minor third.

Corroboration of this pitch is found in Silbermann's organ in Strasbourg minster (1713–1716), the pitch of which, taken in 1880 and reduced to 59° F (as are all pitches in this article), is *a′* 393·2. An old organ at Versailles (1789) was very near this example, *a′* 395·8. Ellis gave Dom Bédos (*L' Art du facture d'orgues,* Paris, 1766) as authority for a mean tone *a′* 376·6. Sir F. G. Ouseley's comparison of the church and chamber pitches of Orlando Gibbons (*vide* Ellis's lecture) clearly shows the minor third in Great Britain in the first half of the 17th century. But the narrowing continued. Bernhardt Schmidt, better known in England as Father Smith, was invited about 1660 to build the organ for the Chapel Royal, Whitehall; two years later he built the organ in Durham Cathedral *a′* 474·1, difference a whole tone, and practically agreeing with the *Cammerton* of Praetorius. The Hampton Court organ of 1690 shows that Schmidt had further lowered his pitch a semitone, to *a′* 441·7. What happened at Durham was that at some subsequent date the pipes were shifted up a semitone to bring the organ into conformity with this lower pitch, with which it is probable Schmidt's organs in St. Paul's and the Temple, and also Trinity college, Cambridge, agreed.

The final adoption of the low church pitch as in the 18th century was no doubt influenced by the introduction of the violin, which would not bear the high tension to which the lutes and viols had been strained. Harpsichords had long been preferred to the *tertia minore.* The *Chorton* of Praetorius, *a′* 422·8, is practically the same pitch as that of the fork the possession of which has been attributed to Handel, *a′* 422·5. It is a very fair mean between G. Silbermann's 18th-century Dresden pitch, *a′* 415, and the organs of Renatus Harris, *a′* 428·7. Stein tuned Mozart's piano to a fork *a′* 421·6, and the Broadwood pianos used at the first London Philharmonic Society concerts (1813) were tuned to a fork *c″* 506·8, which gives a mean tone *a′* 423·7.

According to Schindler (*Niederrheinische Musik-Zeitung,* 1855, Nos. 8 and 9) and the report of the French Commission, 1859, the rise in pitch began at the Congress of Vienna in 1816, the military bands being the cause. With the improvements in wind instruments this continued, as more brilliant effects were gained. In 1823 Weber's *Euryanthe* is recorded as having been played in Vienna at *a′* 437·5, and in 1834 Kreutzer's *Nachtlager* at *a′* 440. The measurements are doubtful, but the upward tendency is clear. Scheibler, by his simple and accurate tonometer, has recorded pitches in Vienna about 1834 from *a′* 433·9 to 440·2. About that time, or it may be a few years earlier, Sir George Smart established a fork for the Philharmonic Society, *a′* 433·2. Forks intended for this vibration number, stamped "Philharmonic," were sold as late as 1846. But about that year the performing pitch of the Society had reached 452·5. Sir Michael Costa was the conductor 1846–54, and from his acceptance of that high pitch the fork became known as Costa's, and its inception was attributed to him, though on insufficient grounds. In 1874 a further rise in the fork to *a′* 454 was instigated by Sir Charles Hallé. The British army is required by His Majesty's Rules and Regulations to play at the Philharmonic pitch, and a fork tuned to *a′* 452·5 in 1890 is preserved as the standard for the Military Training School at Kneller Hall. But the Philharmonic Society adopted the diapason normal in 1896, and the military bands have not gone with it.

It was the irrepressible upward tendency that caused the French Government in 1859, acting with the advice of Halévy, Meyerbeer, Auber, Ambroise Thomas and Rossini, to establish by law the diapason normal, *i.e., á* 439 at 68° Fahr. or *á* 435 at 59° Fahr. Other countries have gradually followed, and, with few exceptions, the low pitch derived from the diapason normal may be said to prevail throughout the musical world. Great Britain was the last to fall in, but the predominance of the low pitch is assured. The proprietors of Queen's Hall, London, did much for it when they undertook the alteration, at great expense, of their large concert organ, which had only just been erected. In 1896 the Philharmonic Society adopted the diapason normal and in 1899 Messrs. Broadwood made a successful effort to get the same vibration number accepted by their competitors in Great Britain. The high pitch remains only where there are large concert organs not yet lowered, and with the military and brass bands.

The consideration of temperature as affecting the use of a standard pitch was not attended to when the French Government issued its *ordonnance.* The 15° C attached to the description of the standard fork in Paris was intended for the definition and verification of the fork only. The alteration of the fork due to heat is scarcely perceptible, but wind instruments, and particularly the organ, rise almost proportionately to the increase in temperature of the surrounding air, because sound travels at an enhanced rate as the temperature rises. The coefficient of this rise is equivalent to half a vibration (0·5) per degree Fahr. per second. The French Commission, in establishing the diapason normal, should have chosen a temperature of 20° C. There would then have been less disturbance owing to the breath of the players and heat of the theatres or concert-rooms. As things are, even the established diapason normal implies a variation from 435 to 440 vibrations a second for *a′*, inasmuch as temperature must always be reckoned with.

In writings on music the pitch of a note is indicated in various ways when it is desired to convey this without the employment of actual notation. Thus organists speak of "great C," "double C" and "tenor C" to indicate the notes sounded by pipes of 16ft., 8ft. and 4ft. respectively, the same notes being also indicated alternatively by the lettering CCC, CC and C. Another system is based on the employment of different types (*i.e.,* either capitals or small italic letters), supplemented by small strokes, placed above or below the letters as the case may be. Thus under this system 16ft. C is represented by C′, 8ft. C by C without any stroke, 4ft. C by *c*, the C above ("middle C" on the pianoforte) by *c′*, the C above that (or treble C) by *c″*, the C above that again by *c‴*, and so on, the intermediate notes in each octave being of course similarly indicated. Or instead of strokes small numerals are sometimes used, *e.g.,* C_2, C_1, c^1, c^2, c^3, etc. The expressions "in alt" and "in altissimo" are also employed for the same purpose, "in alt" signifying the notes in the octave beginning with the C above the treble octave (*g″*) and "in altissimo" those in the octave above (*g‴*, *a‴*, *b‴*, etc.). (*See* ALT.) (A. J. H.; X.)

PITCHBLENDE or **URANINITE,** a mineral species consisting essentially of uranium oxide, of importance as a source of uranium and radium. It is a very heavy (specific gravity 9·0–9·7), compact mineral with a conchoidal to uneven fracture, and a brownish to velvet-black colour and pitchy lustre. Crystals are rare; they have the form of regular octahedra or less often of cubes. The hardness is 5½, and the streak is brown with a greenish tinge. The mineral has been known since 1727 to occur at Jáchymov (Joachimsthal) in Bohemia, and it was early called pitchblende because of its appearance; but its true nature was not recognized until 1789, when M. H. Klaproth's analysis of it resulted in the discovery of the element uranium. Analyses of material from different localities exhibit wide variations in chemical composition; in addition to uranium oxides, there are thorium, cerium (and lanthanum), yttrium and lead oxides, each varying in amount from a trace up to 10%. Calcium, iron, magnesium, manganese, silica, water, etc., are also present in small amounts, and the content of uranous and uranic oxides (UO_2, 21–72; UO_3, 13–59%) also vary considerably. The mineral is often described as a uranate of uranyl, lead, thorium and cerium; but in the least altered material from Branchville in Connecticut the uranous oxide predominates, whilst in altered specimens uranic oxide is in excess. In the closely allied mineral, thorianite, thorium predominates (ThO_2, 76; UO_2, 12%). Since the dioxides of uranium, thorium and cerium may be obtained artificially as cubic crystals, it seems probable that pitchblende consists of isomorphous mixtures of these dioxides, the uranic oxide being due to oxidation.

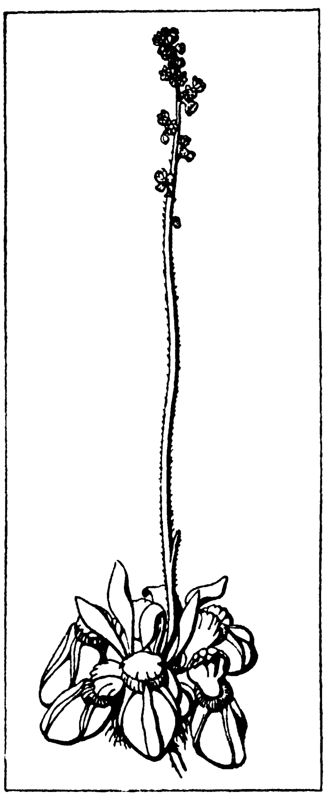
The radio-active properties of pitchblende are of special interest. The fact that this mineral is more strongly radio-active than metallic uranium led to the discovery in it of the elements radium, polonium and actinium. When pitchblende is ignited

or dissolved in dilute sulphuric acid, a gas is evolved which consists largely of helium and argon; terrestrial helium was first recognized in this mineral.

Pitchblende occurs either as a primary constituent of granitic rocks or as one of secondary origin in metalliferous veins. Octahedral crystals ("cleveite" and "bröggerite") occur in the pegmatite veins of southern Norway, being occasionally found in the felspar quarries at Moss, Arendal and other places. Crystals are found under similar conditions at Middletown and Branchville in Connecticut, Llano county in Texas ("nivenite"), Mitchell county in North Carolina, Villeneuve in Quebec, and other American localities. Thorianite, found as water-worn cubes in the gem-gravels near Balangoda in Sabaragamuwa province, Ceylon, has also no doubt been derived from crystalline rocks. On the other hand, the mineral found in metalliferous veins, and to which the name pitchblende is more properly restricted, never occurs as crystals, but as compact masses rendered more or less impure by admixture of other minerals, the specific gravity being sometimes as low as 6·5; thorium, cerium, etc., are absent, and radium and helium are present in smaller amounts. This variety occurs with ores of silver, lead, copper, nickel, cobalt, bismuth, etc., at Johanngeorgenstadt, Marienberg and Schneeberg in Saxony, Jáchymov and Příbram in Bohemia, Gilpin county in Colorado, St. Just, Redruth, Grampound Road and elsewhere in Cornwall, and at Kasola in Katanga, Belgian Congo.

Often associated with pitchblende, and resulting from its alteration, is an orange-yellow, amorphous, gum-like mineral called gummite, which is a hydrous uranic oxide with small amounts of lead, calcium, iron, etc.

PITCHER PLANTS, in botany, the name given to plants in which the leaves bear pitcher-like structures or are pitcher-like in form. The plant generally understood by this name is *Nepenthes,* family Nepenthaceae, a genus containing nearly 60 species, natives of tropical Asia, north Australia and (one only) of Madagascar. North Borneo is especially rich in species. They are shrubby plants climbing over surrounding vegetation by means of tendril-like prolongations of the midrib of the leaf beyond the leaf-tip.

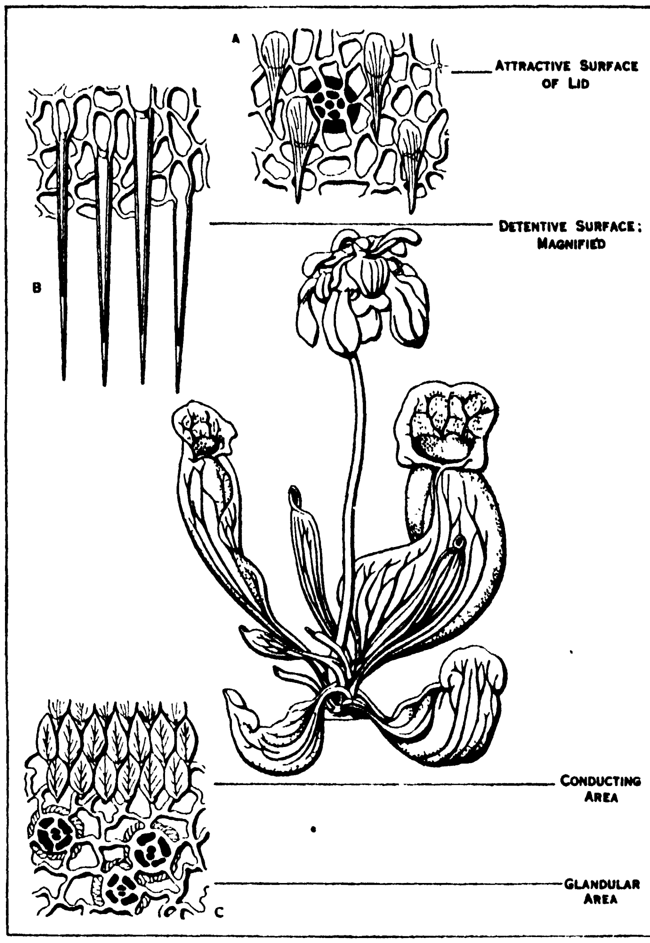


FROM "CURTIS' BOTANICAL MAGAZINE"

PITCHER PLANT (CEPHALOTUS FOLLICULARIS), SHOWING LEAVES, PITCHERS AND TALL FLOWER STEM WITH SMALL FLOWERS

The pitcher is a development at the end of the tendril and is generally tubular in form and often shows a pair of wings running longitudinally on the outer surface. The mouth of the pitcher has a corrugated rim (peristome) formed by incurving of the margin, the convex surface of which is firm and shining. It is traversed by more or less prominent parallel ridges, which are usually prolonged as teeth beyond the infolded margin. Above the mouth is the lid (operculum), which varies in size from a small narrow process to a large heart-shaped expansion. A study of the development of the pitcher, especially in the young pitchers of seedling plants, shows that the inflated portion is a development of the midrib of the leaf, while the wings, which are especially well represented in the terrestrial type of pitcher, represent the upper portion of the leaf-blade which has become separated from the lower portion by the tendril; the lid is regarded as representing two leaflets which have become fused. The short straight or curved process from the back of the pitcher behind the lid represents the organic apex of the leaf.

The size of the pitcher varies widely in the different species, from a thimble to the size of a quart pot. The colour also varies considerably, even in different pitchers of the same individual, according to age, light exposure or soil conditions. Insects are attracted to the mouth of the pitcher by a series of glands, yielding a sweet secretion, which occurs on the stem and also on the leaf from the base of the leaf-stalk to the lid and peristome.



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

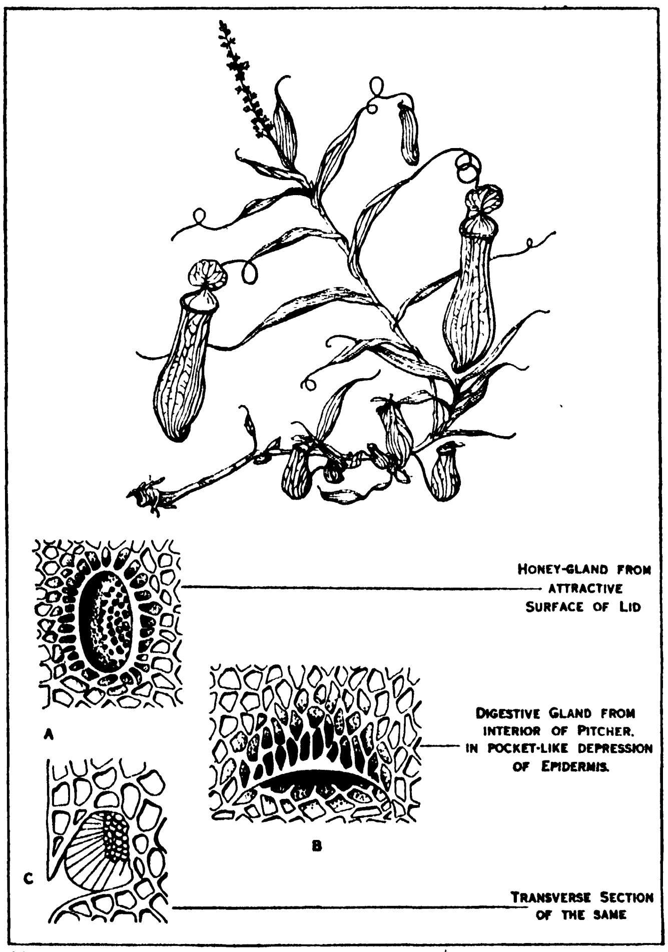
SIDE SADDLE FLOWER (SARRACENIA PURPUREA): SHOWING LEAVES, THE WHOLE OF WHICH FORM THE PITCHERS; AND A, B AND C SHOWING THE MINUTE STRUCTURE OF PITCHERS (A AND C FROM S. FLAVA)

Embedded in the incurved margin of the rim which affords a very insecure foothold to insects are a number of large glands secreting a sweet juice. The cavity of the pitcher is in some species lined throughout with a smooth glistening surface over which glands are uniformly distributed; these glands secrete a watery fluid which is found in the pitcher even in the young state while it is still hermetically closed by the lid. In other species the glands are confined to the lower portion of the cavity surface, while the upper part bears a smooth waxy surface on which it is impossible for insects to secure a foothold. This area is termed the "conducting" area, as distinguished from the lower or "detentive" gland-bearing area. Insects, especially running insects, which have followed the track of honey glands upwards from the stem along the leaf, reach the mouth of the pitcher, and in their efforts to sip from the attractive marginal glands fall over into the liquid. The smooth walls above the liquid afford no foothold, owing to the presence of minute waxy scales, and they are drowned. The fluid, as first secreted, is not acid and contains no digestive enzyme, but the presence of an insect causes the glands to secrete both acid and a proteolytic (protein-dissolving) enzyme. The bodies of the insects are thus digested and the products of digestion absorbed by the glands in the pitcher-wall. Thus *Nepenthes* secures a supply of nitrogenous food from the animal world in a manner somewhat similar to that adopted by the British sundew, butterwort, and

other insectivorous plants. In spite of the presence of a digestive enzyme, the pitchers constantly contain an association of living organism desmids, diatoms, *Acarina*, larvae of Diptera, etc.

The side-saddle plant, *Sarracenia*, native of the eastern United States, is also known as a pitcher-plant. There are about seven species, herbs with clusters of radical leaves some or all of which are more or less trumpet- or pitcher-shaped. The leaf has a broadly sheathing base succeeded by a short stalk bearing the pitcher, which represents a much enlarged midrib with a wing-like lamina. Above the rim of the pitcher is a broad flattened lid, which is also a laminar development. The surface of the leaf, especially the laminar wing, bears glands which in spring exude large glistening drops of nectar. The lid and mouth of the pitcher are brighter coloured than the rest of the leaf, which varies from yellow-green to deep crimson in different species and in individuals according to exposure to sunlight and other conditions. This forms the attractive area, and the inner surface of the lid also bears a large number of glands, as well as downward-pointing hairs, each one having a delicately striated surface.

Below the lid is the conducting surface of glassy epidermal cells, with short downward-directed points, which facilitate the descent, but impede the ascent of an insect. Then come the glandular sur-

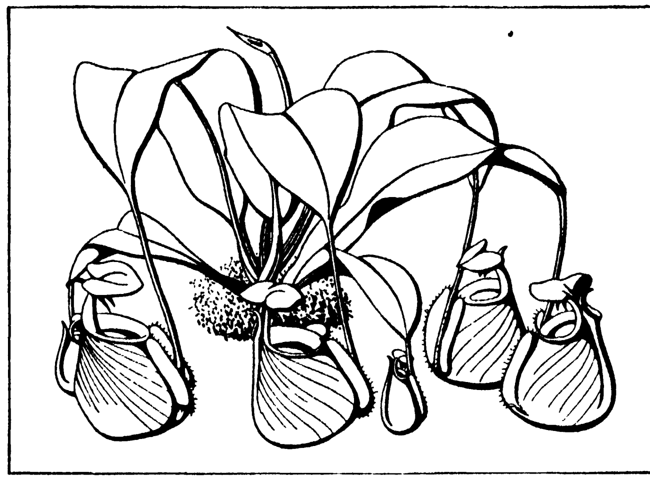


BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

PITCHER PLANT (NEPENTHES GRACILIS): SHOWING GENERAL HABIT OF GROWTH; AND A, B AND C MINUTE STRUCTURE OF PITCHER PLANT

face, which is formed of smooth polished epidermis with numerous glands that secrete the fluid contents of the pitcher, and finally the detentive surface, of which the cells are produced into long and strong bristles which point downwards and meet in the centre of the diminishing cavity so as to render escape impossible. The secretion wets an insect very rapidly, but its digestive power is uncertain. The pitchers accumulate vast quantities of insects in the course of a season, and must thus abundantly manure the surrounding soil when they die. Moreover, the feast is largely shared by unbidden guests. Not to speak of insects which feed upon the pitcher itself, some drop their eggs into the putrescent mass, where their larvae find abundant nourishment, while birds often slit open the pitchers with their beaks and devour the maggots in their turn.

Cephalotus follicularis, a native of south-west Australia, a small herbaceous plant, bears ordinary leaves close to the ground as well as pitchers The latter somewhat resemble in general form



BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

PITCHER PLANT (NEPENTHES BICALCARATA), A PLANT WITH PITCHERS ONLY AT THE END OF THE LEAVES

those of *Nepenthes*. The lid is especially attractive to insects from its bright colour and honey secretion; three wings lead up to the mouth of the pitcher, on the inside of which a row of sharp spines points downwards, and below this a circular ridge armed with papillae serves as a conducting area. A number of glands on the interior of the pitcher secrete a fluid in which insects are found but how they are utilized is still obscure.

For further details, *see* K. Göbel, *Pflanzenbiologische Schilderungen* (Marburg, 1889–93); F. Knoll, "Über die Ursache des Ausgleitens der Insektenbeine an wachsbedeckten Pflanzenteilen," *Jahrb. f. wiss. Bot.* (1914); J. S. Hepburn, "A Study of the Protease of the Pitcher Liquid of *Nepenthes*," *Contrib. Bot. Lab. Univ. Penn.* (1919); P. van Oye, "Zur Biologie der Kanne von *Nepenthes melamphora*," *Biol. Centralbl.* (1921).

PITCHSTONE, in petrology, a glassy igneous rock having a resinous lustre and breaking with a hollow or conchoidal fracture (Ger. *Pechstein,* from its resemblance to pitch). It differs from obsidian principally in its rather dull lustre, for obsidian is bright and vitreous in appearance; pitchstones also contain water in combination amounting to from 5 to 10% of their weight or 10 to 20% of their volume. The majority of the rocks of this class occur as intrusive dikes or veins; they are glassy forms of quartz-porphyry and other dike rocks. Their dull lustre may be connected with the great abundance of minute crystallites and microlites they nearly always contain; these are visible only in microscopic sections, and their varied shapes make pitchstones very interesting to the microscopist.

Although pitchstones of Devonian age are known (*e.g.*, the glassy dacite of the Tay Bridge in Scotland, and the andesite-pitchstones of the Cheviots), most of them are Tertiary or recent, as like all natural glasses they tend to crystallize or become devitrified in course of time. In some of the older pitchstones the greater part of the mass is changed to a dull felsitic substance, while only nodules or kernels of unaltered glass remain. Some are very acid. containing 70 to 75% of silica, and have close chemical affinities to granites and rhyolites; others contain more alkalis and less silica, being apparently vitreous types of trachyte or keratophyre; others have the composition of dacite and andesite, but the black basaltic glasses are not usually classified among the pitchstones. Very well known rocks of this group occur at Chemnitz and Meissen in Saxony. These rocks are brown or dark green in colour, very frequently perlitic, and show progressive devitrification starting from cracks and joints and spreading inwards through the mass. For a long time the pitchstone dikes of Arran, Scotland have been famous for the great beauty and variety of skele-

ton crystals they contain; they are dull green in hand specimens; some of them contain phenocrysts of felspar, augite, etc., others do not, but in all there is great abundance of branching feathery crystalline growths in the ground mass, minute crystalline rods being built together in aggregates which often recall frost patterns. It is supposed that they consist of hornblende. In addition to these larger growths there are many small microlites scattered through the glass, also hair-like trichites, and fine rounded globulites. When phenocrysts are present the small crystals are planted on their surfaces like grass on a turf-covered wall. These pitchstones are believed to proceed from the great eruptive centres of early Tertiary times in western Scotland. Another pitchstone of the same period forms a great craggy ridge or scuir in the island of Eigg (Scotland).

In chemical composition this latter rock resembles the trachytes rather than the rhyolites; in Eigg and Skye there are many dikes of pitchstone, mostly of intermediate rather than of acid character, all connected with the great eruptive activity which characterized that region in early Tertiary times.

The following analyses give the chemical composition of a few well-known pitchstones:—

bishop (10th), formed the nuclei of the town; and the donjon built in the 10th century for Héloïse, lady of Pithiviers, was one of the finest of the period.

PITHOM, one of the "treasure cities" stated to have been built for Pharaoh by the Hebrews in Goshen during the Oppression (Exod. i. 11). We have here the Hebraized form of the Egyptian Petōm, "House of (the sun-god) Etōm," in Greek, Patūmos, capital of the 8th nome of Lower Egypt and situated in the Wadi Tumilat on the canal from the Nile to the Red Sea. Succoth (Egyptian Thuket) was identical with it or was in its immediate neighbourhood. The site, now Tell el Maskhuta, has yielded several important monuments, including the best preserved of the trilingual stelae of Darius which commemorated his work on the canal.

PITIGLIANO, a town in Italy, province of Grosseto. Pop. (1921), 5,845. It is the cathedral city of the bishopric named after the neighbouring town of Sovana, and was originally a fief of the countship of Sovana, which in 1293 came by marriage into the possession of the Orsini. In 1410 Sovana was taken by the Sienese, but the Orsini retained Pitigliano, Gentile Orsini assuming the title of count. In 1562 the Medici of Florence seized part

	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	H_2O
I. Meissen, Saxony	72·42	11·26	0·75	0·28	1·35	2·86	3·80	7·64
II. Corriegills, Arran	72·07	11·26	3·24	tr.	1·53	0·61	5·61	5·45
III. Scuir of Eigg, Scotland	65·81	14·01	4·43	0·89	2·01	4·15	6·08	2·70

The first two of these contain much water for rocks the ingredients of which are but little decomposed. They are of acid or rhyolitic character, while the third is richer in alkalis and contains less silica; it belongs more naturally to the intermediate rocks (or trachytes). (J. S. F.)

PITE, WILLIAM ALFRED (1860–), F.R.I.B.A., British architect, was born on Aug. 4, 1860 in London. He studied at the National Art Training School, afterward winning several studentships. Later he became vice-president of the Architectural Association, and examiner and member of council of the R.I.B.A. His works include an important series of hospitals in London and the provinces, including King's College Hospital; three churches, of which the Perceval Memorial church at Ealing is perhaps the most interesting, and a number of private houses.

PITEŞTI. The capital of the department of Argeş, Rumania; beautifully situated among the outlying hills of the Carpathians, on the river Argeş, which is here joined by several smaller streams, and on the junction of the main Bucharest-Craiova line with branches to Câmpulung and Curtea de Argeş. Pop. (1928) 25,000. The surrounding uplands produce good wine, fruit and grain, and are rich in petroleum and salt; the town is a centre of the petroleum industry. It has lacquer and varnish mills and distilleries.

PITHECANTHROPUS, the name given by Dr. Eugene Dubois, of the Dutch army medical service, to the creature (*P. erectus*) of which he found fossilized remains in Java. These fragments consisted of a thigh-bone, two teeth, and the upper part of a skull, and were unearthed in 1891–92 on the left bank of the Bengawan river near Trinil. The skull appears to have been low and depressed with strong supraciliary ridges; the teeth are very large, and the femur is quite human. The teeth and skull were found together, the femur a few yards away a year afterwards. The discoverer, however, stated it as his belief that the fragments were portions of the same skeleton and belonged to a creature half-way between man and the higher apes and of the Pleistocene age, and, in spite of opposition, is now admitted.

See Dubois, *Pithecanthropus erectus* (1894); a later paper read by Dr. Dubois before the Berlin Anthropological Society, translated in 1898 *Smithsonian Report;* Sir A. Keith, *Antiquity of Man* (1915).

PITHIVIERS, a town of north central France, in the department of Loiret, 28 m. N.N.E. of Orleans, on the railway to Malesherbes. Pop. (1926) 5,540. The town is an important centre for the saffron of the region of Gâtinais. The shrines of St. Solomon (9th century) and of St. Gregory, an Armenian

of their territories, and acquired the rest by exchange in 1580. The Orsini stronghold still stands in the town, which is perhaps identical with the Etruscan Statonia.

PITLOCHRY, village of Perthshire, Scotland, 28½ m. N.W. of Perth by the L.M.S. railway. Pop. (1921), 2,241. It lies on the left bank of the Tummel, a little below the confluence of that river and the Garry, 350 ft. above the sea. It is a tourist centre.

PITMAN, SIR ISAAC (1813–1897), English phonographer, was born at Trowbridge, Wiltshire, on Jan. 4, 1813. He started in life as a clerk in a cloth factory, but in 1831 he was sent to a training college for teachers. After eleven years of teaching in elementary schools he opened a private school in Bath. In 1829 he took up Samuel Taylor's system of shorthand, and became an enthusiast in developing the art of phonography. In 1837 he drew up a manual of Taylor's system and offered it to Samuel Bagster (1771–1852). The publisher did not accept the work, but suggested that Pitman should invent a new system (*see* SHORTHAND) of his own. The result was his *Stenographic Soundhand* (1837). Bagster's friendship and active help had been secured by Pitman's undertaking to verify the half-million references in the *Comprehensive Bible*, and he published the inventor's books at a low price, thus helping to bring the system within the reach of all. Pitman established at Bath a Phonetic Institute and a *Phonetic Journal* for this purpose; he printed in shorthand a number of standard works, and his book *Phonography* (1840) went through many editions. He was an enthusiastic spelling reformer, and adopted a phonetic system which he tried to bring into general use. In 1894 he was knighted. He died at Bath on Jan. 12, 1897. Isaac Pitman's system revolutionized the work of reporting.

His Life was written in 1902 by his brother Benn Pitman (1822–1911) and by Alfred Baker in 1908.

PIT PONY. The pit pony is usually a small pony—14 hands high and under—used for hauling the tubs for the conveyance of coal from the working face of the coal seam to a point, variously termed the "flat," "double-parting," "station" or "landing," where the tubs are made up into "sets" or trains and conveyed, either by horses or, more commonly, by mechanical haulage, to the shaft bottom. That is to say, the pit ponies ply between the face and flat, bringing the full tubs out from the hewer and serving him with empty tubs.

The use of pit ponies has decreased with the extended development of electrically driven haulage underground.

The care and treatment of horses and ponies at mines in the United Kingdom are the subject of stringent provisions in the Coal Mines Act, 1911 (third schedule).

PIT-SHAFT: *see* COAL AND COAL MINING.

PITT, THOMAS (1653–1726), British East India merchant and governor of Madras, usually called "Diamond Pitt," was born at Blandford, Dorset, on July 5, 1653. From his headquarters at Balasore, he engaged in trade in opposition to the East India Company, whom he opposed also in the law courts. Unable to check him the East India Company took him into its service in 1695, and in 1697 he became president of Fort St. George, or Madras. While in India Pitt bought the fine diamond which was named after him; in 1717 he sold this to the regent of France, Philip duke of Orleans, and it is now the property of the French government. During his stay in England Pitt acquired the manor of Old Sarum, and for a short time he represented this borough in parliament. After his final return from India in 1710 he again became member of parliament for Old Sarum. He died at Swallowfield, near Reading, on April 28, 1726. His eldest son, Robert, was the father of William Pitt, earl of Chatham (*q.v.*); and of Thomas Pitt (d. 1761), whose son became the first Lord Camelford; his second son, Thomas Pitt (*c.* 1688–1729), having married Frances (d. 1772), daughter of Robert Ridgeway, 4th earl of Londonderry (d. 1714), was himself created earl of Londonderry in 1726.

See Sir C. N. Dalton, *Life of Thomas Pitt* (1915).

PITT, WILLIAM (1759–1806), English statesman, second son of William Pitt, earl of Chatham, and of Lady Hester Grenville, was born at Hayes, near Bromley, Kent, on May 28, 1759, in the year of the pinnacle of his father's glory. Both because of his extreme delicacy and because his father was an early critic of the public school system, he was educated at home under the tutorship of the Rev. Edward Wilson of Pembroke Hall, Cambridge, and the earnest supervision of Chatham himself—a plan which tended to the intensive development of the child's unusual precocity. Before he was ten years old he was a good classical scholar: at 13 he had composed a strange political tragedy *Laurentino, King of Chersonese.* In Oct. 1773, in his 15th year, he went into residence at Pembroke Hall, Cambridge, where his tutor was the Rev. Dr. George Pretyman (he changed his name in 1803 to Tomline), to whom Pitt in later years awarded the bishopric of Lincoln, and at the last bequeathed his papers: and who in return became his pupil's first biographer. Pitt had not been at Cambridge long when he fell seriously ill and was obliged to return home. It was then that the family physician, Dr. Anthony Addington prescribed that generous consumption of port wine which was to become the habit of a life. He returned to Cambridge in July 1774; and in 1776, by the privilege of his birth as the son of a peer, graduated as a master of arts without examination. That year saw the Declaration of American Independence, and the next the battle of Saratoga. On April 7, 1778 Pitt was the witness of his father's last dramatic utterance in the House of Lords. A month later Chatham died. Pitt was left with an income of £300 a year; he began to keep his terms at Lincoln's Inn; was called to the bar on June 12, 1780 and joined the western circuit. At the general election in September Pitt was defeated for the University of Cambridge but was returned for Sir James Lowther's pocket borough of Appleby. He entered parliament on Jan. 23, 1771: he was not yet 22 years old.

Parliament.—Pitt was attached to that section of the opposition which had followed his father, and was now led by Lord Shelburne. His maiden speech on Feb. 26 was made in support of Burke's Bill for economical reform, and produced a series of famous eulogies, Lord North admitting it the best first speech he had ever heard, and Burke, with even greater prodigality, declaring him "not a chip of the old block but the old block itself." A year later, when North's ministry was near its fall, Pitt had the self-confidence to announce in the House of Commons (March 8, 1782) that, should he conceivably be asked to join the new ministry, he would never accept a subordinate position in it; nor did he alter his mind when Rockingham, shortly afterwards offered him certain well-paid but unimportant posts, and even though one of them—the vice-treasurership of Ireland—had been held by Chatham before him.

As a private member Pitt now supported a new version of Burke's reform project, a measure for shortening the duration of parliaments, and another for destroying bribery at elections. On May 7 he presented his own motion for a select committee to inquire into the state of the representation. It was only defeated by 20 votes. Shortly afterwards the death of Rockingham on July 1 provoked a major crisis. The king appointed Shelburne as his successor. Fox, Lord John Cavendish and Burke immediately refused to serve with him; whereupon Shelburne turned to Pitt, who on July 6 accepted the office of chancellor of the exchequer.

The Shelburne Ministry.—The ministry was only to last until the following February. On Jan. 20, 1783, the preliminaries of the Peace of Versailles were signed, and provided the opposition with an easy target. It was essential for Shelburne to obtain more support, and on Feb. 11, by agreement with his chief, Pitt visited Fox to invite him to return to the ministry. Fox replied that he would only serve on the condition that Shelburne resigned the premiership, whereupon Pitt replied "I did not come here to betray Lord Shelburne." The incident is important. It marks the beginning of the ceaseless political warfare between Fox and Pitt; it marks the end of the Shelburne ministry, and the origin of the coalition between Fox and North. Speaking of North's Government only in the previous year, Fox had declared "From the moment when I shall make any terms with one of them, I will rest satisfied to be called the most infamous of mankind," and he had loudly demanded their impeachment: yet he who had poured his blistering scorn upon North's conduct of the war, now joined with North in execrating the terms of the peace. The ministry was defeated (Feb. 21) and two days later Shelburne resigned. For a month the king sought to escape the coalition. But Pitt, who was pressed to accept the Treasury preferred to bide his time, and North could not be lured from Fox. On April 2 the Fox-North coalition under the nominal leadership of the duke of Portland took office.

The Coalition Ministry.—On May 7 Pitt brought forward resolutions for checking bribery at elections, disfranchising corrupt constituencies, and increasing the number of county and London members of parliament. The resolutions were refused by 293 to 149. On June 2 he brought forward another bill which passed the Commons but failed in the Lords, for reforming abuses in public offices: he instanced North's mysterious consumption of stationery, which totalled £1,300 and contained an item of £340 for whipcord.

During September and October Pitt visited France—his only venture outside his own country. In November parliament reassembled and Fox immediately introduced his India bill. Passed in the Commons the measure was defeated in the Lords (Dec. 17) because George III. plainly informed the peers at large through Lord Temple that he should regard anyone who voted for the bill as his enemy. The Government very properly refused to resign. Whereupon the king, on Dec. 19, depending upon a barely literal interpretation of his constitutional rights, but reflecting by accident the wishes of his people, dismissed his ministers and appointed Pitt as first lord of the treasury and chancellor of the exchequer. The coalition had been jockeyed out of office, and it is not surprising that the House received the news of Pitt's appointment with mirth. It is mistakenly generous, however, to suppose that Pitt assumed office from pure altruism and without a certain confidence in the future. The strident Opposition no longer represented its constituency and Pitt knew it, and while they were wasting their breath deriding the "boyish prank," Pitt was converting the electorate—voters who were to be more valuable to him than the voters in the House of Commons. Almost as important, the influence of the City and of the East India Company was on his side. Until the end of March he struggled on, continually defeated in the House, but steadily refusing to resign. Outside his popularity was growing, while the action of the Opposition in threatening to oppose even the votes of supply cast on them the obvious accusation of factiousness. The hostile majority diminished daily until on March 8 Fox's "representation" was carried by only one vote. On March 24 parliament was dissolved. The essential business had been forced

through. At the ensuing election some 160 of "Fox's Martyrs" were rejected. This was the answer to the charge of unconstitutional action: throughout the struggle Pitt had in fact represented the nation. Pitt was himself elected for Cambridge university, which he represented for the rest of his life.

PITT'S FIRST MINISTRY

Finance.—Finance was the first consideration. There was a heavy debt and the fiscal machinery was antiquated. Pitt floated a loan of £6,000,000, offering the tenders to public competition, and funded £6,600,000 of the floating debt. The loss to the revenue which had long resulted from the systematic evasion of the high protective tariffs he countered by a radical reduction of duties—that on tea being reduced from 119% to 12%. To meet the loss he increased the window tax, and many new taxes were instituted to touch the whole people. But he withdrew the tax on raw cotton, and pronounced it as his principle that "manufactures in general ought to be free from taxes."

Pitt, who had been one of the earliest students of Adam Smith, next attempted the establishment of free trade between England and Ireland. The Irish accepted his propositions (Feb. 7, 1785) but in England the measure was met by the organized opposition of vested interest, prejudice, and faction. Pitt was obliged to alter his original scheme, and in that form the Irish, disappointed and inflamed by Fox's subtle tongue, rejected it.

In 1786 Pitt introduced his sinking fund, a measure adapted from a scheme of Dr. Richard Price (*q.v.*). Economically it was undoubtedly mistaken, but it was believed to be a sovereign remedy, and it at least inspired public confidence.

On April 18, 1785, Pitt brought forward a bill proposing to suppress 36 pocket boroughs and to transfer their members to increase the representation of certain towns and counties. £1,000,000 was to be spent upon the purchase of the interests of the various owners. The bill, for which he eloquently pleaded, was rejected by 248 to 174.

India.—Pitt's India Bill, which had been rejected during the first struggle in the spring of 1784, was passed in the summer easily enough. Pitt's bill, unlike Fox's, left the ordinary patronage with the directors of the company while passing to the Crown the political control. Moreover, he had the tact and the wisdom to consult the company and to present as a final draft a measure to which he knew they were prepared to agree. The bill was not without serious defects—especially in its subordination of the governor-general not only to his council, but in all important concerns to the home Government. Warren Hastings resigned at once, and upon his return, his conduct of the Government was called in question. Pitt who had voted against the Rohilla charge (which was not carried) voted in favour of the Benares and the Begum charges. His action decided the issue. The motions were carried, and the impeachment pursued. Pitt has been heavily criticised for his conduct. But the truth that Hastings had been a great administrator could not disguise the fact that here was a patent scandal, which demanded inquiry. Indeed Hastings, through his agent in the House, had himself originated the discussions; and Pitt deliberately chose to support the Opposition in a matter where he honestly believed them to be right, instead of following the usual custom of opposing whatever measure the Opposition proposed.

The Regency Question.—In Nov. 1788 the king's illness provoked a crisis which might have ended Pitt's political career. There was a traditional enmity between the Hanoverian monarchs and their sons, and the whole influence of the prince of Wales (doubly hostile because Pitt would not pay his debts), was directed to the cause of the Whigs. The king being insane it was essential to appoint a regent, and Pitt was inevitably agreed that there could be no other candidate for the office than the prince of Wales. The point at issue lay in the claim of Fox and his party that the prince had a prerogative right to the position. Pitt claimed that he could only become regent by act of parliament, and drew up that act so as to restrain the regent from making peers or granting pensions, while the king's person and household and the patronage of the Crown were to be placed under the direction of the queen. The bill passed the Commons (Feb. 5, 1789) and while it was under discussion in the Lords the king recovered. The situation had been dangerous, for though the resolutions had been carried, there had been much uneasiness among Pitt's followers. Pitt himself believed that he would be unable to retain office and would have to resume work as a lawyer. The London merchants at this time offered him £100,000 in recognition of his conduct, but Pitt replied that "No consideration on earth shall ever induce me to accept it." At the general election of 1790 he obtained an increased majority. In April 1791 by his Constitutional Act he arranged for the division of Canada into Upper and Lower Canada. The following year he accepted the wardenship of the Cinque Ports which carried a salary of £3,000 a year.

Foreign Policy.—The first important act of Pitt's foreign policy—the commercial treaty with France—was complementary to his reorganization of the home finances. The abandonment of useless trade restrictions was plainly to the benefit of both countries and Fox could think of no better ground of attack than to assert that France was the unalterable enemy of England, to which objection Pitt replied that "to suppose that any nation could be unalterably the enemy of another is weak and childish." In 1787 there was trouble in Holland. The Emperor Joseph II. had been for some time preparing a labyrinthine scheme whereby he should consolidate his dominions by annexing Bavaria, whose elector was to be compensated in the Austrian Netherlands. The scheme was agreeable to France who was intriguing for the overthrow of the Dutch stadholder and complete influence in Holland. War was only avoided after full preparations had been made (an expedition for instance was actually prepared for the capture of the Cape) because Prussia, who was opposed to Joseph II.'s policy was at length persuaded to stand with England. Upon Prussia's entry into Holland the Austro-Russo-French intrigue collapsed and the stadholder was restored. In 1789 England was brought into conflict with Spain who had seized the British trading post at Nootka Sound. Again war seemed imminent (over two millions sterling were spent in naval preparations), but Spain, receiving no support in Europe, was obliged to withdraw. Less successful was Pitt's intervention in the Eastern question. Catherine II. of Russia was at war with Sweden and Turkey. The Triple Alliance (of England, Prussia and Holland) had gained a prestige which placed it in a position to work for the maintenance of the balance of power. But though Austria's support was detached from Russia and Gustavus III. made peace with Catherine, the empress was not to be diverted from her ambitions in Eastern Europe. She gained great success in 1791, and Pitt, without adequate means of supporting his policy, determined to prevent Russia from establishing her power in the Black sea. He demanded that Russia should give up Oczakov, but Oczakov meant nothing on earth to the British public, and Catherine perceiving there was no force behind the ultimatum was unmoved by it. Though armament credits had been voted, Pitt was obliged to retire.

Pitt had not at first anticipated that the French Revolution would involve England in hostilities. In the spring of 1792 he was happily discussing finance, prophesying the reduction of 25 millions of debt in the next 15 years, and declaring in support of his vision that "there never was a time when, from the situation of Europe, we might more reasonably expect 15 years of peace than we may at the present moment." He had no intention of interfering in a matter which concerned France alone, and indeed in its original conception he was not unsympathetic to the aims of the Revolution. On Aug. 10th, the French monarchy fell, and the English ambassador was recalled from Paris, and Chauvelin in London could henceforward be only received unofficially. But this was merely a question of diplomatic routine: friendly relations were not strained until the French, having already declared war upon Austria and Prussia, followed the victory of Jemappes by occupying the Austrian Netherlands, threatening Holland, and overturning the treaties which governed the navigation of the Scheldt. England was bound by treaty to support Holland; and, as she had been through the centuries, she was not less insistently bound in this matter by her own interests. The execution of the king, and among the French people a rising tide of truculence swiftly fol-

lowed. On Feb. 1, while Pitt was outlining the provocations which Britain had received from France that country was despatching yet another in the shape of a declaration of war. The remainder of Pitt's life was to be spent in the shade of the revolutionary wars.

War.—The history of the wars with France is discussed under FRENCH REVOLUTIONARY WARS, NAPOLEONIC CAMPAIGNS, NAPOLEON; FRANCE, etc. It is only possible here to estimate generally the part that Pitt played in the organization of Europe. It has long been a current *cliché* to say that Pitt was a great peace minister and a poor war minister. But if Pitt's talents were indeed essentially suited to peace, it is equally true that Napoleon was finally encompassed in disaster by the dogged determination of the English premier, and after his death by the remembered influence of that resolution. To compare him with his father is idle; Chatham had every advantage. His allies were great commanders, his France was effete. But revolutionary France was inspired with a fanatic hope, and England's continental allies proved continually worthless. Year after year Pitt laboured to sustain his coalitions of the Powers; year after year the coalitions melted away before the victorious advances of the French. England, who had no call to be anything but a member of a general European league against France was forced to be the inspiration as well financially as politically of the entire organization.

Home Policy.—At home the war changed entirely the tranquil prospects of national wealth and prosperity. New voices were in the air—voices of political discontent, and shortly the voices too of hunger. Pitt's policy at home at this juncture is of great importance. Because he never again brought forward the question of reform after his failure in 1785, and opposed it whenever it was proposed by others, his sincerity has been openly called in question. His actions certainly demand some explanation. It is in the first place important to admit that there was as yet no national enthusiasm for reform: the cry had been raised largely in protest against the unconstitutional behaviour of the king, and had been lulled since the declaration of peace; moreover those who had been foremost in urging "economical reform" had no such belief in the necessity of parliamentary reform. A statesman—especially one on whom practically the whole conduct of a Government devolves—can not persist in a measure which has been again and again rejected in one form or another. Pitt had a large majority. But the fact that he remained in office for so long has obscured the truth that he was to a very large extent dependent upon the caprices of that majority. A contemporary political estimate recorded the number of those gentlemen who "would probably support his majesty's Government"—roughly the Court Party—as more than three times the size of Pitt's personal party: and there was a further shifting and entirely independent vote For all his dominance of the House Pitt was sometimes defeated—over the Westminster petition (*see* FOX, CHARLES JAMES), over Ireland, over his proposals in 1786 to fortify Plymouth and Portsmouth. The demand for reform was not seriously supported in the House of Commons. More important still it was not as yet properly vocal outside its walls.

In 1792 Tom Paine's *Rights of Man* had been published, suddenly jolting the English Radical movement into a new mind at the moment when the French doctrines were filtering into England in a fashion admittedly designed to provoke dissensions. The circumstances had become altered. Pitt's refusal to support the motion for the repeal of the Test and Corporation Acts in 1789 and 1790 was unintelligibly craven; but when he refused to support Grey in 1792 he had excuse. "The hurricane season" had set in. Pitt allowed himself to be stampeded by a species of panic which was entirely unjustified by the facts. Talleyrand at this time remarked that those curiously deceived themselves who believed that England was on the verge of revolution. He was a more shrewd observer of truth—but it must be admitted that he had the advantage of looking at Britain not only in perspective but also dispassionately. Deceived or not, Pitt declared that this was no time to revise a constitution, and proceeded to punish severely any who should advocate reform doctrines. It was lamentable; it was essentially unjust; and there is but one excuse—the excuse which in sympathy has condoned many shameful persecutions, when things are done in panic which are never justified by the patent facts but are believed to be necessary for profound reasons of State that can only be guessed at.

In 1793, and again in 1795–1801 *Habeas Corpus* was suspended, and bills for the suppression of sedition followed. There succeeded the trials and transportations of men like Skirving, Margarot, Gerrald, Muir, condemned for nothing more treasonable than advocating parliamentary reform or universal suffrage. Societies for constitutional reform were raided and suppressed. It is unpleasant to find that the records of the confiscated papers of those clubs reveal without exception nothing indicative of revolutionary organization. And yet in 1795 Pitt declared that were he to resign he would lose his head within six months. The circumstances were extraordinary, and it is just to suppose that Pitt was honest: he was not the less grievously wrong.

It was not long before the pain of war was felt in England. Pitt had based his confidence in a short period of war upon the pathetic belief that France would be financially incapable of sustaining a prolonged struggle. But the war advanced, and Pitt's subsidies were swallowed up upon the Continent by allies who made little or no return for them. The nation's debt mounted. The coalition crumbled. More money to buy more allies was needed In 1795 after a season of bad harvests Pitt had to ask for a loan of 18 millions, and to increase the general taxation. Shortly afterwards followed the legacy duties. In 1797 taxation was increased by two millions; the next year produced the income tax

Ireland.—One of Pitt's major pre-occupations was still Ireland. He had failed in 1785, but he never ceased to plan for the final consummation of his hopes. In 1793 Pitt forwarded the passage in the Irish House of Commons of the Catholic relief bill; but in 1794 he suffered disappointment when Irish opinion was again alienated by the position he was forced to adopt against the antics of Lord Fitzwilliam, who had been made lord lieutenant as a concession to the Portland Whigs who had entered the ministry in that year. Fitzwilliam and his party were anxious for a broad policy of reform and emancipation; but Pitt had laid down a cautious line of action, and it had been determined that Fitzwilliam should do nothing without the consent of the cabinet. But by "an open breach of a most solemn promise" he proceeded to dismiss the Irish Tory officials, and without authorization to promise widely the immediate prospect of a full emancipation. Fitzwilliam was recalled, and Ireland left to nurse an angry grievance. The whole bungling led directly to the disasters which followed; the state of semi-civil war in 1797 and the rebellion of 1798 and that disaffection which could welcome the French invasion. The union of Ireland and England which he had sought earlier for the mutual benefit of both countries was now imperative as a solution to a state of war. On Jan. 23, 1799, Pitt brought forward his proposals for a union of the two countries. Emancipation was not promised (the hostility of George III.'s eccentric conscience precluded the suggestion) but the hope was held out that this would follow in due course. The bill was pressed through the Irish parliament by Cornwallis, the viceroy, and Castlereagh, the secretary for Ireland. The distribution of titles and money played some part in this and more than a million pounds was expended in compensation to the holders of suppressed rotten boroughs. However open to moral criticism the latter decision may have been, it was essential to the support of the bill and it destroyed an entirely dishonest system of representation. As for the measure of the general corruption, that has at least been over-estimated, and in so far as material persuasion was adopted it must be remembered that bribery in the Irish parliament was a deeply respected tradition. Moreover it must have been patent to the guiding minds in Ireland that the present state of affairs was impossible, and the possible benefits of the union, for instance to trade, were obvious. The bill having passed the Irish parliament in 1800, the first united parliament met in Jan 1801. Pitt had now to enlarge his policy, and once more the solution of Ireland's troubles was tragically postponed. Pitt had not promised emancipation, but those who had voted for the measure had been led to expect that it must follow. With a secrecy which

was perhaps unwise but understandable in the circumstances Pitt drew up his preliminary suggestions for the abolition of religious tests, the commutation of tithes, and provision for Catholic and dissenting clergy. The plan was opposed in the cabinet, principally by Lord Loughborough, the chancellor, who reported the matter to the king. George was enraged, and adamant against the proposals, and on Feb. 5 accepted the resignation which Pitt had tendered on Feb. 3. Immediately afterwards the situation was complicated by the king's relapse. During his temporary insanity, Pitt retained office until his recovery, finally resigning on March 14. Many bitter things were spoken of him. Once again he was accused of betraying his cause. But he had boldly brought forward his reforms, and his resignation followed upon their veto. Had he pressed his legislation, the king would have persisted inevitably in his opposition: moreover with the war going extremely ill it was not the moment to precipitate a domestic crisis. His promise to George never again to introduce the subject during the reign was sentimental, not necessary, and politically unwise. But he made it because the king had accused him of causing his illness and after all he might reasonably expect that the reign would be shortly finished. That Pitt intended to return to the fullest implications of his project is certain. But he himself had only five more years to live.

1801–1806

Retirement.—Henry Addington, who was called upon to lead the Government, had been universally praised as an expert speaker of the House of Commons; but he was no statesman. Pitt promised to do all he could to support Addington, and generously assisted in the conduct of negotiations for the Peace of Amiens. These terms which Grenville branded as "disgraceful and ruinous" appeared in general "highly satisfactory" to Pitt. Though he had long been anxious to conclude any peace which was at all reasonable, it is difficult to justify him in supporting a peace which recognized the failure of the coalitions to establish the independence of the Netherlands—which had been the ostensible *casus belli.* On the other hand there is evidence that Pitt was conscious of the unstable nature of the peace, and foresaw that a greater struggle was probable. The public supported the peace; and during the discussions a severe vote of censure upon Pitt was rejected, and a counter motion passed by 211 to 52 declaring that he had "rendered great and important services to his country, and deserves the thanks of the house." He retired now from parliament for the space of about a year, living largely at Walmer Castle, where as warden of the Cinque Ports he organized with great diligence and enthusiasm a local volunteer force. The brief interval gave an opportunity too for the examination of his debts. Pitt who had been so astute in public economy was careless of his own. He who had scornfully demanded an explanation of Lord North's expenditure of £340 of public money on whipcord, had himself to account for the grotesque item of £600 for hats. Both thoughtless and generous, Pitt was the victim of swindlers, and in 1800 already owed £45,000 despite the fact that he had received a salary of over £10,000 for many years. He nevertheless refused an offer of £100,000 from the citizens of London, and a gift of £30,000 from the king, though he accepted £11,700 as a loan from a committee of private friends; he was obliged to sell his house Hollwood.

Addington had won a great victory at the general election, but it was not long before his policy began to drift towards perilous courses. When it was clear that a rupture of the peace was imminent, Pitt was approached, but he no longer felt that Addington's policy could receive his honest support, and later negotiations provoked so wide and insistent divergencies of mind upon the personnel of a possible cabinet as to make agreement impossible and even to interrupt an ancient friendship. War broke out again on May 16, 1803. Against the insufficient programme of the ministry Pitt opposed a vigorous policy in a speech (May 23) which provoked the enthusiasm of all parties. But while the cleavage was growing plainer and plainer Pitt yet refused directly to oppose Addington, to whom he had promised his support. The situation was becoming increasingly serious. In the face of the growing danger of invasion the measures of the Government were entirely inadequate, and early in 1804 Pitt was forced into stronger opposition. Complicated once again by a threatened relapse of the king, negotiations for a stronger administration were protracted. The ministry was doomed when a motion of Fox's for a committee of enquiry into the national defences was powerfully supported by Pitt, and after some days of negotiation he returned as chancellor of the exchequer and first lord of the treasury on May 10.

Second Ministry.—Pitt's second term of office was marked by no great enterprises of governance. The war alone absorbed his energies. The labour and the inspiration of the great European coalition again rested exclusively upon Pitt, and his health, now gravely undermined, was beginning to break beneath the strain when early in April 1805 he suffered the pain of witnessing the public disgrace of his old friend and colleague Dundas (Lord Melville, *q.v.*). The battle of Trafalgar (Oct. 21) destroyed the possibility of invasion; but the year closed in disaster. The capitulation of Ulm (Oct. 20) was succeeded by Austerlitz (Dec. 2). At first Pitt was able to doubt the full implications of the news; but, gradually as despatches authenticated the reports he came to realize that the mighty coalition was hopelessly broken. England had saved herself by her exertions, he had remarked at the Lord Mayor's banquet in the previous November: she would save Europe by her example. And now Napoleon stood without a force to oppose him upon the whole continent; and Pitt, with prophetic accuracy, was brought to the bitter admission that the map of Europe would "not be wanted these ten years." On Jan. 23, 1806, he died, and if his last words were not "My country! How I leave my country!" his thoughts can have been none other.

Constitutional Importance.—The period of Pitt's government covered a supremely important moment of political transition. It was also a period of a not less important crystallization of British constitutional doctrine. It would be wrong-headed to attribute that growth too strongly to Pitt's political acumen. Both the length, and the critical instant, of his ministry made development natural and inevitable. He was placed in the position of leadership at precisely the tactical moment. The fruit was ripe: but it was the harvest of a century of other men's labours. Pitt was the first Hanoverian minister to appeal definitely from the vote of the House of Commons to the vote of the constituencies, and throughout his career his strength was derived from the public confidence. In his colleagues Pitt appeared to prefer industry to genius. If this was partly because of an exaggerated sense of his own authority, it must also be remembered that the choice was also one of necessity. Pitt did overshadow his colleagues—but it was no difficult task. The result contributed to his general theory that the independence of Government departments was impossible. They must rather be bound together with a corporate policy, responsible to the Crown under a common allegiance to the prime minister. Walpole, who is generally considered the first prime minister, denied the title, and was succeeded by Governments which could only exist under the leadership of duumvirates and triumvirates. Pitt not only claimed the title of prime minister but declared that the office was essential to sane government. In 1803, when negotiations were on foot for a ministry in which the authority should be shared by himself and Addington, he stated that it was "an absolute necessity that there should be an avowed and real minister, possessing the Chief Weight in the Council and the principal place in the confidence of the King; in that respect there can be no rivalry or division of power. It must rest in the person generally called *first minister,* who ought to be at the head of the finances." And if a difference of opinion arose "the sentiments of the minister must be understood to prevail." This view moreover was widely understood by contemporary commentators. In 1794 when Lord Fitzwilliam went to Ireland he was pledged to support the Government "considering Mr. Pitt as the *Prime Minister* without whom no material measure as to *Things* or *persons* is to be concerted or done" (*Carlisle Papers*); and the Glenbervie Diary (Dec. 30, 1798) corroborates this language. In everything Pitt laboured to assert the authority of the cabinet, and of the premier within the cabinet. He was the king's

minister; but not the minister of the king's policy. The theory was thrashed out over small details. Pitt claimed, for instance, that the Crown must follow his recommendations in the nominations of bishops, and when the king refused to concur declared that he would take it as a decisive mark of lack of confidence.

Cold, aloof, and sarcastic, supporting a reputation for an almost tiresome integrity, Pitt was not popular except, at a distance, with the people, who saw him as an inspired leader, or with his few intimates, who found him secretly gentle and affectionate. In perspective he has become a man of no little mystery and of unexpected inconsistencies. There seems no good enough reason adequately to explain his changed attitude towards Reform; his treatment of the Reform agitators; his cold indifference to social suffering in England; his support of the Addington ministry in spite of his patent disapproval of its conduct; the lack of a firmer policy during the Fitzwilliam fiasco in Ireland. He remains a statesman: indisputably supreme in debate and tactics and tireless in organization. Because of the failure of the allied cause in the war, it was once popular to assume that Pitt neglected the army and navy, depending solely upon his efforts as an international financier. The assumption is entirely unfair. British naval prestige was at a low ebb at the end of the American war, and it was largely owing to Pitt's interest and to his generous allocations of money that the administration was reformed, and the mastery of the sea re-captured. When Pitt entered office English credit was debased: restoration was effected by his regenerated understanding of finance. In 1783 England was practically outside the concert of Europe, yet in a few years she had become the director of an almost united European policy. A true perception of the future of the Empire was not to come before the 19th century. Yet Pitt's colonial interests were remarkably wide—covering not only the great administrative acts for India and Canada but also the colonization of Australia; the fortification of the West Indies; the defence of Nootka Sound. African settlements were considered, and the territories annexed during the war selected with remarkable discretion.

Actually and theoretically Pitt bridged the distance between the 18th and 19th centuries. He was the source of the emancipation of trade and finance from antiquated restrictions. He was the origin of modern financial theory. Yet, though he warmly supported the abolition of the slave trade, he did nothing to improve the condition of the worker, nothing to promote social emancipation at home. That is perhaps the measure of his position in history. He is revered but not loved.

Pitt was never married. He once professed a tender inclination towards the daughter of Lord Auckland; but the embarrassment of his debts prevented him from a formal declaration of his feelings. His real passion was for his work; and to that he gave his life.

Bibliography.—The article in the Dictionary of National Biography contains a full bibliography. *See especially* Lord Rosebery's *William Pitt* and the works of Prof. J. H. Rose: *William Pitt and National Revival*, and *William Pitt and the Great War* (also published in one volume *Life of William Pitt*); *Pitt and Napoleon;* and *A Short Life of William Pitt.* (V. C. C.-B.)

PITTA, a genus of birds remarkable for their great beauty of coloration. For a long while the pittas were commonly supposed to be allied to the *Turdidae*, but they form a separate family, *Pittidae* of the Passeres. There are about 50 species, divided into a number of genera, confined to the Old World, and ranging from India and North China to Australia, New Guinea and New Britain, with one species in West Africa, the greatest number being found in Borneo and Sumatra. Pittas vary in size from that of a jay to that of a lark, and have a strong bill, a thick-set form, which is mounted on rather high legs with scutellated "tarsi," and a very short tail. In many of the forms there is little external difference between the sexes.

PITTACUS, of Mytilene in Lesbos (650?–570 B.C.), one of the Seven Sages of Greece. About 611, with the assistance of the brothers of the poet Alcaeus, he overthrew Melanchrus, tyrant of Lesbos. In a war (606) between the Mytilenaeans and Athenians for the possession of Sigeum on the Hellespont he slew the Athenian commander Phrynon in single combat. In 589 his fellow citizens entrusted Pittacus with despotic power (with the title of Aesymnetes) for the purpose of protecting them against the exiled nobles. He resigned the government after holding it for ten years. According to Diogenes Laërtius, who credits him with an undoubtedly spurious letter to Croesus, Pittacus was a writer of elegiac poems, from which he quotes five lines.

See Herodotus v. 27, 94; Diog. Laët. i. 4; Lucian, *Macrobii*, 18; Strabo xiii. 600, 617–618; Aristotle, *Politics*, ii. 12, iii. 14; T. Bergk, *Poetae lyrici graeci.*

PITTOSPORUM, in botany, the most numerous genus of the family Pittosporaceae, comprising about 100 species of evergreen trees and shrubs, native to tropical regions of the Old World, chiefly in the Southern Hemisphere. Many species are grown as ornamentals in warm regions, as in Florida and California, and as house or greenhouse plants in cooler latitudes. *P. Tobira* (Japanese pittosporum) and *P. viridiflorum* (Cape pittosporum) are attractive winter-blooming shrubs; *P. rhombifolium* (Queensland pittosporum) is often planted for avenues; *P. undulatum* (Victorian box), of Australia, is suitable for pruned hedges; *P. eugenioides* (tarata), of New Zealand, is useful in shrubberies; and *P. crassifolium* (karo) is planted for seaside windbreaks.

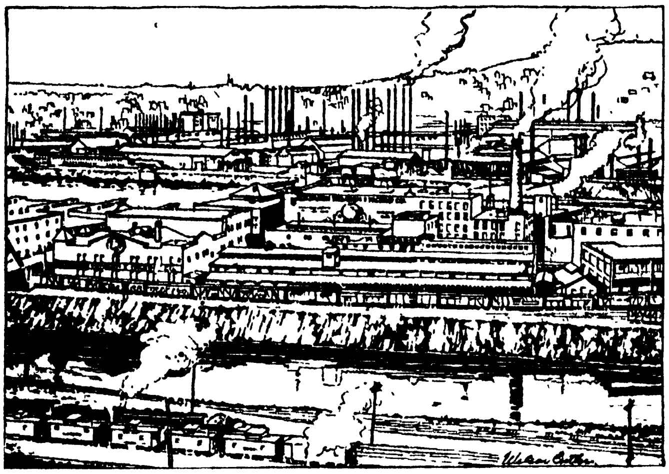
PITT-RIVERS, AUGUSTUS HENRY LANE-FOX (1827–1900), English soldier and archaeologist, son of W. A. Lane-Fox, was born on April 14, 1827. He entered the army, served in the Crimean War, and was one of the founders of the Hythe School of Musketry. General Pitt-Rivers made a collection of weapons and other things which was presented in 1883 to the University of Oxford. When, in 1880, General Pitt-Rivers obtained possession of his great-uncle's estates—practically untouched by the excavator since they had been the battleground of the West Saxons, the Romans and the Britons—he devoted himself to exploring them. His excavations round Rushmore resulted in valuable "finds"; he founded a local museum and published several illustrated volumes. As a scientific archaeologist he attained high rank. He received various honours, including the F.R.S. He married, in 1853, Alice Margaret, daughter of the second Lord Stanley of Alderley, and was the father of a large family; his second daughter became in 1884 the wife of Sir John Lubbock (Lord Avebury). He died at Rushmore on May 4, 1900.

PITTSBURG, a city of Contra Costa county, California. It is served by the Santa Fé, the Southern Pacific, the Western Pacific and electric railways and by steamship lines. Pop. 4,715 (1920), 35% foreign-born white; estimated locally at 14,000 in 1928. It has fisheries, salmon and fruit canneries, bean dryers, the largest steel works west of Chicago, ship-yards, planing mills and asbestos, rubber, cigar and chemical factories. It was founded in 1835. Coal was discovered in 1863, and the town was incorporated under the name of Black Diamond. In 1911 it was chartered as a city and the present name was adopted because of its industrial development and prospects. Since 1918 it has had a city-manager form of government.

PITTSBURG, a city of Crawford county, Kansas, U.S.A., on Federal highway 73E, near the south-east corner of the State It is served by the Frisco, the Kansas City Southern, the Missouri Pacific, the Santa Fe, and electric railways. Pop. 18,052 in 1920 (92% native white); 22,000 in 1928. It is in a great bituminous coal-field, where 3,000,000 tons or more are mined annually, and is near oil and gas-fields and the lead and zinc region of Kansas and Missouri. The main shops of the Kansas City Southern railway are here, and there are iron foundries, large brick and sewer tile works, and other manufacturing industries, with an aggregate output in 1925 valued at $4,632,914. Bank clearings for 1926 amounted to $78,800,000. The Kansas State Teachers college of Pittsburg (established 1903) has an annual enrolment of over 5,000. The city was settled about 1879 and chartered in 1880, when the population was 624. Between 1880 and 1890 it increased more than tenfold.

PITTSBURGH (sometimes, but erroneously, spelled Pittsburg), the second largest city of Pennsylvania, U.S.A., and the county seat of Allegheny county, on the Allegheny, Monongahela

and Ohio rivers, 440m. by rail, W. by S. of New York city, 348.5m. W. by N. of Philadelphia, 368m. N.W. of Washington and 468m. E. by S. of Chicago. Pop. (1910, after annexation of Allegheny) 533,905, and (1920) 588,343, increased (1927 U.S. census est.) to 665,500. In previous census years, the population was as follows: (1800), 1,565; (1820), 7,248; (1840), 21,115; (1860), 49,221; (1880), 156,389; (1890), 238,617; (1900), 321,616. After the 1920 census was taken, and up to 1927, parts of Chartiers, Reserve and Lower St. Clair townships, Frick Woods and St. Clair, Carrick, Knoxville and Westwood boroughs, with a population of 30,000 were annexed. Area 31,474·43ac. or 49·179 square miles. The chief business area, called the golden triangle, covers 974·3ac. or 1·52 square miles. Population within 10m. radius, 659·44 sq.m. (1920), 1,207,504, and of Allegheny county (1920), 1,184,832. As a city Pittsburgh ranks ninth and as a metropolitan fifth, in the United States. The sesquicentennial anniversary (1758–1908) of the city was elaborately observed in 1908.


THE CARNEGIE STEEL WORKS, ONE OF THE MANY STEEL PLANTS IN PITTSBURGH; SEEN FROM TROY HALL, ON THE NORTH SIDE

In the city, illiteracy is 4·8% compared with State average 4·6% but the illiteracy of native white is 0·3 compared with State average 0·8. The negro population was (1920) 6·4% or 37,725. Orientals are few. Of the 120,266 (1920) foreign born, 7,374 were natives of England, 2,758 of Scotland, 13,989 of Ireland, 1,512 of Wales, 1,049 of Sweden, 16,028 of Germany, 15,531 of Poland, 13,837 of Russia, 10,072 of Austria, 4,323 of Hungary, 3,607 of Czechoslovakia, 3,784 of Yugoslavia, 2,242 of Lithuania, 15,371 of Italy, 1,489 of Canada and 7,294 miscellaneous. Pittsburgh is served by the Pennsylvania, the Baltimore and Ohio, the New York Central (Pittsburgh and Lake Erie), the Buffalo, Rochester and Pittsburgh, the Bessemer and Lake Erie, and the Pittsburgh and West Virginia railways, and by boats on the Ohio, Monongahela and Allegheny rivers.

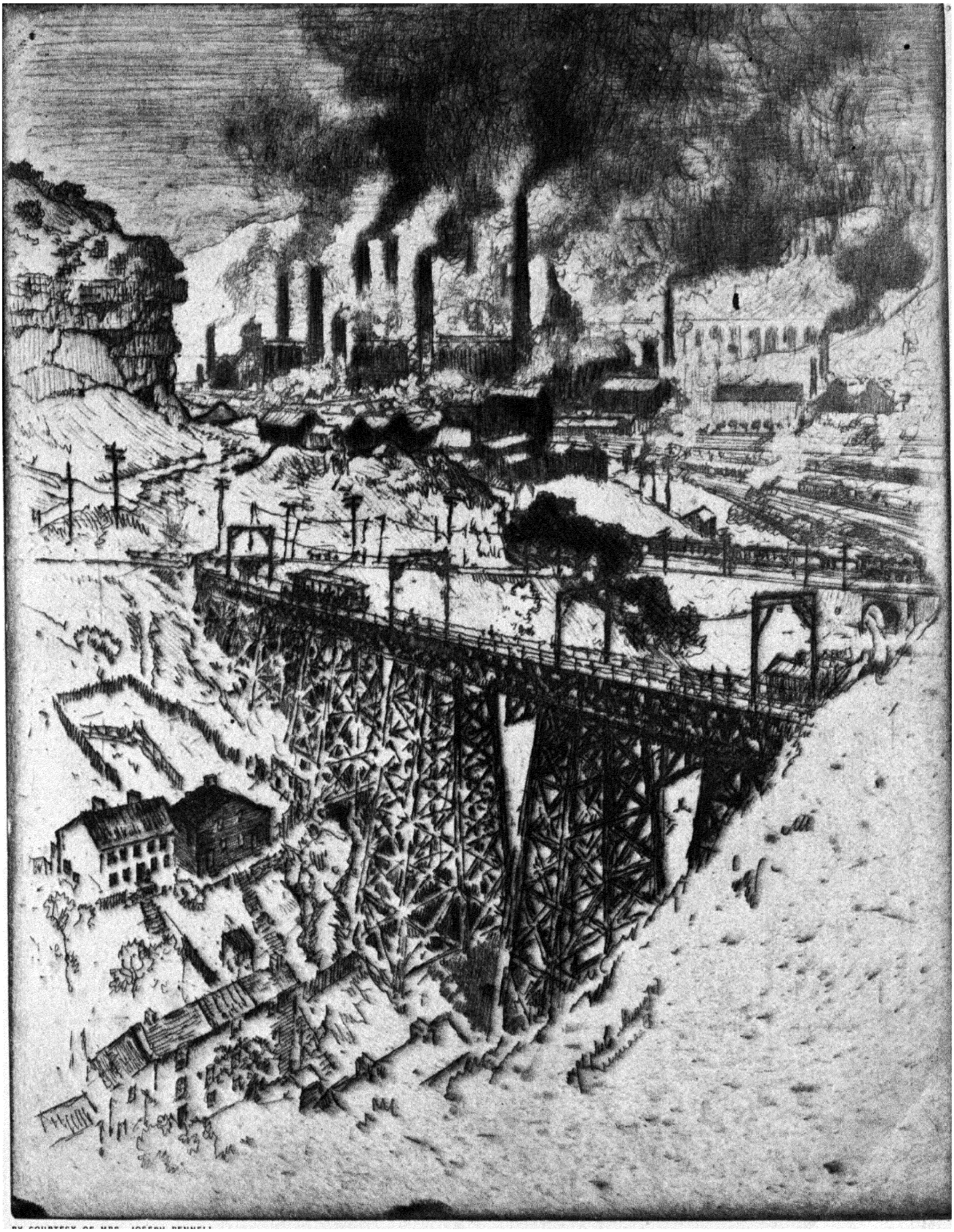
Picturesque rolling plateaux, the three rivers and narrow valleys from which rise high hills or precipitous bluffs, are the principal natural features of the district over which the city extends. Retail houses, wholesale houses, banks, tall office buildings, hotels, theatres and railway terminals are crowded into the angle, or "The Point," formed at the confluence of the Allegheny and Monongahela rivers, with Fifth avenue as the principal thoroughfare, especially for the retail houses, and Fourth avenue as the great banking thoroughfare. Factories extend for several miles along the banks of all three rivers into the tributary valleys, and are the cause of Pittsburgh's former nickname, "The Smoky City." With the practical elimination of smoke through the use of natural gas, a more recent nickname is the "Steel City" or "Electric City." The more attractive residential districts are on the plateau in the eastern portion of the district between the Allegheny and Monongahela rivers and on the undulating hills overlooking the Allegheny river from the north. Overlooking the Monongahela river is Schenley park (about 422ac.), the first city park, of which about 400ac. were given to the city in 1890 by Mrs. Mary E. Schenley. About 2m. to the north, overlooking the Allegheny river, is Highland park (about 366ac.), which contains the city reservoirs and a picturesque lake. Not far from Schenley park are Homewood and Calvary cemeteries; and the Frick woods (21ac.) donated for a park by the late Henry C. Frick; and not far from Highland park is Allegheny cemetery, also overlooking the Allegheny river. Across the Allegheny river, in the Allegheny district, are the beautiful Riverview park (240 ac.) in which is the Allegheny observatory, and West park (about 100 acres). In 1927 the county acquired the North and South parks (each 1,200ac.). Sixteen bridges span the rivers. The county in 1923 completed twin tunnels—each tube 25ft. wide and 5,889ft. long—at a cost of $6,000,000 under Mt. Washington to connect the southern hill with the city by a high-level bridge over the Monongahela.

Public Buildings and Institutions.—The city has some fine public buildings, office buildings and churches. The Allegheny county court house (1884–88) is one of H. H. Richardson's masterpieces. The Nixon theatre is also notable architecturally. The high Frick office building has exterior walls of white granite; in its main hall is a stained-glass window by John La Farge representing Fortune and her wheel. A large Government building of polished granite contains the post office and the customs offices. Other notable buildings are the City-County, Union Trust, Chamber of Commerce and a dozen others, equally imposing, together with several new hotels. St. Paul's cathedral (Roman Catholic, 1903–6) is largely of Indiana limestone. The city is the see of a Roman Catholic and a Protestant Episcopal bishop, and the residence of a bishop of the Methodist Episcopal Church. Other fine churches are Calvary, Sacred Heart, First Baptist and First Presbyterian. At the entrance to Schenley park, a great civic, educational, art and social centre is in process of development, including the University of Pittsburgh, Carnegie Institute and School of Technology, the Twentieth Century, University, Athletic, Knights of Columbus, Y.M.H.A. clubs, Soldiers' and Sailors' Memorial Hall, Masonic Temple, Syria Mosque, Armory, Schenley hotel, Forbes field (1903) and University stadium and, under construction in 1928, the 31-storey Cathedral of Learning.

In Schenley park is the Carnegie Institute (established by a gift of $10,000,000 from Andrew Carnegie, who made further contributions for its maintenance, its endowment in 1927 being $7,300,000 and that of the school $15,346,000 with provision for an addition to the latter of $12,000,000 by 1946) with a main building containing a library, a department of fine arts, a museum and a music hall, and separate buildings for the School of Technology which had (1927) 335 teachers and 6,716 students. The main building, dedicated in April 1907, is 600ft. long and 400ft. wide; in its great entrance hall is a series of mural decorations by John White Alexander, a native of the city. The library, in which the institution had its beginning in 1895, contained (1927) 630,629 volumes and has nine branches. The art department maintains the only international exhibition of modern paintings in the United States. The Phipps conservatory was presented to the city in 1903 by Henry Phipps (b. 1839), a steel manufacturer associated with Andrew Carnegie. It is the largest in America, and, with its Hall of Botany, which is utilized in instructing school children in botany, is situated in Schenley park. There is a zoological garden in Highland park.

In December 1907 it was decided that the several departments of the Western University of Pennsylvania, then situated in different parts of the city, should be brought together on a new campus of 43ac., increased to 77ac. (1927), near the Carnegie Institute. In July 1908 the name was changed to The University of Pittsburgh, in which are (1927) 824 professors and 10,207 students. The institution had its beginning in the Pittsburgh academy, which was opened perhaps as early as 1780 and was incorporated in 1787. It was incorporated as the Western University of Pennsylvania in 1819.

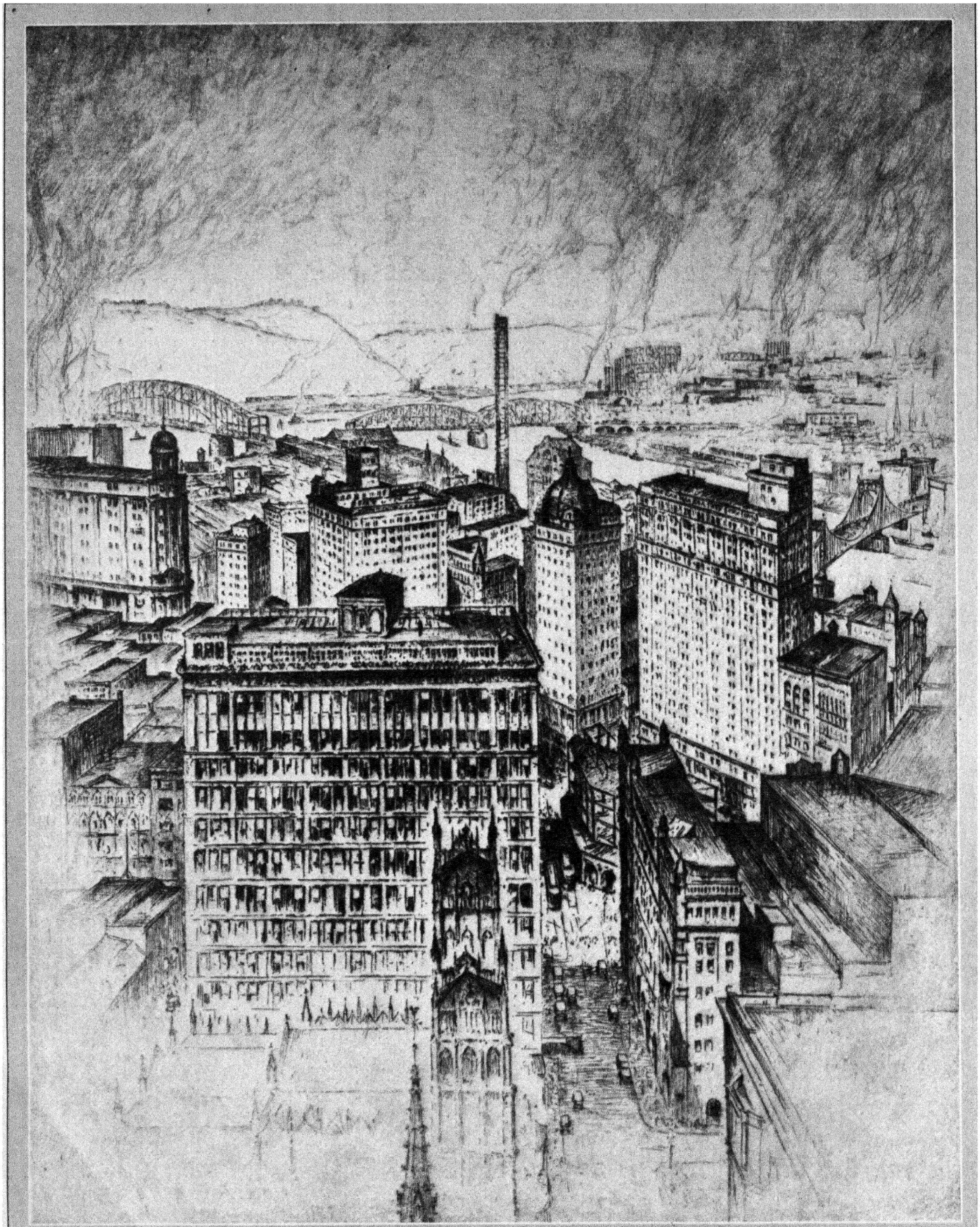
The Pennsylvania College for Women (Presbyterian; chartered in 1869), has collegiate and musical departments, and in 1927 had 39 teachers and 348 students. Overlooking the golden triangle is Duquesne university (Roman Catholic) with its schools of liberal arts, commerce, pharmacy and law and its 104



BY COURTESY OF MRS. JOSEPH PENNELL

AN ETCHING BY JOSEPH PENNELL OF STEEL WORKS IN PITTSBURGH

"Edgar Thomson's Steel Works," one of Pennell's etchings of scenes in the Pittsburgh steel manufacturing district



THE PITTSBURGH BUSINESS SECTION

A view of Pittsburgh, from an etching by Anton Schutz, looking toward the Monongahela and Allegheny rivers, which here join to form the Ohio river

teachers and 6,716 students (1927). In the Allegheny district are the Allegheny Theological seminary (United Presbyterian, 1825), the Western Theological seminary (Presbyterian, opened 1827), and the Reformed Presbyterian Theological seminary (1856). Under the new school code (1911) a board of education consisting of 15 members appointed by the judges of the common pleas courts controls the public schools. There were (1927) 17 high schools, with 979 teachers and 22,727 pupils, one Teachers' Training school, six special schools, 136 elementary schools, with 2,022 teachers and 79,122 pupils and evening schools with 12,224 pupils. The parochial schools had 11 high schools, 84 teachers and 2,837 pupils and 78 grade schools, 817 teachers and 38,254 pupils; and there are many private schools and academies, among them Shadyside academy. The Henry C. Frick Education Commission has an endowment of several millions for the improvement of teaching in the public schools.

The *Pittsburgh Gazette* (1786) was probably the oldest newspaper west of the Allegheny mountains and was (1906) consolidated with the *Times* (1879) under the name of *Gazette-Times* and recently (1927) consolidated with the *Post* (Sunday, 1792; daily, 1842) under the name *Post-Gazette,* the only morning paper. The evening papers are *Sun-Telegraph* and the *Pittsburgh Press* which purchased and discontinued (1923) the *Dispatch* (1846) and the *Leader* (Sunday 1864, daily 1870). A German and a Polish daily, weeklies in Slovak, Italian and other languages, and iron, steel, building, coal, glass, agriculture and other trade journals are published in the city. In Pittsburgh are published the *Presbyterian Banner* (1814, the second oldest religious paper in the United States), the *United Presbyterian,* the *Christian Advocate,* the *Catholic Observer,* the *Pittsburgh Catholic* and other weeklies.

The oldest hospital was the Reineman (1893), for maternity cases, made the University maternity hospital (1893) and transferred to Magee hospital (1910), the latter with the Children's, Eye and Ear and Presbyterian forming the new medical Centre of the University of Pittsburgh Other hospitals are: Municipal (1878), Tuberculosis, Homeopathic, Montefiore, Passavant, Roselia Maternity, St. Johns, St. Josephs, St. Margaret Memorial, South Side, West Penn, Allegheny General, Columbia, in charge of United Presbyterian Women's Association, and the Sisters of Mercy, Mercy hospital, Sisters of St. Francis, St. Francis hospital, and the Sisters of Charity, Pittsburgh hospital. The Western Pennsylvania schools for the deaf and for the blind, are located in Pittsburgh and many of the hospitals, schools, homes and charitable institutions, non-sectarian, are in part maintained by the State. The Y.M.C.A. had 14 branches and the Y.W.C A. (metropolitan) had six branches (1927), and there were 556 churches, 20 all-year playgrounds, 14 public swimming pools, 28 parks and over 200 social and welfare agencies.

Industry and Commerce.—Pittsburgh is in the midst of the most productive coal-fields in the country; the region is also rich in petroleum and natural gas. The city is on one of the main lines of communication between the east and the west, is the centre of a vast railway system, and has freight yards in and outside the city with a total capacity for more than 60,000 cars. Its harbour has a total length on the three rivers of 27·2m., and an average width of about 1,000ft., and has been deepened by the construction (in 1877–85) of the Davis Island dam, by dredging, under a Federal project of 1899. This dam has been superseded by the Emsworth fixed dam. Slack water navigation has been secured on the Allegheny by locks and dams (1890, 1896 *et seq.*) at an expense up to July 1909 of $1,658,804; and up to that time $263,625 had been spent for open-channel work. In 1927–28 three new dams, Nos. 4, 5 and 6 were completed. The Monongahela from Pittsburgh to the West Virginia State line (91·5m.) was improved in 1836 *et seq.*, by a private company which built seven locks and dams; this property was condemned and bought for $3,761,615 by the United States Government in 1897, and, under the project of 1899 for rebuilding three of the locks and enlarging another, and that of 1907 for a new lock and dam and for other improvements, $2,675,692 was spent up to July 1909. Since then six of these have been entirely rebuilt and changed to two chamber locks and instead of no. 7 two new and larger locks have been constructed. Coal is brought to the city from the coal-fields by boats on the Allegheny and Monongahela rivers as well as by rail, and great fleets of barges carry coal and other heavy freight, such as steel rails, cotton ties, sheet iron, wire and nails, down the Ohio in the winter and spring. A ship canal to provide water communication between Pittsburgh and Lake Erie has been projected and is awaiting the approval of the army engineers. The railways have a heavy tonnage of coal, coke and iron and steel products, and a large portion of the iron ore that is produced in the Lake Superior region is brought to Pittsburgh. In 1926 the river traffic amounted to 30,717,002 tons and in 1925 it was 35,458,669, much of which was carried on barges down the Ohio. Pittsburgh is also a port of entry; in 1927 the value of its imports amounted to $9,181,226.

The value of factory and mine products (1926) including 11 industries and 2,316 establishments, was $2,976,503,400, and the by-products, $1,079,650,000. In the manufacture of iron and steel products Pittsburgh ranks first among the cities of the United States, the value of these products amounting in 1926 to $1,295,911,100 with by-products amounting to $514,096,800. The amount of salaries and wages paid was $343,111,000 and the capital invested was $1,129,587,600 In the World War Pittsburgh made 58% of war munitions. Pittsburgh was first in iron, steel, glass, electrical machinery, steel cars, tin plate, air brakes, fire-brick, white lead, food preserving, corks, aluminium, railway signals and safety devices, vanadium, bituminous coal and coke, furnishing 25% of the nation's steel, 10% of steel rails, 47% of pipe and tubing, 20% of pig iron, 20% of plate and window glass, 40% of bituminous coal, 33% of by-product coke and 86% of beehive coke. Pittsburgh occupies with San Francisco and Los Angeles fifth place in bank clearings and (Oct. 1927) had national bank deposits $459,667,442, State bank deposits $153,399,522 and trust and savings deposits $351,256,793. In Pittsburgh or the immediate vicinity are the more important plants of the United States Steel corporation, including that of the Carnegie company, and the Jones and Laughlin Steel corporation, one of the largest independent steel companies in the United States. Here, too, are the plants of the Westinghouse company for the manufacture of electrical apparatus, of air-brakes invented by George Westinghouse (born 1846), and of devices for railway signals which he also invented. In the Allegheny district the H. J. Heinz company with its 57 varieties has its main food-preserving plant, the largest establishment of the kind in the country.

Government.—The Pittsburgh charter of 1816 vested the more important powers of the city government in a common council of 15 members and a select council of nine members, and until 1834 the mayor was appointed annually by these city councils from their own number. By the Wallace Act of the State legislature in 1874 a form of government was provided for cities of three classes, and Pittsburgh became a city of the second class (population between 100,000 and 300,000); under the Act of 1895 a new classification was made, under which Pittsburgh remains in the second class. An Act of 1887 had amended the provisions of the Wallace Act in regard to second class cities by changing the terms of select councilmen from two to four years and of common councilmen from one to two years. In 1901 a new act was passed for the government of cities of the second class. It provided that the executive be a "city recorder"; this provision was repealed in 1903, when the title of mayor again came into use. By act of legislature (1911) the former common and select councils were superseded by a small council of nine members, elected by general vote of the entire city. The mayor, elected by the people for a term of two years, continued to appoint the heads of departments (public safety, public works, assessors, treasurer, law, welfare, health and supplies), and the comptroller also continued to be elected by popular vote. By a two-thirds vote the council may pass resolutions or ordinances over the mayor's veto. The department of public safety controls the bureaux of police, fire, building inspection, electricity and general office; the department of public works controls the bureaux of water, highway and sewers, property, parks, recrea-

tions, tests, lights, deed registry, bridges and construction. The mayor appoints the members of the civil service commission. Through a city-planning commission, recommending zoning ordinances and through a board of adjustment, the height and character of all buildings are controlled. A bureau of traffic relief and a traffic commission were created in 1924, and in 1925 a department of city transit, charged with the regulation of traffic conditions and with the matter of recommending subways and a comprehensive system of rapid-transit lines for the entire city. In 1927 the taxable valuation was $344,625,560 for land and buildings and the tax rate was 22·40 mills on land, 11·20 on buildings and 11·50 for schools. The water supply of Pittsburgh is taken from the Allegheny river and pumped into reservoirs, the highest of which, in Highland park, is 367ft. above the river; and there is a slow sand filtration plant for the filtration of the entire supply. (S. B. McC.)

PITTSFIELD, a city of western Massachusetts, U.S.A., the county seat of Berkshire county; on Federal highways 7 and 20, and served by the Boston and Albany and the New York, New Haven and Hartford railways. Pop. (1920) 41,763 (20% foreign-born white); 1928 local estimate 50,000. It occupies 41·4 sq.m., at an altitude of 1,000 ft., in the midst of the Berkshire hills. Three branches of the Housatonic river wind through the city, uniting about a mile from the central green. Within its limits are the villages of Barkerville, Coltsville Junction, Pontoosuc, Shaker, Stearnsville, Taconic, Tillotsons and West Pittsfield, and the whole or parts of five lakes (Pontoosuc, Onota, Morewood, Silver and Richmond). It is a well built city, with dignified public buildings, substantial business blocks, modern schools, shaded residential streets and on the outskirts large manufacturing plants. The assessed valuation for 1927 was $57,809,775. Pittsfield is a touring centre and a resort for winter sports. Its manufacturing industries are large and distinctive, with an output in 1925 valued at $51,880,490. They include a plant of the General Electric Company, making monster transformers and other machinery and devices, where artificial lightning was produced in 1927; and the mill that makes all the paper used for the U.S. bank notes and Government bonds. The oldest industry (still one of the most important) is textile manufacturing, chiefly woollen goods. Fine stationery, paper-mill equipment, machine tools, spool silks and silk braids are other leading products. The first settlement within the present boundaries of Pittsfield (Boston Plantation or Pontoosuc), made in 1743, was soon abandoned because of trouble with the Indians. It was revived in 1749, and in 1761 was incorporated as the town of Pittsfield, named in honour of the elder William Pitt. The town was chartered as a city in 1889. Shaker Village was settled (by Shakers) about 1790. Elkanah Watson (1758–1842), while living (1807–16) at what is now the Country club, introduced the merino sheep.

PITTSTON, a city of Luzerne county, Pennsylvania, U.S.A., on the Susquehanna river just below the mouth of the Lackawanna, about midway between Scranton and Wilkes-Barre. It is served by the Central of New Jersey, the Delaware and Hudson, the Erie, the Lackawanna, the Lackawanna and Wyoming Valley and the Lehigh Valley railways. Pop. (1920) 18,497 (26% foreign-born white, about half from Italy), and 6,968 in the adjoining borough of West Pittston (87% native white). Within 2·5 m. of the city hall about 60,000 persons were living in 1928. Pittston is in the midst of the anthracite coal region. Fire-clay also abounds. The city has paper, silk and knitting mills, terra-cotta works, brass foundries, cigar and cut-glass factories, and the Lehigh Valley railroad employs 1,200 men. It was one of the five towns founded in the Wyoming valley by the Susquehanna company of Connecticut, and was named after the elder Pitt. It was settled about 1770, incorporated as a borough in 1803 and chartered as a city in 1894.

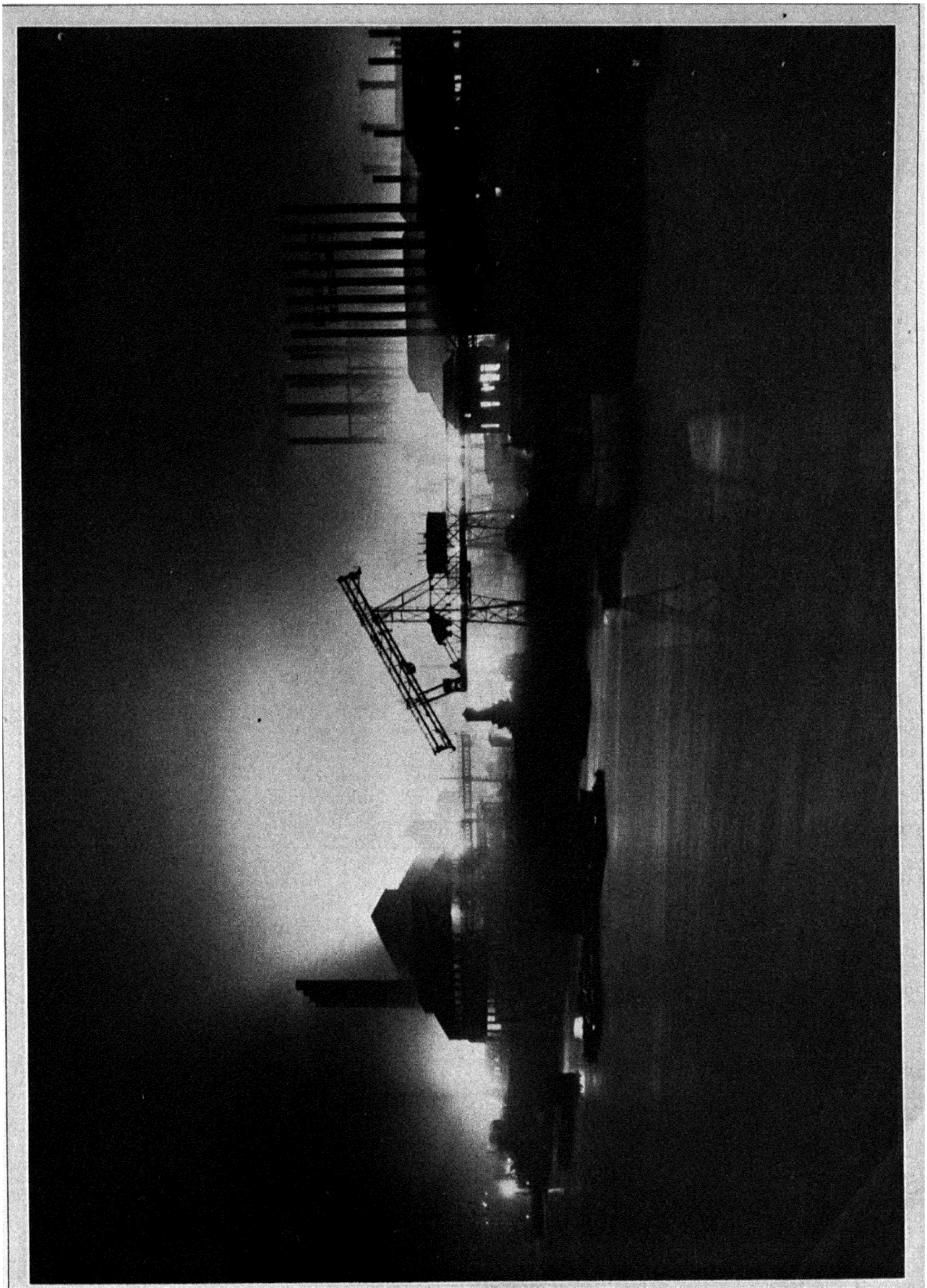
PITUITARY EXTRACT or **PITUITRIN:** *see* ANIMAL EXTRACTS.

PITYRIASIS VERSICOLOR, a skin disease, consisting of patches of brown discoloration, mostly on the front of the body, and often attended with itching, especially after exercise. The epidermis is scaly over the patch, and among the *débris* there may be seen minute oval spores of a vegetable parasite, the *Microsporon furfur*. The disease is mostly one of adults, found all over the world, and not associated in any special way with poor general health. The treatment consists of rubbing in an ointment of potassium sulphide or one of the mercurial ointments, or using sulphur-soap habitually.

PIURA, a coast department of northern Peru, with area 15,239 sq.m.; pop. (est. 1920) 213,909. The department includes mountainous areas in the north (Cerros de Amatope) and east (cordilleran *sierra*) and a great desert (Sechura) in the south. The chief rivers are the Chira, a permanent stream, and the Piura. Crops are grown with the aid of irrigation as there is rainfall only at intervals of years. Cotton-growing is the leading industry in the irrigated valleys, stock-raising in the *sierra*. The cultivation of *aspero* (full-rough cotton) is peculiar to this department, the product of a large bush, and is known as vegetable wool (*see* PERU: *Agriculture*). There are gins and factories for making cotton-seed oil and cake; also a crushing-mill for castor-beans which produces about 20,000 gal. of castor-oil annually. Other crops include rice, sugar, tobacco, maize, potatoes, yuca, beans, cacao and fruits, all of which are consumed locally. *Sierran* cattle are fattened in the upper valleys. Goats are raised extensively. Charcoal is made from the wood of the algaroba tree. Though mineral deposits are widespread, petroleum is the only one exploited. It now heads the list of Peruvian exports and the only producing oil fields in the republic are in the department of Piura and the adjoining province of Tumbez. They lie along the north-western coast, a narrow belt about 60 m. in length. The two chief operating companies are in Piura; the International Petroleum Corporation, a subsidiary of the Standard Oil Company, whose chief field is Negritos, 40 m. north-west of Paita, produces about 80% of the national output (1,140,000 tons in 1926) and has a modern refinery at its port, Talara. The Lobitos Oil Company, 10 m. north of Talara, formerly British, now Peruvian, produced 271,000 tons in 1926, shipped *via* Talara to the United States and Canada for refining. About 15% of total production is consumed in Peru, largely as crude oil by railways. A standard gauge railway runs from Paita (*q.v.*), to Piura (58 m.) by way of Sullana, a distributing centre for southern Ecuador, and narrow gauge railways connect the oil-fields with Talara. Roads are under active construction and sections of the coast highway and of the road across the Andes from Paita to the Amazon are finished. Piura, capital of the department, pop. (estimated 1920) 15,000, is on the Piura river, 164 ft. above sea-level. It was founded by Pizarro in 1532 on a slightly different site. It has electric lights, telephone and telegraph, banks, theatres, superior court, secondary schools and an excellent hospital. Catacaos, 6 m. south of the capital, is the centre of the Panama hat industry. Hats are woven from leaves of *toquilla* palm (*Carludovica palmata*).

PIUS I., pope from about 141 to 154. He was the brother of Hermas, author of the *Shepherd*.

PIUS II. (Enea Silvio de Piccolomini, known in literature as Aeneas Silvius), pope from 1458 to 1464, was born on Oct. 18, 1405, at Corsignano (later called Pienza after him) near Siena. His family claimed to trace descent from Romulus. The eldest of 18 children, he worked on the farm with his father until a priest enabled him, at the age of 18, to go as a poor student to Siena, where he divided his time between severe humanistic studies and sensual pleasure. He was attracted to Florence by the teaching of Filelfo. He became secretary to Domenico Capranica, bishop of Fermo, and went with him to the Council of Basle, where he stayed several years (1431–35), changing masters whenever he could improve his position. He was engaged on various errands, some of them dangerous; they included a long journey to England and Scotland on secret diplomatic business. In 1436 he was back at Basle, and, although a layman, obtained a seat in the council and exercised considerable influence. Aeneas took an active part in the council after it was transferred to Florence, and though he still declined to take orders, he was given a position on the conciliar conclave which elected Amadeus of Savoy as pope under the title of Felix V. In return for his



VIEW OF PITTSBURGH STEEL MILLS AT NIGHT

PHOTOGRAPH, HINE FROM EWING GALLOWAY

services Felix made Aeneas papal secretary.

A new period of his career opened in 1442, when he was sent by the council to take part in the diet of Frankfurt-on-Main. Here he met Frederick III. of Germany, who made him poet laureate and his private secretary. He ingratiated himself with the chancellor, Kasper Schlick, at Vienna, one of whose adventures he celebrated in *Lucretia and Eurialus*, a novel in the style of Boccaccio. At this period he also wrote his witty but immoral play, *Chrisis*. In 1446 he took orders as subdeacon, and wrote that he meant to reform, "forsaking Venus for Bacchus." Aeneas was useful to Frederick as a diplomatist, and managed to give all parties the impression that he was the devoted advocate of each. He took an important part in the diet of Nuremburg (1444), and in 1445 made his peace with Eugenius. At the diet of Frankfurt (Sept. 1446) Aeneas modified the hostility of the electors to pope and emperor. The new pope, Nicholas V., made him bishop of Siena, and for his services in negotiating the concordat of Aschaffenburg in 1448 he was made prince of the empire and cardinal.

The death of Calixtus III. (who succeeded Nicholas V.) occurred on Aug. 5, 1458. After a hot fight in the conclave, Aeneas was elected and took the title Pius II., with a reminiscence of Virgil's "pius Aeneas." The humanists hailed his election with joy, and flocked around to secure a share of the good things, but they were bitterly disappointed, as Pius did not prove himself the liberal and undiscriminating patron they hoped. The fall of Constantinople in 1453 made a deep impression upon Pius, and he never ceased to preach the crusade against the Turk. In Sept. 1459 he opened a congress at Mantua to promote the crusade, but both the French and the Germans were annoyed with him for different reasons, and he received little support. He believed that the decline in the papal influence was due to the usurpation of power by the councils, and he now issued (Jan. 1460) the bull *Execrabilis et in pristinis temporibus inauditus*, in which he condemned as heretical the doctrine that the councils were superior to the popes, and proclaimed the anathema against any one who should dare to appeal to one.

While Pius was at Mantua war broke out between the French and Spanish in southern Italy, and a rising of the barons devastated the Campagna. Hurrying back to Rome, Pius succeeded in quelling the disorders. This measure still further alienated the pope from the French, with whom he was at that time negotiating for the abrogation of the Pragmatic Sanction. When Louis XI. came to the throne (Nov. 1461), he sent to Pius saying that he had abolished the Pragmatic Sanction, hoping in return to get the kingdom of Naples, for his countryman, René of Anjou. As Pius continued to support Ferdinand, Louis retaliated by reasserting the ancient liberties of the Gallican Church. At the same time a serious quarrel with the Germans prevented anything being done towards a crusade. George Podiebrad, king of Bohemia, was plotting to depose the emperor Frederick III., who was supported by Pius. Diether, archbishop of Mainz, took the side of Podiebrad, and replied to Pius's measures by appealing to a general council. He was declared deposed by the pope, but kept his seat, and in 1464 compelled the pope to recognize him again. The quarrel with Podiebrad, who was accused of supporting the Utraquist heresy, continued with increasing bitterness, but without any decisive result, until the death of Pius. In the meantime the pope did what he could to further the cause of the crusade. The discovery of alum mines at Tolfa gave him an unexpected pecuniary resource, and to stimulate the zeal of Christendom, Pius took the cross on June 18, 1464. He set out for Venice, where he intended to sail for the East, but he was attacked with a fever, and on Aug. 14, 1464, he died.

Pius II. was a voluminous author. Besides poems, a novel and a play, he wrote a number of orations, which were considered models of eloquence in their day. The tale of *Euryalus and Lucrezia* was translated into many languages (Eng., 1560), and his Latin poems, *Miseriae curialium* (Rome, 1473), were read throughout Europe. Alexander Barclay translated some of them in *Certayne Eglogues* . . . (1548?) repr. by Spenser Society (1885). His most valuable work, however, is his *Pii II. Commentarii rerum memorabilium quae temporibus suis contigerunt*, a history of his times, told in an interesting and rational manner. Also, there is the *Cosmographia in Asiae et Europae . . . descriptione*, of which a complete edition was published at Venice in 1503, and *Historia Bohemica* (Cologne, 1532).

Bibliography.—The letters of Pius II. are in process of publication by R. Wolkan, *Der Briefwechsel des Eneas Silvius Piccolomini* (Vienna, 1909–), in *Fontes rerum Austriacarum*. The *Commentaries* were published in 1584, as begun by Pius himself, and completed by J. Gobellinus. His other works are found in *Aenae Silvii opera omnia*, edit. M. Hopperus (Basle, 1551). *See* also Herzog-Hauck, *Real-encyklopädie* (1904), vol. xv., where a full bibliography will be found; Voigt, *Pius II.* (1856–63); L. Pastor, *History of the Popes from the Close of the Middle Ages* (Eng. trans., 1896, vol. ii.); M. Creighton, *History of the Papacy during the Reformation*, vol. ii. (1882); W. Boulting, *Aeneas Silvius* (1908); C. M. Ady, *Pius II.: the Humanist Pope* (1913); C. Lucius, *Pius II. und Ludwig XI. von Frankreich, 1461–62* (1913).

PIUS III. (Francesco Nanni-Todeschini-Piccolomini), pope from Sept. 22 to Oct. 18, 1503, was born at Siena on May 9, 1439. He was made archbishop of Siena and cardinal-deacon of St. Eustachio by his uncle Pius II. He was employed by subsequent popes in several important legations. He opposed the policy of Alexander VI., and succeeded him as pope through the interested influence of Cardinal della Rovere, afterwards Julius II.

The main importance of his pontificate lies in his reassembling of the Council of Trent, which Paul IV. had allowed to disband, considering its work completed. It was finally closed, after sessions lasting more than two years, in Dec. 1563, and the bull confirming its decrees was issued in Jan. 1564. Pius was a man of blameless life, and would doubtless have accomplished much had he lived. His successor was Julius II.

See L. Pastor, *History of the Popes*, vol. vi., trans. by F. I. Antrobus (London, 1898); M. Creighton, *History of the Papacy*, vol. v. (London, 1901); F. Gregorovius, *Rome in the Middle Ages*, vol. viii., trans. by Mrs. G. W. Hamilton (London, 1900–1902); Piccolomini, "Il Pontificato di Pio III.," in *Archivio stor. ital.*, vol. v. (Firenze, 1903).

PIUS IV. (Giovanni Angelo Medici, or "Medighino"), pope from 1559 to 1565, was born at Milan on March 31, 1499. He began his career as a lawyer, but later entered the service of Paul III., who made him a cardinal in 1549. In the protracted conclave that followed the death of Paul IV. the election of Pius (Dec. 25, 1559) was due to a compromise between the Spanish and French. In temperament Pius was affable, vivacious, convivial. He was, moreover, astute, diplomatic and experienced in affairs. He allowed the reform movement initiated by Paul IV. free course, but tried to repair certain injustices of Paul IV., and mitigated some of his extreme decrees. But to the nephews of Paul he showed no mercy: they were charged with various crimes, condemned, upon testimony of suspicious validity, and executed on March 5, 1561. With England lost to the papacy, Germany overwhelmingly Protestant, and France on the verge of civil war, Pius realized how fatuous was the anti-Spanish policy of his predecessor. He therefore recognized Ferdinand as emperor, and conciliated Philip II. with extensive ecclesiastical privileges. But subsequently, antagonized by Philip's arrogance, he assisted France with troops and money for use against the Huguenots.

After a suspension of ten years the council of Trent reconvened on Jan. 18, 1562. Among the demands presented by the various nations were the recognition of the equality of the episcopate, communion in both kinds, clerical marriage and the use of the vernacular in Church services. It required all the pope's diplomacy to avoid compliance on the one hand, and a breach with the powers on the other. Thanks to Morone and Borromeo, however, he achieved his end. The council was dissolved on Dec. 4, 1563, and its decrees and definitions confirmed by the pope (Jan. 26, 1564), who reserved to himself the sole right of interpretation, and took various measures for enforcing its decisions.

After the termination of the council Pius indulged his desire for ease and pleasure, to the great offence of the rigorists. Pius fortified Rome, and contributed much to the embellishment of the city—among other works, the church of Sta. Maria degli Angeli in the Baths of Diocletian; the Porta Pia; the Villa Pia in the

Vatican Gardens; and the Palace of the Conservatori. He died on Dec. 9, 1565, and was succeeded by Pius V.

See Panvinio, continuator of Platina, *De vitis pontiff. rom.* (a contemporary of Pius); Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–02; also contemporary); T. Müller, *Das Konklave Pius IV.* (Gotha, 1889; more comprehensive than the title suggests); Ranke, *Popes* (Eng. trans., Austin), i. 323 *seq.*, 358 *seq.*; and v. Reumont, *Gesch. der Stadt Rom.* iii. 2, 534 *seq.*, 730 *seq.*

PIUS V. (Michele Ghislieri), pope from 1566 to 1572, was born on Jan. 17, 1504, in the Milanese. At the age of fourteen he became a Dominican monk. He was appointed inquisitor in Como, where his zeal provoked such opposition as to compel his recall (1550). The chief inquisitor, Caraffa, convinced of his value, straightway sent him upon a mission to Lombardy, and in 1551 appointed him commissary-general of the Holy Office. When Caraffa became pope, Ghislieri was made bishop of Nepi and Sutri, cardinal (1557), and finally grand inquisitor. In this office he was continued by Pius IV., whom, however, he antagonized by his censoriousness and obstinacy. But after the death of Pius IV., the rigorists, led by Borromeo, had no difficulty in making him pope (Jan. 7, 1566). Retaining his ascetic mode of life, Pius immediately began the work of reform. Decrees and ordinances were rapidly issued; the papal court became a model of sobriety; prostitutes were driven from the city, or confined to a certain quarter; penalties were attached to Sunday desecration, profanity and animal baiting; clerical residence was enforced; conventuals were compelled to live in strict seclusion according to their vows; catechetical instruction was enjoined. A new catechism appeared in 1566, followed by an improved breviary (1568), and an improved missal (1570). The use of indulgences and dispensations was restricted, and the penitential system reformed.

Pius was the avowed enemy of nepotism. One nephew, it is true, he made cardinal, but allowed him no influence: the rest of his relatives he kept at a distance. By the constitution *Admonet nos* (March 29, 1567), he forbade the reinvestiture of fiefs that should revert to the Holy See, and bound the cardinals by oath to observe it. In March 1569 Pius ordered the expulsion of the Jews from the States of the Church. For commercial reasons they were allowed to remain in Rome and Ancona, but only upon humiliating conditions. In February 1571, the Umiliati, a degenerate monastic order of Milan, was suppressed on account of an attempt upon the life of the archbishop, Carlo Borromeo.

The rules governing the Holy Office were sharpened; old charges, long suspended, were revived; rank offered no protection, but rather exposed its possessor to fiercer attack; none were pursued more relentlessly than the cultured, among whom many of the Protestant doctrines had found acceptance; princes and states withdrew their protection, and courted the favour of the Holy See by surrendering distinguished offenders. Cosimo de' Medici handed over Pietro Carnesecchi (and two years later received in reward the title of grand duke, Sept. 1569); Venice delivered Guido Zanetti; Philip II., Bartolomé de Carranza, the archbishop of Toledo. In March 1571 the Congregation of the Index was established, and hundreds of printers took flight to Switzerland and Germany. The regret of Pius was that he had sometimes been too lenient. He spurred Philip II. on in the Netherlands, and commanded the utter extermination (*ad internecionem usque*) of the Huguenots; he protested against the tolerance shown by the emperor. One of his cherished schemes was the dethronement of Elizabeth, whom he excommunicated and declared a usurper (Feb. 25, 1570); but he had to content himself with abetting plots and rebellions. He effected an alliance with Spain and Venice against the Turks, and contributed to the victory of Lepanto (Oct. 6, 1571). Pius died on May 1, 1572; and was canonized by Clement XI. in 1712.

See Ciaconius, *Vitae et res gestae summorum pontiff. rom.* (Rome, 1601–02; a contemporary of Pius); *Acta sanctorum, maij,* tom. i. pp. 616 *seq.*, containing the life by Gabuzio (1605), based upon an earlier one by Catena (1586); Falloux, *Hist. de St. Pie V.* (3rd ed., Paris, 1858), eulogistic; Mendham, *Life and Pontificate of St. Pius V.* (London, 1832), a bitter polemic. The life of Pius has also been written by Fuenmayor (Madrid, 1595), Paolo Alessandro Maffei (Rome, 1712), and by T. M. Granello (Bologna, 1877). His letters have been edited by Catena (*vide supra*), Goubau (Antwerp, 1640), and a select number in a French translation, by de Potter (Paris, 1826). *See* also Hilliger, *Die Wahl Pius V. zum Papste* (Leipzig, 1891); Ranke, *Popes* (Eng. trans., Austin), i. 361 *seq.*, 384 *seq.*; and von Reumont, *Gesch. der Stadt Rom.* iii. 2, 557 *seq.*

PIUS VI. (Giovanni Angelo Braschi), pope from 1775 to 1799, was born at Cesena, on Dec. 27, 1717. After taking the degree of doctor of laws he went to Ferrara and became the private secretary of Cardinal Ruffo, in whose bishopric of Ostia and Velletri he held the post of *uditore* until 1753. His skill in the conduct of a mission to the court of Naples won him the esteem of Benedict XIV., who appointed him one of his secretaries and canon of St. Peter's. In 1758 he was raised to the prelature, and in 1766 to the treasurership of the apostolic chamber by Clement XIII., and in 1773 he became cardinal-priest of San Onofrio. In the four months' conclave which followed the death of Clement XIV., Spain, France and Portugal at length dropped their objection to Braschi, and he was elected to the vacant see on Feb. 15, 1775.

Pius had received the support of the ministers of the Crowns and the anti-Jesuit party upon a tacit understanding that he would continue the action of Clement, by whose brief *Dominus ac redemptor* (1773) the dissolution of the Society of Jesus had been pronounced. On the other hand the *zelanti*, who believed him secretly inclined towards Jesuitism, expected from him some reparation for the alleged wrongs of the previous reign. The half-measures adopted by Pius gave little satisfaction to either party. It is perhaps largely due to him that the order was able to escape shipwreck in White Russia and Silesia; in 1792 he considered its re-establishment as a bulwark against revolutionary ideas.

The authority of the papacy was threatened in Austria by the social and ecclesiastical reforms undertaken by Joseph II. and, in the hope of staying them, Pius adopted the exceptional course of visiting Vienna in person. His mission proved a fiasco; he was, however, able a few years later to curb those German archbishops who, in 1786 at the Congress at Ems, had shown a tendency towards independence. Difficulties also arose in Naples and in Tuscany. At the outbreak of the French Revolution Pius saw the old Gallican Church suppressed, the pontifical and ecclesiastical possessions in France confiscated and an effigy of himself burnt by the populace at the Palais Royal. The murder of the republican agent, Hugo Basseville, in the streets of Rome (January 1793) gave new ground of offence; the papal court was charged with complicity by the French Convention; and Pius threw in his lot with the league against France. In 1796 Napoleon invaded Italy, defeated the papal troops and occupied Ancona and Loreto. Pius sued for peace, which was granted at Tolentino on Feb. 19, 1797; but on Dec. 28 of that year, in a riot created by some Italian and French revolutionists, General Duphot of the French embassy was killed and a new pretext furnished for invasion. General Berthier marched to Rome, entered it unopposed on Feb. 13, 1798, and, proclaiming a republic, demanded of the pope the renunciation of his temporal authority. Upon his refusal he was taken prisoner, and on Feb. 20 was escorted from the Vatican to Siena, and thence to the Certosa near Florence. The French declaration of war against Tuscany led to his removal by way of Parma, Piacenza, Turin and Grenoble to the citadel of Valence, where he died six weeks later, on Aug. 29, 1799. Pius VII. succeeded him.

See Zöpffel and Benrath, "Pius VI.," in Herzog-Hauck, *Realencyklopädie*, 3rd ed., vol. xv., pp. 441–451 (Leipzig, 1904, with elaborate bibliography); F. Nielsen, *History of the Papacy in the 19th Century*, vol. i. chap. vii. (London, 1906); J. Gendry, *Pie VI. sa vie, son pontificat, d'après les archives vaticanes et de nombreux documents inédits* (2 vols., 1907).

PIUS VII. (Luigi Barnaba Chiaramonti), pope from 1800 to 1823, the son of Count Scipione Chiaramonti and the deeply religious Countess Ghini, was born at Cesena on Aug. 14, 1740 (not 1742). He entered the Benedictine monastery of St. Mary at Cesena, and held various teaching appointments in the colleges of his order at Parma and at Rome. He was created an abbot of his order by his relative Pius VI., who also appointed him bishop of Tivoli in 1782, and raised him to the cardinalate and the see of Imola in 1785. He became pope on March 14, 1800.

His attention was at once directed to the ecclesiastical anarchy of France, and he negotiated the celebrated concordat of 1801.

(*See* CONCORDAT.) The importance of this agreement was, however, considerably lessened by the "articles organiques" appended to it by the French government on April 8, 1802. In 1804 Napoleon opened negotiations to secure at the pope's hands his formal consecration as emperor. After some hesitation Pius was induced to perform the ceremony at Notre Dame and to extend his visit to Paris for four months; but in return for these favours he was able to obtain from Napoleon merely one or two minor concessions. Napoleon soon began to disregard the Italian concordat of 1803, and himself decreed the dissolution of the marriage of his brother Jerome with Miss Patterson of Baltimore. The irritation between France and the Vatican increased so rapidly that on Feb. 2, 1808 Rome was occupied by General Miollis; a month later the provinces of Ancona, Macerata, Fermo and Urbino were united to the kingdom of Italy, and diplomatic relations between Napoleon and Rome were broken off; finally, by a decree issued from Schönbrunn on May 17, 1809, the emperor united the Papal States to France. Pius retaliated by a bull excommunicating the invaders; and, to prevent insurrection, Miollis—either on his own responsibility, as Napoleon afterwards asserted, or by order of the latter—employed General Radet to take possession of the pope's person. On July 5 Pius was made prisoner; he was taken to Grenoble, and then to Savona, where he steadfastly refused canonical institution to the bishops nominated by Napoleon. In 1812 the aged and sick pontiff was removed to Fontainebleau, where he was lodged in a suite of regal magnificence to await the return of the emperor from Moscow. When Napoleon arrived, he entered into personal negotiations with the pope, who on Jan. 25, 1813 assented to a concordat so degrading that his conscience found no relief until, on the advice of the cardinal Pacca and Consalvi, he abrogated it (March 24); and on the 9th of May he defied the emperor by declaring invalid all the official acts of the new French bishops. Napoleon sent him back to Savona for safe keeping; but the course of events in 1814 forced him to liberate the pope and give back the States of the Church. On the 19th of March Pius left Savona, and was received with rejoicing at Rome on May 24. Reaction set in at Rome; the Jesuits were restored; the French legislation, much of which was of great social value, was repealed; the Index and the Inquisition were revived. On his return from the congress of Vienna Consalvi conducted a more enlightened and highly centralized administration, based largely on the famous *Motu proprio* of 1816; nevertheless the finances were in a desperate condition. Discontent centred perhaps in the *Carbonari*, a Liberal secret society condemned by the pope in 1821. Consalvi negotiated a series of valuable concordats with all the Roman Catholic powers save Austria. In the latter years of Pius's life royalty often came to Rome; the pope was very gracious to exiled kings and showed notable magnanimity toward the family of Napoleon. He attracted many artists to the city, including the greatest sculptors of the time, one of whom, the Protestant Thorwaldsen, prepared the tomb in which repose the remains of the gentle and courageous pontiff, who passed into rest on Aug. 20, 1823. His successor was Leo XII.

BIBLIOGRAPHY.—*See* Zöpffel and Benrath, "Pius VII.," in Herzog-Hauck, *Realencyklopädie*, xv. 451–458 (Leipzig, 1904) (long list of older literature); Ilario Rinieri, *La Diplomazia pontifica nel secolo XIX.* (Rome, 1902), two volumes treating the years 1800–05, based largely on Vatican sources; I. Rinieri, *Napoleone Pio VII.* (1804–1813), *relazioni storiche su documenti inediti dell' archivio vaticano* (Turin, 1906); H. Chotard, *Le Pape Pie VII. à Savone* (Paris, 1887); Mary H. Allies, *Pius the Seventh* (London, 1897), a popular Roman Catholic biography; Leo König, S.J., *Pius VII. Die Säkularisation und das Reichskonkordat* (Innsbruck, 1904), based chiefly on Vienna material; H. Welschinger, *Le Pape et l'empereur, 1804–1815* (Paris, 1905); Louis Madelin, *La Rome de Napoléon: la domination française à Rome de 1809 à 1814* (Paris, 1906), an elaborate study; L. G. Wickham-Legg, "The Concordats" (*Cambridge Modern History*, vol. ix. ch. 7, 1906); Lady Blennerhassett, "The Papacy and the Catholic Church" (*Cambridge Modern History*, vol. x. ch. 5, 1907). Both these last have good bibliographies.

PIUS VIII. (Francesco Xaviero Castiglioni), pope from 1829 to 1830, was born at Cingoli on Nov. 20, 1761. He studied canon law at Rome, became vicar-general at Anagni and later at Fano; in 1800 was appointed bishop of Montalto and in 1816 of Cesena. In 1821 he was made cardinal-bishop of Frascati, also grand penitentiary; and later he became prefect of the Congregation of the Index. In the conclave which followed the death of Leo XII., Castiglioni, the candidate of France, was elected pope on March 31, 1829. He abandoned the system of espionage employed by his predecessor, and published an encyclical condemning Bible societies and secret associations. He exhibited a pacific spirit in dealing with the problem of mixed marriages in Germany. He died on Dec. 1, 1830. His successor was Gregory XVI.

See Zöpffel and Benrath, "Pius VIII.," in Herzog-Hauck, *Realencyklopädie*, xv. 458 *seq.* (Leipzig, 1904, with bibliography); F. Nielsen, *A History of the Papacy in the 19th Century*, ii. 31–50 (1906); P. B. Gams, *Series episcoporum ecclesiae catholicae* (Regensburg, 1873).

PIUS IX. (Giovanni Maria Mastai-Ferretti), pope from 1846 to 1878, was born on May 13, 1792 at Sinigaglia, the fourth son of Count Jerome and Countess Catherine Vollazi; the family of Mastai was of ancient descent, and the title of count came to it in the 17th century, while later the elder branch, allied by marriage with the Ferretti family, took that name in addition. He spent some time at the College of Piarists in Volaterra, and prepared to enter the pontifical guard as an officer but was refused on the ground that he suffered from epilepsy. The malady, however, was surmounted; and in 1819 he was ordained priest. After ministering for some time in his native town, he accompanied Cardinal Muzzi to Chile (1823). On his return he was entrusted by Leo XII. with the direction of the Roman hospital of San Michele; in 1830 he received the archbishopric of Spoleto, in 1832 the bishopric of Imola, and in 1840 Gregory XVI. created him a cardinal, with the title Santi Pietro e Marecellino.

On the death of Gregory XVI. (June 1, 1846) the College of Cardinals met in conclave on June 14, and on June 16 Mastai-Ferretti obtained the requisite two-thirds majority, and ascended the papal chair under the title of Pius IX. In his various capacities he had gained much popularity: he had shown himself to be of a kindly disposition and a zealous churchman, and his reputation for piety and tact stood high; he possessed, too, a winning personality and a handsome presence.

Papal Reforms.—The reign of Pius IX. began at an extremely critical time. The problem of the government of the Papal States, transmitted to him by his predecessor, stood in urgent need of solution, for the conditions were intolerable. Dissatisfaction found vent in revolts which could only be quelled by the intervention of foreign powers; and the ferment in the dominions of the Church was accentuated by the revolutionary disturbances throughout ascendant in all the states of Europe. The proclamation of a general political amnesty made an excellent impression; and Pius at once instituted preparations for a reform of the administration, the judicature and the financial system. The regulations affecting the censorship were mitigated, and a breath of political liberalism vitalized the whole government. Pius at once acquired the reputation of a reforming pope. But two demands were urged with ever increasing energy—a share in the government and a national Italian policy. The problem of popular representation was one of peculiar difficulty in the Papal States. It was not simply a question of adjusting the claims of monarch and subject: it was necessary to oust the clergy—who, till then, had held all the more important offices—from their dominant position, or at least to limit their privileges. That the clerical character of the administration could not be indefinitely retained was plain to any clear-thinking statesman: for, since the restoration of the Papal State in 1814, the pernicious effects of this confusion of the spiritual and the secular power could no longer be denied. But Pius IX. lacked the courage and perspicacity to draw the inevitable conclusions from these premises; and the higher clergy at Rome were naturally opposed to any change which would deprive them of power and privileges. In the course of the year 1847 the pope by a series of decrees gave a reorganized municipal council to Rome and instituted a state council, and a responsible ministry, but these reforms were hedged in with reservations which made them unacceptable to the people. In March 1848 the pope promulgated a constitution, with a parliament consisting of two chambers.

Revolution of 1848.—The utility of this constitution was

never tested; for the demand for an extension of popular rights was now eclipsed by a still more passionate aspiration towards the national unity of Italy. This nationalist movement at once took head against Austria. On March 18 the revolution broke out in Milan, and King Albert of Sardinia undertook the conduct of the war against the emperor. The populace was swept by a whirlwind of enthusiasm: the Austrian embassy was mobbed; the imperial arms, surmounting the main gate of the palace, were torn down; and great troops of volunteers clamoured to be led against Austria. Pius seemed, after his proclamation of March 30, on the point of conferring his blessing upon the war against Austria. But on April 29, in his allocation to the cardinals, he proclaimed the papal neutrality; and the storm broke. Mamiani, Fabbri and Rossi, in successive ministries, sought to restore order. On Nov. 15 Rossi was assassinated as he was about to open the session of the chambers. The pope then assented to the formation of a radically democratic ministry under Galetti. The Swiss, who composed the papal guard, were disbanded; and the protection of the pontiff was transferred to the civil militia; in other words, Pius IX. was a prisoner. On Nov. 24 he fled, with the aid of the French and Bavarian ambassadors—the duc d'Harcourt and Count Spaur—to Gaeta in the kingdom of Naples. On Feb. 9, 1849 the constituent assembly decreed, by 142 votes to 23, the erection of a Roman republic. Pius answered by a protest dated Feb. 14. He had already appealed to the European Powers for assistance. For the intervention of France and Austria *see* ITALY. On July 14 Oudinot proclaimed the restoration of the pontifical dominion; and, three days later, Pius IX. issued a manifesto entrusting the government to a commission appointed by himself.

Loss of the Temporal Power.—On April 12, 1850 Pius returned to Rome, supported by foreign arms, embittered, and hostile henceforward to every form of political liberalism or national sentiment. In Gaeta he had mentally cut himself loose from all ideas of progress, and had thrown himself into the arms of the Jesuits. His subsequent policy was stamped by reaction. Whether it might have been possible to avoid the catastrophe of 1870, in which the remnant of the Papal States was lost, is a difficult question. But undoubtedly the policy which Pius now inaugurated, of restoring the old pre-revolutionary conditions, sealed the fate of the temporal dominion of the papacy. He made no attempt to regain the estranged affections of the populace, and took no measures to liberate himself and his subjects from the incubus of the last few years. The system of precautionary arrest, as it was termed, rendered it possible for any man to be thrown into prison, without trial and without verdict, simply on the ground that he lay under suspicion of plotting against the Government. The priests, who usurped the judicial function, displayed such cruelty on several occasions that officers of the Austrian army were compelled to record a protest. The consequence of these methods was that every victim—innocent or guilty—ranked as a martyr in the estimation of his fellow-citizens. Brigandage revived, corruption was rampant, and the financial administration under Cardinal Antonelli (*q.v.*) was disastrous.

The mismanagement which obtained in the papal dominions could not escape the observation of the other powers. As early as the Congress of Paris in 1856 the English ambassador, Lord Clarendon, had directed an annihilating criticism against the government of the pontiff; and a convincing proof of the justice of his verdict was given by Pius himself, in his treatment of the famous Mortara case (*see* MORTARA, EDGAR), which gave rise to diplomatic representations from France and England. The sequel to this mode of government was that the growing embitterment of the subjects of the Church came to be sympathized with outside the bounds of Italy, and the question whether the secular authority of the papacy could be allowed to continue became a much-debated problem. The continued existence of the Papal States as such, depended in fact on the maintenance of the understanding between the two powers protecting the papal state—France and Austria.

But Napoleon came to an agreement with Cavour against Austria, and one of the results of the war of 1859 was that the pope forfeited two-thirds of his dominions. After the war of 1866 (*see* ITALY: *History*), the States of the Church formed the last remaining obstacle to complete national unity. The news of the fall of the French empire in 1870 produced an electrical effect in Italy. The French troops had evacuated Rome in 1869, and the Italian parliament now called on the king to occupy Rome; on Sept. 8 Victor Emmanuel crossed the borders; and on Sept. 20 the green-white-and-red of the tricolour floated over the Capitol. The protests of Pius IX. remained unheeded, and his attempts to secure another foreign intervention met with no success. On Oct. 2 Victor Emmanuel instituted a *plébiscite* in Rome and the possessions of the Church to decide the question of annexation. The result of the suffrage was that 153,681 votes were given in favour of union with Italy, and 1,507 against the proposed incorporation: that is to say only the direct dependants of the Vatican were opposed to the change. The papal state was now merged in the kingdom of Italy, which proceeded to define its diplomatic relations with the Holy See by the law of May 13, 1871. (*See* ITALY: *History.*)

Ultramontanism.—In his capacity as head of the Church, Pius IX. adhered to the principles of the Ultramontanist party, and contributed materially to the victory of that cause. The political reaction which followed the revolutionary era in most quarters of Europe offered a favourite soil for his efforts; and in several countries he found it possible to regulate the relations between Church and state from the standpoint of the curia. In 1851 he concluded a concordat with Queen Isabella II. of Spain, proclaiming Roman Catholicism the sole religion of the Spanish people, to the exclusion of every other creed (art. 1); and we find the same provision in another concordat with the South American republic of Ecuador (1862). A third concordat, negotiated with the emperor Francis Joseph I. of Austria (1855), entrusted the supervision of schools and the censorship of literature to the clergy, recognized the canon law, and repealed all secular legislation conflicting with it. France came into line with the wishes of the pope in every respect, as Napoleon needed clerical support in his political designs. Even in Germany he found no resistance; on the contrary, he was able to secure advantageous compacts from individual states (Hesse, 1854; Württemberg, 1857).

Among the most important acts of Pius IX. must be counted his proclamation of the dogma of the Immaculate Conception of the Virgin Mary, by the bull *Ineffabilis Deus,* on Dec. 8, 1854. In this bull the preservation of Mary from every stain of hereditary sin, in the first moment of her conception, was declared to be a divinely revealed truth, which consequently demanded universal acceptance. (*See* IMMACULATE CONCEPTION.) By this means a view, which till then had been no more than a pious belief, was elevated into a dogma to be held *de fide;* though grave doubts on the subject had always been entertained, even in the midst of the Church itself. For the inner life of that Church this solution of the controversy was of great significance, and created a desire for further dogmatic decisions on the Virgin Mary—her resurrection and ascension.

As reigning sovereign of the Papal States Pius IX. had passed through a "liberal period": as head of the Church, he had never been liable to attacks of liberalism. Nevertheless, his return from exile left its mark on his spiritual administration. For from this period onwards he set his face against the influence of modernism on ecclesiastical life; showed his displeasure at and distrust of the scientific theology and philosophy which marked a moderate advance (Günther, Frohschammer and Döllinger); and, entrenched in the stronghold of mediaeval ideals, combated the transformations of the new order of society, and the changes in the relationship between Church and state, which obtained in most countries of Europe since the French Revolution. After long and careful consultation, the adverse criticisms which he had expressed on various occasions were published on Dec. 8, 1864, together with the encyclical *Quanta cura,* under the title *Syllabus complectens praecipuos nostrae aetatis errores.* (*See* SYLLABUS.) In this Pius claimed for the Church the control of all culture and all science, and of the whole educational system. He rejected the liberty of faith, conscience and worship enjoyed by other creeds; and

made an easy farewell to the idea of tolerance. He claimed the complete independence of the Church from state control; upheld the necessity of a continuance of the temporal power of the Roman See; and finally, in the last clause, declared that "the pontiff neither can be nor ought to be reconciled with progress, liberalism and modern civilization."

The publication of this syllabus created a profound impression: for it declared war on modern society, and committed the papacy to the principles of Ultramontanism (*q.v.*). But, as any attempt to translate its precepts into practice would entail a disastrous conflict with the existing régime as established by law, Roman Catholic circles have frequently shown a tendency to belittle the significance of the manifesto and to deny that its rules are absolutely binding. But these well-meant explanations, however comprehensible, are refuted by the unequivocal pronouncements of Pius IX., Leo XIII., and many recognized ecclesiastical authorities—*e.g.*, Cardinal Manning, archbishop of Westminster, who described the syllabus as an emanation from the highest doctrinal authority in the Church.

Infallibility.—The zenith of Pius's pontificate was attained on July 18, 1870, when the Vatican council proclaimed the infallibility of the pope and the universality of his episcopate, thus elevating him to a pinnacle which none of his predecessors had reached and at the same time fulfilling his dearest wish. That, personally, he laid great stress on the acceptance of the dogma, was a fact which he did not attempt to conceal during the long preliminary deliberations of the council; and his attitude was a not inconsiderable factor in determining its final resolutions. But the loss of the Papal States, immediately afterwards, was a blow from which he never recovered. Whenever he brought himself to speak of the subject—and it was not rarely—he repeated his protest in the bitterest terms, and, to the end of his days, refused to be reconciled with the "sacrilegious" king of Italy. When, in Germany, the situation created by the Vatican council led to the outbreak of the *Kulturkampf*, Pius IX. failed to display the tact peculiar to his successor. For, in the encyclical *Quod numquam* (Feb. 5, 1875), he took the rash step of declaring invalid the Prussian laws regulating the relationship between Church and state—the only result being that the feud was still further embittered.

In these later years the dark days of his "captivity" were amply compensated by the proofs of reverence displayed by Roman Catholic Christianity, which accorded him magnificent ovations as his period of jubilee began to fall due. The twenty-fifth anniversary of his pontificate was celebrated with great splendour on June 16, 1871; for he was the first pope who had thus reached the traditional "years of Peter." In 1872 his 80th birthday gave occasion for new demonstrations; and 1875 was a so-called "year of jubilee." Finally, in 1877, the fifty years of his priesthood were completed: an event which brought him innumerable expressions of loyalty and led to a great manifestation of devotion to the Holy See from all the Roman Catholic world. He will be remembered as the pope who re-established the hierarchy in England. On Feb. 7, 1878 Pius IX. died. His successor was Leo XIII. (C. Mi.; X.)

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PIUS X. (Giuseppe Sarto), pope from Aug. 4, 1903, to Aug. 20, 1914, was born of humble parents on June 2, 1835, at Riete in the province of Treviso, Italy, and studied at the episcopal seminaries of Treviso and Padua, being ordained priest in 1858. For 17 years he acted as parish priest at various places in Venetia until his appointment in 1875 as canon of the cathedral and superior of the seminary at Treviso. In 1880 he refused the bishopric of Treviso, but accepted that of Mantua in 1884, at the command of Leo XIII. On June 12, 1893, he was created a cardinal and three days later was nominated patriarch of Venice, where his piety, simplicity and readiness to act in harmony with the Italian Government made him very popular. He succeeded Leo XIII. in his election to the papal chair on Aug. 4, 1903.

During his pontificate, in the defence of the faith, his condemnation of the 65 propositions of Modernism in 1907 will rank as a parallel to the condemnation of the 68 propositions of Molinism by Innocent XI. in 1637 or the 101 propositions of Jansenism condemned by Clement XI. in 1713.

Reforms of the first importance were undertaken—the codification of canon law; the protection of the liberty of the conclave by the abolition of the *exclusiva;* the simplification and security of the conditions of marriage by the *ne temere* legislation; the restoration of the Rota as the supreme court of appeal; the regulation of the triennial or quinquennial visits of bishops to Rome; the legislation as to church music; and the decree as to first communion, and the encouragement of international eucharistic congresses; the reform of the Roman breviary; the founding of the biblical institute for the work of Scriptural research; the regulation of studies in the seminaries; the creation of the commission for the great work of editing the true text of the Vulgate; the reconstruction of the official machinery of the Roman curia; the transfer of the English-speaking countries from the propaganda or missionary régime to the normal government of the Church. To these may be added in the domain of discipline the unflinching vindication by Pius X. of the Church's right to depose delinquent bishops, carried out even at the cost of rupture of diplomatic relations with France; an apostolic visitation rigorously carried out through the dioceses of Italy, resulting in four bishops being made to resign on account of neglect or inefficiency; a further regulation by which no one can be proposed for a bishopric unless his promotion receives the visa of the Holy Office, which means that his past life has been free from ecclesiastical censure or reproach.

The well-known personal characteristics of Pius X. were his piety, charity, deep humility, simplicity, pastoral zeal, combined with great charm of manner to all who approached him. For war he had nothing but horror and it was the shock of the outbreak of the World War that hastened his death, which took place in Rome on Aug. 20, 1914. It is said that one of his last acts was to refuse the request of the Austrian emperor to bless his cause, saying: "I do not bless war: I bless peace."

PIUS XI. (1857–), pope since 1922, was born on May 31, 1857, at Desio, a small town north of Monza, in the environs of Milan, on the road to Como, and was named Ambrose Damien Achille. His father was Francesco Ratti, the manager of one of the great silk factories of Desio, and partner in the firm of Gadda. Achille was educated at the seminaries of San Pietro Martire and of Monza, and at the college of St. Charles at Milan, where he graduated. Feeling that he was called to the priesthood, he studied for two years in the greater seminary. His life at this time was profoundly influenced by his spending his vacation months with his uncle, Don Rodolpho, the venerable and exemplary parish priest and provost of Asso, a village in the promontory of the Bellagio. From his windows he could see Lake Como and the Alps, of which later on he was so strongly to feel the lure. It was also here that he came under the personal notice of the archbishop of Milan, Mgr. Nazario di Calebiana, who was staying as the guest of Count de Herra and was a frequent visitor at his uncle's presbytery. The archbishop was much struck by the future pope's earnestness and maturity of judgment, and was wont to call him his "young old man." Ever afterwards he took a deep interest in his career. He sent him to the college of St. Martin and then to Rome to study at the Lombard college and attend the lectures at the Gregorian university. Here Achille Ratti took with distinction the degrees of doctor of philosophy, of theology and canon law. He was ordained priest on Dec. 20, 1879.

At the Lombard college his fellow student and closest friend

was Alessandro Lualdi, later cardinal archbishop of Palermo. These two were mentioned to the pope by Professor Liberatore as the most brilliant of his students. They were the first to win the doctorate at the Angelico, the new Thomistic college founded by Leo XIII. at Rome. The pope sent for the two students and while passing through the Clementine Hall, from his chair in which he was being carried to the Vatican gardens he delivered to them an impressive lecture upon the vital importance of a sound philosophy and of their mission in promoting it in the years which lay before them. In 1882 Dr. Ratti returned to Milan and was appointed for a period of some months to a curacy at the village of Barni.

Following up the intentions of Leo XIII., the archbishop transferred him to the Great Seminary, where he filled for five years the post of professor of dogmatic theology. In 1888 he was admitted as a member of the college of doctors at the great Ambrosian Library. This appointment gave a new direction to his scholarship. In this task, Dr. Ratti found a congenial field of labour under the guidance of the prefect of the college, the learned Abbate Cerriani. He became an expert, especially in Latin palaeography and published several studies, and contributed numerous articles to the learned reviews. In 1907 he succeeded Cerriani as prefect of the library. He was made domestic prelate by Pius X. During 1905–07 he undertook and carried out a reclassification of the library upon modern methods so as to facilitate the work of consultation and research. His success in this enterprise was recognized by the king of Italy, who bestowed on him the knighthood of the Order of Saints Maurice and Lazarus.

From 1888 onwards he was chaplain and director to the nuns of the Cenacle, an order specially devoted to the work of arranging spiritual retreats or conferences for all classes of women. At their convent he was brought into contact with all that was most distinguished and zealous among the laity of Milan and became an active organiser of their manifold works of charity. At the same time, he spent the hours that he could spare from his library in teaching the catechism to numbers of poor children, including the little chimney sweeps that annually come down from Tirol. He clung to this work during the 30 years that he remained in Milan.

He more than once visited England. In June 1900 he stayed for a time with his intimate friend, Bishop Casartelli, at Manchester. He studied at the Bodleian in Oxford and at the British Museum and said Mass in Westminster cathedral. In his summer vacations it was his custom to make climbing excursions in the Alps. The *Bolletino* of the Italian Alpine Club relates how, in 1889, he discovered a new way of ascent by the eastern slope to Monte Rosa, and how on one occasion by his courage and promptitude he saved the life of his guide. The ascent is commemorated by a monument erected by the club at Macugnaga. In 1908 during the riots at Milan, he was active in pacifying the turbulent elements and intervened successfully to save the Capucine convent from destruction during the bombardment.

Cardinal Ferrari had made him his trusted counsellor in the government of the diocese and in 1909 appointed him to a canonry in the cathedral. In 1912 Pius X. called him to Rome, made him vice-prefect of the Vatican library (where he served under Cardinal Gasquet) and at the same time promoted him to a canonry of St. Peter's. On the succession of Benedict XV. he became the familiar friend of the new pope, who, with a keen appreciation of his qualities singled him out for the diplomatic service and entrusted him with the delicate mission of apostolic visitor to the new republic of Poland. Here his clear judgment and tact and his fluent knowledge of German and Polish enabled him to achieve a marked success in dealing with the complicated claims along the Russian-Polish frontier.

In June 1919 Ratti was made nuncio apostolic in Poland and titular archbishop of Lepanto and on July 3 was consecrated in Warsaw by the archbishop, Mgr. Katowski. It was a mark of the confidence reposed in him by all classes that he was chosen by the Interallied Commission to act as high ecclesiastical commissioner for the plebiscite of Upper Silesia by agreement of both the Polish and German Governments. During the Bolshevik invasion, when most of the embassies withdrew from Warsaw, the nuncio remained and carried on his work of conciliation and of succour for the poor in devastated regions. Pope Benedict XV. sent him the pallium, the Polish Government decorated him with the Order of the White Eagle and the university enrolled him amongst its doctors. On the death of Cardinal Ferrari, Benedict XV., in June, 1921, appointed him archbishop of Milan, and made him a cardinal under the title of S.S. Silvestro and Martino ai Monti. On Sept. 2 he returned from a pilgrimage to Lourdes and on the following day was solemnly enthroned.

Pope Benedict XV. died on Jan. 22, 1922. On Feb. 2 the cardinals entered into conclave and on Feb. 6 Cardinal Ratti was elected pope. He chose the name of Pius XI., and was proclaimed from the balcony of St. Peter's. He received the triple obedience of the cardinals and on Feb. 11 was crowned in the presence of an enormous concourse in the Basilica. Since then the life of Pius XI. may be summed up as one of constant activity, in which his encouragement of all high ideals and good works has been marked by staunchness in matters of principle and the spirit of pacification and conciliation in administration. During 1925, the year of the jubilee, he was brought, perhaps more than any other pontiff, into personal contact with his spiritual subjects by receiving more than 1,250,000 pilgrims from all parts of the Catholic world. By all he is revered for his learning, his charity, piety and width of sympathy, his courtesy, tact and charm of deportment and, most of all, for his untiring devotion to the duties of his exalted pastorate. (J. Ms.)

Pope Pius XI. will go down in history as the supreme pontiff who, with the cordial co-operation of Mussolini—and their respective advisers—closed the breach between Church and State, known as the Roman Question. (*See* PAPACY.) His holiness is said to have devoted over two-and-a-half years of patient and persistent study to the problems that were involved. Examination of the *communiqués* that were available at the time of the signing of the treaties between the Holy See and Italy shows that all bore the stamp of the august humility which has always characterized Pius XI.'s utterances. He is reported to have said, on the day the treaties were signed (Feb. 11, 1929), that he had asked for the least possible indemnity because he regarded himself as a father negotiating with his children, and, therefore, he had wished to make agreement as easy as possible.

The seventh anniversary of Pius XI.'s coronation (Feb. 12, 1929) coincided with his appearance on the balcony of St. Peter's, when he gave the pontifical blessing, *Urbi et Orbi*. A crowd, 100,000 strong, gathered in the square, shouted, "Hail, Pius, Pope and King!" The ratification of the treaties by his own signature and by that of the king of Italy set the seal to documents the importance of which will appear more and more evident as time goes on.

It is now very apparent that the world has, in Pius XI., a great force making for righteousness, whose influence became all the stronger the moment it was known that the renewal of papal sovereignty carried with it no territorial expansion or material aggrandisement. A new factor has entered into the relations of the nations. The cause of universal peace and goodwill has received an historic impetus and reinforcement. Whatever view may be taken of the fact, the earth has one monarch whose power is entirely spiritual and moral, whose office it is to hold aloft the banner of the highest ideals in the eyes of a world whose vision is too often obscured by selfishness and greed

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PIZARRO, FRANCISCO (*c.* 1471 or 1475–1541), discoverer and conqueror of Peru, was born at Trujillo in Estremadura, Spain, about 1471 (or 1475). He was an illegitimate son of Gonzalo Pizarro. Of Pizarro's early years hardly anything is known; but he appears to have been poorly cared for, and his education was neglected. Shortly after the news of the discovery of the New World had reached Spain he was in Seville, and thence

found his way across the Atlantic. There he is heard of in 1510 as having taken part in an expedition from Hispaniola to Urabá under Alonzo de Ojeda, by whom he was entrusted with the charge of the unfortunate settlement at San Sebastian. He accompanied Balboa (whom he afterwards helped to bring to the block) in the discovery of the Pacific.

In 1522 he entered into a partnership with a priest named Hernando de Luque, and a soldier named Diego de Almagro, for purposes of exploration and conquest towards the south. Explorations were then undertaken down the west coast of South America, in which Pizarro was left for months with but 13 followers on the island of Gallo, without ship or stores. There it was that Pizarro displayed the courage which has made famous the story of himself and his companions. (Some authorities, among them Xeres, Pizarro's secretary, give the number of his companions as 16. Herrera states the names of 13; Garcilasso supplies the remaining three.) But Pizarro persisted till he had coasted as far as about 9° south and obtained distinct accounts of the Peruvian empire. The governor of Panama showing little disposition to encourage the adventurers, Pizarro resolved to apply to the sovereign in person for help, and with this object sailed from Panama for Spain, accompanied by Pedro de Candia, in the spring of 1528, reaching Seville in early summer. Charles V. was won over. Pizarro was decorated with the order of Santiago, was granted a coat-of-arms and 13 of his heroic companions were ennobled by name.

On July 26, 1529, was executed at Toledo the famous *capitulación,* by which Pizarro was upon certain conditions made governor and captain general of the province of New Castile for the distance of 200 leagues along the newly discovered coast, and invested with all the authority and prerogatives of a viceroy, his associates being left in wholly secondary positions. One of the conditions of the grant was that within six months Pizarro should raise a sufficiently equipped force of men, of whom 100 might be drawn from the colonies; as he could not make up his due complement he sailed clandestinely from San Lucar in Jan. 1530. He was afterwards joined by his brother Hernando with the remaining vessels, and when the expedition left Panama in January of the following year it numbered three ships, 180 men and 27 horses. The subsequent movements of Pizarro belong to the history of Peru (*q.v.*). After the final effort of the Incas to recover Cuzco from 1536 to 1537 had been defeated by Diego de Almagro, a dispute occurred between him and Pizarro respecting the limits of their jurisdiction. This led to battle; Almagro was defeated (1538) and executed; but his supporters conspired, and assassinated Pizarro on June 26, 1541.

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PIZARRO, GONZALO (?1505–1548), explorer, half-brother of Francisco Pizarro, was born at Truxillo in 1505 or 1506 He accompanied the Peruvian expedition in 1531, and received for his services extensive grants in the Potosi mines. In 1539 he was made governor of Quito, and in 1541–42 he led an expedition east of Quito in the course of which Francisco de Orellan explored the Amazon. Two years later he defeated Vela, the new viceroy, and was declared governor of Peru, but in 1548 he was himself defeated by a Spanish force under Pedro de la Casco, was compelled to surrender and was executed on April 10, 1548.

PIZZICATO, a musical term indicating that a given passage for a stringed instrument is to be plucked by the fingers instead of played by the bow.

PLACARD, a bill or poster pasted or affixed to a wall or in any prominent position. (*See* Poster.)

PLACE, FRANCIS (1771–1854), radical reformer, was born on Nov. 3, 1771, and later apprenticed to a leather-breeches maker. He suffered great hardships owing to the decline of this trade, and in 1793 organized an unsuccessful strike of London breeches-makers. He acted as secretary to other trade clubs and from 1794–97 was prominent in the London Corresponding Society. He used his frequent enforced leisure for self-education, especially in political economy, and became a great admirer of Bentham. In 1799 he and a partner opened a tailoring shop in Charing Cross road, and the next year he went into business alone, rapidly becoming so successful that in one year he made £3,000. He was already known as a Radical politician when in 1814 he took up seriously a campaign to secure the repeal of the Combination Acts forbidding trade unions. For some years he met with little success, but in 1824, acting through Joseph Hume, M.P, he secured a parliamentary committee "on artisans and machinery" which reported in favour of the abolition of the acts. Bills to this effect were carried, amid general indifference; the premier, indeed, afterwards assured the House of Commons that he had no idea of the contents of the bills when he recommended them. The immediate effect of the repeal was a sudden increase in the number and activity of trade unions, and next year the Government attempted to restore the prohibition. The public excitement and the interest of the working-men were such that after a parliamentary struggle of an unusual stiffness, Place secured the passing of an act which scarcely altered the position.

His skilled political organization made the Westminster elections from 1807–32 events of national importance in the struggle for parliamentary reform. In 1831 and 1832 he greatly assisted behind the scenes in the preparations for military revolt should the Lords remain obstinate. Together with Joseph Parkes of Birmingham he framed the placard "TO STOP THE DUKE, GO FOR GOLD" which produced the run on the banks that drove Wellington from office and carried the Reform bill without violence. He also disorganized the "Rotundanist" reformers, who wished the extension of the franchise to the working class, by the organization of a "tame" working class union at the height of the struggle. He died at the age of 83, having been for many years out of politics.

See Graham Wallas, *Francis Place* (1918). Place's mss. and guard-books, an incomparable source of political information from 1790 to 1850, are in the British Museum. (R. W. P.)

PLACE-NAMES. Ancient historians often speculated upon the meaning of place-names, inventing persons who are presumed to have been the first founders of the country and to have left their mark on its nomenclature. But it is only within the last half-century that attempts have been made to lay the foundations of a science of place-names. Förstemann in Germany, Rygh in Norway, Noreen in Sweden, Skeat in England, Longnon in France, are perhaps the best-known pioneers in this work. The main foundations upon which they built were the recognition (1) that no place-name can be interpreted in the light of its present-day form alone, but must be traced back to its earliest recorded form, (2) that no explanation of a place-name, however convincing as philology, can hold good if inconsistent with the known history and topography of the site, and, conversely that no explanation based upon legend or topography, is of value if inconsistent with philology.

Processes of Change.—The ordinary word is to some extent controlled by the written or printed book. But the transmission of most place names is still very largely oral, and as the name is merely a name, and rarely has any significance in itself, at least to its modern user, there is little or nothing to check the process of change. The natural result is that the modern form of the name is often misleading. *Cenwulfesleah* has become *Knowsley, Tidwulfestreo* has become *Elstree;* and *Cholmondeley, Cirencester, Auchinleck,* and *Wymondham,* while in spelling they retain something like their original form, in pronunciation have been reduced to *Chumley, Sissiter, Affleck* and *Wyndham.* (It should be noted that the spread of the printed word and universal primary education are now tending to reverse the process and to substitute spelling-pronunciations for the genuine local ones.) The lack of stress upon the final element together with certain common sound-assimilations have obscured the history of many names. Thus *Embleton* really should end in *don,* "hill." *Hallington* is really *"holy dene"* (the site of the battle of "Heavenfield"), *Warden*-on-Tyne is a "watch *don*" or "hill" at the junction of north and south Tyne. So, also, nearly all the place-names in *-hall,* such as *Willen-*

hall, really end in *hale*, "nook" or "corner of land." The proximity of some similar sounding name may lead to its ultimate substitution as when *Combe-in-Teignhead* replaces *Combe-in-Tenhide* because the place stands on a headland at the mouth of the *Teign*.

Folk-Etymology.—When we come across a name which in itself conveys no meaning we are apt to turn it into something which conveys some sort of meaning, however inapposite. Thus all the places once called *Fivehide* have now become *Fivehead* or *Fyfield*, since we are no longer aware what a "hide" of land is. *Highenovre* (lit. "high bank") becomes *High and Over*. Folk-etymology has led to the formation of a series of "ghost" place-names, commonly spoken of as "back-formations." *Cambridge* is assumed to be the "bridge over the Cam" and the river is henceforward so called, though in reality *Cambridge* is an Anglo-Norman corruption of an earlier *Grantabrycg* and the correct name of the river is *Granta*. This process is specially common with river-names. The Sussex *Arun* and *Rother* are back-formations from *Arundel* and *Rotherfield*, while the *Adur* is a back-formation from the false identification of *Portus Adurni* with Shoreham. The old names for the rivers, in this case *Tarrant, Limen, Bramber*, were early lost and new names had to be found.

Early forms of certain names may be recorded by early geographers, historians or chroniclers but for most we have to turn elsewhere, to national surveys such as *Domesday Book* or the Danish Landbook of King Valdemar, to ancient charters, which often give not only the name of the land granted but also the names of the land-marks on its boundaries, royal and episcopal documents of every kind and, in later days, surveys, extents, terriers, maps. Here fresh difficulties arise. We find a large number of faulty and fantastic spellings, as when *Knighton* (O.E. *cnihtatun*) commonly appears in Domesday as *Chenistetone*, or *Gilling* (O.E. *Gillingas*) is disguised as *Gwyllingues*. Such forms, if they appeared repeatedly in official documents, might actually be recognized as the correct names even locally. Thus the *Ciren-* of *Cirencester* is the Norman-French spelling for the native English *Churn*, the river on which that town stands, and *Durham* is the result of the Norman's attempt to pronounce *Dunholm*, in which the sound-combinations *nh* and *lm* proved too difficult for him.

Interpretation.—In the interpretation of early forms, we have, first, words descriptive of the actual topography and secondly personal names belonging to those who have been owners or occupiers of the site. Most of the descriptive words can readily be recognized but a goodly number furnish difficulties. Our knowledge of the vocabulary of our forefathers is derived chiefly from works of religious or homiletic character and there are extensive gaps in our knowledge of their secular vocabulary, especially in its earliest stages. These lost words may be found in place-names. Thus in *Herne* (Beds) and *Harome* (Yorks) we have an otherwise unknown O.E. *har*, "a stony place, heap, hill," found in various cognate languages. So also a word in common use in early days may have passed completely out of use in our language and still survive in place-names. O.E. *hearg*, "heathen grove" only survives in such place-names as *Harrow, Harrowden* and *Arrow* Hill. And similar difficulties arise with regard to the personal names found in place-names. Often when a personal name has been assumed the very name itself turns up later in some newly discovered document. Thus a personal name *Blicc* with a diminutive *Bliccel* was assumed to explain *Blickling* and then later the name was found in a 12th century cartulary.

In most countries we have to deal not with one people or language alone but with successive settlements by peoples using different languages. If the new race is only a powerful minority, as for example the Normans in England or the English in Ireland, its influence on place-names may be very small. In the case of the Romans in Celtic Britain it was almost negligible. If the invasion or settlement was a mass one, there may be very extensive renaming of the places, as was the case with the English in most parts of England, the Vikings in certain parts of the Danelaw and in Normandy, and the Celtic refugees who settled in Brittany. In England the dominant race and speech since the beginning of the 6th century has been English and, except in Cornwall, Monmouthshire and Herefordshire, the nomenclature of the counties of England is predominantly English or Scandinavian. The only exception to this general statement is to be found in a good number of the names of natural features, such as rivers and mountains. Here, and in other countries also, the old names were usually kept. The rivers ran through wide tracts of country and were not the property of any single settler, while the mountains had no attractions for settlers in search of good pasture or arable land. Thus it is that *Wear, Tyne, Avon, Cheviot, Eildon, Malvern, Mendip*, are Celtic names, though English ones are not entirely wanting, as, for example, *Blyth, Loud, Clent*. Many river and hill-names cannot be explained even upon a Celtic basis and may have been taken over by the Celts from still earlier peoples. We must also note that some names which now look convincingly English may really be folk-etymological perversions of earlier Celtic names. The Celtic name has in a few cases survived to prove it, as in the case of O.E. in *Eoforwic, Searoburh* our *York* and *Salisbury*, which mean in Old English "boar-dwelling" and "trickery-fort" respectively but are really anglicisings of the old Romano-Celtic names *Eburacum* and *Sorbiodunum*. How many similar cases there may be in which the evidence for it has not chanced to survive it is impossible to say.

The Romans seldom renamed the British towns, and beyond one or two somewhat doubtful examples, such as *Speen* and *Chester* (earlier *Lega-ceaster*) and *Lincoln* from the Latin *spinae*, (*urbs*) *legionis* and *Lindum colonia*, they left little to be handed on to the English. The latter had picked up a certain number of Latin words both in their old Continental homes and in England through the channels of war and trade and Christianity, such as *castra*, (*via*) *strata, monasterium*. These became *ceaster, Strat* and *mynster* in their own language and have given rise to groups of names in *-chester, -cester, -caster*, in *Street-, Stret-, Strat-, Streat-* and in *-minster*. The first of these elements is very commonly found in the names of the old Romano-British fortified towns, but it should be noted that the first element in such names (*e.g., Gloucester, Cirencester, Wroxeter, Exeter*) is Celtic and not Roman, the old names being *Glevum, Corinium, Uriconium* and *Isca*.

The English Conquest involved widespread renaming of the countryside. The comparative frequency of place-names in *-ing* and *-ingham* in the eastern and south-eastern counties and their comparative rarity elsewhere suggests the importance of the great leader and his followers in the early stages of the invasion, for in O.E. the suffix *ing(as)* was added to a personal name to denote that man and his family, followers, etc. Thus *Basing* denotes the "followers of Basa" and *Whittingham* is the "home of the followers of Hwita." The elements *ham* and *stede*, "site," "place," later *ste(a)d*, were freely used in the early days of the invasion. The suffix *ton*, from O.E. *tun* "enclosure" becomes relatively much more frequent as we travel westwards to the districts latest conquered and this suffix remained a living one till long after the Norman Conquest. *Worth, worthy* and *wardine* all denote small enclosures but the first soon ceased to be a living suffix. *Port* was used for a town (a loan-word from Lat. *porta*), and *burh* (dat. sing. *byrig*) is the source of many names in *bury* and a few in *borough, burgh*. It denotes a fortified place, of whatever age, and has none of the constitutional associations of the common word *borough*. Large areas of land were still covered with forest; as these were brought under cultivation names in *-ley* and *-field* arose, from the O.E. words *leah*, "clearing in woodland," and *feld*, "open country." Land dedicated to the service of religion was often called *stow*, hence *Halstow*, "holy place," *Bridstow*, "St. Bride's land," corresponding to the Welsh *Llan san Bregit*. Many other elements of a purely topographical character are found in place-names. Here and in other countries we find early peoples very sensitive to slight differences of terrain and a place might be called a *cliff*, e.g., *Egglescliffe*, or *hangra* (*i.e.*, "hanging wood," as in *Shelfanger*), where we should only note a slight slope. The personal names found in these place-names, especially in eastern and south-eastern England, are often of an exceedingly archaic type, suggesting that soon after the settlement there were rapid changes in the nomenclature among our forefathers.

The Scandinavian settlement of certain districts of England

affected the place-nomenclature as deeply as the earlier English settlements, but its intensity varied a good deal from area to area and as the speech of the Vikings was closely allied it is not always easy to differentiate native and Scandinavian names. Changes were brought about in various ways. The commonest was entirely to re-name the place, as when O.E. *Nor-worig* became *Derby*. There was also a good deal of Scandinavianizing of names, as when O.E. *Eofor-wic* became *Jor-vik* (and so *Yorick* and *York*) or places which had once ended in *-bury* were given the Scandinavian suffix *-by*, so that in the middle of the 10th century *Badby* (Northants.) is called indifferently *Baddanby* and *Baddanburh*. How deep the influence of Scandinavian speech went is shown by more than one place-name which retains Scandinavian inflexional forms (e.g., *Beckermet*, "meeting of the stream," which contains the gen. sing. *bekkjar* of O.Norse *bekkr*, and still more by a name like *Osmotherley* in which the English personal name *Osmund* was given a Scandinavian gen. sing. in *ar* even before an English second element). In some counties, where raids were extensive but where there was no organized dividing up of the land among the new settlers (*e.g.*, Northumberland and a good part of Durham), the number of Scandinavian names is small but in others (*e.g.*, the North and East Ridings of Yorkshire and in Lindsey), where the land was parcelled out among the Danish, we have a dominantly Scandinavian nomenclature. Danes for the most part settled in eastern England, Norsemen in northwestern England. That there were some colonies of Norsemen amid a prevailing Danish population is shown by the *Normanbys* and *Normantons* in the east and the Midlands, all settlements of Norsemen and not of Normans. In the North Riding there were enough Norsemen for certain villages to have to be distinguished as *Danby*, "villages of the Danes." Where the English were almost entirely ousted we have a few *Inglebys*, isolated villages of the English surviving, while the *Denbys* and *Denaby* of Derbyshire and the West Riding suggest Danish settlements amid a prevalent English population. Those Vikings, chiefly Norsemen, who had previously been raiding in Ireland were commonly known as the "Irishmen" and gave their name to certain *Irbys*, *Irebys* and *Iretons*. When they had been to Wales they were nicknamed *Brettar* and so we get *Bretby* and two or three *Birkbys*, which were earlier *Brettaby*. The commonest suffixes denoting various kinds of settlement are as follows: *by*, denoting variously farm, hamlet and village, *thorpe*, "a village," especially an "offshoot from a larger one" (carefully to be distinguished from the native *thorp, throp*, often found in the South Midlands, as in *Eythrope, Thrupp, Sedrup, Colstrope*), *thwaite*, "clearing," "paddock," *toft*, "piece of ground," "messuage," "homestead." To the Vikings also we owe the *ridings* of Yorkshire and Lincolnshire, from O.Norse *thrithungr*, "third part" and the *wapentakes* of Scandinavian England generally, from O. Norse *vapna-tak*, "taking of weapons." They had their own topographical terms, some of the commonest being found in the suffixes *scoe, skew* "wood," *with*, "wood," *force*, "waterfall," *fell*, "mountain," Norse *breck* and Danish *brink* "slope," *wath*, "ford," Norse *slack*, "shallow valley." Personal names are very common as first elements in their place-names while in a few we have post-position of the personal name (e.g., *Aspatria*, lit. ash-Patrick), showing that the Norsemen when in Ireland must have learned the old Gaelic method of putting the personal name after the significant element. This name and others, such as *Commondale*, earlier *Colmandale*, containing the O.Ir. name *Colman* show how common Gaelic names were among these Vikings who had intermarried with the Celts. In gauging Scandinavian influence on the basis of place-names it should be borne in mind that many Scandinavian words (e.g., *biggin, fell*) soon became part of the English speech and that certain Scandinavian names such as *Harold* soon came to be borne by persons of English descent, so that the presence of such elements in place-names is no certain proof of their Scandinavian origin.

The main sphere of Norman-French influence on place-names has already been indicated, viz., its importance in changing the spelling and pronunciation of many of the older names. Such influence was specially common in the neighbourhood of the great castles and monasteries. They themselves often bore French, or at least Gallicised names, such as *Richmond, Devizes, Belvoir, Rievaulx, Jervaulx*. The traditional pronunciations of these names are Anglo-French in character and thus it is that we have *Bewley* for *Beaulieu*, *Beaver* for *Belvoir, Rivers* for *Rievaulx*, and *Beaumont* commonly pronounced as *Beamont* or *Bewmont*. Knowledge of modern French is gradually ousting these in favour of pseudo-educated ones. Norman-French feudalism led to the distinguishing of one manor from another by the suffixing (or occasional prefixing) of the name of its feudal holder, whence such names as *Stanstead Mountfitchet, Buckland Sororum* (*i.e.*, of the nuns), *Bishop's Tawton*.

The more one studies the history of place-names the more one finds what a large proportion of them are really early in their origin. There are however two types which are definitely late. The type whereby a place came to be called *Poynatts, Chequers*, and the like, from the family names, *Poynatt, Chequer*, dates from the 14th century onwards. Place-names formed from phrases, often of a humorous character, such as *Glororum* (glower o'er 'em), *Make 'em Rich, Bo-peep* come even later, belonging as a rule to the 17th century or later.

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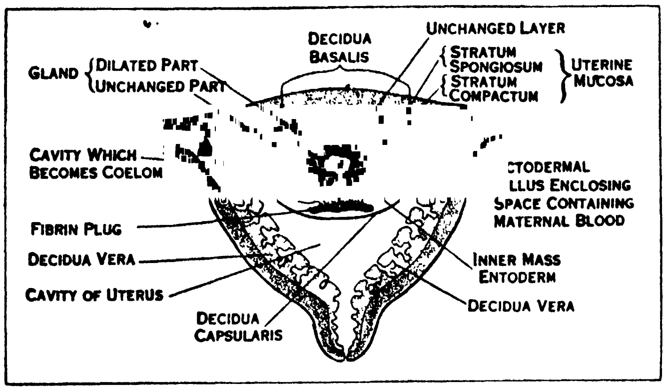
(A. M.)

PLACENTA, the organ by which the embryo is nourished within the womb of its mother. When the young one is born the placenta and membranes come away as the "afterbirth." The human placenta is a circular disk about 7 or 8 in. in diameter and 1¼ in. in thickness at its centre, while at its margin it is very thin and is continuous with the foetal membranes. It weighs about a pound.

Mode of Formation.—Before each menstrual period, during the child-bearing age of a woman, the mucous membrane of the uterus hypertrophies, and, at the period, is cast off, but if a fertilized ovum reaches the uterus the casting off is postponed until the birth of the child. From the fact that the thickened mucous membrane lining the interior of the uterus is cast off sooner or later, it is spoken of as the "decidua." The fertilized ovum, on reaching the uterus, embeds itself in the already prepared decidua, and, as it enlarges, there is one part of the decidua lying between it and the uterine wall ("decidua serotina" or "basalis"), one part stretched over the surface of the enlarging ovum ("decidua reflexa" or "capsularis") and one part lining the rest of the uterus ("decidua vera") (*see* fig. 1) It is the decidua

basalis which is specially concerned in formation of the placenta. That part which is nearest the ovum is called the "stratum compactum," but farther away the uterine glands dilate and give a spongy appearance to the mucous membrane (stratum spongiosum). Processes from the surface of the ovum penetrate the stratum compactum and push their way into the enlarged maternal blood sinuses; these are the "chorionic villi." Later,



FROM A. H. YOUNG AND A. ROBINSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 1.—DIAGRAM REPRESENTING A VERY YOUNG HUMAN OVUM ALMOST IMMEDIATELY AFTER ITS ENTRANCE INTO THE DECIDUA. THE PLACE OF ENTRANCE STILL BEING COVERED WITH A PLUG OF FIBRIN

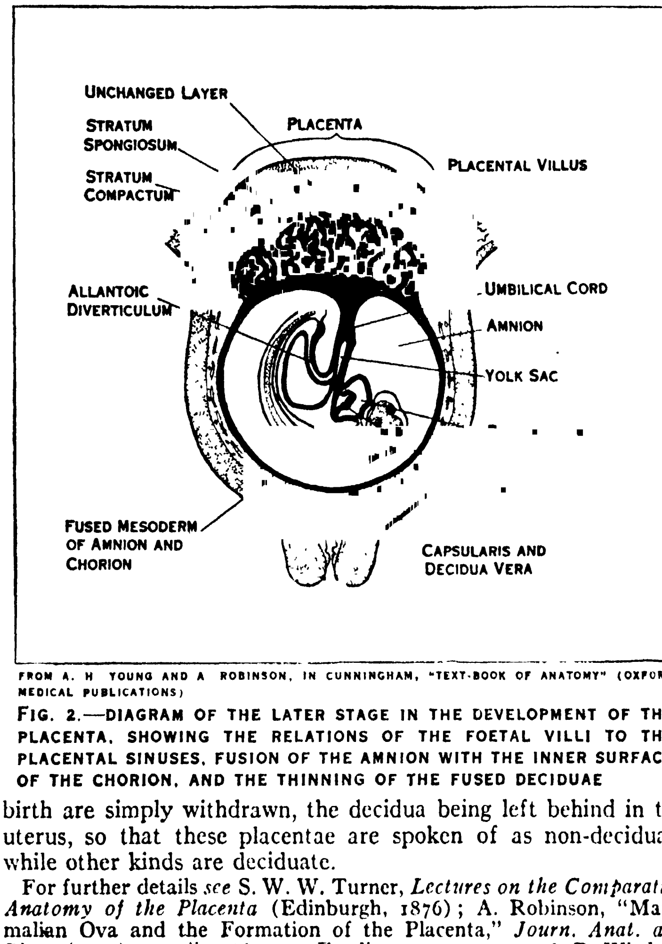
the "allantoic" or "abdominal stalk" grows from the mesoderm of the hind end of the embryo into the chorionic villi which enter the decidua basalis, and in this blood-vessels push their way into the maternal blood sinuses. Eventually the original walls of these sinuses and the false amnion, disappear, and nothing separates the maternal from the foetal blood except the delicate walls of the foetal vessels covered by undifferentiated, nucleated tissue (*syncytium*), derived from the chorionic epithelium, so that the embryo is able to take its supply of oxygen and materials for growth from the blood of its mother and to give up carbonic acid and excretory matters. It is the gradual enlargement of the chorionic villi in the decidua basalis together with the intervillous maternal blood sinuses that forms the placenta; the decidua capsularis and vera become pressed together as the embryo enlarges, and atrophy. The allantoic stalk elongates enormously, and in its later stages contains two arteries (umbilical) and one vein embedded in loose connective tissue known as "Wharton's jelly." At first the stalk of the yolk-sac is quite distinct from this, but later the two structures become bound together (*see* fig. 2), as the "umbilical cord." A distinction must be made between the allantoic stalk and the allantois; the latter is an entodermal outgrowth from the hind end of the mesodaeum or primitive alimentary canal, which in the human subject only reaches a little way toward the placenta. The allantoic stalk is the mass of mesoderm containing blood-vessels which is pushed in front of the allantois and, as has been shown, reaches and blends with the decidua basalis to form the placenta.

For further details *see* Quain's *Anatomy*, vol. i. (London, 1908); and, for literature, O. Hertwig's *Handbuch der Entwickelungslehre* (Jena).

Comparative Anatomy.—If the placenta is to be regarded as a close union between the vascular system of the parent and embryo, the condition may be found scattered throughout the phylum of the Chordata. In so lowly a member as Salpa, a placenta is formed, and the embryo is nourished within the body of its parent. In some of the viviparous sharks, *e.g.*, the blue shark (Cacharias), the yolk-sac has ridges which fit into grooves in the wall of the oviduct and allow interchange between maternal and foetal blood. This is an example of an "umbilical placenta." In the viviparous blennies (*Zoarces viviparus*), among the teleostean fishes, 200 or 300 young are nourished in the hollow ovary, which develops villi secreting nutritive material.

The mammals are divided into Placentalia and Aplacentalia; in the latter group, to which the monotremes and most marsupials belong, the ova have a great deal of yolk, and the young, born in a very immature condition, finish their development in their mother's pouch; but although these mammals have no allantoic placenta there is an intimate connection between the walls of the yolk-sac and the uterine mucous membrane, and so an umbilical placenta exists. The name Aplacentalia therefore only means that they have no allantoic placenta. Among the Placentalia the umbilical and allantoic placentae sometimes coexist for some time, as in the hedgehog, bandicoot and mouse.

In the Carnivora, elephant, procavia (Hyrax) and aard vark (Orycteropus), there is a "zonary-placenta" which forms a girdle round the embryo. In sloths and lemurs the placenta is dome-shaped, while in rodents, insectivores and bats, it is a ventral disk or closely applied pair of disks, thus differing from the dorsal disk of the ant-eater, armadillo and higher Primates, which is known as a "metadiscoidal placenta." Thus the form of the placenta is not an altogether trustworthy indication of the systemic position of its owner. In the diffuse and cotyledonous placentae the villi do not penetrate very deeply into the decidua, and at



FROM A. H YOUNG AND A ROBINSON, IN CUNNINGHAM, "TEXT-BOOK OF ANATOMY" (OXFORD MEDICAL PUBLICATIONS)

FIG. 2.—DIAGRAM OF THE LATER STAGE IN THE DEVELOPMENT OF THE PLACENTA, SHOWING THE RELATIONS OF THE FOETAL VILLI TO THE PLACENTAL SINUSES, FUSION OF THE AMNION WITH THE INNER SURFACE OF THE CHORION, AND THE THINNING OF THE FUSED DECIDUAE

birth are simply withdrawn, the decidua being left behind in the uterus, so that these placentae are spoken of as non-deciduate while other kinds are deciduate.

For further details *see* S. W. W. Turner, *Lectures on the Comparative Anatomy of the Placenta* (Edinburgh, 1876); A. Robinson, "Mammalian Ova and the Formation of the Placenta," *Journ. Anat. and Phys.* (1904) xxxviii., 186, 325. For literature up to 1906, R. Wiedersheim's *Comparative Anatomy of Vertebrates*, trans. and adapted by W. N. Parker (London, 1907); O. Terasaki, *Ueber die Githerfaserstructuren i. d. menschlichen Placenta*, Ztschr. f. Geburtsh. u. Gyn., 92, 94 (1927, bibl.); J. W. Williams, *Placenta circumvallata*, Am. J. Obst. and Gyn., 13, 1 (1927, bibl.); H. Westermark, *Weight of the Human Placenta relative to that of the Foetus, etc.*, Acta Obst. et Gyn. Scandin., 4, 249 (1925–26, bibl.), and F. L. Adair and H. Thelander, Am. J. Obst. and Gyn., 10, 172 (1925, bibl.); H. Richter, *Zur Physiologie u. Morphologie der Placenta*, Arch. f. Gyn., 124, 557 (1925, bibl.); J. E. Davis, B. V. Kellog and A. L. Amolsch, *Anatomical and Clinical Studies upon 875 placentae*, Am. J. Obst. and Gyn., 7, 637 (1924, bibl.); G. I. Strachan, *Physiology of the placenta*, J. Obst. and Gyn., Brit. Emp., 32, 89 (1925, bibl.); O. Grosser, *Vergleichende u. menschliche Placentationslehre*, in Halban and Seitz, *Biologie u. Pathologie d. Weibes*, vol. vi., part 1, p. 41 (bibl.); H. A. Dietrich, *Biologie der Placenta*, ibid. p. 195 (bibl.); H. Hinselman, *Normales u. path. Verhalten der Placenta u. d. Fruchtwassers*, ibid. p. 241 (bibl.).

PLACERS, the common name given to the alluvial deposits in which gold frequently occurs. They consist of sand and gravel deposited by existing or former streams of water carrying de-

tritus of gold-bearing rocks. Other metals, *e.g.*, tin, are similarly deposited. The gold of the placers consists of grains called "gold-dust" and larger pieces, rounded by attrition, called "nuggets." The placer of an ancient stream may be deep-lying because covered since its formation with other deposits or even lava. (*See* GOLD MINING and METALLURGY.)

PLAGIARISM, an appropriation or copying from the work of another, in literature or art, and the passing off of the same as original. The Lat. *plagiarius* meant a kidnapper, stealer or abductor of a slave or child, though it is also used in the modern sense by Martial (I. 53, 9). (*See* COPYRIGHT.)

PLAGIOCLASE, an important group of rock-forming minerals constituting an isomorphous series between albite felspar and anorthite felspar. The intermediate members are soda-lime felspar which in their crystallographical, optical and other physical properties vary progressively between the two extremes, albite (Ab) $NaAlSi_3O_8$, and anorthite (An) $CaAlSi_2O_8$. The name plagioclase is derived from the Gr. *πλάγιος,* "oblique," and *κλᾶν,* "to break," in allusion to the oblique angle between the cleavages. Names are applied to members of the plagioclase group falling between certain arbitrary composition limits, those now commonly adopted being albite (Ab_{100}–Ab_{90}), oligoclase (Ab_{90}–Ab_{70}), andesine (Ab_{70}–Ab_{50}), labradorite (Ab_{50}–Ab_{30}), bytownite (Ab_{30}–Ab_{10}), anorthite (Ab_{10}–An_{100}). The pure end members are practically unknown in nature. All the plagioclases crystallize in the triclinic system, and as members of an isomorphous series show closely similar crystallographic constants. They possess a perfect cleavage parallel to the basal pinacoid (001) and a less pronounced cleavage parallel to the pinacoid (010), the angle between the two cleavages varying progressively from 86° 24′ in albite to 85° 50′ in anorthite. The molecular volumes are closely similar (Ab 100·1) (An 101·5). The habit of well-formed crystals is usually tabular on the plane 010, sometimes flattened parallel to 001 or, as in microlitic plagioclases of volcanic rocks, elongated in the direction of the edge 001:010. Twinning is a very important character of the plagioclases, being almost invariably present and affording a ready means of distinguishing them from other felspars. The chief twin laws are the Carlsbad, albite and pericline; the latter two, being commonly polysynthetic, give rise to numerous thin lamellae, which are the cause of the fine striations seen on cleavage planes, and of the banded character visible in thin sections of the minerals examined in polarized light.

With the exception of the sodic end member (albite), which, owing to the high viscosity of its melts, is with difficulty crystallized, the plagioclases are readily prepared from dry melts of the component oxides. They show a continuous melting curve, the intermediate members exhibiting a melting interval. The temperatures of beginning of melting (solidus) have been determined in the laboratory for compositions ranging from pure An to Ab_3An_1, and of completion of melting (liquidus) for a range An to Ab_8An_1. These data are shown below.

Composition	*Temperature of beginning of melting (solidus)*	*Temperature of completion of melting (liquidus)*
Albite ($Ab_{98}An_2$)	1,100°C	—
Oligoclase (Ab_3An_1)	1,175°C	1,362°C
Andesine (Ab_2An_1)	1,205°C	1,394°C
Andesine-Labradorite (Ab_1An_1)	1,287°C	1,450°C
Labradorite (Ab_1An_2)	1,372°C	1,490°C
Bytownite (Ab_1An_5)	1,465°C	1,521°C
Anorthite (An_{100})	1,550°C	1,550°C

The density and mean refractive index of the plagioclase felspars vary progressively, the extremes being albite, $D = 2{\cdot}605, \mu = 1{\cdot}530$; anorthite, $D = 2{\cdot}765, \mu = 1{\cdot}587$.

Since the plagioclases are of great importance in petrology much detailed study of their optical properties has been undertaken, so that it is now possible to determine by simple examination of thin slices of these minerals the exact chemical composition and crystallographic orientation of the selected section. For this purpose, the chief determinations are the refractive indices, and the optical extinctions of oriented sections, principally on cleavage flakes (001 and 010), sections cut perpendicular to the optic axes and bisectrices, and especially those perpendicular to the plane of albite twinning (010) in multiple-twinned crystals. Other optical determinations are available for discriminating the various members of the group.

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PLAGUE, in medicine, a term formerly given to any epidemic disease causing a great mortality, but now confined to a specific infectious fever caused by *b. pestis.*

History to 1880.—The first historical notice of the plague is contained in a fragment of the physician Rufus of Ephesus, who lived in the time of Trajan, preserved in the *Collections of Oribasius*[1]. Rufus speaks of the buboes called pestilential as being specially fatal and as being found chiefly in Libya, Egypt and Syria. This passage shows the antiquity of the plague in northern Africa, which for centuries was considered as its home. It is not till the 6th century of our era, that we find bubonic plague in Europe, as a part of the great cycle of pestilence, which lasted fifty years, and spread over the whole Roman world, beginning in maritime towns and radiating inland. In another direction it extended from Egypt along the north coast of Africa. Whether the numerous pestilences recorded in the 7th century were the plague cannot now be said; but it is possible the pestilences in England chronicled by Bede in the years 664, 672, 679 and 683 may have been of this disease, especially as in 690 *pestis inguinaria* is again recorded in Rome.

In the great cycle of epidemics in the 14th century known as the Black Death, some at least were bubonic plague. The mortality of the black death was, as is well known, enormous. It is estimated in various parts of Europe at two-thirds or three-fourths of the population in the first pestilence, in England even higher; but some countries were much less severely affected. Hecker calculates that one-fourth of the population of Europe, or 25 millions of persons, died in the whole of the epidemics.

The Great Plague of London.—The great plague of 1664–1665 must not be regarded as an isolated phenomenon. Plague had recurred frequently in all parts of Europe in the 15th, 16th and 17th centuries. Nevertheless in London the preceding years had been unusually free from plague, and it was not mentioned in the bills of mortality till in the autumn of 1664 (Nov. 2) a few isolated cases were observed in Westminster and a few occurred in the following winter, which was very severe. About May 1665 the disease again became noticeable and spread, but somewhat slowly. Boghurst, a contemporary doctor, notices that it crept down Holborn and took six months to travel from the western suburbs to the eastern through the city. The mortality rapidly rose from 43 in May to 590 in June, 6,137 in July, 17,036 in August, 31,159 in September, after which it began to decline. The total number of deaths from plague in that year, according to the bills of mortality, was 68,596, in a population estimated at 460,000, out of whom two-thirds are supposed to have fled to escape the contagion. This number is likely to be underestimated, since of the 6,432 recorded deaths from spotted fever many were probably really from plague, though not declared so to avoid painful restrictions. In December there was a sudden fall in the mortality which continued through the winter; but in 1666 nearly 2,000 deaths are recorded.

According to some authorities, the plague was imported into London by bales of merchandise from Holland, which came originally from the Levant; according to others it was introduced

[1]Lib. xliv. cap. 17—*Oeuvres de Oribase,* ed. Bussemaker and Daremberg (Paris, 1851), iii. 607.

by Dutch prisoners of war. From London the disease spread widely over England.

After 1666 there was no epidemic of plague in London or any part of England, though sporadic cases appear in bills of mortality up to 1679; and a column filled up with "o" was left till 1703, when it finally disappeared. The disappearance of plague in London was attributed to the Great Fire, but no such cause existed in other cities. It has also been ascribed to quarantine, but no effective quarantine was established till 1720, so that the cessation of plague in England must be regarded as spontaneous.

But this was no isolated fact. A similar cessation of plague was noted soon after in the greater part of western Europe. In 1666 a severe plague raged in Cologne and on the Rhine, which was prolonged till 1670 in the district. In the Netherlands there was plague in 1667–1669, but there are no definite notices of it after 1672. France saw the last plague epidemic in 1668, till it reappeared in 1720. In the years 1675–1684 a new plague epidemic appeared in North Africa, Turkey, Poland, Hungary, Austria and Germany, progressing generally northward. Malta lost 11,000 persons in 1675. The plague of Vienna in 1679 was very severe, causing 76,000 or probably more deaths. Prague in 1681 lost 83,000 by plague. Dresden was affected in 1680, Magdeburg and Halle in 1682—in the latter town with a mortality of 4,397 out of a population of about 10,000. Many North German cities suffered about the same time; but in 1683 the plague disappeared from Germany till the epidemic of 1707. In Spain it ceased about 1681; in Italy certain cities were attacked till the end of the century, but not later (Hirsch).

The plague-epidemics in Egypt between 1833 and 1845 are very important in the history of plague, since the disease was almost for the first time scientifically studied in its home by skilled European physicians, chiefly French. The disease was found to be less contagious than reported to be by popular tradition, and most of the French school went so far as to deny the contagiousness of the disease altogether.

An outbreak of plague in 1878–1879 on the banks of the Volga caused a panic throughout Europe and most European governments sent special commissions to the spot. The British commissioners were Surgeon-Major Colvill and Dr. J. F. Payne, who, like all the foreign commissioners, arrived when the epidemic was over. In the opinion of Dr. Payne the real beginning of the disease was in the year 1877, in the vicinity of Astrakhan, and the sudden development of the malignant out of a mild form of the disease was no more than had been observed in other places.

Plague in India.—It used to be held as a maxim that plague never appeared east of the Indus; nevertheless it was observed during the 19th century in more than one distinct centre in India. So long ago as 1815 the disease appeared in Guzerat, Kattywar and Cutch, "after three years of severe famine." It reappeared early next year, in the same locality, when it extended to Sind as far as Hyderabad, and in another direction south-east as far as Ahmedabad and Dhollerah. But it disappeared from these parts in 1820 or early in 1821, and was not heard of again till July 1836, when a disease broke out into violence at the town of Pali in Marwar in Rajputana. It spread from Pali to the province of Meywar, but died out spontaneously in the hot season of 1837.

In 1823 (though not officially known till later) an epidemic broke out at Kedarnath in Garhwal, a sub-district of Kumaon on the south-west of the Himalayas, on a high situation. In 1834 and 1836 other epidemics occurred, which at last attracted the attention of the government. In 1849–1850, and again in 1852, the disease raged very severely and spread southward. In 1853 Dr. Francis and Dr. Pearson were appointed a commission to inquire into the malady. In 1876–1877 another outbreak occurred. The symptoms of this disease, called *maha murree* or *mahamari* by the natives, were precisely those of oriental plague. The feature of blood-spitting, to which much importance had been attached, appeared to be not a common one. A very remarkable circumstance was the death of animals (rats, and more rarely snakes) at the outbreak of an epidemic. The rats brought up blood, and the body of one examined after death by Dr. Francis showed an affection of the lungs.

History Since 1880.—In 1880 plague existed or had existed within ten years, in the following parts of the world: (1) Benghazi, Africa; (2) Persian Kurdistan; (3) Irak, on the Tigris and Euphrates; (4) the Asīr country, western Arabia; (5) on the lower Volga, Russia; (6) northern Persia and the shores of the Caspian; (7) Kumaon and Garhwal, India; (8) Yunnan and Pakhoi, China.

The most striking feature of the early history of plague is the gradual retrocession of plague from the west, after a series of exceedingly destructive outbreaks extending over several centuries, and its disappearance from Europe. Western countries were the first to be freed from its presence, namely, England, Portugal and Spain. From all these it finally disappeared about 1680, at the close of a period of pandemic prevalence. Northern and central Europe became free about 1714, and the south of France in 1722. The last outbreak in northern Russia occurred in 1770. After this plague only appeared in the south-east of Europe, where in turn it gradually died away during the first half of the 19th century. In 1841 its long reign on this continent came to an end with an isolated outbreak in Turkey. From that time until quite recently it remained extinct, except in the East. The province of Astrakhan, where a very small and limited outbreak occurred in 1878, is politically in Europe, but geographically it belongs rather to Asia. And even in the East plague was confined to more or less clearly localized epidemics; it showed no power of pandemic diffusion. In short, if we regard the history of this disease as a whole, it appears to have lost such power from the time of the Great Plague of London in 1665, which was part of a pandemic wave, until the present day. There was not merely a gradual withdrawal eastwards lasting nearly two hundred years, but the outbreaks which occurred during that period, violent as some of them were, showed a constantly diminishing power of diffusion and an increasing tendency to localization. The sudden reversal of that long process is therefore a very remarkable occurrence. Emerging from the remote endemic centres to which it had retreated, plague has once more taken its place among the zymotic diseases with which modern science has to reckon.

Diffusion.—Visitations of cholera can be traced definitely to a point of origin often in India. (*See* CHOLERA.) Similarly, though not with equal precision, a wave of influenza was shown to have started from central Asia in the spring of 1889, to have travelled through Europe from east to west, to have been carried thence across the sea to America and the Antipodes, until it eventually invaded every inhabited part of the globe (*see* INFLUENZA). In both cases no doubt remains that the all-important means of dissemination is human intercourse. The movements of plague cannot be followed in the same way. With regard to origin, several endemic centres are now recognized in Asia and Africa, namely, (1) the district of Assyr in Arabia, on the eastern shore of the Red Sea; (2) parts of Mesopotamia and Persia; (3) the district of Garhwal and Kumaon in the North-West Provinces of India; (4) Yunnan in China; (5) East and Central Africa. The last was discovered by Dr. Koch.

The following is a list of countries in which plague is known to have been present in each year (*see* Local Government Board's Reports): 1880, Mesopotamia; 1881, Mesopotamia, Persia and China; 1882, Persia and China; 1883, China; 1884, China and India (as *mahamari*); 1885, Persia; 1886, 1887, 1888, India (as *mahamari*); 1889, Arabia, Persia and China; 1890, Arabia, Persia and China; 1891, Arabia, China and India (as *mahamari*); 1892, Mesopotamia, Persia, China, Russia (in central Asia); 1893, Arabia, Persia, China, Japan, Russia, East Africa, Madagascar and China and India (as *mahamari*); 1895, Arabia and China; 1896, Arabia, Asia Minor, China, Japan, Russia and India (Bombay); 1897, Arabia, China, Japan, India, Russia and East Africa; 1898, Arabia, Persia, China, Japan, Russia, East Africa, Madagascar and Vienna; 1899, Arabia, Persia, China, Japan, Mesopotamia, East Africa, West Africa, Philippine Islands, Straits Settlements, Madagascar, Mauritius, Réunion, Egypt, European Russia, Portugal, Sandwich Islands, New Caledonia, Paraguay, Argentine, Brazil: 1900, to the foregoing should be added Turkey, Australia, California, Mexico and Glasgow; in 1901, South Africa

and in 1902 Russia, chiefly at Odessa.

In 1896 plague appeared in the city of Bombay; the infection spread gradually and slowly at first, but during the first three months of 1897 not only was the town of Bombay severely affected, but district after district in the presidency was attacked, notably Poona, Karachi, Cutch Mandvi, Bhiwandi and Daman. The following figures give the mortality for Bombay and Bengal, as well as the total mortality in India.

Year	Bengal Presidency (including Calcutta)	Bombay Presidency (including Bombay City)	All India
1896	.	2,219	2,219
1897		47,710	47,974
1898	219	86,191	89,265
1899	3,264	96,592	102,369
1900	38,412	33,196	73,576
1901	78,629	128,259	236,433
1902	32,967	184,752	452,655
1903	65,680	281,269	684,445
1904	75,438	223,957	938,010
1905	126,084	71,363	940,821
1906	59,619	51,525	300,355

In 1900, there was an outbreak of plague in Australia. The total number of cases reported in Queensland was only 123, with 53 deaths. In Sydney there were 303 cases, with 103 deaths, a case mortality of 34%. The infection is supposed to have been brought from Noumea, in New Caledonia, where it was present at the end of 1899. Plague in Glasgow was on a still smaller scale. It began, so far as could be ascertained, in August 1900, and during the two months it lasted there were 34 cases and 15 deaths. Once more the disease was not at first recognized, and its origin could not be traced. In 1901 plague invaded South Africa, and obtained a distinct footing both at Cape Town and Port Elizabeth. The total number of cases down to July was 760, with 362 deaths; the number of Europeans attacked was 196, with 68 deaths, the rest being natives, Malays, Indians, Chinese and negroes. With regard to Great Britain, a few ship-borne cases had to be dealt with at the ports.

Causation.—Plague is a specific infectious fever, caused by the *bacillus pestis*, which was identified in 1894 by Kitasato, and subsequently, but independently, by Yersin (*see* BACTERIA and DISEASE). It is found in the buboes in ordinary cases, in the blood in the so-called "septicaemic" cases, and in the sputum of pneumonic cases. It may also be present in the urine. *Post mortem* it is found in great abundance in the spleen and liver. Nothing is known of its natural history outside the body, but on cultivation it is apt to undergo numerous involution forms. Its presence in a patient is regarded as positive diagnostic proof of plague; but failure to find or to identify it does not possess an equal negative value, and should not be too readily accepted. It is quite clear, from the extreme variations in the severity of the illness, that the resisting power of individuals varies greatly. According to the Plague Research Committee of Bombay, the predisposing causes are "those leading to a lower state of vitality," of which insufficient food is probably the most important. There is no evidence that age, sex or race exercises a distinct predisposing influence. The largest incidence in Bombay was on young adults; but then they are more numerous and more exposed to infection, because they go about more than the younger and the older. Similarly, the comparative immunity of Europeans in the East may be explained by their different conditions of life. It is doubtful whether the distinction drawn between *pestis minor* and *pestis major* has a real aetiological basis. Very mild cases occurring in the course of an outbreak of typical plague may be explained by greater power of resistance in individuals, but the epidemic prevalence of a mild illness preceding the appearance of undoubted plague suggests some difference or modification of the exciting cause. Of course plague does not stand alone in this respect. Epidemic outbreaks of other diseases—for instance, cholera, diphtheria and typhoid fever—are often preceded and followed by the prevalence of mild illness of an allied type.

Clinical Characters.—One of the results of recent observation is the classification of plague cases under the three heads: (1) bubonic, (2) pneumonic, (3) septicaemic. This classification is a clinical one, and the second and third varieties are just as much plague as the first. It is necessary to say this, because a misleading use of the word "bubonic" has given rise to the erroneous idea that true plague is necessarily bubonic, and that non-bubonic types are a different disease altogether.

The illness varies within the widest limits, and exhibits all gradations of severity, from a mere indisposition, which may pass almost unnoticed, to an extreme violence, only equalled by the most violent forms of cholera. The mild cases are always bubonic; the other varieties are invariably severe, and almost always fatal. Incubation is generally from four to six days, but it has been observed as short as thirty-six hours and as long as ten days (Bombay Research Committee). As a rule the onset is sudden and well marked.

(1) Bubonic cases usually constitute three-fourths of the whole, and the symptoms may therefore be called typical. In a well-marked case there is usually an initial rigor—in children convulsions—followed by a rise of temperature, with vomiting, headache, giddiness, intolerance to light; pain in epigastrium, back and limbs; sleeplessness, apathy or delirium. The headache is described as splitting; delirium is of the busy type, like delirium tremens. The temperature varies greatly; it is not usually high on the first day—from 101° to 103°—and may even be normal, but sometimes it rises rapidly to 104° or 105° or even 107° F; a fall of two or three degrees on the second or third day has frequently been observed. The eyes are red and inflamed; the tongue is somewhat swollen, and at first covered with a thin white fur, except at the tip and edges, but later it is dry, and the fur yellow or brownish. Prostration is marked. Constipation is the rule at first, but diarrhoea may be present, and is a bad sign. A characteristic symptom in severe cases is that the patient appears dazed and stupid, is thick in speech, and staggers. The condition has often been mistaken for intoxication. There is nothing, however, in all these symptoms positively distinctive of plague, unless it is already prevalent. The really pathognomonic sign is the appearance of buboes or inflamed glands, which happens early in the illness, usually on the second day; sometimes they are present from the outset, sometimes they cannot be detected before the third day, or even later. The commonest seat is the groin, and next to that the axilla; the cervical, submaxillary and femoral glands are less frequently affected. Sometimes the buboes are multiple and on both sides, but more commonly they are unilateral. The pain is described as lancinating. If left, they usually suppurate and open outwards by sloughing of the skin, but they may subside spontaneously, or remain hard and indurated. Petechiae occur over buboes or on the abdomen, but they are not very common, except in fatal cases, when they appear shortly before death. Boils and carbuncles are rare.

(2) Pneumonic plague was observed and described in many of the old epidemics, but its precise significance was first recognized by Childe in Bombay. He demonstrated the presence of the bacilli in the sputa, and showed that the inflammation in the lungs was set up by primary plague infection. The pneumonia is usually lobular, the onset marked by rigors, with difficult and hurried breathing, cough and expectoration. The prostration is great and the course of the illness rapid. The breathing becomes very hurried—forty to sixty respirations in the minute—and the face dusky. The expectoration soon becomes watery and profuse, with little whitish specks, which contain great quantities of bacilli The temperature is high and irregular. The physical signs are those of broncho-pneumonia; oedema of the lungs soon supervenes, and death occurs in three or four days.

(3) In septicaemic cases the symptoms are those of the bubonic type, but more severe and without buboes. Prostration and cerebral symptoms are particularly marked; the temperature rises rapidly and very high. The patient may die comatose within twenty-four hours, but more commonly death occurs on the second or third day. Recovery is very rare.

The case mortality of plague still remains exceedingly high. The lowest recorded is 34% in Sydney, and the highest 95% at

Hong Kong in 1899. During the first few weeks in Bombay it was calculated by Dr. Viegas to be as high as 99%. It is very much higher among Orientals than among Europeans. In the Bombay hospitals it was about 70% among the former, and between 30% and 40% among the latter, which was much the same as in Oporto, Sydney and Cape Town. It appears, therefore, that plague is less fatal to Europeans than cholera. The average duration of fatal cases is five or six days; in the House of Correction at Byculla, where the exact period could be well observed, it was five and a half days. Patients who survive the tenth or twelfth day have a good chance of recovery. Convalescence is usually prolonged. Second attacks are rare, but not unknown.

Diagnosis.—When plague is prevalent in a locality, the diagnosis is easy in fairly well-marked cases of the bubonic type, but less so in the other varieties. When it is not prevalent the diagnosis is never easy, and in pneumonic and septicaemic cases it is impossible without bacteriological assistance. The earliest cases have hardly ever been even suspected at the time in any outbreak in a fresh locality. It may be taken at first for almost any fever, particularly typhoid, or for venereal disease or lymphangitis. In plague countries the diseases with which it is most liable to be confounded are malaria, relapsing fever and typhus, or bronchopneumonia in pneumonic cases.

Dissemination.—The investigations of the Indian plague commission working in conjunction with the advisory committee showed that bubonic and septicaemic plague are transmitted by the agency of fleas. Highly susceptible animals are not infected by their plague-stricken fellows so long as fleas are excluded from the cages, but with the introduction of these ectoparasites the disease forthwith spreads from the sick to the healthy. Subsequent experience has confirmed the main findings of the commission, and outbreaks of human plague are unquestionably mere extensions of preceding or concurrent plague affecting animals. Rats (*Rattus rattus*) are of outstanding importance as reservoirs of infection through their close association with man, but marmots (*Arctomys bobac*), gerbilles (*Tatera lovengulae*) and ground squirrels (*Citellus beecheyi*) have been responsible for epidemic outbreaks in China, South Africa and California respectively.

The plague commission concluded that the disease can be transmitted by the faeces of infected fleas, but did not state that this is the usual method of spread. Bacot and Martin later demonstrated that the entrance to the flea's stomach becomes obstructed by a mass of plague bacilli. Such fleas in their persistent efforts to feed merely succeed in distending the gullet with blood, which, now contaminated, regurgitates on to the skin of the host. The organisms then enter the body either through the flea's bite or through some abrasion of the skin.

The flea most commonly incriminated as a plague-vector is *Xenopsylla cheopis*, but several other species of rat fleas (*Ceratophyllus fasciatus, Stivalius ahalae*), the common mouse flea (*Leptopsylla musculi*), the dog flea (*Ctenocephalus canis*), a marmot flea (*Ceratophyllus silantievi*) and the human flea (*Pulex irritans*), amongst others, are proven carriers of plague.

Epidemiology.—Laborious studies on the biology of fleas have added to our knowledge of the epidemiology of plague. These insects cannot withstand desiccation, and their survival apart from their host is proportional to the rate at which they lose moisture. Bacot and Martin (1924) found the water content of fleas to be 80% of their weight, and death occurred before the loss of water had reached 60% of their weight. This goes far to explain the observation that plague does not maintain itself in epidemic form when the temperature rises above 80° F, accompanied by a saturation deficiency of over ·30 of an inch.

The seasonal variations in the spread of plague have been recognised for many centuries. In temperate countries epidemics attain their maximum in the summer months, whereas in tropical climates the onset of hot, dry weather brings an existing epidemic to an end. In each case, the peak of the plague curve coincides with meteorological conditions most favourable to the activity and longevity of fleas. In contradistinction to the foregoing, pneumonic plague, once established, spreads independently of animals and fleas. In outbreaks of ordinary plague, a secondary involvement of the lungs supervenes in a small proportion of cases, and if atmospheric and environmental conditions favour the survival and transmission of the bacilli an epidemic of pneumonic plague may result, the virus being transmitted from the cougher to the victim up to a range of about three feet.

Treatment and Prophylaxis.—Unfortunately, there is no plague specific. Serum, to be really effective, must be given before the symptoms of the disease are manifest, an impossible procedure in most cases. Still, when available, serum should be administered intravenously in doses of 80–100 c.c.'s, and repeated. Some advocate injection of tincture of iodine (7–10 minims), or other antiseptics, intravenously, and also into the buboes. These measures are of doubtful benefit. Buboes showing signs of suppuration should be incised. Otherwise, treatment is on general lines, and cardiac stimulants should be administered early.

So long as members of a community are content to live in association with rats and fleas correlative plague is a likely result. Meanwhile, plague prophylaxis consists mainly of warfare against rats, in the hope of ultimately banishing them from human habitations and from contact with man. Any general elimination of these pests over wide areas is a slow, costly and usually impracticable affair, and all that can be achieved in most cases is some degree of palliation by rat-proofing of grain stores, wharves and other places which serve as centres for the dissemination of plague. Destruction of rats by trapping and poisoning is a commendable procedure, but of itself will never eradicate endemic plague, for the losses in the rat population are quickly made good if survivors are provided with food and harbourage. An important measure of personal prophylaxis is inoculation with anti-plague vaccine, which affords a good degree of protection. Persons entering plague-infected houses should wear gaiters, and otherwise render their clothing as flea-proof as possible; if there is any suspicion of pneumonic plague, goggles, and masks made of several layers of fine gauze, should be worn without fail.

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(J. F. P., A. Sl., H. L. He.)

PLAICE (*Pleuronectes platessa*), a flat-fish that ranges from Iceland and northern Europe to south of Great Britain, and one of the most important commercial fishes of the North sea. Other species of somewhat similar form, with large eyes on the right side and with a small terminal mouth, are the dab and flounder; from these the plaice is easily distinguished by the red spots scattered over the body. The pharyngeal bones are strong and bear large blunt teeth, used for crushing the shells of the bivalves that are the principal food of this species. A length of more than 30 in. and a weight of 8 lb. may be attained, but nearly all the fish marketed are less than half that length.

PLAINFIELD, a city of Union county, New Jersey, U.S.A., 24 m. W. by S. of New York city; served by the Baltimore and Ohio, the Central of New Jersey and the Reading railways. Pop. (1920) 27,700 (20% foreign-born white and 9% negro). With the adjacent boroughs of North Plainfield and South Plainfield, the population of "the Plainfields" was estimated locally at 49,500 in 1928. Situated on high ground among the charming Watchung hills, well laid out and strictly zoned, Plainfield is one of the most attractive of the residential suburbs of New York. There are five golf courses in and near the city, clubs devoted to various sports and recreations, a symphony orchestra, a community playhouse and excellent public and private schools. While manufacturing is relatively unimportant, there are substantial industries and the aggregate output in 1925 was valued at $16,972,652. The city's

assessed valuation for 1928 was $55,545,725. Settlement here dates from 1684. In 1760 a grist-mill was erected, and for several years the village was called Milltown. The township of Plainfield was created out of the township of Westfield in 1847 and in 1867 the city was chartered.

PLAINS INDIANS. The tribes of the central portion of the North American continent, on the open plains and parkland prairies extending from Alberta and Saskatchewan to Texas and from the Rocky Mountains almost to the Mississippi river, formed a natural unit, both in environment and culture. Essentially, this territory is the habitat of the American bison (buffalo); and on this animal the Plains tribes primarily depended for food, shelter, clothing and many utensils, and to its habits many of their customs were adapted. The eastern tribes, in the prairies, seasonally combined bison hunting and maize farming; the western ones, in the plains proper, were wholly nomadic. Originally, they transported their tents and belongings on travois frames dragged by dogs. After the introduction of the horse by the Spaniards, beginning about 1650, this animal gradually replaced the dog, tribal movements became freer, while their numbers augmented and their culture elaborated. They camped in large circles of tepees, conical tents of bison skins supported by long poles leaning on a primary tripod (or four poles)—a highly specialized, convenient dwelling quickly pitched and struck. Cooking was by roasting, or with hot stones in bison rawhide containers; meat predominated heavily in the diet. Property and food were stored and transported in rawhide bags and "parfleches." Clothing was of deer (antelope, elk) skins, supplemented by bison robes, and was well tailored, ample, comfortable, and often highly ornamented with embroidery of porcupine quills, later beads. Social organization was simple: matrilinear clans, patrilinear clans, or non-exogamic bands, according to tribe. Warfare was constant, being carried on partly for profit (horse raiding) but chiefly for honour, a man's career depending directly on the prestige of his war exploits; hence arose the system of "counting coups," that is, publicly recounting blows struck on enemies. The best known ritual was the so-called Sun dance. Most other rites were conducted by societies, which among some tribes were age-graded. Supernatural power was sought in visions by most men, warriors as well as curers. There were sacred "bundles" for tribes, clans and societies; these were fetiches preserved for generations.

The Plains tribes are proud, brave, out-spoken and direct, and possess an unusual sense of individuality and personality. The physique is exceptionally tall, rangy and hardy. With their long braided hair, fringed costume, eagle feather war-bonnets, mounted on ponies, with tepees as a background, the Plains tribes have captured the imagination of recent generations of whites; and pass popularly as the most representative of Indians. The most typical Plains tribes are the Dakota, Assiniboine, Blackfeet, Gros Ventre, Arapaho, Cheyenne, Kiowa, Comanche; others are the Sarsi, Plains Cree, Plains Ojibwa, Wind River Shoshone, Mandan, Hidatsa, Arikara, Pawnee, Omaha, Ponca, Iowa, Oto, Missouri, Kansas, Osage, Wichita, Kiowa Apache; and, among the tribes in or across the Rocky mountains, the Kootenay, Flathead, Nez Percé, Bannock, Ute and Jicarilla Apache have been especially influenced by Plains culture. The preponderant stock is the Siouan; next, the Algonkin; Shoshonean, Athabascan, Caddoan are also each represented by two or more tribes.

See C. Wissler, "Indians of the Plains" (*Am. Mus. Nat. Hist.*, 1912) for a general summary; and monographs or books by G. Catlin, W. P. Clark, E. H. Curtis, G. A. Dorsey, J. O. Dorsey, A. C. Fletcher, G. B. Grinnell, A. L. Kroeber, F. La Flesche, Lewis and Clark, R. H. Lowie, Maximilian (Prince zu Wied), W. McClintock, J. Mooney, J. Murie, S. Riggs, J. W. Schultz, L. Spier, C. Wissler. (A. L. K.)

PLAINSONG or PLAIN CHANT. A general term for a certain style of unisonal music, comprising chiefly the church-music called "Gregorian" which belongs to Rome, and that called "Ambrosian" which hails from Milan. But the other Western collections of church-music, much less well-known than these, and a good many groups of Eastern church-music could also quite properly be put under this heading.

Origin.—There are various factors in the genesis of music which determine its essential characteristics. Music intended for a dance is necessarily regular in its rhythm; so also, though less tied, is music which is set to metrical verse. On the other hand music fitted to a prose text is not so regular. Thus there arise different kinds of rhythm in music, ranging from strict time to the freest of movement. Again some music arises from recitation and the need to declaim some words artistically and audibly; while other music aims at melody, that is to say a succession of sounds, which is pleasant for its own sake, and would be so independently of any words.

The ecclesiastical music which is called plainsong is so named because it is unmeasured music, not regular in rhythm, a *cantus planus* as contrasted with *cantus mensurabilis* or measured music. It is this feature that chiefly differentiates it from modern music; and at the same time allies it with such things as sea-chanties, counting-out rhymes, and the like. The Christian church, like other worshipping bodies, requires euphonious sounds for the recitation of its psalms, and for the reading of its scriptures in public. As these passages are not (for the most part) written in any strict metre, the music to be provided is essentially a "plain" chant; there are several classes of such plainsong.

Influence of the Psalter.—The chief influence in this evolution has been that of the Psalter. Hebrew poetry follows a metrical system, but this disappears in translation. There survives however, a more obvious feature of the original, viz., its parallelism. This consequently becomes a prominent characteristic of certain sorts of plainsong, so that the chants directly derived from the psalms take a binary form. The recitation demands a reciting note, on which the text can be freely recited in its own rhythm and shape. If this note alone is used, the effect soon becomes, in the strict sense of the word, monotonous. Therefore the music adopts the natural tendency of the voice to rise up to its reciting note at the beginning and to drop down from it at the end of the phrase. Thus arises the commonest chant-form of plainsong, consisting of (1) an intonation, (2) recitation, and (3) cadence, in each half-verse. The psalm-tones whether Gregorian or Ambrosian take this shape; and the form is capable of more or less elaboration for the psalms. The Gregorian tones are very simple; more elaborate forms of them are used for the Gospel-canticles; and still more developed forms for the Introits. A limit is naturally set to the amount of elaboration either (a) when whole psalms are to be sung at length, or (b) when they are to be sung by the whole congregation. When, however, select verses only are sung, and are sung by trained singers, there is far more scope for elaboration; and the developed responds used both at Mass and at the Choir-office exhibit this chant-form in a highly ornamental shape.

The chief development occurs in the Cadences. In its simplest form the musical cadence affects only the last syllable, *e.g.* there is the drop of a minor third. Next it concerns the last two syllables. These two simple cadences are familiar, even to those who do not know the Gregorian tones, from their being used in the Versicles and Responses of the Prayer Book. The more elaborate cadences naturally followed the "cursus" used by Latin prose-writers of the best, or at any rate, the most formal, style. In the responds a five-syllable cadence is constantly in use, and often in a highly decorated form.

All this music arises out of the recitation of psalms. For the purpose of declaiming the lessons of Scripture only the simpler inflexions were used; and the same is true of the prayers or collects, except a few which are of exceptional solemnity such as the "Preface" or the Lord's Prayer, as used in the consecration prayer at Mass; or the Hallowing of the Font at Baptism.

Antiphons.—Next to be considered is a totally different way of beautifying the recitation of psalms or other prose texts. Instead of elaborating the chant itself there was interpolated between the verses a suitable refrain. These refrains came to be known as "antiphons": and thus side by side with the older method, which came to be called "responsorial" from the responds which represented it at its fullest development, there arose the newer "antiphonal" method. The former music developed from recitation, and even in its most elaborate forms in more or less degree it hung round a reciting note. The antiphons were purely melodic and the method had its quality and meaning determined.

not by reference to a "dominant" reciting-note, but to the "final" note on which it ultimately came to rest.

Antiphonal music underwent modification and development just as the responsorial music did. Its relation to the psalm altered; the singing of the refrain after each verse survived mainly in processional use. In choir offices the refrain was dropped so that it was sung only at the beginning and end of the psalm, or else in a curtailed form at the beginning and in full only at the end. In the psalmody of the Mass the opposite form of abbreviation was adopted. For at the Introit and the Communion the psalm became restricted to only one or two verses, and at the Communion it ultimately disappeared altogether, leaving the Antiphon alone.

Some antiphons composed on a large scale arose independently of any connection with a psalm. These were used especially in processions. Others retained the idea of a psalm-verse, but utilized for such verses not the normal psalm-tones, but independent melodies, perhaps as elaborate as the psalm itself. Such antiphons especially prevailed at the Offertory in the Mass.

The greater part of the classical Gregorian plain-chant falls into one or other of these two classes. The amount of elaboration depended mainly upon two considerations (1) the importance of the occasion; and (2) the capacity of the singers. A great festival or a specially dignified part of the service demanded richer treatment: and the trained singers undertook more difficult music than the congregation, the soloists than the choir generally.

The Gregorian Music.—The *Cantilena Romana*, Gregorian chant proper, is thus a body of music, purely vocal and ecclesiastical, evolved by the Papal choir in the course of the fifth and sixth centuries. This was codified in the time of St. Gregory (*c.* 540–604) (*q.v.*) and it stands as the basis of all the Gregorian Music. The Milanese tradition was similar but less artistic. It is called "Ambrosian" (*see* St. Ambrose) but the term has no historical significance as the term Gregorian has. A comparison of these two families of plain-chant brings out clearly the comparative crudity of the Ambrosian tradition as distinct from the artistic balance and delicate finish of the classical Gregorian chant. The same is true also of such other specimens of Western ecclesiastical chant as are known. The Gregorian reform marks the close of a golden age of classical monody. The middle-ages subsequent to St. Gregory produced nothing so good; and the later part of them while producing only little and decadent plainsong depraved also the form of the classical tradition.

Something more must be said to describe the contents of the Gregorian *corpus* and also to explain the musical theory which lay behind it. The music covers the whole set of services of the Roman rite, but principally the Mass and the series of daily Choir Services. At the Mass some of the things sung are invariable, while others change according to the Sunday, or Festival, or occasion generally. The unchanging elements are chiefly the *Kyrie, Credo, Sanctus, Agnus dei,* and *Gloria in excelsis.* For these the old tradition provided little or no change of music; and what there was followed very simple lines suitable for congregational singing. The variable elements were principally the Introit-psalm, the Gradual-respond, the Offertory-antiphon and the Communion-antiphon. The Gradual was at times replaced or supplemented by an Alleluia with a Verse attached to it, or by a Tract. The Alleluia belonged specially to festive seasons and occasions, the Tract to penitential. Neither of these falls exactly into either of the two chief categories responsorial and antiphonal. The Tract is a very ancient but elaborate type of the developed psalmody; the Alleluia was an innovation which came in towards the end of the classical period, and extended beyond it into the "Silver Age" when little else was being composed.

For the choir-offices there was provided a large number of antiphons to go with the psalmody, and a considerable number of responds which mainly served as interludes between the lessons at Mattins. When hymnody began with St. Ambrose it was taken up and incorporated into the services by the monks; but Rome was for a long time too conservative to admit hymns. The plainsong hymn-tunes are, in the nature of the case, more definitely metrical than the other music: but they retain a considerable freedom of movement, and are not "measured," like modern hymn-tunes.

Underlying Musical Theory.—The musical theory which lies behind this music is based on a series of eight scales or Modes. It uses the old diatonic scale of the Greek theorists (equivalent to the white notes of the pianoforte with the addition of B), but the modes themselves are different from the old Greek modes, and the use of the old Greek names only leads to confusion. The eight-mode system was probably the same as the ὀκτόηχος which underlies the Eastern church music; but the origins are obscure alike in East and West. The scheme seems to go back at least to St. John of Damascus (*c.* 750); but it is known in the West only in theoretical treatises derived through the Byzantine teachers at the court of Charlemagne at the end of the eighth century.

The eight modes are really four pairs, each pair being founded on the same note, the one scale (called Authentic Mode) being an octave ranging above the foundation or final note, the companion (called Plagal) being an octave ranging above and below it.

First / Second	A BCD EF G a bc d
Third / Fourth	BC D EF G a bc d e
Fifth / Sixth	C D EF G a bc d ef
Seventh / Eighth	D EF G a bc d ef g

Each of these pairs has a character or tonality of its own, dependent upon the position which the semitones have in the scale. None is similar to the major or minor key of modern music. It is this tonality which gives the special character to plain-song melody. Some theorists have reckoned twelve or even fourteen Modes; but this is unnecessary. So far as pitch goes, the range of two octaves covered by the eight modes is adequate; and so far as tonality is concerned, the new modes would be only the same as the first four or six over again with the B♭ used instead of B. (For further discussion of the Modes *see* Harmony.)

This modal theory does not fully account for all the procedure of the classical plain-chant (practice always surpasses theory): but these eight modes are clearly the foundation of this music, whether responsorial or antiphonal.

In the middle ages the *cantilena Romana* was handed on by tradition from St. Gregory's days; in the ninth century it was recorded in the notation reames. The notation on a staff which began a couple of centuries later, while it fixed accurately the pitch of each note, failed to reproduce the rhythmical delicacies which the earlier notation had recorded. Hence the recent renascence of classical plain-song has been based on a return to the reames, as interpreted by the subsequent tradition.

The revived interest in music of the Carolingian era stimulated composition, which had been long in abeyance. Not only new music for new feasts arose, but fresh settings of the "Ordinary" (fixed elements) of the Mass. While the old music was preserved, it was padded out with new and inferior interpolations called by the generic name of "Tropes." These had their day and pervaded all the church music for a century or more; but then they went out of fashion, leaving only two considerable legacies, (a) a further series of settings of the "Ordinary," (b) the new form of rhythmical, or (later) metrical, poem called Sequences or Proses. These survived in considerable numbers down to the sixteenth century, but at the present time only a few are in use.

Modern Revival.—The rise of the art of harmony beginning from the eleventh century, diverted attention from the monody of plain-chant, and part-singing had the effect of "measuring" the music so that it fell into regular time and was no longer free or "plain." Under these influences the old plain-song was progressively debased and as harmonized music went up, plain chant went down. Not until the nineteenth century did this degradation cease. The efforts then made in various quarters to recover alike the true rhythm and tonality of the old music have culminated in the work of the Benedictines of Solesmes and their

followers, and in the revival which has produced the new Vatican Gradual and is producing by degrees a restored Antiphonal as well. With the recovery of the music has come a new insistence upon its use and study, as being the official music of the Roman Church. (W. H. F.)

PLAINTIFF: *see* PRACTICE AND PROCEDURE.

PLAINVIEW, a city of north-western Texas, U.S.A., 270 m. W. by N. of Fort Worth, on the south plains of the "Panhandle" at an altitude of 3,370 ft.; the county seat of Hale county. It is on Federal highways 70 and 385, and is served by the Santa Fe and the Colorado and Southern railway systems. Pop. (1920) 3,989; estimated locally at 10,000 in 1928. It is the trade centre of 5,000 sq.m. of farming territory (partly irrigated) raising chiefly cotton, wheat and grain sorghums. The Texas Panhandle Plains Dairy Show is held here annually. The site for the city was surveyed in 1887. The settlement remained a mere trading post for the cattlemen who then occupied the entire region until the railway reached it in 1907, whereupon it was incorporated as a city. By 1927 it had an assessed valuation of $6,443,061. Diversified farming began to displace ranching about 1915, and the cultivation of cotton began in 1918.

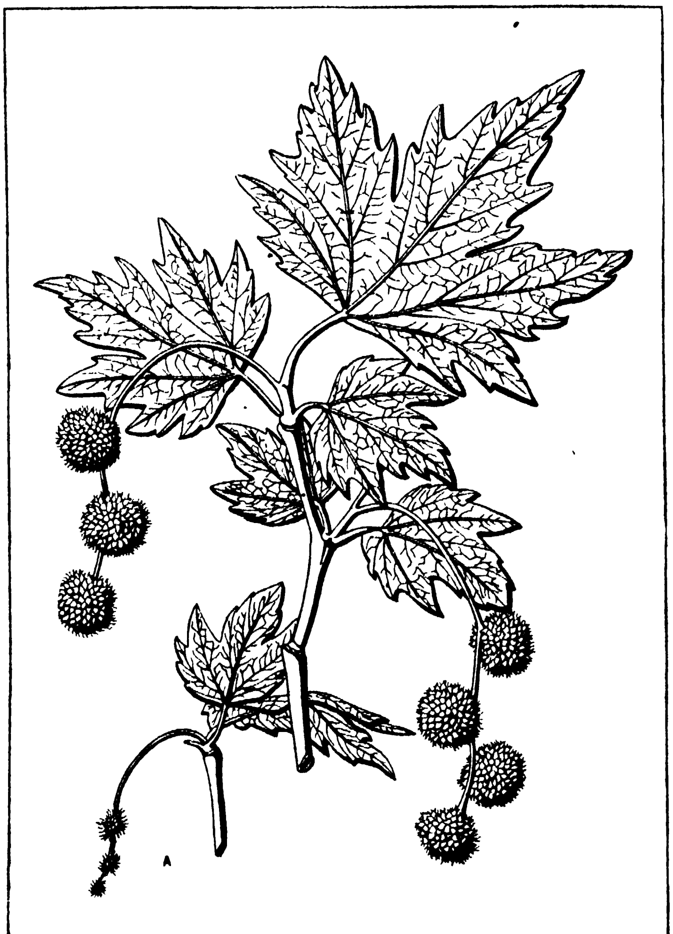
PLANCK, MAX (1858–), German physicist, was born at Kiel on April 23, 1858. He studied at the universities of Munich and Berlin, became an assistant in Munich University, and was subsequently appointed a professor in Kiel (1885) and in Berlin (1889). Planck devoted himself to the study of theoretical physics, and in particular to that of thermodynamics. His lectures on this subject appeared in book form and were translated into English, French and Russian. He gained international fame by his *Law of Radiation* (1901), which asserts that the energy of radiation is emitted and absorbed in integral multiples of certain indivisible "quanta" of energy, which depend on the frequency of oscillation of the electrons. In 1912 Planck extended this "quantum theory" (*q.v.*) to all kinds of energy and added the assumption that only emission proceeds discontinuously, in quanta, while absorption is continuous. On this assumption he was able to derive the distribution of energy in the spectrum of black-body radiation. The quantum theory has been developed and modified by him and many other physicists but the foundation was laid by Planck's work on black-body radiation. In 1918 he was awarded the Nobel Prize for physics. Planck became editor of the *Annalen der Physik*. He was elected a foreign member of the Royal Society in 1926.

Among his works are: *Die Entstehung und bisherige Entwickelung der Quantentheorie* (1920, Eng. trans. 1922); *Vorlesungen über die Theorie der Wärmestrahlung* (1921); *Physikalische Rundblicke* (1922, Eng. trans. 1925); *Einführung in die Theorie der Elektrizität und des Magnetismus* (1922); and *Die Ableitung des Strahlungsgesetzes* (1923).

PLANE. The simplest definition of plane given by the Greek geometers is that of Heron of Alexandria (*c.* 200):—a surface "such that if a straight line passes through two points on it, the line coincides wholly with it at every spot, all ways." Crelle (1834) defined it as the surface containing all the straight lines (throughout their entire lengths) passing through a fixed point and also intersecting a straight line in space. (For plane, a tool, *see* EDGE TOOLS.)

See H. Schotten, *Inhalt und Methode des planimetrischen Unterrichts* (Leipzig, 1890, 1893); Sir T. L. Heath, *The Thirteen Books of Euclid's Elements* (1926). (*See* also SURFACE.)

In botany, plane is the common name of a handsome tree known botanically as *Platanus orientalis* (family Platanaceae), a native of Greece and western Asia, a favourite shade-tree of the ancient Greeks and Romans, and introduced by the latter to south-west Europe. It is one of the most successful trees in London and other large towns; the smooth face of the leaf is easily washed by rain; and the periodical peeling of the bark also serves to get rid of surface deposits of soot, etc. It is a large tree with widely spreading branches and alternate, palmately five-lobed leaves, resembling those of the sycamore in shape, but quite hairless and of a brighter green. The bud in the leaf axil is protected during its development by the hollow base of the leaf-stalk, which lifts off like an extinguisher when the leaf falls in autumn. The minute, unisexual flowers are borne in dense pendulous heads, which contain either male or female flowers; the small one-seeded fruits are densely crowded in a ball, from which they gradually separate in drying, and are readily carried by the wind. A variety of forms are known in cultivation, the commonest being the maple-leaved (*acerifolia*), the London plane, which has usually three-lobed leaves; var. *laciniata* has very deeply much divided leaves, and var. *variegata*, variegated foli-



PLANE (PLATANUS ORIENTALIS), SHOWING BRANCH WITH FRUITS. A. BRANCH WITH DROOPING FEMALE HEADS WHICH ARE WIND POLLINATED

age. *Platanus occidentalis,* an allied species, is a native of the United States, being most abundant and growing to its largest size in the basin of the lower Ohio and the Mississippi rivers It was introduced into England early in the 17th century, and is occasionally met with in western and central Europe; it is known in America as sycamore and buttonwood. It differs from *P. orientalis* in its less deeply lobed, more leathery pubescent leaves and in the usually solitary balls of fruit. Both the native sycamore and the London plane are extensively planted as ornamental trees in the eastern United States. The California sycamore (*P racemosa*) and the Arizona sycamore (*P. Wrightii*), of the extreme South-west, are much smaller than the eastern species.

PLANER: *see* MACHINE TOOLS; WOODWORKING MACHINERY

PLANET (Gr. πλανήτης, a wanderer). The term was applied in the ancient Ptolemaic or geocentric astronomy to the seven heavenly bodies which were observed to change their places as projected against the background of the so-called fixed stars. These bodies were the Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn, all of which were supposed to revolve round the earth In the modern or heliocentric astronomy (taught by Aristarchus of Samos in the third century B.C. but forgotten or neglected till revived by Copernicus in the 16th century of the Christian era) it is applied to all dark and opaque bodies in revolution round the sun, and the number of such bodies known has been greatly increased by successive discoveries. In 1781 William Herschel discovered Uranus. In 1801, on the first night of the new century,

TABLE I. *Elements of the Orbits of the Eight Major Planets for the Epoch 1925, Jan., O.G.M.N.*

Planet	Symbol	Mean distance from sun in: Astronomical units α	Mean distance from sun in: Millions of miles	Eccentricity e	Inclination i ° ′ ″	Mean longitude of: Ascending node ☊ ° ′ ″	Mean longitude of: Perihelion $\tilde{\omega}$ ° ′ ″	Mean longitude of: Planet at epoch L ° ′ ″	Period of Sidereal revolution* P	Mean daily motion °
Mercury	☿	0·387099	36·0	0·2056193	7 0 12·0	47 26 32·1	76 17 18·9	105 40 25·31	87·967 days	4·0923
Venus	♀	0·723331	67·2	0·0068088	3 23 38·0	76 0 16·7	130 30 56·8	212 10 10·23	224·701 „	1·6021
Earth	⊕	1·000000	92·9	0·0167406			101 39 2·3	99 38 33·06	365·256 „	0·9856
Mars	♂	1·523688	141·5	0·0933359	1 51 0·6	48 58 45·0	334 40 42·2	39 2 29·19	1·881 years	0·52403
Jupiter	♃	5·202803	483·3	0·0483786	1 18 26·4	99 41 26·3	13 6 51·4	277 6 16·69	11·862 „	0·083091
Saturn	♄	9·538843	886·1	0·0558035	2 29 28·7	113 0 5·7	91 34 42·0	212 26 2·90	29·458 „	0·033460
Uranus	♅	19·190978	1782·8	0·0471140	0 46 22·1	73 36 57·7	169 26 56·8	350 50 7·04	84·015 „	0·011731
Neptune	♆	30·070672	2793·5	0·0085493	1 46 36·7	130 57 13·3	43 58 27·9	139 59 22·73	164·788 „	0·005981

*In mean solar days and tropical years.

Piazzi discovered Ceres, a small planet revolving between the orbits of Mars and Jupiter and the first of a great host of small bodies known as minor planets or asteroids; while in 1846 Neptune was added to the list of major planets following on the mathematical work on the unexplained irregularities in the motion of Uranus by Le Verrier and, independently, by Adams (*see* notes on Neptune). Taken in its widest sense the term planet is also sometimes applied to the satellites attendant on the greater planets, the latter being called *primary*, and the former *secondary*, planets. Of these secondary planets or satellites, so far as at present known, Neptune possesses one, Uranus four, Saturn nine, Jupiter nine, Mars two and the Earth one. The order of the primary planets reckoning outwards from the sun is: Mercury, Venus, the Earth, Mars, Minor Planets, Jupiter, Saturn, Uranus and Neptune.

Distances of the Planets.—An empirical law expressing very closely the relative distances from the sun of the primary planets known to the ancients was discovered about the middle of the eighteenth century by Titius of Wittenburg, but it was later brought into notice by Bode and is generally known as Bode's law. If a series of 4's be written down, and 3 be added to the second, 6 to the third, 12 to the fourth and so on, each of the added numbers being double its predecessor, the sums of the first seven numbers are 4, 7, 10, 16, 28, 52, 100. These numbers divided by 10 were found to give with a surprising closeness the relative distances of the planets as far as Saturn, except that no planet was known to revolve in the orbit corresponding to 2·8 between the orbits of Mars and Jupiter. When Uranus was discovered and found to fit in well with the next number in the series (19·6) the conviction was strengthened that the gap between Mars and Jupiter must be occupied by some planet and a search for the missing body was organized. But before systematic work was actually begun the little planet Ceres was found. The discovery was soon followed by others, and at the present time considerably more than 1,000 of these minor planets are known. They are not, however, actually confined to the gap above mentioned. The little planet Eros discovered by Witt in 1898 comes at perihelion within 13,000,000 miles of the earth's orbit and hence it is of special value to astronomers for the determination of the solar parallax which fixes the scale of the planetary system. Hidalgo, discovered by Baade in 1922, in the most distant part of its orbit goes out as far as the orbit of Saturn and has a mean distance slightly greater than that of Jupiter. The actual distances of the greater planets from the sun in miles will be found in Table I.

Orbits and Phases of the Planets.—From the observations of Tycho Brahe, the great Danish observer, Kepler deduced the following three great laws of planetary motion:—

(1) The planets move in ellipses with the sun at one focus. Hitherto it had been believed that the circle being the most perfect geometrical figure celestial motions took place in circles.

(2) The straight line from the sun to a planet (radius vector) passes over equal areas in equal times. The importance of this law was that it involves a continually varying rate of motion, which was also contrary to accepted beliefs at the time. To maintain the equal description of areas in unit time a planet must travel faster in the neighbourhood of perihelion where the radius vector is at a minimum than near aphelion where it attains its maximum value.

(3) The squares of the periodic times (the times required for the orbital revolutions of the planets) are proportional to the cubes of the mean distances (the semi-major axes of their orbits). This is commonly known as the *harmonic law* and defines the relationship between a planet's orbital motion and its distance from the sun.

From these laws of planetary motion Newton deduced his law of universal gravitation which has achieved such remarkable successes and prepared the way for Einstein's relativity theory.

The dimensions, form and aspect of a planet's orbit as well as the position of the planet in the orbit at any time are defined by what are known as its *elements*. These are:—

(1) Half the major axis, or mean distance (generally denoted by α). This defines the *size* of the orbit.

(2) The eccentricity (e) or the ratio of the distance of the sun from the centre of the orbit to the mean distance. This defines the *shape* of the orbit.

(3) The inclination (i) of the orbit plane to the ecliptic, *i.e.*, to the plane of the earth's orbit.

(4) The longitude of the ascending node (☊), *i.e.*, the direction at the sun of the point on the orbit (measured from the vernal equinox or "first point of Aries") at which the planet crosses the ecliptic from its south to its north side. This defines the *aspect* of the orbit.

(5) The longitude of the perihelion (ω). This defines the direction of the major axis in the plane of the orbit.

(6) The period (P), *i.e.*, the time the planet takes for a revolution.

(7) The longitude of the planet at the epoch (L) or time (T) of the planet's perihelion passage. These elements are given for the several planets in Table I.

Since the orbits of Mercury and Venus lie within that of the earth these two planets when observed telescopically will show phases similar to those presented by the moon. When on the far side of the sun, *i.e.*, near the time of superior conjunction, each of them will appear like a small full moon. As the angle earth-planet-sun increases a proportionally diminishing fraction of the illuminated surface will be presented to view, and when the angle reaches 90° the planet will appear half illuminated like the moon at first quarter. Following this a crescent form of steadily diminishing breadth will be assumed as the planet moves towards inferior conjunction, at which point it passes between the earth and the sun. Subsequently to this the phases described will be repeated in the reverse order up to superior conjunction when the planet will again be "full." The phases of a planet revolving outside the earth's orbit differ from those of Mercury and Venus in as much as the angle earth-planet-sun can never increase to 90°. Thus Mars, although at times presenting a markedly gibbous aspect like a nine or ten days' old moon, is always more than half illuminated. In the case of Jupiter the defect of illumination is so small as to be almost imperceptible, but during the occultation of a satellite the planet's dark limb is seen across the satellite's disk, and a narrow black space separates the latter from the bright part of the planet's surface. In the cases of the planets revolving outside Jupiter the phase is quite imperceptible even in powerful telescopes. The variations in apparent diameter and brightness will,

TABLE II. *Physical Constants Pertaining to the Major Planets*

Planet	Angular semi-ameter at unit distance: Equatorial (″)	Angular semi-ameter at unit distance: Polar (″)	Equatorial diameter in miles	Volume (⊕=1)	Mass (⊕=1)	Density: Water =1	Density: ⊕=1	Inclination of equator to orbit	Rotation period	Stellar magnitude at mean opposition	Black sphere* temperature at distance of planet from sun (°C)	Velocity of escape in miles per second
Mercury	3·34	3·3	3,000	0·055	0·037	3·73	0·68	near zero	88 days	0·16†	172 C	2·2
Venus	8·41	8·4	7,600	0·876	0·826	5·21	0·94	?	uncertain	−4·1†	53	6·3
Earth	8·80	8·7	7,927	1·000	1·000	5·53	1·00	23° 27′	23h 56m 4·1s		4	7·0
Mars	4·68	4·6	4,200	0·151	0·108	3·95	0·71	25° 10′	24h 37m 22·6s	−1·8	− 49	3·1
Jupiter	98·47	91·1	88,700	1,312	318·4	1·34	0·24	3° 7′	9h 50·5m – 9h 56·0m	−2·2	−152	37
Saturn	83·33	74·7	75,100	763	95·2	0·69	0·12	26° 45′	10h 14m – 10h 38m	+0·9 to −0·2	−183	22
Uranus	34·28		30,900	59	14·6	1·36	0·25	98·0°	10·7h	5·7	−210	13
Neptune	36·56		33,900	72	16·9	1·30	0·24	151·0°?	15·7h‡‡	7·6	−221	14

* Rotating quickly but without atmosphere. † At elongation. ‡ Derived spectroscopically.

of course, also be small in the cases of the remoter planets.

Physical Condition and Atmospheres.—There is a broad distinction between the two groups of the major planets on either side of the zone of the asteroids. The planets of the inner group are of relatively small mass and high density and possess solid surfaces. Those of the outer group, especially Jupiter and Saturn, are of much larger mass but of very low density. The density of Saturn is actually less than that of water. The masses of the planets possessing satellites are derived from the distances and periodic times of the satellites by an application of Kepler's third law. The masses of Mercury and Venus are deduced from their gravitational effect on other bodies.

There is for each of the planets a certain critical velocity determined by the force of gravity at its surface, and a particle of matter travelling at a speed in excess of this value will escape from the planet in question and revolve in an independent orbit round the sun. These critical values for the several planets are given in column 12 of Table II. Now according to the kinetic theory of gases every molecule of a gas is an independent particle and is in constant motion. Its velocity will depend on the atomic weight and the temperature and may attain to thousands of feet per second. A molecule with such a high speed in the upper part of a planet's atmosphere where it will be comparatively free from collision with other molecules cannot be retained by a body with low surface gravity but will escape into space. It might be expected, accordingly, that only the large and massive planets are enveloped in dense atmospheres, and that those of small mass and low surface gravity have atmospheres which are of greater rarity and tenuity. Observation shows that this is in general the case. The spectra of the planets of the outer group contain strongly marked absorption bands due to their atmospheres, while those of the inner group—Mars, Venus and Mercury—show but little deviation from the ordinary solar spectrum. It may be that the light received from Venus is almost entirely reflected from the upper part of the atmosphere, but in the cases of Mars and Mercury most of it has passed through the planetary atmosphere twice. As a matter of fact the atmosphere of Mercury seems to be almost negligible. It is known that the moon which is still smaller has none at all that is appreciable, and it cannot be supposed that an atmosphere exists on any of the minor planets, the largest of which (Ceres) has a mass only $\frac{1}{8,000}$ and a surface gravity only $\frac{1}{30}$ as great as the corresponding values for the earth.

The interpretation of the spectra of the outer planets, apart from the mere fact of considerable absorption, is puzzling. From the accompanying plate and Table III. it will be seen that there are one or two rather faint but broad bands in the spectrum of Jupiter which are seen to be much stronger in the spectra of Saturn, Uranus and Neptune. The two latter also contain a number of additional bands. The origin of the bands was still unknown in 1927.

Temperatures of the Planets.—A matter of special interest in regard to the planets is that of the temperature of their surfaces. Speaking generally it may be said that the surface temperature of a planet which is without appreciable heat of its own and is warmed only by the solar radiation is determined by a number of factors of which the following may be specially mentioned:—(1) The distance of the planet from the sun, the intensity of solar radiation obeying the well-known inverse-square law. (2) The degree in which the planet's surface approaches that of a perfect radiator. (3) The presence or absence of an atmosphere and the nature of such atmosphere. (4) The planet's rotation. It can be shown that a black sphere without an atmosphere rotating with sufficient rapidity to be heated equally all round would have a mean surface temperature given by the formula $T=277°/\sqrt{R}$ where T is the temperature in degrees centigrade reckoned from the absolute zero and R is the distance of the body from the sun,

TABLE III.
PLANETARY SPECTRA
Principal Absorption Bands Peculiar to the Planetary Atmospheres

Approximate Wave length	Remarks	Planets
5093		Neptune, Uranus
5428	Broad, unsymmetrical, strong	Neptune, Uranus, Saturn, Neptune
5762	Broad, unsymmetrical, strong	Neptune, Uranus, Saturn,? Jupiter
5973	Strong	Neptune, Uranus
6191	Very strong	Neptune, Uranus, Saturn, Neptune
6077	Broad band	Neptune, Uranus, Saturn, Jupiter?
6812	Strong, narrow	Neptune, Uranus, Saturn, Jupiter
7022	Strong, broad	Neptune, Uranus, Saturn, Jupiter
7260	Strongest band present	Saturn, Jupiter

taking the earth's distance from the sun as unity. But should the periods of axial rotation and orbital revolution be equal, so that the body turns always the same face to the sun, the formula becomes for the point immediately under the sun $T=392°/\sqrt{R}$. This means, *e.g.*, that on a perfectly radiating planet without an atmosphere at the distance of Mercury the point on the surface where the sun is overhead would have a temperature of 631° C (absolute). With a quick rotation the mean surface temperature would be about 445° C (absolute) or 342° F. The corresponding absolute temperatures at the distance of Mars come out 318° C

(113° F) and 224° C (−56° F), and at that of Neptune only 71° C (−332° F) and 51° C (−368° F). The actual temperatures will, of course, be affected to a large extent by the presence of an atmosphere which, while directly reflecting a large proportion of the solar rays, checks the escape by radiation of such as penetrate it and reach the planet's surface.

Until comparatively lately, however, the only available methods of estimating the surface temperatures of the planets were those based on general physical principles, and in view of the great uncertainty as to the conditions prevailing on the planets, and particularly as regards the nature of their atmospheres, the conclusions arrived at were necessarily of a highly speculative character. But in recent years great strides have been made in the development of radiometric apparatus, and by the use of thermo-couples in vacuum cells with extremely small receivers and sensitive galvanometers it has been found practicable to measure with considerable accuracy the radiations received from the planetary surfaces, and even, in some cases, from particular parts of those surfaces. In these measurements transmission screens of such materials as water, quartz, glass, fluorite, are interposed in the path of the rays which absorb the radiations in certain parts of the spectrum, and thus enable the total radiation to be resolved into a number of spectral components. For example, when a water cell is employed, the infra-red heat radiations are cut out, and the ratio of the transmitted to the total radiation of the planet provides data for determining the temperature of the planet's surface. It will be clear that if the ratio of transmission through the water cell is large the heat radiated by the planet is small, but that if the transmission ratio is small the proportion of heat rays is comparatively great. The matter is, of course, complicated somewhat by the presence of water vapour in the terrestrial and planetary atmospheres, but the necessary corrections can be estimated, and it is found that the reduction of the observations by various methods such as those based on (1) the distribution of energy in the spectrum, (2) the fourth power law and the measured water cell transmission, as worked out by Menzel and (3) a comparison with observations of the moon, all lead to satisfactorily accordant results.

The conclusions reached are of great interest. Measurements of the heat radiations from Mercury give values which support the conclusion that the planet's periods of rotation and orbital revolution are the same, and that its atmosphere is negligible or nearly so. In the case of Venus a considerable amount of heat is apparently emitted even by the unilluminated surface, which suggests a quick rotation. Observations of Mars at the Lowell observatory in 1922, 1924 and 1926, which are in fair agreement with those made at Mount Wilson, show that despite the planet's distance from the sun the temperature during the day rises well above the freezing point, and exceeds that value even at the polar regions during the summer; that the bright regions are cooler than the dark regions; that the summer hemisphere is warmer than the winter hemisphere; that afternoon temperatures are higher than those of the morning, and that low temperatures are recorded from what appear to be cloud surfaces which check the escape of heat from below. These radiometric results for Mars are consistent with telescopic observations of the surface features—particularly with the melting of the polar caps—and with terrestrial experiences of seasonal and diurnal temperature changes.

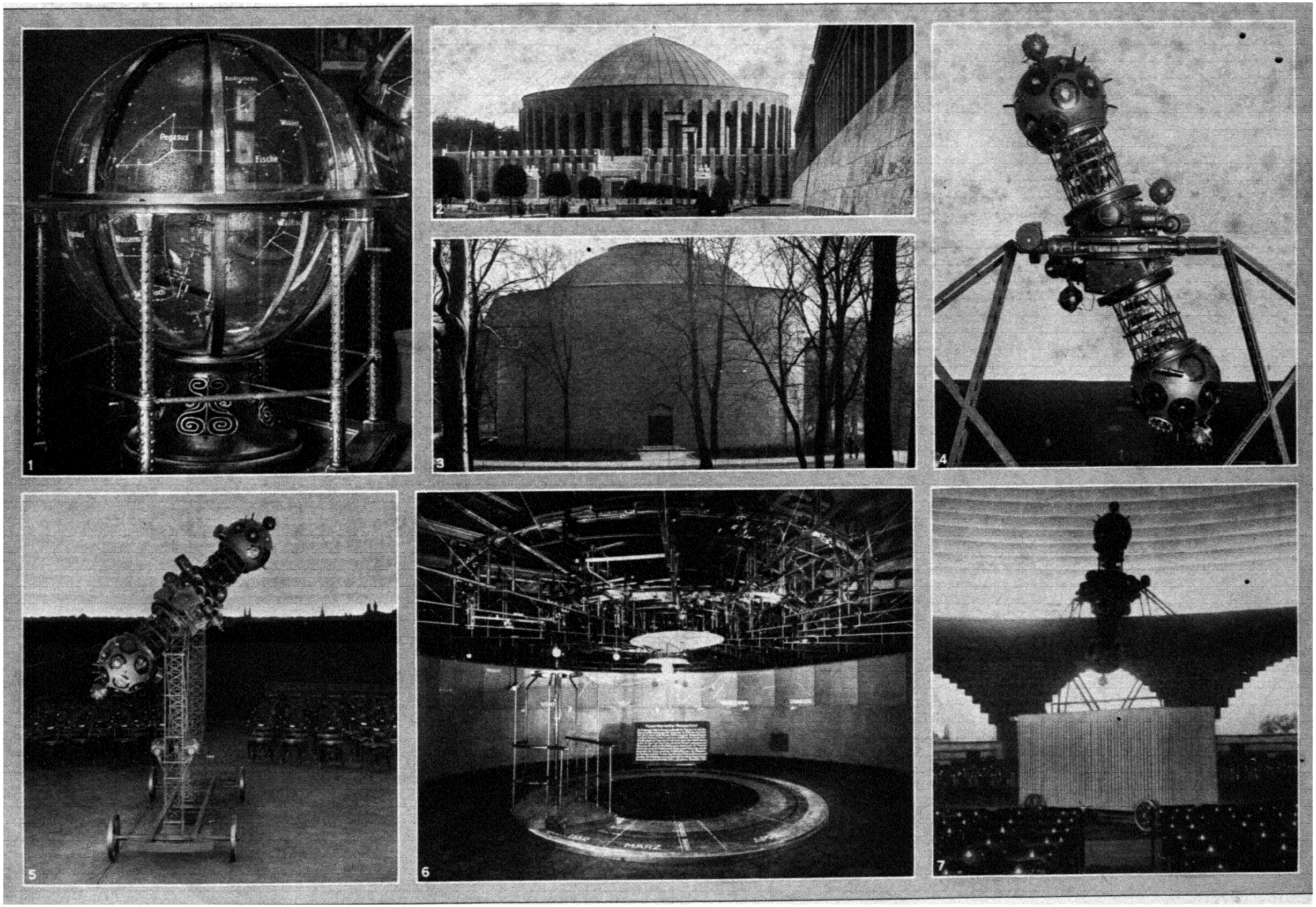
As regards Jupiter and Saturn the results obtained have given occasion for some surprise. Physical observations of the surface features of these planets, particularly the former, combined with the known low density, suggest very strong analogies with the sun, and apparently give evidence of considerable stores of heat. Yet the radiometric researches of Coblentz, Lampland and Menzel indicate a temperature of about 100° C for the visible surface of Jupiter and a value slightly higher for that of Saturn. Dr. H. Jeffreys, too, has concluded on theoretical grounds that the temperature of these planets is low. Observers, however, find it difficult to accept the position that the very large and violent disturbances and rapid changes exhibited by Jupiter can have their origin merely in solar radiation, and incline to the view that whatever the superficial temperature there must be a considerable difference between that at the centre and that of the external parts of the planet's mass. The difficulty might be removed if it can be supposed that the cloudy surfaces of Jupiter and Saturn are composed of substances which have a very low boiling point.

Habitability of the Planets.—It will be clear that the various points above referred to have an important bearing on the question of the suitability of the planets to be the abode of life. Apart from the question of temperature their low density rules out the large planets of the outer group as possible habitations for anything at all resembling human life. It is on the planets of the inner group with their solid surfaces and their proximity to the sun that the requisite conditions must be looked for. Of these planets Mercury, whose periods of axial rotation and orbital revolution are identical, with its scanty atmosphere, its extremely high temperature on the sunlit side and the intense cold of that which is in perpetual night cannot be habitable unless it be in the restricted region near the boundary of the light and dark hemispheres. Of Venus almost nothing is known apart from its resemblance to the earth in volume and mass and its possession of a seemingly cloud-laden atmosphere. About Mars much information has been gathered. Its transparent atmosphere has permitted a study in considerable detail of its surface markings and physical condition with the result that the planet is known despite its small dimensions to exhibit important resemblances to the earth. It may, accordingly, well support some form of animate life, though certain important differences in the conditions prevailing on its surface would seem to preclude its habitation by beings quite like man. More than this can hardly be said, but it may be held probable that on a planet where the required conditions are found life of some sort exists, and that at some period in such a planet's life evolutionary processes may bring its inhabitants to the status of intelligent beings.

See ASTRONOMY and articles under planetary names.

PLANETARIUM is the name given to an arrangement, made by Zeiss of Jena, for producing an artificial sky. By optical methods images of the sun, moon, planets and stars are projected on a large hemispherical dome and by mechanical and electrical means the apparatus can be revolved so as to show the principal motions. The name planetarium is apparently given because of the success with which the apparent motions of the planets amongst the stars can be shown; but the apparatus makes possible the representation of many other astronomical phenomena.

For several centuries orreries have been used to demonstrate the motion of the planets round the sun according to the Copernican system. Perhaps the best arrangement of this kind is in the German Museum at Munich where the observer can be carried in a cage which is moved in a path representing the earth's orbit. By means of a periscope he can look out on the motions of the other planets and at the stars of the zodiacal constellations shown on the wall by means of small electric bulbs. But it is impossible in a model of this nature to make the relative distances correct and thus to get the proper alignment of the various bodies. When this instrument was ordered from Zeiss in 1913 it was suggested that another astronomical model might be made depicting the heavens as actually seen from the earth and it was suggested that the heavenly bodies might be represented by electric bulbs fixed or moving on a rotating dome. This suggestion, however, was soon discarded in favour of another, due to Dr. Bauersfeld, in which the images of the bodies were projected optically on a fixed dome. The resulting apparatus has been a great success. It is found that when a dome 50ft. or more in diameter is used, the appearance is extremely like that of the actual sky. For the stars it is merely necessary to have the projector mounted so that it can be rotated about an axis parallel to the earth's axis. For the sun, moon and planets small models, true to nature, are constructed. The angles between the orbit planes are allowed for and by the use of eccentric circular motion the elliptic motion is quite closely represented. For showing say the planet Venus, the model has pins representing Venus and the earth moving round the sun. A little projector is attached to the pin representing Venus and a linkage between the planets always directs the light away from the earth. Consequently, the image of the planet on the dome



COURTESY OF (1, 6) DEUTSCHES MUSEUM, (2, 7) JULIUS SOHN, (3, 5) O. E. SCHWEIZER, (4) CARL ZEISS

CONSTRUCTION AND HOUSING OF THE PLANETARIUM, AN OPTICAL APPARATUS FOR REPRESENTING ASTRONOMICAL PHENOME....

1. Ptolemaic Planetarium. **2.** Exterior, Düsseldorf Planetarium. **3.** Nuremberg Planetarium, exterior view. **4.** Projection apparatus, principal axis perpendicular to plane of earth's orbit. **5.** Rotunda, Nuremberg planetarium. **6.** Copernican planetarium, Munich. **7.** Interior, Düsseldorf planetarium

is in the correct position amongst the stars. The gearing is so arranged that the mean motions are accurately reproduced and only comparatively slight periodic errors affect the motions of the sun, moon and planets. The phases of the moon are shown by an occulting device.

The planetarium can be operated at varying speeds corresponding to the phenomenon to be demonstrated so that even such a slow motion as that of the procession of the equinoxes is within its range. To show the rising and setting of the heavenly bodies a day is compressed into an interval of from 1 to 4 minutes; to show that of the planets the diurnal motion can be put out of gear and a year run off in intervals varying from 7 seconds to 4 minutes. The original model was made for one latitude only, but in later ones, by introducing an additional axis of rotation, the latitude can be altered at will. The stars are shown brighter than they appear in the sky—the eyes of the spectators coming from the daylight would otherwise take too long to be sensitive enough to see them. It is, of course, impossible to make the sun as bright as in nature but this has the advantage of enabling the stars to be seen in the sky along with the sun and thus demonstrate the motion of the sun amongst the stars.

With the planetarium the spectator can see in an hour or so motions which can only be seen in the heavens by years of watching. When a year is compressed into a minute or two the planets can be seen chasing one another about the sky describing loops, advancing and retrograding, just as they do so slowly in nature. Great attention has been paid to details so as to make the apparatus as perfect as possible; *e.g.*, the brightness of the objects is dimmed as they approach the horizon and the light is practically cut off as the star actually reaches the horizon. A number of devices have been introduced to assist a lecturer in describing the phenomena. The date corresponding to the configuration can be projected on the dome at any time as well as the names of the constellations, and by means of a luminous pointer the lecturer can point out objects of interest. The whole demonstration is most fascinating and has attracted large audiences in a considerable number of towns in Germany where planetaria have been erected. Instruments are now being erected in other countries.

(J. N.)

PLANING-MACHINES rank in importance with the lathes and drilling-machines, and cut various kinds of plane surfaces in metal. The principle is that of attaching the metal to a long table which slides truly upon a massive bed, so that by holding a cutting tool in a slide overhead, the material becomes shaved off as the table moves. The width of surface is treated by giving the tool a cross traverse. The slide moves on a horizontal rail for this purpose, and the rail is adjustable up and down two uprights flanking the bed. Tool-slides are often put on the faces of the uprights as well, so that the sides of the work may be planed. Planing-machines are of value both for big and small articles; they may take one of the former and deal with it singly, or a whole string of small objects can be clamped in line on the table and surfaced off. (*See* also WOOD-WORKING MACHINERY; MACHINE TOOLS.)

PLANKTON is the name which is now given to the drifting (and usually microscopic) life contained in the waters of the seas, lakes, ponds and streams. Its study was begun, just prior to 1845, by the great German zoologist, Johannes Müller in the sea round Heligoland. Associated with Müller, in 1845, were his pupils, Max Müller, Busch, Wilms, Wagener and others. Ernst Haeckel, as a student of 20 years of age, was with J. Müller at Heligoland, in 1854, and began to study the plankton. "Then," said Müller, "you have once entered this pelagic, magic world you will not easily leave it again." Rapid extension of plankton investigation followed, both in Germany and in Great Britain, and the great names associated with this branch of 19th century marine biology are Heinrich Müller, A. Kölliker, C. Gegenbaur, Leuckart, Carl Vogt, T. H. Huxley and McIntosh.

In 1873–76 the "Challenger" made her voyage of circumnavigation and great collections of plankton were made in all the seas of the world. Many other voyages have since been made but there has been none that did so much work as was carried out during those three years under the direction of Wyville Thomson and John Murray. Another equally great landmark was the "Plankton Expedition" carried out by the "National." Victor Hensen, of the University of Kiel, led this expedition (which worked in the Atlantic ocean) and with him were associated Brandt, Schütt, Fischer and Krümmell. All subsequent work on the plankton has been dominated by the methods elaborated by these workers and by the extraordinarily fertile ideas of Hensen, and these methods, with their results, make up the modern science of hydrobiology.

The Plankton in General.—The passively drifting, pelagic life of the sea and of fresh waters consists mainly of microscopic organisms. There are some large plants and animals that are planktonic in their habits: such are the gulf-weed (*Sargassum*), medusae, siphonophores and other jelly-fishes; some molluscs like the pteropods ("whale-feed"), the pearly nautilus, etc. It is not usual, however, to consider these relatively large plants and animals when we are discussing the plankton: in practice we take the latter to mean the organisms which are, as a rule, invisible to the naked eye, because of their minute size and translucency. Even the most transparent sea water may contain very large numbers of these microscopic organisms and sometimes they are so abundant that the water may be coloured, or turbid, and they may even tint snow and ice. A practical distinction is made between the Macroplankton, which can be caught by filtering the water through very finely woven silk cloth, and the Microplankton, which are so small that they escape through the pores of the finest fabrics that can be employed. Later on we shall consider more fully the methods of collecting the plankton. A further practical distinction, in discussing distribution, is that between the Transitory Plankton and the Permanent Plankton. The former category includes all those organisms which have a brief, pelagic, drifting stage in their life history, after which they develop into actively swimming, large animals (the Nekton), or into rooted or sedentary plants and animals (the Benthos). The latter category includes a multitude of species of organisms which live throughout their lives as planktonic, passively drifting individuals. It is customary to distinguish between Oceanic and Neritic Plankton, the former inhabiting water which is far from land and the latter being practically restricted to the zone of shallow water near the Continental coasts. Then there are many plankton organisms that prefer to live near the surface of the sea and these we call the Epiplankton, while there are others that habitually live in the deeper layers of the ocean: these make up the Bathyplankton. Finally the different oceans, seas, zones of latitudes, etc., tend to harbour characteristic plankton communities, so that a naturalist who is very familiar with plankton investigations can often say where an unknown sample has been collected.

After this general survey we may now consider the various kinds of organisms that occur in the plankton.

The Transitory Plankton.—A great number of marine organisms "spawn" in the general sense—that is, they discharge their spores, eggs and larvae into the sea, where these things simply drift about while they undergo development. After the latter process is complete the organisms leave the plankton communities, either to settle down on the sea-bottom or to roam about in the sea as freely-locomotory animals. Thus the eggs and larvae of innumerable marine species are transitorily planktonic organisms, finally becoming benthic or nektic ones. Benthos includes all the organisms that live on or are attached to the sea bottom, while nekton includes those others that are actively locomotory in their habits. (*See* MARINE BIOLOGY.)

Thus most of the fishes spawn, emitting their eggs and spermatozoa into the sea water, where the processes of fertilization and embryonic development occur. When embryonic development ends the little fish is a larva, and as such it simply drifts about in the sea. Finally its development is completed by a metamorphosis and then it assumes the form and habits which are characteristic of its species. It leaves the plankton and becomes a nektic animal. Most of the marine Crustacea reproduce in the same way, that is they may directly emit eggs into the sea,

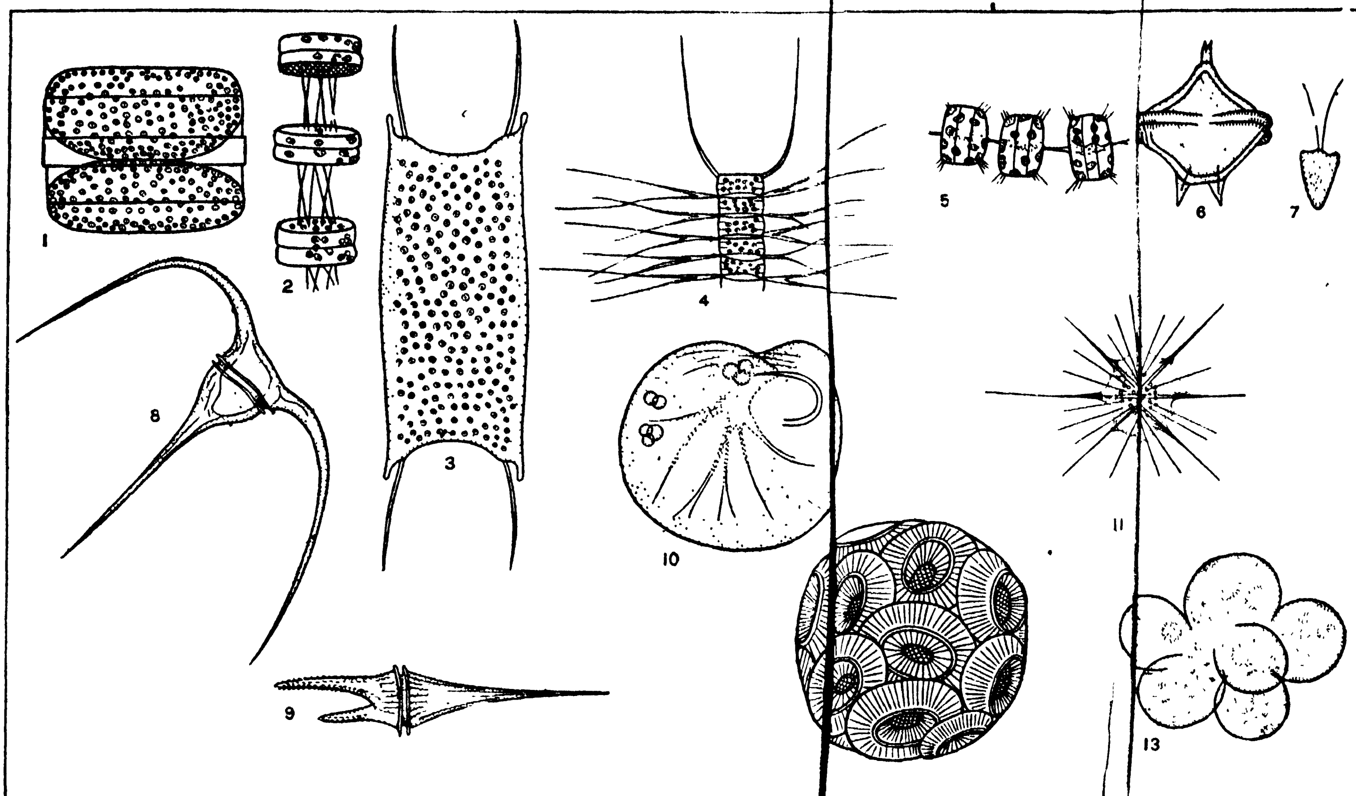


FIG 1—PLANKTON: DIATOMS, PERIDINIANS, ALGAE (HIGHLY MAGNIFIED)
1. Coscinodiscus, 2. Coscinosira, 3. Biddulphia, 4. Chaetoceras, 5. Thalassiosira, 6. Peridinium, 7. Algal Zoospore, 8. Ceratium, 9. Ceratium, 10. Noctiluca, 11. Acanthometron, 12. Coccosphaera, 13. Phaeocystis (12 and 13. Unicellular algae)

or the parents may, for a time, carry these eggs attached to their bodies, but in most cases the embryos develop into larvae which are always small, practically non-migratory and which finish their development while drifting in the plankton. Many of the Mollusca lay their eggs (enclosed in cases, or cocoons) on the sea bottom, but others emit the eggs and sperms into the water. In all cases, however, the larvae drift about for a time. Just the same general life-history is displayed by most of the worms, the polyzoa and practically all the echinoderms, sponges and coelenterates. The rooted algae liberate their zoospores into the sea on the littoral and shallow-water zones and there these myriads of (even microscopically) tiny organisms drift about and perish.

The wealth of life that is so produced is incredibly great. Even one large cod will spawn annually several millions of eggs, all of which exist for a short time in the plankton, and some of which become larvae and small baby cod. So also with almost every kind of marine animal: its eggs that are spawned every year must generally be counted by the thousands or hundreds of thousands. Yet, on the average, of all the eggs produced by any marine animal only one or two can undergo development and growth up to full reproductive maturity. The remainder, destined to perish in the struggle for existence, have their life-phase for a few weeks or months in the hordes of transitorily planktonic organisms.

The Permanent Plankton.—In all parts of the seas and oceans the plankton always contains great numbers of organisms that have this habitat throughout their whole lives. There are many large, permanently planktonic organisms—some algae; many medusae (which are sometimes so numerous as to make a visible, coloured carpet on the surface of the sea); many other coelenterates (such as the Siphonophores and the Ctenophores); some worms; some molluscs like the pearly nautilus, and the Heteropods and Pteropods (the latter may exist in great shoals and form the food of the whalebone whales). These large plankton animals and plants are, however, few and unimportant when compared with the multitudes of the microscopically small animals and plants which abound even in water that appears, to the naked eye, to be perfectly clear and barren.

Among the Crustacea the little animals called Copepods, Schizopods, Ostracods, Cumacea, with some less abundant groups are always and everywhere present in the plankton and sometimes they are extraordinarily abundant. They live mainly in the upper layers of the sea, but many species are also found in very deep water. Their significance, even for human affairs, is very great for they are the food of such fishes as herrings, pilchards, sprats, like and other kinds that are regularly caught by the fishermen. Many other marine animals, of course, eat them. They may be so very abundant that sufficiently large numbers to cook and eat may be taken by fine nets drawn through the sea.

Worms belonging to the groups called Polychaetes and Chaetognaths (these are the bristly jointed worms and the translucent "arrow-worms") abound. The only planktonic vertebrate (or rather "chordate") animals are some of the Tunicates, and one kind of these creatures—the salps—may at times be so very abundant in the sea as to clog and sink the drift nets set by the herring fishermen. The Heteropods and Pteropods are the only permanent plankton dwellers belonging to the Mollusca. There are no echinoderms that are always planktonic but the beautiful larvae of these animals live for a time pelagically. The Coelenterates are, some of them, permanently planktonic (*see* above), but most of them (the zoophytes, sea anemones, corals, etc.) live on the sea bottom and their larvae appear for a short time only among the plankton. None of the sponges are permanent plankton denizens.

Great numbers of species of unicellular animals and plants are always planktonic: we shall notice the principal kinds very briefly, premising that their full description means writing great books on zoology and botany. Among the Protozoa are the Foraminifera and Radiolaria—the former characterized by their calcareous and the latter by their siliceous skeletons. These animals are microscopic in size (though sometimes big enough just to be discerned by the naked eye). They are found everywhere in the sea and they are so numerous that extensive regions of ocean-floor, at depths of about 2 to 3m., are covered with fine oozes made up almost entirely of the shells of Foraminifera and Radiolaria that

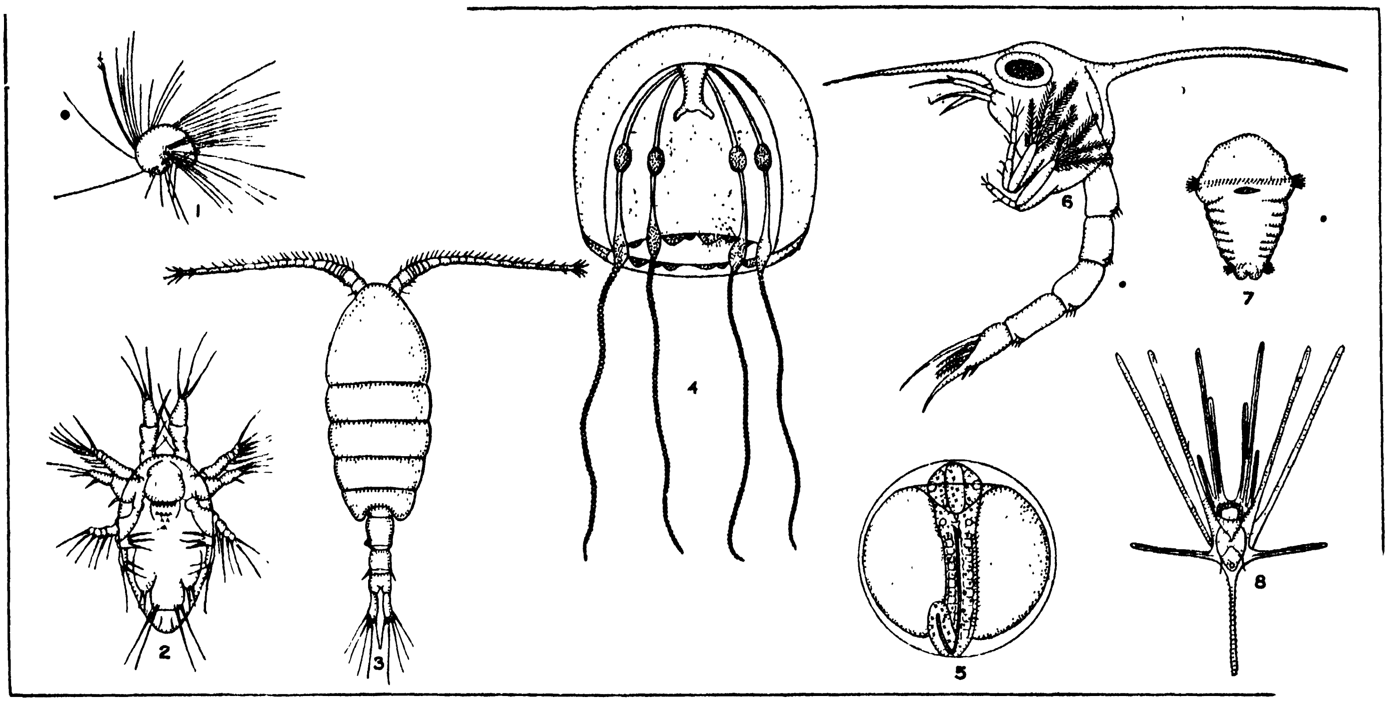


FIG. 2.—VARIOUS LARVAE OF MARINE ANIMALS (HIGHLY MAGNIFIED)

1. Spionid larva of a marine worm, 2. Copepod "nauplius," larva, 3. Parapontella (Copepod), 4. Eucope (Medusoid), 5. Fish-egg, 6 larva, a "Zoea," 7. "Metatrochophore" larva of a marine worm, 8. "Pluteus," larva of a Brittle-Starfish

live and die in the upper layers of the ocean. These shells are beautiful and interesting objects when seen under the microscope. Very important from the human point of view are the Peridinians: these are unicellular organisms that can be regarded either as plants or animals and they are about as abundant as the Protozoa that we have already mentioned. They also have very elegant shells made of a kind of cellulose material which is impregnated with silica. Great numbers of Peridinians live in the sand and mud in the very shallow sea bottom near the land, but most of the species are pelagic—that is, they are permanently planktonic. The pelagic Peridinians are important food materials for some fishes—mainly the pilchard (when it is in the sardine stage). These organisms are interesting from another aspect—it is they that mainly cause the phosphorescence of the sea. Sometimes, when the sea is very fiery, an organism called *Noctiluca* is so abundant that the water may be visibly turbid and discoloured.

The Diatoms are to be regarded as unicellular, algal plants, and they are, on the whole, the most abundant of all the planktonic organisms. They have external, transparent, siliceous shells which are elegant in form and are often sculptured with beautiful patterns. They exist everywhere in water—in ponds, lakes, on the mud and sand of the foreshore and sea bottom, attached to weeds, etc.—the main restriction on their presence is the absence of light, for, being green plants, they cannot live except in the presence of solar radiation. There are innumerable species and they are so abundant in the ocean that millions of square miles of bottom, at about 2,000 fathoms in depth (and mainly in the Antarctic) are covered by the dead shells of Diatoms.

The Microplankton.—The above observations apply to the larger planktonic organisms, but there are numerous species which are not captured by using the ordinary "tow nets" (presently we refer to the methods that are employed by the planktologists). These smaller species (the Micro- or Nannoplankton) include many minute Diatoms, Peridinians, shelled and naked Protozoa, Flagellates, unicellular Algae and algal zoospores. There are, of course, hosts of marine bacteria, but these we do not consider in this connection. We shall see that, in point of numbers of individuals, the microplanktonic organisms far exceed the larger forms.

The Seasonal Variations in the Plankton.—Everywhere in the sea and in fresh waters the composition and abundance of the plankton change with the season. To some extent the nature and sequences of these changes depend on the re being investigated and this is particularly the case sider the larvae, for the nature and abundance of pend on the nature of the local benthic and nek however, we consider the North Atlantic regio general descriptions will apply, to some extent, most local regions.

The cold and dark months, December to Febr periods when the marine plankton is scarce and and Peridinians, in particular, are relatively fe is because of the feeble intensity of sunlight, for the growth and reproduction of these orga time about March or April there is a great outb sea. Certain indispensable food materials (in compounds, silica and phosphates) have been ac ing the dark months; in the spring there is a ri perature and this acts as a stimulus to vital proce main factor is the increase in the length of the day an ing intensity of sunlight. The result of these changes the vegetable plankton, but particularly the Diatoms, stimulated to reproduce, so that there is almost an explosiv burst of life in the sea and great swarms of Diatoms invade shallow sea areas. This is the great event of the year—the "ver nal maximum" of vegetable life in the sea.

Immediately following it comes the reproduction of the nektic and benthic animals. Hosts of Fishes, Crustacea, Mollusca, Echinoderms and worms spawn their eggs into the water, or deposit them on the sea bottom. The eggs hatch out and the waters of the sea teem with larvae. The latter must feed and they utilize the vegetable plankton (Diatoms, algal spores, etc.). The production of animal larvae lasts into the early summer (or even later with some species), but while it goes on there is a diminution in the abundance of the Diatoms. Those indispensable food-stuffs which accumulated during the winter months are largely used up while the vernal maximum of vegetable plankton lasts. The extraordinary abundance of Diatoms therefore falls off during the months of June to August, but about then the Peridinians begin to increase. The summer months are characterized then by a relative scarcity of Diatoms, a great increase in the Peridinians, an abundance of larvae belonging to many groups of invertebrates and a great abundance in the Copepods.

In the autumn or early winter the Diatoms sometimes increase

again—there is an autumnal maximum. But this is a very brief phase and with the shortening of the day and the drop in sea temperature towards the annual minimum all kinds of planktonic life in the sea decrease. In this very summary account of the seasonal change stress has been laid on certain physical agencies —light, temperature and inorganic food substances—that are regarded as of importance, but we must never forget that intrinsic causes are also operative. Heredity has implanted, in the organizations of all marine organisms, a cyclical tendency so that the annual outbursts of reproductive activity are stimulated, or set off, so to speak, by the seasonal changes.

The Abundance of the Plankton.—There is no part of the seas and oceans where planktonic organisms do not occur. Even in the greatest depths of the ocean we suspect that certain micro-crustacea exist. Under the ice, in polar regions, rich collections may be taken and there are abundant algal organisms in the pools that form in hollows on the surfaces of ice-floes in the summer. Snow and ice may actually be tinted with Diatoms and other organisms. The richest plankton in any part of the world-ocean is that found just on the borders of the polar seas, in the regions of melting ice. In general the temperate and cold seas are rich plankton, while the tropical and warm waters are relatively

ıt absolute quantities of plankton-organisms exist in the
'ere is so much variation with regions and seasons that it
to give definite figures without going into great detail.
's of experimental hauls made in the Irish sea gave a
age of one or two organisms in every cubic centi-
'er, while at the periods of greatest abundance each
tre contained about a dozen organisms. But this in-
e larger planktonic individuals, and it is generally the
nicro-forms are far more numerous. In some experi-
Plymouth it was shown that there must have been
l hundreds of individual organisms (macro- and
'n every cubic centimetre of sea water.
es refer to the numbers of organisms in the sea
ılar moment, and we ought also to consider the
reproduce and grow. There is not the knowl-
'hich would enable us to make such estimates,
ıate idea of the total mass of living material
a sea area can be obtained by indirect methods.
rst, that all animal life in the sea depends on
ıe animals can only subsist by eating other ani-
but the plants can use as their source of food-
ıc acid that is dissolved in the water. Utilizing the
.light they can synthesize this carbonic acid into
ȷ other vegetable substance. Now it is mainly the
'eridinians (and other plankton organisms that have
ıble mode of nutrition) that do this, for the total mass
ıe rooted algae must be very small in comparison with
.ass of the vegetable plankton. It is possible, by routine
.emical methods, to find out how much carbonic acid is removed
rom solution in a sea area, during the spring and summer seasons, and then converted into carbohydrate by the activity of the vegetable plankton. The result is very surprising: at least 300,000 kilog. of dry organic carbohydrate must be produced during a single season per square kilometre of sea surface. Or, expressed in more familiar terms, a spring and summer of organic production in the sea gives origin to about ten tons of moist vegetable substance per acre of sea. This is the marine harvest due to the activity of the vegetable plankton: at present man reaps only a very small fraction of it in the shape of the fishes and other edible animals that he catches.

Methods of Studying Plankton.—A veritable wonderland awaits the amateur naturalist who can spend a short time at the seaside during the spring months. He will require a student's microscope (magnifying 50 to 500 diameters) and some cheap, home-made apparatus. The net is simply a conical bag of the finest and strongest muslin obtainable: it is about 1 to 2ft. in diameter and about 4ft. long. Its mouth consists of an iron ring, to which a selvage of strong canvas is laced. The net is sewn on to this canvas edging. It is towed in the sea behind a rowing boat for about half an hour.

When the net is hauled it is drained of water and turned outside in. The pointed end is then rinsed in sea water contained in a 2 lb. glass jam jar. A small sieve is made by loosely tacking a piece of muslin on a square wooden frame about 4in. along each side. The water containing the catch is then slowly poured through the central part of the sieve. Then the latter is turned upside down and the plankton is washed off into a little sea water in the bottom of a saucer. This will now be a thick, greenish turbid mass. A dipping tube is made (like a fountain pen filler, but with a wider opening) and some of the plankton is lifted with this and put into a watch glass, which is then examined under the microscope. Examined day by day the spring and summer plankton is full of the most beautiful things.

Nets contrived to fish quantitatively are also used. In such investigations fine miller's silk bolting cloth is used. This has meshes of over 100 to the inch. Heaps of organisms escape through this net. To catch the very minute plankton the water must be centrifuged, or cultures are made in an analogous way to those employed by bacteriologists. Elaborate methods have been evolved for counting the organisms taken in a plankton catch.

Bibliography.—There is a huge literature on plankton but many general papers are cited, and their source stated, in *The Marine Plankton*, by Johnstone, Scott and Chadwick (Liverpool, 1924).

(J. A. J.)

PLANTAGENET, a surname conveniently, but unhistorically, applied to the royal line descended from the union of Geoffrey, count of Anjou, with the empress Maud, who are now styled by historians the Angevin house. It was, historically, only a personal nickname of Geoffrey, as was "Curtmantel" of his son (Henry II.), and was derived from his wearing in his cap a sprig of the broom (*genet*) plant. When the fashion of personal nicknames passed away, the members of the royal house were usually named from their birthplace, as Thomas "of Brotherton," Thomas "of Woodstock," and so forth. But Edward I. and his younger brother, the founder of the house of Lancaster, had still nicknames respectively, as "Longshanks" and "Crouchback." In the later days of the dynasty the surname of Beaufort was adopted by the legitimated issue of John of Gaunt by Katherine Swynford, but that of Plantagenet was bestowed on Arthur, natural son of Edward IV., who was created Viscount L'Isle. It appears, however, to have been adopted as a surname by Richard duke of York (father of Edward IV.) some 12 years before his death.

At the death of Geoffrey's grandson, Richard I., his younger brother John succeeded. John's younger son Richard, king of the Romans, left a son Edmund, earl of Cornwall, with whom his line ended; his elder son Henry III. left two sons of whom the younger was created earl of Lancaster and was grandfather of Henry, earl of Lancaster, whose heiress married John of Gaunt (*i.e.*, Ghent). (*See* Lancaster, House of.) John of Gaunt's next brother, Edmund of Langley, founded the Yorkist line. (*See* York, House of.)

Although no other dynasty has reigned so long over England since the Norman Conquest, the whole legitimate male issue of Count Geoffrey Plantagenet is clearly proved to have become extinct in 1499.

PLANTAGINACEAE, a family of dicotyledonous herbs, the best known members of which are the plantains (*Plantago*), cosmopolitan weeds, of which five species occur in Great Britain and upwards of 30 in the United States. (*See* Plantain.) The family contains three genera and about 200 species. The seeds of *Plantago Psyllium* (Mediterranean) are used in silk and cotton manufacture. The flowers, usually hermaphrodite and inconspicuous, are wind-pollinated.

PLANTAIN, a name given to certain plants with broad leaves. This is the case with certain species of *Plantago, Alisma* and *Musa,* to all of which the term is popularly applied. The species of *Plantago* (family Plantaginaceae) are mostly weeds with a dense tuft of radical leaves and scapes bearing terminal spikes of small flowers; the long spikes of *P. major,* when in seed, are used for feeding cage-birds; *P. lanceolata,* so called from its nar-

row lanceolate 3-6 ribbed leaves, is popularly known as ribwort; *Alisma Plantago-aquaticum* (family Alismaceae) is the water-plantain, so called from the resemblance of its broad ribbed aerial leaves to those of *P. major*. The tropical fruit known as plantain belongs to the genus *Musa*. (*See* BANANA.)

PLANTAIN-EATER: *see* TOURACOU.

PLANTATION, literally the placing of plants in the ground, hence a place planted or a collection of growing things, particularly used of ground planted with young trees. The term was early applied, in a figurative sense, to the settlement of people, and particularly to the colonization of North America in the early part of the 17th century and to the settlement of Scottish and English in the forfeited lands in Ireland. The practice of sending convicted criminals to serve on the plantations in the colonies became common in the 17th century (*see* DEPORTATION). For "plantation songs" *see* NEGRO.

PLANT BREEDING. The first object of plant breeding is to produce new varieties superior to one or more of the old ones. Superiority means agricultural superiority and is measured by net monetary return per acre. It may be sought in many directions, of which yielding capacity and quality of produce are chief. In many countries and for a diversity of crops, resistance to disease has a great importance. Rapid growth is sometimes a transcendent consideration because it ensures escape from an intensely hot summer or from early frosts.

The earliest efforts in crop improvement consisted of the simple practice, many centuries old, of picking out the finest plants as the source of seed for the next season. During the 19th century the two methods of breeding now universally used—selection of single plants and artificial hybridization—were brought to a relatively high pitch. But they were entirely empirical and, uninformed by scientific knowledge, appeared incapable of any substantial modification. Then, swiftly, with the opening of the 20th century, came Mendel's laws of heredity, Johannsen's theory of pure lines, and the mutation theory of de Vries. These great advances, while recasting biological science, gave to plant breeding an orderly basis and a new outlook.

An ordinary field crop, especially in a backward or agriculturally young country often contains plants of several different varieties. By selecting and separately propagating single plants it is possible to produce seed stock of these several varieties. Those which, on test, prove best, may be introduced into general cultivation. This procedure, the selection method of breeding, is widely used. Chevallier and Goldthorpe barleys and also Potato and Sandy oats, all of great value in their day, arose from selected single plants. Dr. E. S. Beaven's Archer and Plumage barleys are other notable selections. The earlier exponents sought to carry improvement further by restarting from the best seed from the best plant among the progeny of a single plant. Johannsen demonstrated the futility of this, showing that, in self-fertilizing plants, the descendants of a single plant were normally a "pure line," *i.e.*, all alike save for purely fortuitous differences and such as to breed true on producing seed.

Normal constancy in reproduction may, in some instances, be varied by the production of a "sport" or new type. The biological processes responsible for this happening—or mutation—are still imperfectly understood. But de Vries demonstrated that a mutation, once produced, remains constant in subsequent generations. Thus a valuable mutant type is a permanent asset to agriculture and de Vries' discoveries gave fresh stimulus to the selection method of breeding. Mutations may arise either in the reproduction of plants by seed or as buds. In citrus fruits mutant buds arise with marked frequency and it is by finding and propagating them that Californian growers of the navel orange have developed a considerable number of new types, some of all-round superiority to the original navel orange which was introduced from Brazil.

Artificial hybridization or crossing, now the chief method of breeding, may be illustrated by a simple hypothetical example. Suppose it were desired to breed a wheat having short straw and earliness in ripening (short-early); that the only short straw variety adapted to the country concerned was late ripening (short-late); and that the only available early ripening variety had tall straw (tall-early). The actual half-bred or first-hybrid (F_1) obtained by hybridizing the two chosen varieties would be about intermediate in straw and maturity. If allowed to self-fertilize it would form seeds from which would grow the second hybrid generation (F_2) plants. Mendel's laws make it possible to predict (i.) That among the F_2 plants would be four types, viz., short-late: short-early: tall-late: tall-early. (ii.) That the four types would occur in certain definite proportions (in other crosses, involving different plant characters, the proportions might be different from these but they would always be constant and systematically explicable for any one case) (iii.) That only a proportion of the F_2 plants of any one type would breed true to type.

By raising separate progenies from the seed of all short-early F_2 plants it would be possible to select those lines which were fixed or true breeding.

Unfortunately yield and almost all attributes of agricultural consequence do not behave with this hypothetical simplicity. They are, indeed, not single units of inheritance but combinations of many. Thus the breeder cannot pick the ideal F_2 plant and by simple seed propagation build up a stock of an ideal new variety. In cereals, for instance, 10 to 12 years of continual selection must follow on the act of hybridizing before it is possible to obtain a uniform true breeding type having the desired combination of characters from the two parent forms. Not even the keenest eye, the ripest experience or the utmost resource of science is able to detect, in the early stages of breeding, which is best of the new types that hybridization has brought into being. It is necessary by successive years of study to eliminate types one by one until a few remain. These must then be systematically tested for yield and the other characters of importance. The test methods associated with plant breeding represent a specialized field of applied science.

The older hybridists frequently sought to cross widely different parents, as for instance cabbage by turnip or two markedly divergent wheats. Complication or failure was the usual result. Morgan's chromosome theory of heredity has now furnished the breeder with both a test and an understanding of the limits of cross-compatibility.

WHEAT AND OTHER CROPS

Improved varieties of wheat take first rank, and among them the Marquis wheat of Canada is pre-eminent in point of acreage. In 1892, Dr. William Saunders crossed Hard Red Calcutta, a commercial grade rather than a variety, and Red Fife, then the standard wheat of western Canada. Subsequently his son, Dr. Charles E. Saunders, selected one type from the progeny. This became commercially established in Canada in 1911 under the name of Marquis. In 1917 it constituted 80% of the wheat of the prairie provinces. Imported into the United States in 1913 it had, by 1919, a spread of 11,900,000 acres. Only one wheat is now more widespread in America; this is Turkey, which, with twice the area of Marquis, is a striking example of introduction, for it was brought from Russia by Mennonite immigrants. Earlier maturity, the primary distinction between Marquis and the Red Fife and other wheats it has displaced, makes for immunity from rust, drought and frost.

India, with great environmental diversity and characteristic impurity of native varieties, has proved a fine field for the breeder. Under Dr. A. Howard, the Pusa Institute has established selected wheats which are ousting the older forms. Pusa 12 and Pusa 4 have an area of 500,000 acres in the United Provinces, while Punjab 11 is grown in the canalized parts of the Punjab on nearly twice this scale. Helped by the provision of good seed, these new products are estimated to represent an annual gain to the cultivators of £1,000,000.

Something of romance attaches to the introduction into Argentina of a wheat from the Szechwan province of China. It has proved highly resistant to *Puccinia triticina*, the rust which more than anything else threatened to suppress the great promise of wheat-growing in South America. The introducer, Mr. W. O Backhouse, has now raised hybrids which, both rust resistant and generally superior, are fast becoming the standard forms.

From the Swedish station, Svalöf, have come a number of new wheats, barleys, oats and peas; Swedish Iron wheat has added to its laurels by gaining a hold in Great Britain; millers, however, dislike the thick skin and the quality of its grain. The Little Joss and Yeoman wheats bred by Prof. Sir R. H. Biffen and introduced in 1912 and 1917, occupy one-tenth and one-fifth respectively of the whole wheat area of the 14 principal producing counties. Little Joss, a hybrid from Ghirka (Russian), and Square Head's Master (British) are the only forms with a definite resistance to yellow rust (*Puccinia glumarum*), besides possessing a marked standing capacity and a curiously wide soil adaptation. Yeoman is also a product of premeditated synthetic breeding. The parents were Browick (British) and Red Fife—the best bread-making wheat. Heavy yield and great standing power are merits it shares with the best of the older forms; but its quality or bread-making capacity has set a standard formerly believed impossible in British wheats.

Barley.—Barley is of peculiar interest because the quality of beer-making kinds is nearly as important as the yield. At the end of the 19th century Chevallier and Standwell were the prevailing forms in Ireland. Archer barley was introduced from England in 1900, and Irish Archer, a selection made by Dr. H. Hunter, soon displaced the older varieties. An even more marked success attended his hybrid Spratt-Archer (derived from a cross between Archer and Spratt, the latter being an old form with special adaptation to peaty soils), distinguished by high yield, exceptional standing power and superior quality; it now occupies almost 90% of the barley area of Ireland. It is estimated that £40,000 spent on breeding and testing in Ireland during the period 1905–25 has brought an increase equivalent to £250,000 per annum. Contemporaneously the selections, Archer and Plumage, introduced by Dr. E. S. Beaven of Warminster, have contributed to the prosperity of English growers.

Roots.—Roots, such as potatoes which flower uncertainly and mangolds whose varieties freely intercross in the field, are difficult subjects. But mangolds and swedes have yielded to that systematic patience which has done so much in Danish agriculture. Helweg, in Denmark, first made clear that the only sound basis of estimation for mangolds was yield of solid matter per acre and not mere wet bulk. Next he demonstrated that different forms or strains within any one variety might be widely divergent in gross yield and percentage of solid matter. Indeed, two strains of the same variety might correspond to a difference of £6 to £8 in value of feeding material from one acre. The best strains were picked out, and by persistent teaching all bad strains were forced out of cultivation; good seed was ensured, and roots came to have a greater feeding value per acre than corn. In Denmark the area under roots has steadily grown, and when the World War stopped the importation of feeding-stuffs it was roots that saved Denmark. There was a time when wart disease (*Synchytrium endobioticum*) appeared to threaten wholesale destruction of British potato crops. But steady production of immune varieties, reinforced by appropriate legislation, may now be said to have brought security to the one great crop in which this country is still self-supporting.

Other Staple Crops.—Rice in Malaya and South India, the millets in India, the Fulghum oat of Texas and Kansas, the hybrid round-tipped tobacco of Connecticut, Svalöf's Victory oat, which has proved itself to be one of the best oats grown in Great Britain, and Dr. C. A. Barber's new sugar-canes in India are among many other valuable new products of the last decade.

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PLANTIN, CHRISTOPHE (1514–1589), French printer, was born in a village near Tours (probably Saint-Avertin). He learned bookbinding and bookselling at Caen, and, having married in that town, settled in 1549 as bookbinder in Antwerp, where he was soon known as the first in his profession. A bad wound in the arm seems to have been the cause that first led him (about 1555) to apply himself to typography. The first known book printed in his office was *La Institutione di una fanciulla nata nobilmente*, by J. M. Bruto, with a French translation, and this was soon followed by many other works in French and Latin, which in point of execution rivalled the best printing of his time, while the masters in the art of engraving then flourishing in the Netherlands illustrated many of his editions. In 1562, Plantin himself being absent in Paris, his workmen printed an heretical pamphlet, which caused his movables to be seized and sold. It seems, however, that he recovered a great deal of the money, and in 1563 he associated himself with some friends to carry on his business on a larger scale. Among them were two grandnephews of Dan. Bomberg, who furnished him with the fine Hebrew types of that renowned Venetian printer. His editions of the Bible in Hebrew, Latin and Dutch, his *Corpus juris*, Latin and Greek classics, and many other works produced at this period are renowned for their beautiful execution and accuracy.

A much greater enterprise was planned by him in those years—the publication of a *Biblia polyglotta*, which should fix the original text of Old and New Testaments on a scientific basis. In spite of clerical opposition he was supported by Philip II. king of Spain, who sent him the learned Benedictus Arias Montanus to superintend the work. It was finished in five years (1569–73, 8 vols. folio). Plantin earned little profit, but received the privilege of printing all liturgical books for the states of King Philip, and the office of "prototypographus regius." Though outwardly a faithful son of the church, he was till his death the partisan of a mystical sect of heretics; and it is now proved that many of their books published without the name of a printer came from his presses together with the missals, breviaries, etc., for the Roman Catholic Church.

Besides the polyglot Bible, Plantin published in those years editions of St. Augustine and St. Jerome, the botanical works of Dodonaeus, Clusius and Lobelius, the description of the Netherlands by Guicciardini, etc. In 1575 his printing-office reckoned more than 20 presses and 73 workmen, besides a similar number that worked for the office at home. But in Nov. 1576 the town was plundered and in part burnt by the Spaniards, and Plantin had to pay an exorbitant ransom. He established a branch of his office in Paris; and when in 1583 the states of Holland sought a typographer for the newly erected university at Leyden, he left his much reduced business in Antwerp to his sons-in-law John Moerentorf (Moretus) and Francis van Ravelinghen (Raphelengius), and settled there. When in 1585 Antwerp was taken by the prince of Parma and affairs became there more settled, he left the office in Leyden to Raphelengius and returned to Antwerp, where he worked till his death on July 1, 1589. His son-in-law, John Moretus, and his descendants continued to print many works of note "in officina Plantiniana," but from the second half of the 17th century the house began to decline. It continued, however, in the possession of the Moretus family, which religiously left everything in the office untouched, and when in 1876 the town of Antwerp acquired the old buildings with all their contents, for 1,200,000 francs, the authorities created one of the most remarkable museums of its kind in existence, the Musée Plantin, opened Aug. 19, 1877.

See Max Rooses, *Christophe Plantin imprimeur anversois* (Antwerp, 1882); Aug. de Backer and Ch. Ruelens, *Annales de l'imprimerie Plantinienne* (Brussels, 1865); Degeorge, *La Maison Plantin* (2nd ed., Brussels, 1878). (P. A. T.)

PLANTING OF TREES: *see* Tree Planting.

END OF SEVENTEENTH VOLUME

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